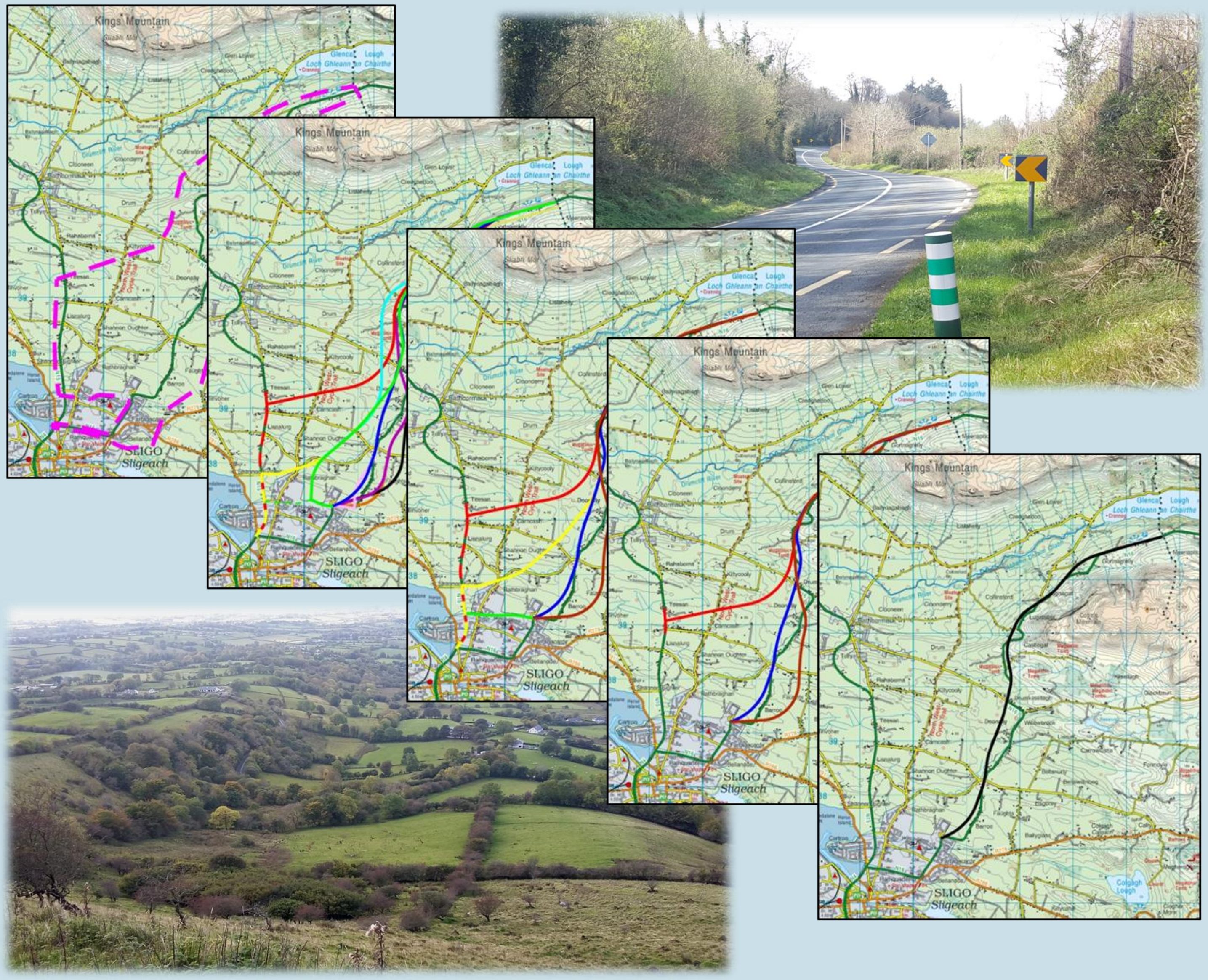
Route Selection Report

Volume 2: Engineering Appendices
PART A: Traffic & Transport Assessment

An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

N16 Sligo to County Boundary



SLIGO COUNTY COUNCIL

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

i. PREFACE

THIS ROUTE SELECTION REPORT CONSISTS OF THE FOLLOWING DOCUMENTS:

Volume 1

- Main Report

Volume 2

- **Engineering appendices:**
  - **PART A: Traffic and Transport Assessment;**
  - Part B: Road Engineering, Road Safety Impact Assessment, Options Comparison Estimate;

Volume 3

- Environmental appendices:
  - PART A: Human Environment (including Urban Planning);
  - PART B: Natural Environment;
  - PART C: Landscape & Visual, and Cultural Heritage;

Volume 4

- Road Safety Audit Stage F;

Volume 5

- Figures;

Volume 6

- Stage 2, Project Appraisal, Multi Criteria Analysis;

Document Control

Status	Issued For	Signed	Date	Approved
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Table 1-1: N16 Sligo to County Boundary Route Selection Team

Study/Element	Body Responsible
Engineering	SCC National Road Design Office
Assessment Coordination, Multi Criteria Analysis and Report Compilation.	
Project Liaison.	
Road Safety Impact Assessment	
Traffic Modelling	Jacobs Engineering
Stage F Road Safety Audit	Kerry and Donegal NRDO's
Economic Appraisal (Stage 2 – Project Appraisal)	Jacobs Engineering
Landscape & Visual	RPS Ireland Ltd.
Flora, Fauna & Fisheries	RPS Ireland Ltd. With input from Denyer Ecology.
Agricultural and Non-Agricultural Property	John Bligh & Associates
Noise & Vibration	Envest Environmental
Air Quality & Climate Change	Envest Environmental
Hydrology & Hydrogeology	Hydro Environmental (Galway)
Soils & Geology	Roughan & O'Donovan
Socio Economic	Optimize Consulting
Archaeology & Cultural Heritage	ASCU
Architectural Heritage	ASCU
Impacts on Sligo & Environs Development Plan	The Planning Partnership

Design

Sligo County Councils National Roads Project Office is responsible for the design of the various route options contained within this Route Selection Report.

TABLE OF CONTENTS

Tables

ii. Traffic & Transport Assessment

1 Traffic Modelling – Main Report

The following tables outline the Route Options which were modelled for the traffic modelling assessment. The various traffic modelling reports contained within this volume of the Route Selection Report refer to the Route Options modelled by means of a 'Saturn Coding Reference'. For ease of interpretation these have been included in *Table 1-1*, *Table 1-2* and *Table 1-3*. This is in addition to the 'Do-Nothing' and 'Do-Minimum' scenarios.

Table 1-1: Stage 1, Part 1, Preliminary Options Assessment

Strategic Option	Option Modelled	Feasible Route Options	Saturn Coding Reference
Strategic Option 1	Option 01A	Option 01A	OP1A
	Option 01A/01B	Option 01A/01B	OP1B
Strategic Option 2	Option 02A	Option 02A	OP2A
	Option 02A/02B	Option 02A/02B	OP2B
Strategic Option 3	Option 03	Option 03	OP3
		Option 04	
		Option 10	
		Option 11	
Strategic Option 4	Option 05	Option 05	OP5
	Option 06	Option 06	OP6
	Option 08	Option 07	OP8
		Option 08	
		Option 09	

Table 1-2: Stage 1, Part 2, Preliminary Options Assessment

Strategic Option	Option Modelled	Feasible Route Options	Saturn Coding Reference
Strategic Option 1	Option 01A-v2	Option 01A-v2	Option 1A_S1A
	Option 01A/01B-v2	Option 01A/01B-v2	Option 1B_S1B
Strategic Option 2	Option 02A-v2	Option 02A-v2	Option 2A_S2A
	Option 02A/02B-v2	Option 02A/02B-v2	Option 2B_S2B
Strategic Option 4	Option 05	Option 05	Option 5
	Option 12	Option 08-v2	Option 8
		Option 12	
		Option 12-v2	

Table 1-3: Traffic Modelling Test 3 – Stage 2, Project Appraisal

Strategic Option	Option Modelled	Feasible Route Options	Saturn Coding Reference
Strategic Option 1	Option 01A-v2	Option 01A-v2	Option 1A_S1A
Strategic Option 4	Option 05	Option 05	Option 5
	Option 12	Option 12	Option 12

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N16 Route Selection Study

Sligo County Council

Final Report

32106101 Report 31

May 2017

N16 Route Selection Study

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0	March 2017	Draft for Client Review	LB	DB	JPF	PC
1	March 2017	Client comments	LB	DB	JPF	PC
2	March 2017	TUBA Residual Period	LB	DB	JPF	PC
3	May 2017	Option 12 model refinement	LB	DB	JPF	PC

Contents

N16 Route Selection Study Final Report

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1. Introduction

1.1 Background

Sligo County Council (SCC) is undertaking a study on route selection for the N16 between the Leitrim County boundary and the junction of N4/N15 in Sligo City. SCC has commissioned Jacobs Engineering Ireland Ltd. (Jacobs) to undertake the traffic and transport element of the route selection process. The N16 upgrade comprises an off-line single carriageway arrangement which will provide an improved alignment to the existing sub-standard N16 route.

This *N16 Route Selection Study Report* should be read in conjunction with the two previous Key Performance Indicator (KPI) reports issued in December 2016 and January 2017. In the *N16 Key Performance Indicator Testing Technical Note* (December 2016) nine options were assessed of which the Do Minimum scenario and three emerging options were taken forward for sensitivity testing in the *N16 Key Performance Indicator Sensitivity Testing Technical Note* (January 2017).

In addition to these KPI reports the *N16 Traffic Modelling – Interim Technical Note* issued in May 2016 should also be read in conjunction with this report. The Interim Technical Note presented the approach, methods, processes and outcomes from the SATURN model development for the N16 National Road Upgrade Scheme appraisal and allowed for initial options refinement and design changes.

1.2 Purpose of Report

The purpose of this report is to outline;

- How the SATURN model used in the KPI testing process was developed and validated in accordance with the TII 2016 Project Appraisal Guidelines (PAG);
- The scheme assessment findings of the initial KPI Testing Technical Note (December 2016);
- The scheme assessment findings of the KPI Sensitivity Testing Technical Note (January 2017) of the three emerging options;
- The scheme assessment findings of the three refined emerging options;
- The economic appraisal of the three refined emerging options using TUBA; and
- The Identification of the preferred option for the N16 Route Selection Study.

1.3 Report Structure

The report is divided into the following sections:

- *Section 2 – Modelling Methodology;*
- *Section 3 – Traffic Data Collection;*
- *Section 4 – Model Network Development;*
- *Section 5 – Demand Matrix Development;*
- *Section 6 – Model Calibration and Validation;*
- *Section 7 – Forecast Demand Growth and Refined Matrices;*
- *Section 8 – Scheme Assessment;*
- *Section 9 – Economic Analysis; and*
- *Section 10 – Summary and Conclusions.*

2. Modelling Methodology

2.1 Modelling Approach

The proposed scheme was modelled using the macro modelling software SATURN. This modelling was undertaken through the uplift of available existing base model networks. Available base matrices were uplifted using TII's National Transport Model (NTpM).

Using previous base network and matrices from 2009 developed for the N15 Realignment, the 2015 base SATURN macro model was tailored and uplifted to suit the requirements of the proposed scheme in terms of size and scope and to reflect some software advances. The 2015 model still includes detail of the area surrounding the Sligo urban area, identifying wider urban and regional impacts of the proposed scheme.

The following section provides a more comprehensive overview of the existing Sligo SATURN model.

2.1.1 2009 SATURN Model

The 2009 Base Model, developed using SATURN Version 10.5.12, was built in order to model proposed options, forecast traffic volumes and undertake economic appraisal of the proposed N15 Sligo-County Boundary Realignment project between Sligo City and the Leitrim border east of Mullaghmore.

This model was built by Ryan Hanley WSP/Colin Buchanan and featured 221 nodes and 82 zones. It was a simulation-type network in its entirety, i.e. with no buffer network area. Figure 2.1 shows the extents of the 2009 Base SATURN Model which extends to the Sligo-Leitrim County Border.

The speed-flow relationship used in the 2009 base model was developed using the Irish COBA software package. Speed-flow curves used for the links in this model were grouped into eleven categories with each assigned a speed-flow curve from COBA. Due to differences between COBA equations and those used in SATURN, regression analysis was used in order to estimate the best fit curves for use in the model.

This model featured three time periods: AM, Interpeak (IP) and PM. For both the AM and PM periods a one-hour peak was modelled: 08:00 – 09:00 and 17:00 – 18:00 respectively. For the IP period an average interpeak hour was used.

Traffic data including turning movement counts (manual classified counts), queue length surveys and journey time surveys were undertaken throughout Sligo City and the N15 Sligo City to Sligo / Leitrim county boundary area. This data, dated September 2005 and May/June 2009, was used to replicate traffic flows in the study area. These surveys were also used during the Matrix Estimation, Calibration and Validation phases of the 2009 base model build.

The demand matrices used for the 2009 Base Model were developed and based on a series of Roadside Interviews carried out in September 2005. This information had been processed into appropriate formats to aid matrix development and there were two category matrices in the 2009 base: Light Vehicles and Heavy Vehicles.

Network calibration and validation of the base model was undertaken to observed traffic data. The following criteria outlined in TII's Design Manual for Roads and Bridges (DMRB) were used for calibration:

1. For observed flows of less than 700 Passenger Car Units (PCU), the absolute difference between modelled and observed flow must be less than 100 PCU. For flows between 700 and 2,700 PCU, the absolute percentage difference must be less than 15%, while for observed flows of more than 2,700 PCU, the absolute difference can be as much as 400 PCU, DMRB states that at least 85% of count sites should pass the percentage difference of 15%.

2. The second criterion for assessing the goodness of fit of a model is the calculation of the GEH value for each observed value. DMRB states that at least 85% of count sites should pass the percentage difference of 15%.

For criterion 1, 97.9%, 94.8% and 91.9% of cases passed for the AM, Interpeak and PM respectively. For criterion 2, 85.9%, 94% and 75.6% of cases passed for the AM, Interpeak and PM respectively.

The model was also validated against counts not used on the calibration phase. This achieved 67.0%, 70.7%, and 58.5% for the AM, Interpeak and PM respectively.

A comparison of modelled versus observed Journey Time Survey Routes identified that five out of eight modelled journey time routes were within 15% difference of the observed for the AM and PM periods. Two out of two modelled journey time routes available for the Interpeak period were within 15% of the observed values.

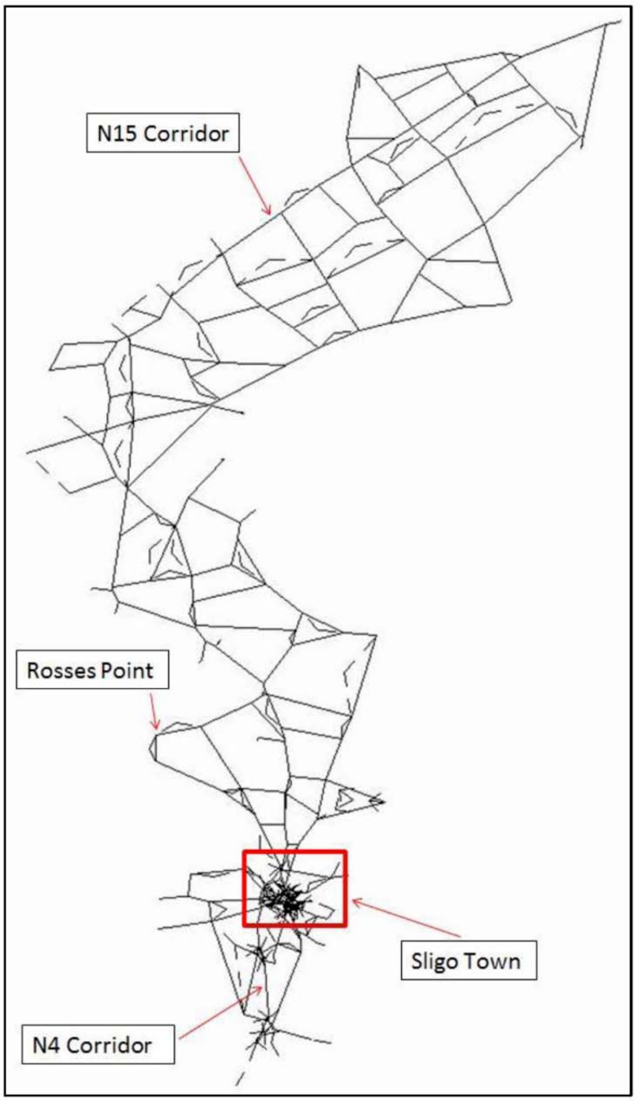

Figure 2.1: 2009 Base SATURN Model

2.2 Proposed Modelling Approach

2.2.1 Update SATURN Macro Model

A comprehensive macro model using SATURN was generated through the uplift of the existing traffic demand and extension of its road network. The 2009 base SATURN model was uplifted to 2015 levels in order to model and forecast the impact of the proposed scheme. The 2009 base network was cordoned along the N15 corridor to remove excess network detail.

Existing demand matrices were revised according to network changes made. This included the removal of zones now redundant following the cordoning of the 2009 base network. These matrices were also uplifted to 2015 levels using indices from TII's NTpM.

Where required, new features available in more recent versions of SATURN were used to enhance network performance.

2.2.2 Proposed Model Extents

Figure 2.2 outlines the outer boundary of the extents of the SATURN model used for the proposed scheme. This illustration shows the extents of the overall SATURN model network and the existing N16 alignment.

2.2.3 Summary of Changes to the Sligo Models

Table 2.1 outlines the overall changes undertaken for the 2015 SATURN Model uplift.

Table 2.1 : Summary of Changes to SATURN Model

Item	2009 Base Model	2015 Base Model
SATURN version	10.5.12	11.3.03G
Base year	2009	2015
Zoning	82 zones	63 zones
Simulation / Buffer Area	All Simulation, No Buffer	All Simulation, No Buffer
Use of Flare Coding Functions	Not available in Version 10.5.12	Flares coded along N4 Inner Relief Road
Network Extents	Comprehensive detail along N15 corridor to Leitrim Boundary	N15 cordoned at Cashelgarran Additional detail provided along N16 corridor to the Leitrim Boundary

Figure 2.2: Extent of Saturn Model

3. Traffic Data Collection

3.1 Background

In order to calibrate and validate the model to existing base conditions, appropriate levels of up-to-date traffic count information was required. This information included Junction Turning Counts at key junctions, Automatic Traffic Counts, Journey Time Routes and Queue Length Surveys. It was crucial that the data used in the model's development was gathered during a period which was deemed to be neutral and avoided school holidays, periods of road works, extreme weather events, protests/strikes, road traffic accidents, traffic signal failure and any other events which may have compromised the gathered data being representative of typical traffic levels.

3.2 Review of Existing Data Sources

In order to scope out the level of traffic surveys required, a gap analysis was carried out in the context of the traffic data already available. This gap analysis was carried out in the context of data available in the study area from TII's permanent traffic counters and the National Transport Authority's (NTA) Traffic Count Database. This gap analysis reviewed data available from TII and the NTA, and the appropriateness of data available from each source with a view to reducing the net amount of locations required for data procurement.

3.2.1 TII Traffic Monitoring Unit Online Data Portal

TII's online traffic data portal was used to identify existing permanent induction loops in and around the study network for which comprehensive, year-round traffic data was available. Unfortuanlety only one site was available, located along the N4 mainline just north of the N59 junction, south of Sligo. This data source was very useful as it contained detailed up to date information.

3.2.2 NTA National Traffic Count Database

The NTA has recently developed a Traffic Count Database. Unlike the TII system, this database stores historical traffic count information gathered in temporary traffic surveys. This data pool was developed during a request made by the NTA to local authorities nationwide for available datasets. Originally developed for the NTA's Regional Transport Models, this data pool was developed into an online interactive dataset repository for the use of local authorities nationwide to aid and assist their infrastructural projects. Locations for which data was available from the NTA in the study area before surveys were commissioned are outlined in Figure 3.1.

The 22 available datasets for the study area were reviewed in the first instance. Following this analysis, further traffic surveys were commissioned in order to fulfil the modelling requirements of the proposed scheme.

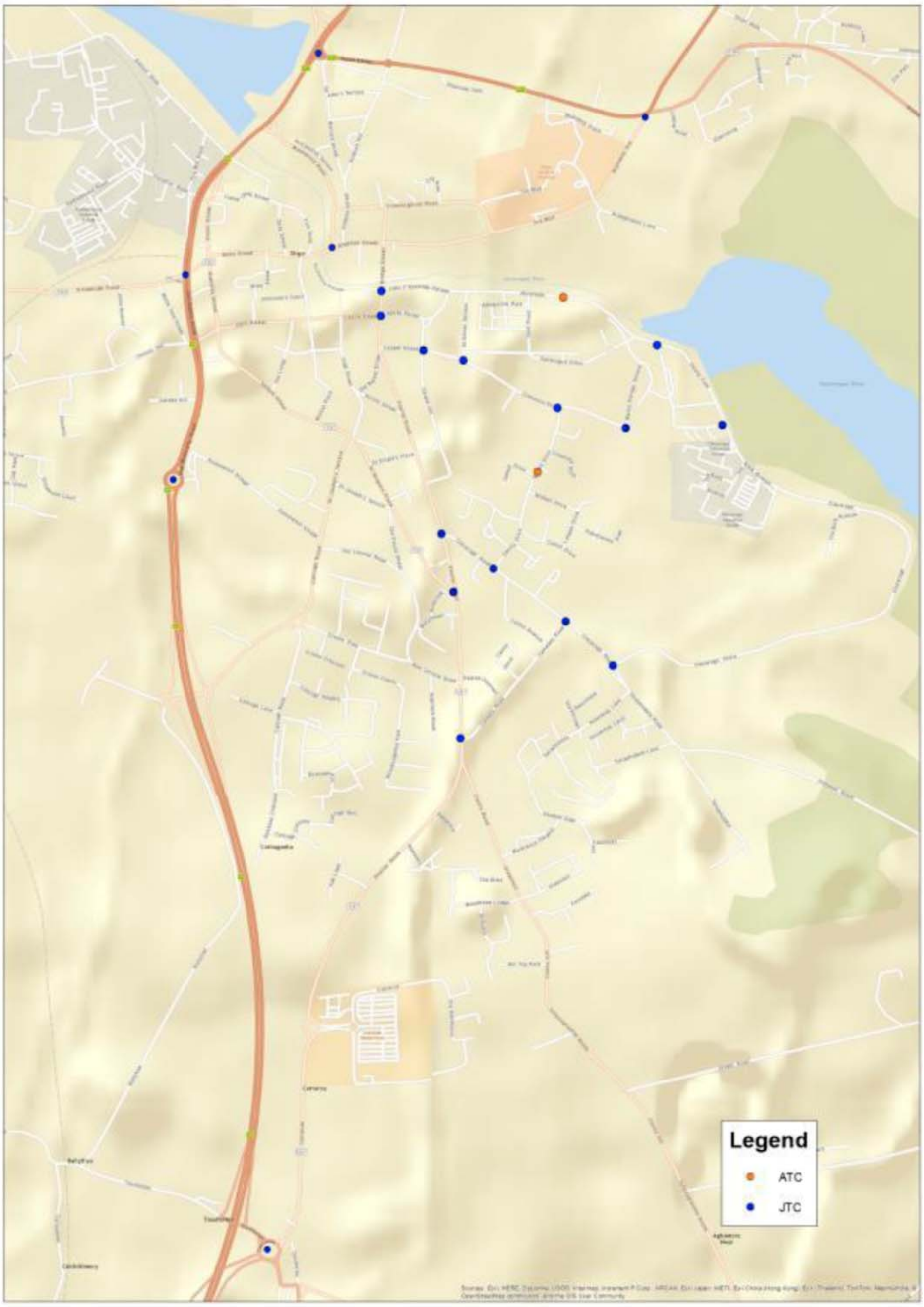

Figure 3.1: NTA Traffic Count Database - Availability in Sligo

3.3 New Survey Data Requirements

Following the gap analysis of the existing survey data, additional survey requirements were identified and agreed with SCC based primarily on the modelling requirements for the proposed scheme. Junction Turning Counts, Pedestrian Counts, Automatic Traffic Counts and Journey Time Surveys were undertaken across Sligo City and the surrounding area. These surveys were undertaken as follows:

- Junction Turning Counts: 43 locations for a 12 hour period (07:00 – 19:00)
- Pedestrian Surveys: 30 locations for a 12 hour period (07:00 – 19:00)
- Automatic Traffic Counts: 17 Locations for a 2 week period; 2 locations for a 24 hour period
- Journey Time Surveys: 8 Bi-directional routes undertaken a minimum of 8 times during each time period

The final specification of locations identified for traffic surveys by Tracsis was outlined spatially in a regional and urban context in Figure 3.2 and Figure 3.3. These locations and types are outlined in further detail in Section 3.3.1 to 3.3.4.

3.3.1 Junction Turning Counts

A number of 24-hour Junction Turning Count (JTC) surveys were undertaken at junctions identified in Figure 3.2 and Figure 3.3. The collection of the stratified individual turning movements typical of this type of surveying provided a comprehensive level of detail with which to calibrate the traffic model, particularly beneficial in a model with a detailed central urban area such as Sligo City. JTC surveys were undertaken on 22nd September 2015. A small number of these were repeated on the 22nd October due to minor localised traffic implications. The sites identified for JTC surveys were based not only upon model requirements for the proposed scheme, but also with a view to ascertaining any cross-country flow along regional roads in the wider regional area.

3.3.2 Pedestrian Counts

Pedestrian surveys were undertaken within the central areas of the model network, predominantly around Sligo City, at key locations of heavy pedestrian traffic. Pedestrian data was always recorded concurrent with the execution of a JTC, although not every junction surveyed by JTC had pedestrian data collected. Data was collected for pedestrian movements across each arm of the locations in Figure 3.3. These surveys were also undertaken on 22nd September 2015.

3.3.3 Automatic Traffic Counts

Automatic Traffic Counts (ATC), using pneumatic tube counting equipment, were used for the calibration of the model. The sites identified for ATC surveys were based not only upon model requirements for the proposed scheme, but also with a view to ascertaining any cross-country flow along regional roads in the wider regional area. ATC sites surveyed are identified in Figure 3.2 and Figure 3.3 and were carried out over a two-week period starting 21st September 2015, providing a robust, comprehensive dataset.

A small number of locations identified for ATC survey were captured by a 'link count' type survey. Link count surveys were undertaken using camera equipment and were undertaken in certain locations where an ATC was not feasible or appropriate due to operational reasons or pedestrian safety. They also gathered classified bi-directional traffic flow along specified links. These were executed for a 24 hour period rather than two weeks.

To supplement the outputs from the aforementioned ATC surveys, data readily available from the TII permanent counter on the N4 between the N59 junction and Carrowroe junction was used.

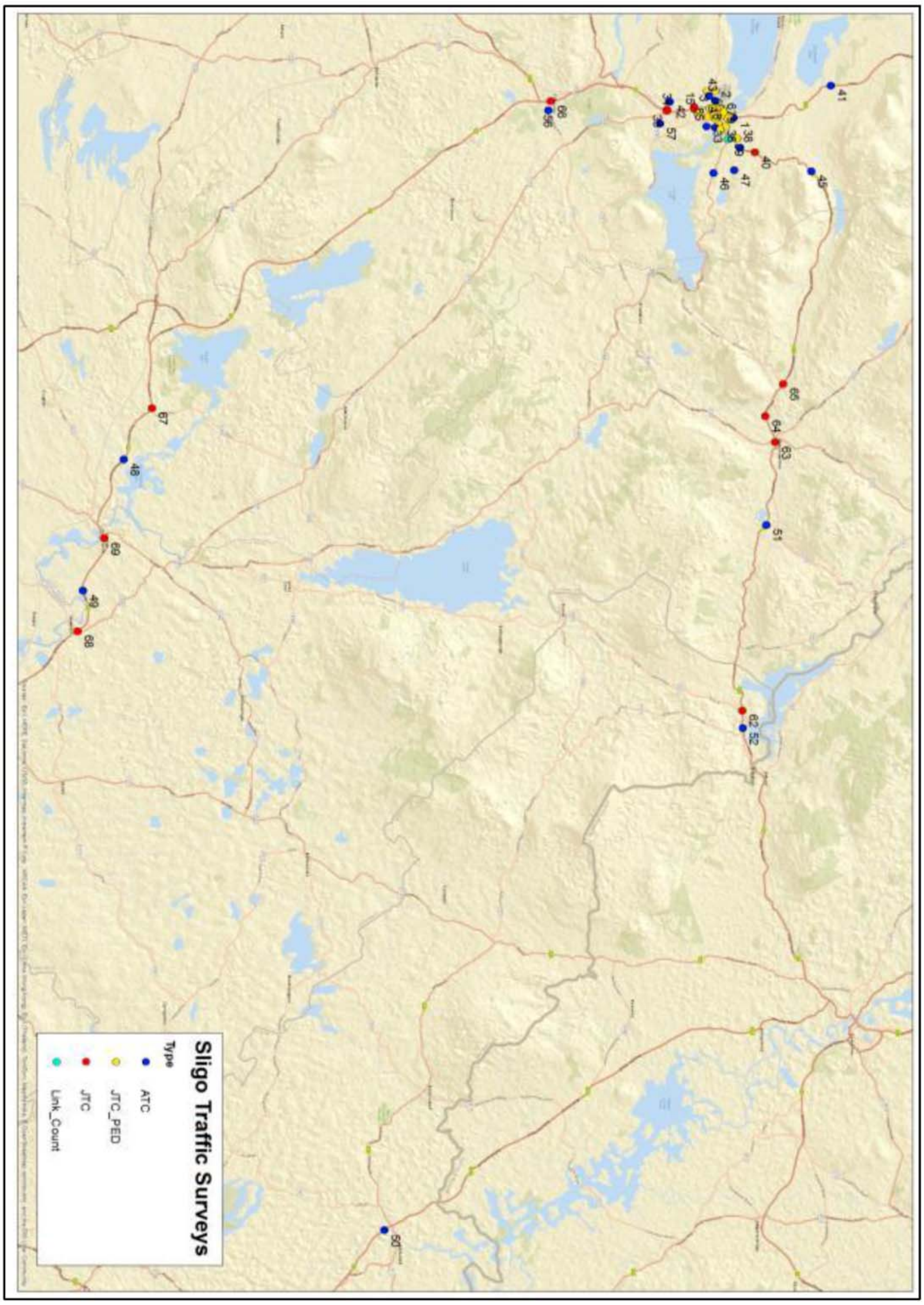

Figure 3.2 Regional Data Collection Locations

N16 Route Selection Study Final Report

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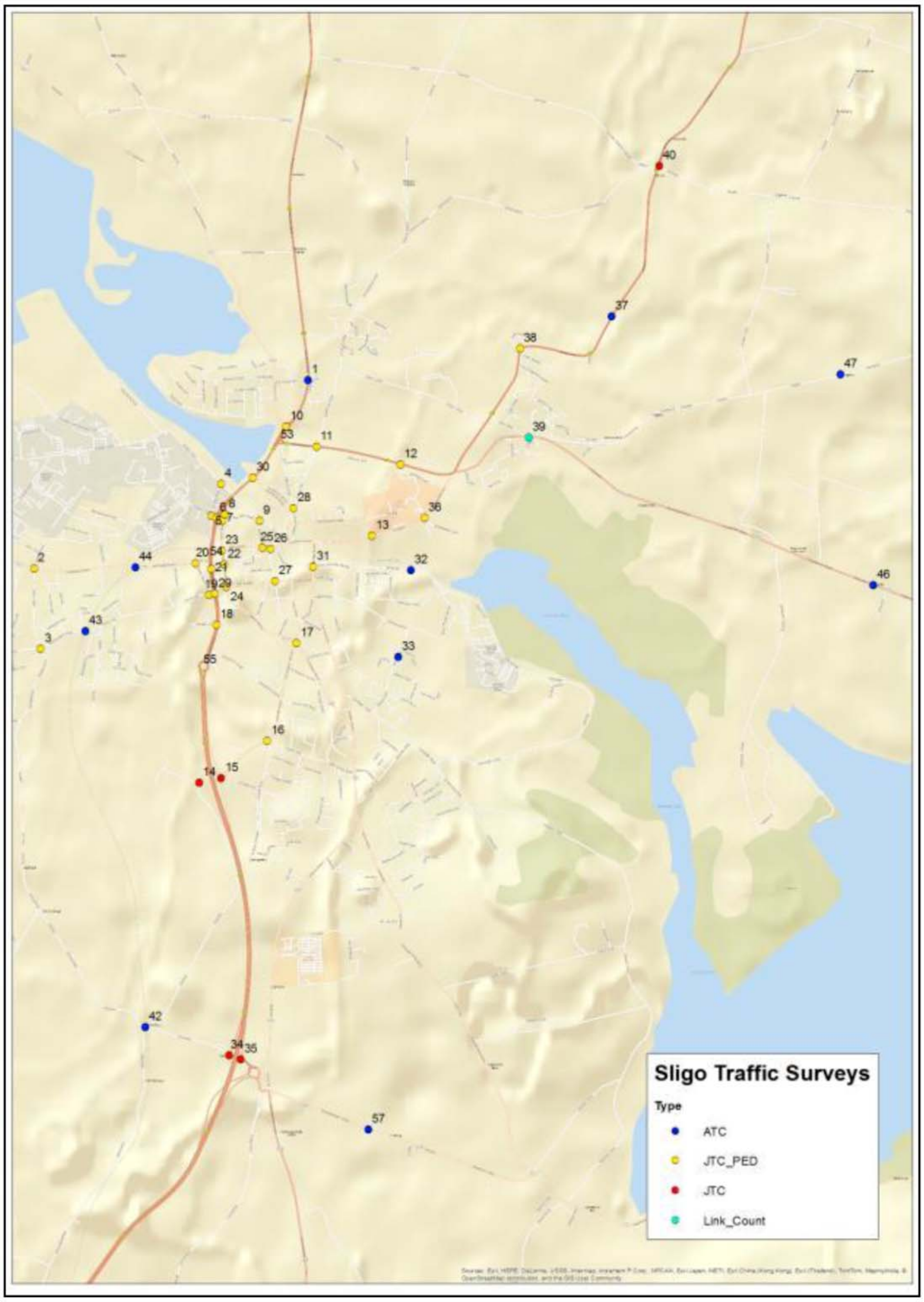

Figure 3.3: Sligo Urban Area Data Collection Locations

13

3.3.4 Journey Time Routes

Journey Time Data, replicating congestion and delays within the network area, were gathered for the validation of the model. Four bi-directional routes, outlined in Figure 3.4, were strategically selected for validation purposes. The selected routes included movements along the existing N16 between the Leitrim County Boundary and the Abbvie Roundabout, key arterial routes, throughout the city centre, and over bridge crossings of the Garavogue River.

The Garavogue River was a key screenline in the study area. Crossing points along the river are central to the network's performance and were required to be adequately represented in Journey Time Surveys.

The journey time routes selected ensured that:

- The N4-N15 corridor was adequately represented including key turning movements
- City Centre traffic was adequately represented
- Crossing points on the River Garavogue screenline were adequately represented

Journey time information was gathered for the identified routes for the following time periods:

- AM (07:00 – 10:00)
- Interpeak (11:00 – 15:00)
- PM (16:00 – 19:00)

Between 8 and 14 runs were undertaken on each route per time period, depending on the particular length of the route and specific time period. More runs were achieved during the Interpeak due to the larger time range involved. These were undertaken on either the 22nd September 2015 or the 20th October 2015.

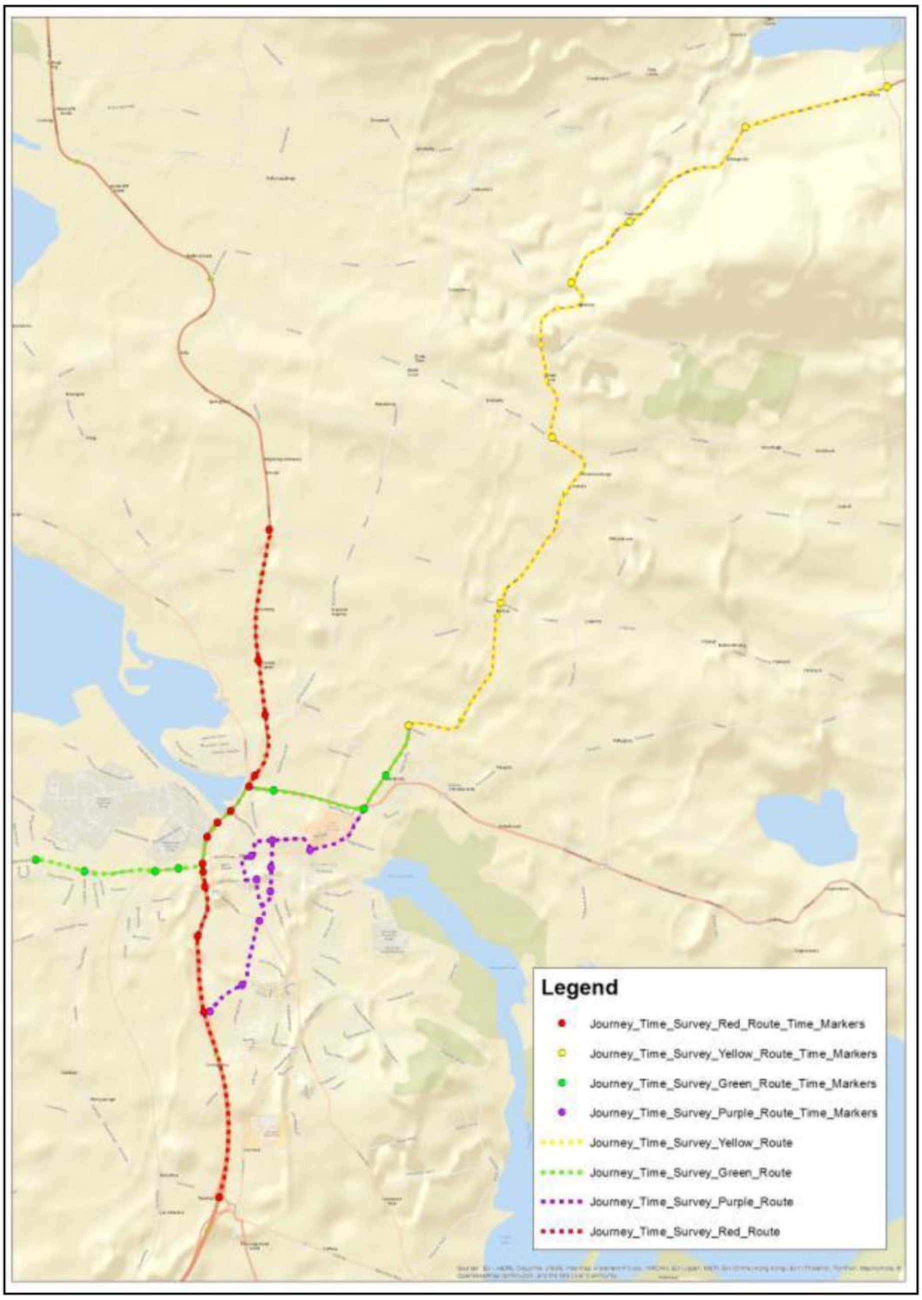

Figure 3.4 Journey Time Surveys

4. Sligo SATURN Network Development

This chapter outlines the updating and the development of the Sligo SATURN model road network. SATURN software version 11.3.03G was used for this modelling exercise. The base year network was coded as 2015 and network wide improvements/upgrades that were carried out on the ground since the 2009 base model were included in the network update.

4.1 Modelled Periods

Similar to the original model three different base models have been used as part of this study: AM, Interpeak (IP) and PM. The road network is the same across all three models with the only difference being signal timings and observed traffic data. For both the AM and PM periods a one hour peak was modelled: 08:00 – 09:00 and 17:00 – 18:00 respectively, both periods corresponding to the periods of peak flow across the network. For the IP Period an average Interpeak hour was used.

Section 3.5 of Unit 5.1 in the TII PAG outlines the inclusion of these three periods is recommended so the model is representative of different time periods during the day and the associated tidal flows "in order to facilitate an accurate cost benefit appraisal".

4.2 2015 SATURN Network

4.2.1 Network Extents

A visual schematic of the previous base network (2009) supplied to Jacobs is outlined in Figure 4.1. This model was developed primarily for the purposes of the realignment of the N15 National Primary Route between Sligo City and the County Boundary with Leitrim. Consequently a significant amount of detail of local and regional roads within the Study Area Corridor was included in that base network. The following is an outline of how the 2009 Base Model was tailored for the needs of the proposed scheme.

The previous 2009 base network was cordoned in the vicinity of the townland of Cashelgarran, west of Benbulbin Mountain along the N15 route corridor. It was concluded that the level of network detail along the N15 corridor north of this point was not appropriate to be included in the updated 2015 Base Model due to its distance from the proposed scheme study area and the likely area of influence of the scheme. Network detail in this particular area was developed in the 2009 base network primarily for the N15 realignment. Figure 4.1 shows the 2009 base network including the point at which it was cordoned. Network detail north of this point was removed.

The new network detail required in the 2015 update includes the Clarion Road, AbbVie Roundabout, the N16 to the Leitrim Boundary, and local road connections to the N16. Figure 4.2 illustrates the additional network extents coded in the 2015 base model.

N16 Route Selection Study Final Report

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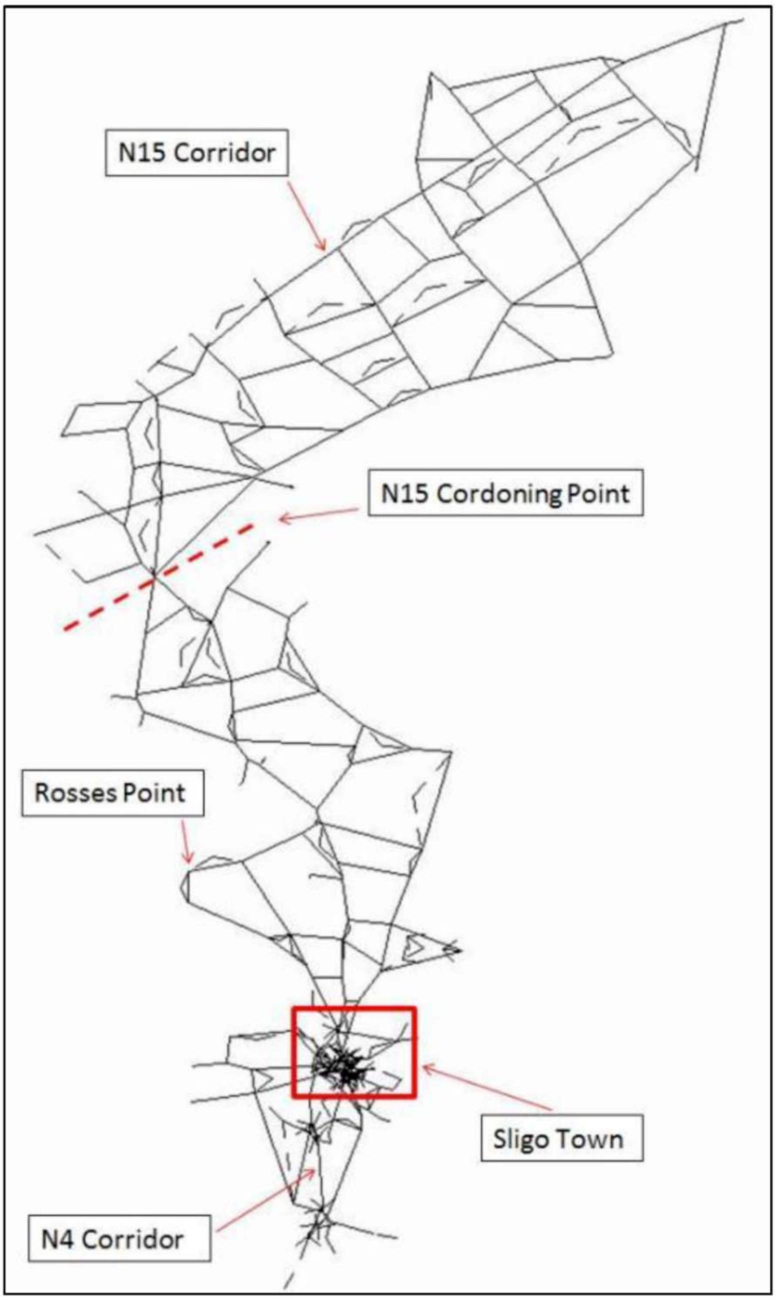


Figure 4.1 : 2009 Base Network with Cordoning Point

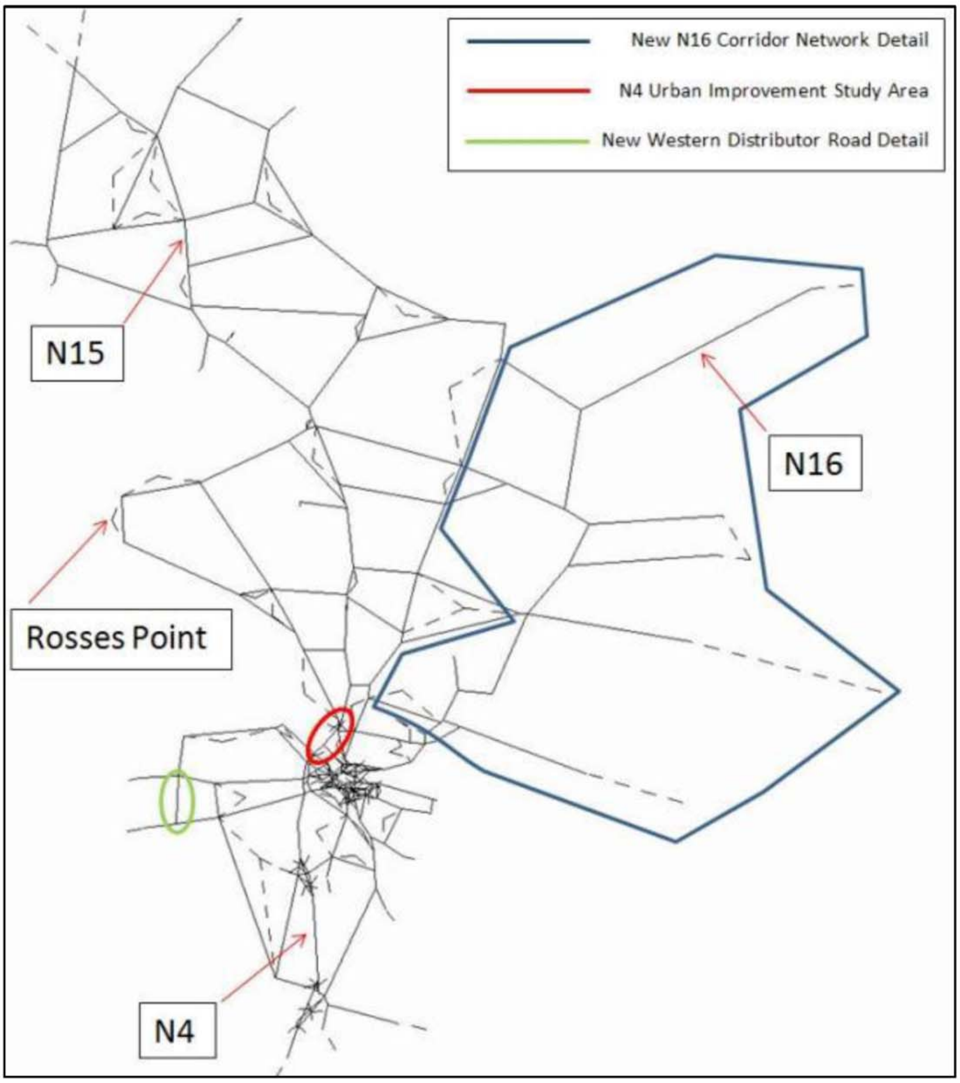


Figure 4.2 : 2015 Base Model

4.2.2 Network Coding

In addition to cordoning and extending the model to meet the requirements of the proposed scheme assessment, there were significant on-site network changes introduced since the previous model was developed in 2009. These network changes were required to be included in the 2015 base model.

The following is a list of network changes made in the Sligo Urban Area to the 2009 base model by Jacobs to refresh the simulation network to the 2015 baseline:

1. **O'Connell Street de-pedestrianised:** This link was included in the model with one lane northbound with right turn only onto Hyde Bridge;
2. **Section of Western Distributor Road:** (Ballydoogan Rd - Strandhill Rd), circled in green in Figure 4.2;
3. **Markievicz Road/Stephen Road/Hyde Bridge:** Bridge approach and Stephen Street approach to junction narrowed to 1 lane each;
4. **Right turn from Fish Quay to Wine Street**: is coded in existing base model. Right Turn movement barred;
5. **Barred Right Turn**: from Union Street to Lord Edward Street;
6. **Barrack Street movement restrictions:** at northern end junction with N4/N15/N16 (central reservation at end of N16; and
7. **Hughes Bridge widening:** three lanes southbound, two lanes northbound.

SATURN version 11.3.3 provides the capability to code and model short turning lanes in greater detail than previously, through the use of "flares". This new feature is a more recent addition to the SATURN software, and allows shorter turning lanes to be coded into the SATURN network with a stacking length in a number of PCUs. This feature more accurately simulates shorter left or right turning lanes at the stop lines of junctions where the road on the ground widens at the end of a link. Flares were coded at junctions along the N4 within Sligo City to better represent the network detail in the proposed scheme study area.

4.2.3 Saturation Flows

The 2009 base model saturation flows were calculated from geometric parameters including turning radii and lane widths measured from OSi mapping. The model was subsequently calibrated. As such, the saturation flows in the original 2009 network coding have not been amended in the 2015 update.

4.2.4 Speed Flow Curves

Speed-flow curves influence how many vehicles use each link in a modelled network. The 2009 base network featured speed flow curves assigned from the COBA manual. These speed flow curves were retained in the 2015 base network update.

4.3 Zone System

The development of the 2015 base network detail resulted in an overall reduction in numbers of zones over the zonal system in the 2009 base network. The 2009 base network featured a total of 82 zones. The first step required in using this model was to cordon out the extents along the N15 corridor to remove excess network detail beyond the area of influence of the proposed N4 and N16 schemes. This cordoning exercise removed 27 zones from the 2009 network (29 – 54, 82) however this exercise derived two new cordon point zones in the N15 corridor, 201 and 202. Their location is outlined in Figure 4.3. This net reduction of 25 zones reduced the cordoned network to 57 zones. Following these amendments, new zones were added and some were relocated in conjunction with network update and expansion.

In the 2009 base network the extent of the network detail north east of Sligo City ended northeast of the N16 / R286 Ash Lane Junction. Zones 65 and 66 were located just north and west of the N16/R286 Ash Lane Junction along the N16 and R286 respectively. Due to the expansion of the network extents in a northwest direction along the N16 corridor from this point, zones 65 and 66 were retained in the updated model network but were relocated to new edge of network locations on the respective roads (N16 and R286 respectively). The new locations for zonal centroids of 65 and 66 are identified in Figure 4.3.

The update of the model to include infrastructural modifications that had occurred on the ground since 2009, and key trip generators in and around the new N16 corridor network detail in the road network on the ground, resulted in the creation of zones 100, 101, 102, 103, 104 and 203 at locations including Clarion Hotel, IT Sligo, Abbvie at Abbvie roundabout, local roads adjacent to the N16 corridor and Cairns Road in the Southeast of the city. The addition of these six new zones brought the final number of zones to 63. The locations of all new zones added to the 2015 base network are outlined in Figure 4.3.

Small additional features of network coding, such as the inclusion of a small section of the Western Distributor Road and the de-pedestrianisation of O'Connell Street were connected to nearby zones existing form the 2009 base network whose locations were not changed. Table 4.1 summarises all additional and relocated node centroids.

Table 4.1 : Centroid Zonal Changes / Additions

Zone No.	Road / Development	Status
65	N16	Relocated to Sligo / Leitrim boundary following extension of network for N16 corridor area
66	R286	Relocated further along R286 following extension of network for N16 corridor area
100	R278	New zone east of N16 following extension of network for N16 corridor area
101	AbbVie Development	New zone for Abbvie at Abbvie Roundabout following extension of network for N16 corridor area
102	Local Road – Carrowlustia / Lisduff Townland	New zone east of N16 following extension of network for N16 corridor area
103	Clarion hotel and adjacent development	New zone for Clarion Hotel following inclusion of Clarion Road for extension of network for N16 corridor
104	Sligo IT	New zone for IT Sligo following extension of network for N16 corridor area
201	Local Road - CashelGarran	New zone derived from the reduction of N15 corridor at the point of cordon
202	N15	New zone derived from the reduction of N15 corridor at the point of cordon
203	Cairns Road	New zone on Cairns Road to facilitate the inclusion of the Cairns Road / Pearse Road Junction

4.4 Summary

The 2009 SATURN model road network and zone system were updated to meet the requirements of the proposed scheme assessment. This included cordoning out unnecessary network, extending the boundary to include the N16, providing greater detail on the N4 and updating the zone system.

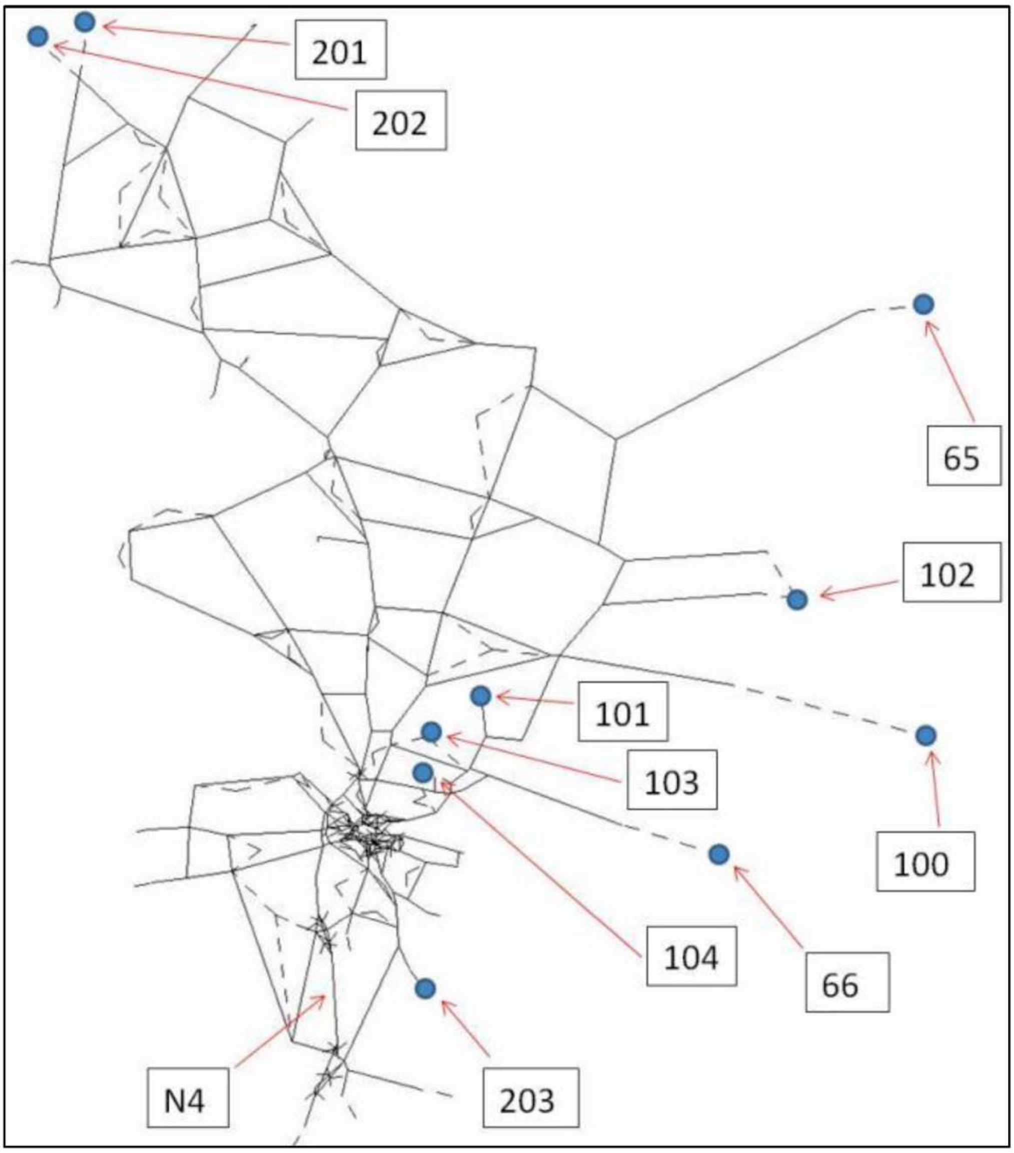


Figure 4.3 : 2015 Base Network Centroid Additions / Relocations - Centroids

5. SATURN Demand Matrix Development

This section outlines the development of the demand matrices used for the 2015 base model. Demand matrices are numerical tabulations representing the overall volumes of traffic between origin and destination zones throughout a modelled traffic network within a given time period. These matrices simulate traffic or trip distribution across the modelled network to current levels and thereby provide a solid foundation from which to subsequently model and forecast the consequences of proposed infrastructural changes and upgrades for future years.

5.1 Prior Matrices

The development of prior matrices was undertaken from two separate sources:

- Sligo SATURN Model 2009 Base Matrices; and
- TII National Transport Model (NTpM) 2013 Base Matrices.

5.1.1 Sligo SATURN Model 2009 Base Matrices

Demand matrices used for the 2009 base model were made available to Jacobs. The demand matrices were calibrated as part of the 2009 Base Model and were developed based on a series of Roadside Interviews carried out in September 2005. For both the AM and PM periods one-hour peak matrices were developed: 08:00 – 09:00 and 17:00 – 18:00 respectively. For the IP Period an average Interpeak hour was used. There were two category matrices in the 2009 Base: Light Vehicles and Heavy Vehicles.

5.1.2 NTpM 2013 Base Matrices

TII provided matrices from the 2013 Base NTpM, cordoned to align with the Sligo SATURN model extents. These matrices consider an average AM peak hour between 07:00 – 09:00 and an average inter peak hour between 12:00 – 14:00 and consider two vehicle categories: Light Vehicles and Heavy Vehicles. As the NTpM does not consider the PM peak, an inverse of the AM peak matrices was assumed.

5.1.3 Development of the Prior Matrices

The Sligo SATURN Model 2009 Base matrices were the starting point for the development of the prior matrices as they contain trip patterns calibrated specifically for the Sligo area. There was limited survey data to indicate that traffic volumes had increased in the Sligo area since 2009, as such no uplift factors were applied at this stage. Where the 2015 Sligo SATURN model was cordoned, the trips associated with the lost zones were removed from the matrices, with the cordoning process providing trips to the cordoned links at the N15.

Where the 2015 SATURN model was extended, the NTpM matrices were utilised to supplement the 2009 Base matrices. As the NTpM provides matrix data in the form of aggregate zones, a zone correspondence was developed that allowed the aggregate NTpM matrices to be disaggregated to the finer 2015 SATURN model zone system.

The combination of the Sligo SATURN Model 2009 Base Matrices and the cordoned NTpM 2013 Base Matrices allowed for the creation of a set of Prior Matrices.

5.2 Matrix Estimation

Matrix Estimation (ME) is a process used to estimate a finalised demand matrix based on observed traffic count information in the format of ATC and JTC as outlined in Section 3 and the demand matrices. The flow replicated within the model is compared to the observed levels within traffic count datasets on links and specific turning movements at key junctions. Changes to the demand matrices are then made in order to adjust the modelled flows to levels within an acceptable variance from those observed.

The finalised matrices from the Prior Matrices process were used as matrix inputs in this process. This element was an iterative process undertaken in parallel to the calibration process. Following each ME run, the estimated matrices were assigned and compared against the calibration criteria. Where necessary amendments were made to the network, in particular at junctions through changes to signal timings, to ensure the network operated as on-site, and the ME process subsequently re-run. The following chapter outlines the outcome of the calibration process undertaken in parallel to the iterative ME process.

6. SATURN Model Calibration and Validation

6.1 Background

This phase of the base model build calibrated and validated the base model to replicate current traffic conditions by using up-to-date matrices, observed traffic flows and journey time information to an acceptable level as per the criteria set out by TII PAG. The result was a model representative of current traffic conditions that aligned with up-to-date traffic count information, thus providing a robust basis on which to assess the forecasts and scheme proposals.

6.1.1 Calibration and Validation Requirements

Table 6.1 outlines the guideline acceptable levels of calibration outlined in Section 5.2 of Unit 5.1 in the PAG. For the purpose of the Sligo SATURN 2015 Base model development traffic volumes are used for calibration and journey times are used for validation.

Table 6.1 TII PAG Model Calibration and Validation Criteria

Criteria and Measures		Acceptability Guideline
Assigned hourly flows compared with observed flows		
1	Individual flows within 15% for flows between 700 & 2,700 vehicles/hour (v/h)	More than 85% of cases
2	Individual flows within 100 v/h for flows less than 700 v/h	
3	Individual flows within 400 v/h for flows greater than 2,700 v/h	
4	Total Screenline flows (>5 links) to be within 5%	
5	GEH Statistic: (i) Individual flows – GEH <5 (ii) Screenline totals – GEH <4	More than 85% of cases
Modelled Journey Times compared to observed times		
6	Times within 15% or 1 minutes if higher	More than 85% of cases

6.2 Model Calibration

6.2.1 Turn Count Calibration

This section outlines the calibration of the Sligo SATURN 2015 Base model to turn counts. In general for macro models, link flow traffic volumes are generally used as the basis for model calibration, however, for the Sligo SATURN model turn counts at junctions were used. The use of turn counts at junctions instead of link flows provides for greater detail in the travel patterns as greater detail is considered through the disaggregation of the link from into the individual turning movements it comprises.

Table 6.2 outlines the calibration results for the 2015 base model for each respective time period, summarising the number and percentage of turn counts that meet the PAG criteria for link flows and for the GEH statistic. Detailed AM, Interpeak & PM period results are outlined in Appendices A, B & C respectively. It can be seen that for the flow criteria each peak period exceeds the specified criteria of 85%, with percentage of turn counts meeting the criteria of a minimum of 91%. For the GEH criteria this figure drops below the 85% specified criteria, with a percentage of 73% achieving the criteria. This is not unexpected as turn counts are a more refined criteria and more difficult to achieve, especially in a macro model. In some cases, due to the zone connector loading points it may not be possible to match turning counts. As such, applying the GEH statistic to turn counts has resulted in a lower percentage achieving the criteria.

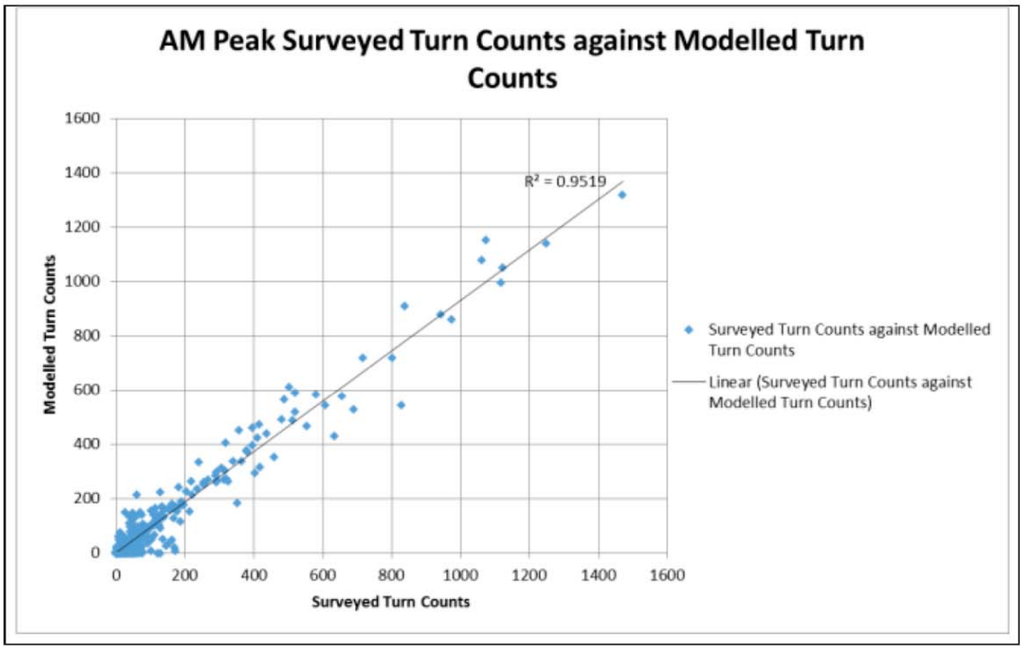
Table 6.2 Sligo SATURN 2015 Base Model Calibration

	AM Peak		Interpeak		PM Peak	
	Number (/300)	%	Number (/272)	%	Number (/278)	%
Flow	283	94%	256	94%	251	90%
GEH	215	72%	199	73%	188	68%

6.2.2 Turn Count Correlation

In addition to the traffic flow GEH comparison the DMRB guidelines also recommend a correlation analysis between the observed traffic surveys and the simulated model outputs. The Correlation Coefficient (R) gives some measure of goodness of model fit. Acceptable values of R are above 0.95. The Coefficient of Determination (R^2) has been utilised which is simply the square of the Correlation Coefficient (R), to determine goodness of fit, as it is a standard spreadsheet output. The DMRB states that acceptable values of R are above 0.95, which translates into acceptable values of R^2 being above 0.9025.

Figure 6.1 details the correlation comparison of traffic flows by scatter plot. The correlation results for the Sligo SATURN 2015 Base Model are within the criteria set by the DMRB for the correlation analysis; the AM, IP and PM peaks having R^2 values of 0.9519, 0.9286 and 0.9273 respectively.



N16 Route Selection Study Final Report

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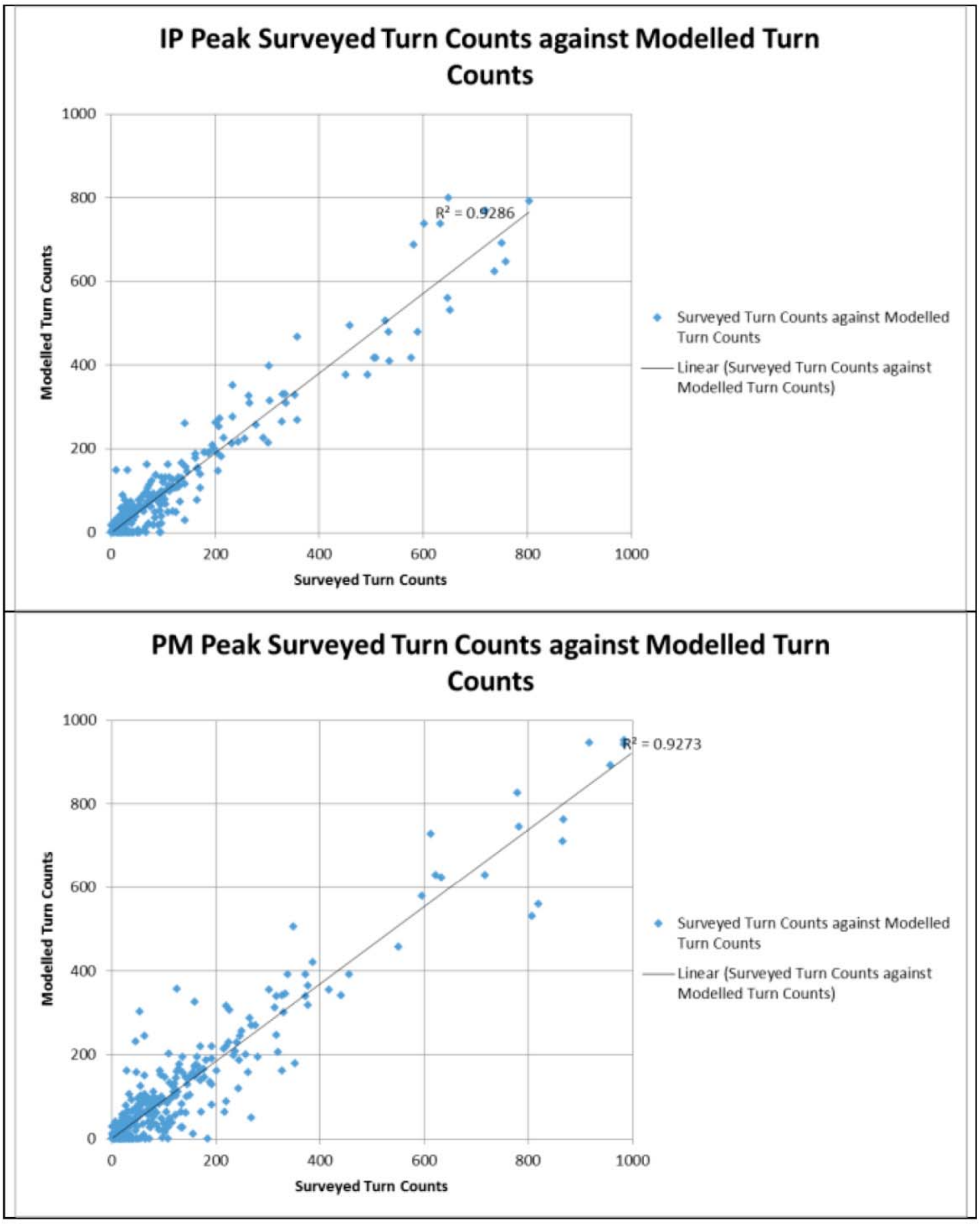


Figure 6.1 SATURN Correlation Analysis

6.2.3 Calibration Summary

The model is considered to have achieved a good level of calibration, with the link flow and correlation analysis exceeding the recommended minimum guidelines. While the GEH analysis does not achieve the PAG targets, it has been undertaken for turn counts rather than link flows, which considers a more refined dataset in greater detail than the link flows. The GEH analysis nevertheless shows a relatively good level of comparison based on the more detailed dataset comparison.

6.3 Model Validation

The model validation has been undertaken based on the journey times, comparing the observed with the modelled journey times. As outlined earlier the PAG sets the validation criteria for modelled journey times, compared with observed times, to be within 15%, or one minute if higher, in more than 85% of cases. The journey time survey data collected in both directions along bi-directional four routes, outlined in Section 3.3.4, in September / October 2015, has been used for this validation exercise.

Table 6.3 to Table 6.5 detail the comparison of modelled journey times relative to the observed times for the AM, Interpeak and PM periods respectively. It can be seen that for all time periods the journey time validation criteria has been met with 87.5% of journey times being within the PAG criteria.

The yellow route represents the journey time survey that corresponds with the N16 route in question. It should be noted that the journey times modelled typically have a longer duration than the observed in a southbound direction and typically have a shorter duration than the observed in a northbound direction. It can be seen that the southbound journey time in the PM peak is slightly outside the recommended range. While this could have been addressed through localised amendments to the speed flow curves, we felt it was best not to as in the model the same speed flow curves have been applied in both directions. We felt that it was appropriate to retain this consistency of coding within the model.

Table 6.3 AM Journey Time Validation

Route	Observed Time	Modelled Time	Difference	% Difference	Within 15%
Route 1 / Yellow Northbound	00:07:13	00:06:36	00:00:37	8.6 %	Yes
Route 1 / Yellow Southbound	00:07:49	00:08:41	00:00:52	11.1 %	Yes
Route 2 / Green Northbound	00:07:42	00:06:50	00:00:52	11.3 %	Yes
Route 2 / Green Southbound	00:05:48	00:05:24	00:00:24	7 %	Yes
Route 3 / Red Northbound	00:07:17	00:06:20	00:00:57	13 %	Yes
Route 3 / Red Southbound	00:08:46	00:08:30	00:00:16	3 %	Yes
Route 4 / Purple Northbound	00:08:54	00:06:59	00:01:55	21.6 %	No
Route 4 / Purple Southbound	00:09:08	00:08:24	00:00:44	8 %	Yes
Validation Criteria Achieved					**87.5% Yes**

Table 6.4 IP Journey Time Validation

Route	Observed Time	Modelled Time	Difference	% Difference	Within 15%
Route 1 / Yellow Northbound	00:07:14	00:06:24	00:00:50	11.5 %	Yes
Route 1 / Yellow Southbound	00:07:42	00:08:21	00:00:39	8.3 %	Yes
Route 2 / Green Northbound	00:06:57	00:07:00	00:00:03	0.7 %	Yes
Route 2 / Green Southbound	00:05:30	00:05:47	00:00:17	5.2 %	Yes
Route 3 / Red Northbound	00:07:41	00:06:21	00:01:20	17.4 %	No
Route 3 / Red Southbound	00:07:35	00:07:34	00:00:01	0.3 %	Yes
Route 4 / Purple Northbound	00:07:27	00:06:36	00:00:51	11.5 %	Yes
Route 4 / Purple Southbound	00:08:28	00:07:24	00:01:04	12.6 %	Yes
Validation Criteria Achieved					**87.5% Yes**

Table 6.5 PM Journey Time Validation

Route	Observed Time	Modelled Time	Difference	% Difference	Within 15%
Route 1 / Yellow Northbound	00:07:17	00:06:25	00:00:52	12 %	Yes
Route 1 / Yellow Southbound	00:08:30	00:09:55	00:01:25	16.7 %	No
Route 2 / Green Northbound	00:08:32	00:07:47	00:00:45	8.7 %	Yes
Route 2 / Green Southbound	00:06:54	00:07:15	00:00:21	5.2 %	Yes
Route 3 / Red Northbound	00:07:32	00:06:30	00:01:02	13.8 %	Yes
Route 3 / Red Southbound	00:07:45	00:07:38	00:00:07	1.5 %	Yes
Route 4 / Purple Northbound	00:08:31	00:07:15	00:01:16	14.9 %	Yes
Route 4 / Purple Southbound	00:08:42	00:08:33	00:00:09	1.7 %	Yes
Validation Criteria Achieved					**87.5% Yes**

6.4 2015 Base Sligo SATURN Model Calibration and Validation Summary

For the calibration process, a detailed approach was undertaken using a more refined dataset; that the flow criteria is met, the GEH criteria still achieves a high level of correlation and that the correlation analysis meets the required criteria, indicate the trip matrices and the road network are considered to have been calibrated adequately for all time periods. In addition the journey time validation criteria has been achieved for all time periods.

Based on the results of the calibration and validation process the Sligo SATURN 2015 Base Model is considered to be calibrated and validated to a good standard and is recommended for further use for future modelling and forecasting for the proposed N16 Route Selection Study.

7. Forecast Demand Growth

7.1 Forecast Scenarios

In order to ensure that the proposed scheme can operate efficiently and deliver benefits into the future, forecasts were required to determine the likely future levels of traffic on the road network. Accurate traffic forecasts are a critical input in ensuring that capacity for transport infrastructure is neither too large nor too small to meet the future demand. Furthermore, traffic forecasts inform the economic appraisal of transport schemes and therefore play a fundamental role in deciding whether a scheme is to progress.

The PAG outlines forecast years that should be considered as part of the assessment of schemes and as part of the economic appraisal. The following outlines the forecast scenarios considered as part of the proposed scheme, in line with the TII PAG:

- 2015 Base Year;
- 2017 Opening Year;
- 2032 Design Year (Opening Year + 15); and
- 2047 Forecast Year (Opening Year + 30).

The 'Opening Year', **'Design Year' and 'Forecast Year' will be uplifted to a representative year at Design Stage and following the establishment of specific scheme extents.**

7.2 Derivation of Growth

The default forecasts were derived from the TII National Transport Model (NTpM). These forecasts are based on high, medium and low growth predictions of population, economic growth, car ownership, labour force and jobs drivers. Cordoned NTpM forecast matrices were received from TII for the study area, consisting of internal and external zones. Figure 7.1 illustrates the NTpM zone system as cordoned for use with the Sligo SATURN modelling assessment.

The current forecast horizons in NTpM are 2030 and 2050. To align the NTpM forecasts with the N16 Route Selection Study forecast years the NTpM growth was interpolated to derive the 2017 Opening Year, 2032 Design Year and 2047 Forecast Year.

The NTpM only provides trip matrix data for the AM peak and the Interpeak time periods. To produce a PM forecast growth the NTpM AM demand matrices were inverted to approximate the PM peak travel patterns.

Forecast growth difference matrices were developed for the NTpM zone system, essentially subtracting the NTpM base matrices from the NTpM forecast matrices, these forecast difference matrices can be added onto the Sligo SATURN 2015 Base demand matrices to derive the forecast traffic matrices. This applies the absolute difference in traffic volumes from the NTpM to the SATURN matrices. This ensures that the detail of the calibrated SATURN matrices are retained while the spatial intelligence and forecast growth from the NTpM model is utilised.

The TII NTpM provides growth rates based on the zoning system for the area, which has approximately 9 zones in the Sligo area with 8 zones on the cordoned periphery of the model. Each zone would have its own growth rate applied to it based on the NTpM forecasts.

The NTpM uses an aggregate zone system when compared to the zone system developed for the Sligo SATURN model. The matrix data received from the NTpM covers 17 NTpM zones, whereas the same area in the Sligo SATURN model comprises 63 zones. A zone correspondence was developed to align the aggregate NTpM zones with the disaggregate Sligo SATURN zones, where multiple SATURN zones are represented by a single NTpM zone the NTpM demand was divided among the SATURN zones.

An absolute difference matrix approach (adding forecast growth numbers) was chosen above a percentage difference matrix approach (multiplying by growth percentage change) as the total demand in the calibrated Sligo SATURN base matrices and the cordoned Sligo NTpM base matrices vary significantly, with the SATURN matrices containing nearly twice as many trips as the NTpM matrices. As such, a percentage difference approach could significantly skew any absolute increase in demand when applied to the Sligo SATURN matrices, significantly uplifting the total trip numbers by nearly twice the uplifted values of the NTpM.

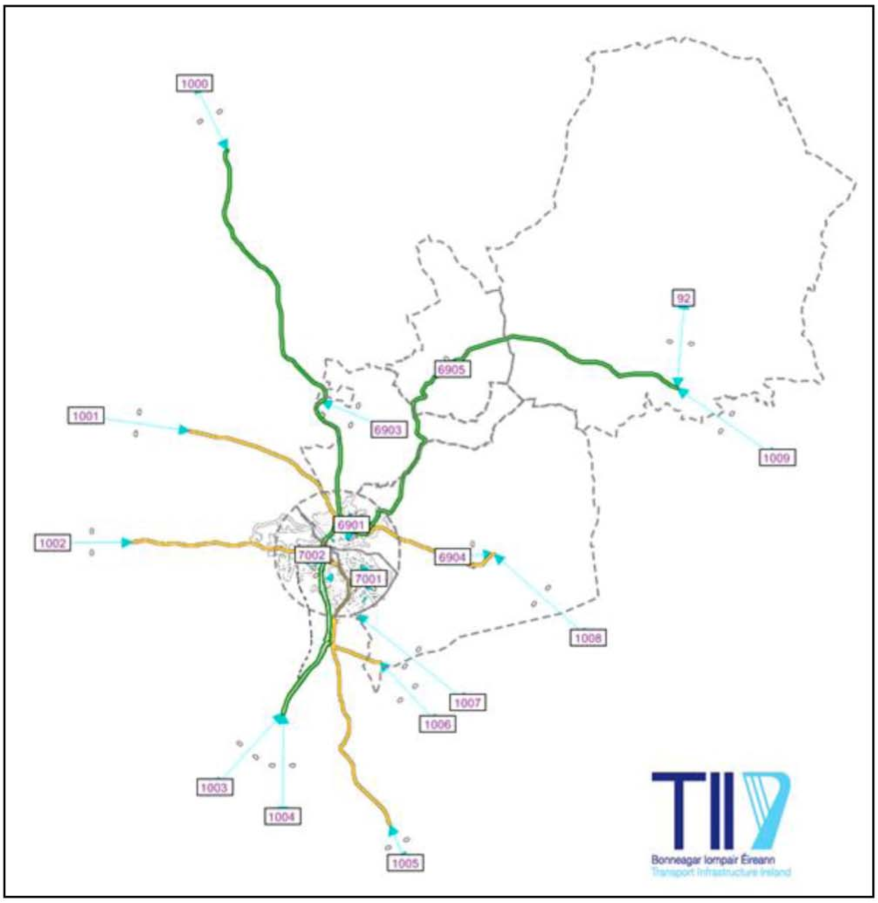
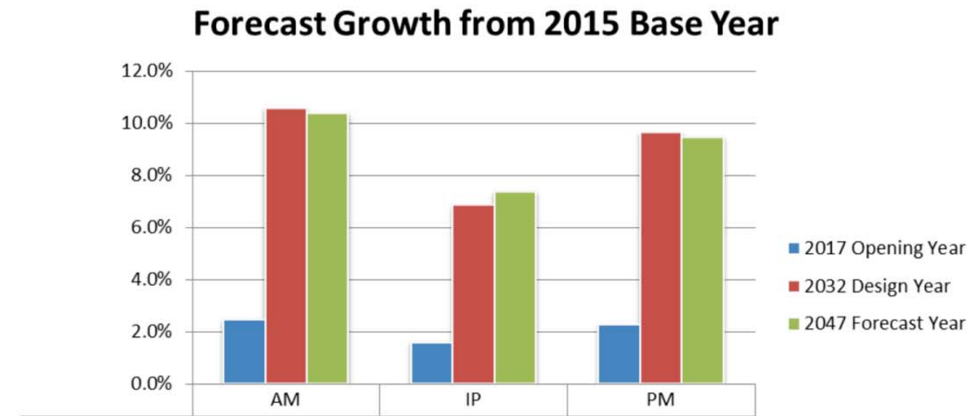


Figure 7.1: National Transport Model Zone System

After the initial KPI Testing Technical Note was submitted, network coding refinements of the proposed schemes were programmed. At this stage, through discussions with SCC, it was deemed appropriate to undertake a slight revision to the loading of traffic growth matrices used in the emerging options taken forward, to better reflect the loading of demand from the high level TII NTpM forecasts onto the N16 network at a more disaggregate level. Following these discussions, matrix modifications were undertaken on the zones to the east of the N16, which is represented only by one large zone in the NTpM (6904). In particular, Zone 102 was identified as a low trip generator was reduced to 10%. The remaining 90% was split evenly across Zone 100 and Zone 66 where trip origins and destinations are greater. These modifications were applied only to the traffic growth and not to the underlying calibrated matrices, therefore not affecting the robustness of the modelling, but adding a more realistic loading pattern to the proposed traffic growth received from the TII NTpM.

7.3 Review of Forecast Demand Growth

Figure 7.2 details the forecast demand growth as a percentage increase from the 2015 Base Year for the medium growth when the absolute difference in forecast traffic volumes from the NTpM is applied to the 2015 Sligo SATURN base matrices. It can be seen that overall traffic will grow by over 10% of the 2015 level by 2032 in the AM and PM peaks. Following the 2032 forecast there is a levelling off of growth with a forecast reduction in traffic from 2032 to 2047 in the AM and PM peak periods.



	AM	IP	PM
2017 Opening Year	2.5%	1.6%	2.3%
2032 Design Year	10.6%	6.9%	9.7%
2047 Forecast Year	10.4%	7.4%	9.5%

Figure 7.2: Forecast Growth from 2015 Base year

7.4 Expansion to Annual Average Daily Traffic

In order to determine the Annual Average Daily Traffic (AADT), expansion factors were developed based on the AM, IP and PM peak model outputs. There is an existing TII Traffic Monitoring Unit (TMU) counter located on the N4 south of Sligo, which was used to determine the AADT expansion factors. TMU data for all of 2015 was obtained and the daily profiles for weekday traffic plotted. Assumed flat AM, IP and PM peak profiles were approximated in order to apply factors to the model peak period results. As the model considers only the weekday traffic, a reduction factor was determined to factor the Annual Average Weekday Traffic (AAWT) to obtain the AADT, which includes the weekend traffic.

Figure 7.3 and Table 7.1 outline the derivation of the expansion factors.

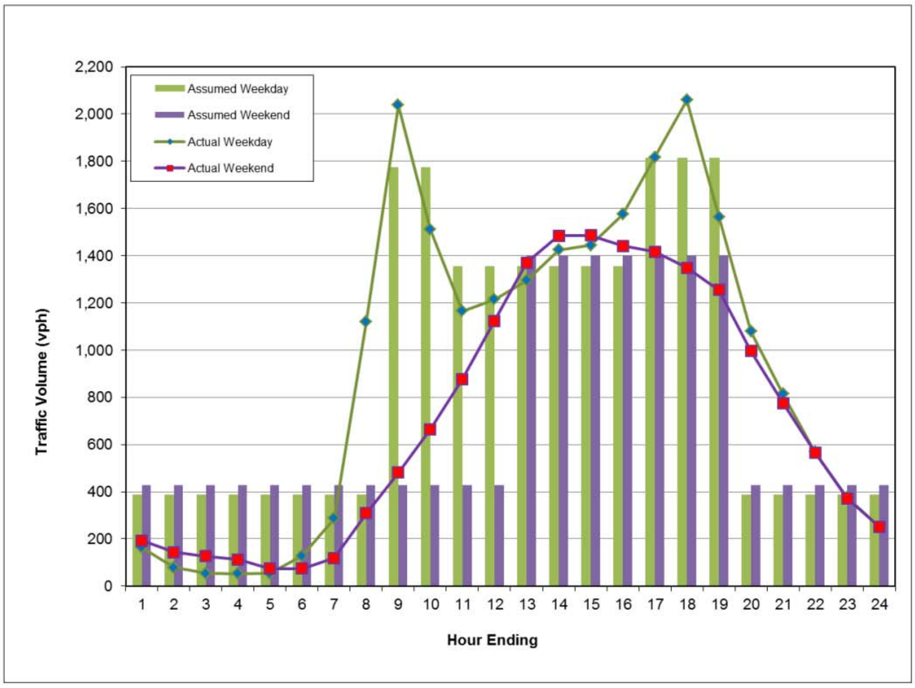


Figure 7.3: N4 Daily Traffic Profiles

Table 7.1: AADT Expansion Factors

	AM	IP	PM	OP	AADT Reduction
Expansion Factors	2	6	3	IP x 3.71	0.934

The following equations outline the expansion factors used to determine AAWT and AADT:

$$AAWT = (2 \times AM) + (6 \times IP) + (3 * PM) + (3.71 \times IP)$$

$$AADT = 0.934 \times \big((2 \times AM) + (6 \times IP) + (3 * PM) + (3.71 \times IP)\big)$$

In order to expand the peak hour SATURN outputs to cover a yearly period the PAG outlines 253 weekdays to be considered. Only the 12 hour period from 07:00 to 19:00 has been considered for the annualisation factoring. These weekday annualisation factors are presented in Table 7.2 below.

Table 7.2: Annualisation Factors – AM, IP and PM

	AM Peak Hour	Inter Peak Hour	PM Peak Hour
Annualisation Factor	506 (2x253)	1518 (6x253)	759 (3x253)

In order to include the weekend (incl. bank holidays) SATURN outputs 365 days of IP hours were considered. This was factored using 6 IP hours for 365 days (6x365 = 2190). Therefore this IP annualisation factor includes the weekday IP and the weekend periods as shown in Table 7.3 below.

Table 7.3: Annualisation Factors – AM, IP (with weekend) and PM

	AM Peak Hour	Inter Peak Hour	PM Peak Hour
Annualisation Factor	506 (2x253)	2190 (6x365)	759 (3x253)

8. Route Selection Assessment

8.1 Introduction

Two route selection assessment Technical Notes have been previously undertaken as part of this N16 Route Selection Study as referred to in Section 1.1 of this Report. The findings of these Technical Notes have been summarised in this section but it is recommended that the two Technical Notes detailed below each be read in conjunction with this Final Report.

- *N16 Key Performance Indicator Testing Technical Note* (December 2016); and
- *N16 Key Performance Indicator Sensitivity Testing Technical Note* (January 2017).

8.2 Summary of N16 KPI Testing Technical Note (December 2016)

The initial KPI Testing Technical Note issued in December 2016 detailed the traffic assessment for the route selection focussing on the strategic and specific study objectives for the N16 scheme. The aim of this KPI assessment was to provide input to SCC to support their sifting of the range of options for the proposed N16 scheme. This study was undertaken for seven options in addition to the Do Nothing and Do Minimum. The strategic and specific objectives of the N16 route selection study and the KPIs developed to quantify how well each option achieved the objective are detailed in Table 8.1 and Table 8.2 below.

Table 8.1: Strategic Objectives and KPIs

	Objective	KPI
1	Meet the policy objectives of National/Regional/County/Local policy documents including both TII and SCC	Qualitative
2	Meet the specific objectives of National/Regional/County/Local policy documents including both TII and SCC	Qualitative
3	Effectively cater for strategic traffic	A: AADTs on N16 B: Select Link Analysis of traffic on N16 at Leitrim Boundary
4	Effectively cater for strategic traffic	AADTs on N15 and N4
5	Efficiently cater for strategic National Road traffic	Journey times from N16 at Leitrim Boundary to N4/N16/N15 junction
6	Efficiently cater for strategic traffic to Sligo City Gateway (NSS)	Journey times from N16 at Leitrim Boundary to Sligo City Centre
7	Operational efficiency of N16	A: V/C ratio of junctions on N16 B: Turn delays at junctions on N16

Table 8.2: Specific Objectives and KPIs

	Objective	KPI
8	Ensure local roads cater for local movement	AADTs on local and regional roads within study area to north of Sligo City appropriate to local levels.
9	Road network to cater for future traffic	A: Number of V/C ratios broken into bands throughout Sligo modelled network. E.g.: number of junctions >85%, 50%-85%, <50%. B: GIS map indicating these locations
10	Reduce congestion on network	Transient and overcapacity queuing
11	Overall network operations	A: Overall travel distance B: Overall travel time C: Average network speed
12	Environment	Vehicle emissions
13	Operational efficiency of N15	V/C ratio of junctions on N15
14	Operational efficiency of key City Centre junctions	V/C ratio of key junctions within Sligo City Centre
15	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City Centre

The assessment of each objective was undertaken using a three score KPI system. The three scores used to assess each Objective were *Very High, High and Medium Preference* and are detailed in Table 8.3 below.

Table 8.3: KPI Scoring System

	Sample Scoring
Very High Preference	1
High Preference	2
Medium Preference	3
Not Applicable	N/A

The KPI scoring for each of the seven scheme options were assessed and are summarised in Table 8.4 below.

Table 8.4: Initial KPI Testing Summary

	Objective	KPI	Option 1A_S1A	Option 1B_S1B	Option 2A_S2A	Option 2B_S2B	Option 3	Option 5	Option 8
3	Effectively cater for strategic traffic on N16	AADT on N16	3	3	3	3	2	1	1
		Select Link Analysis of traffic on N16 at Leitrim Boundary	3	3	3	3	2	1	1
4	Effectively cater for strategic traffic on N15 &	AADT on N15	1	2	1	2	1	1	1
		AADT on N4	1	1	1	1	1	1	1
5	Efficiently cater for strategic national traffic	Journey Times from N16 at Leitrim Boundary to N4/N16/N15 Junction	1	1	1	1	1	2	2
6	Efficiently cater for strategic traffic to sligo city gateway (NSS)	Journey Times from N16 at Leitrim Boundary to Sligo City Centre	1	1	1	1	1	1	1
7	Operational efficiency of N16	V/C ratios of junctions on N16	1	2	1	1	2	1	1
		Turn Delay at Junctions on N16	1	1	1	1	1	1	1
		Overall Score	12	14	12	13	11	9	9

	Objective	KPI	Option 1A_S1A	Option 1B_S1B	Option 2A_S2A	Option 2B_S2B	Option 3	Option 5	Option 8
8	Ensure local roads cater for local movement	AADTs on local and regional roads within study area to north of Sligo City appropriate to local levels	2	2	2	2	2	1	1
9	Road network to cater for future traffic	Number of V/C ratios broken into bands throughout entire Sligo modelled network. E.g. number of junctions >85%, 50% - 85% and <50%	2	3	2	1	2	1	1
		GIS map indicating these locations	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	Reduce congestion on network	Transient and over-capacity queuing	2	1	2	1	1	1	1
11	Overall network operations	Overall travel time	1	1	1	1	1	1	1
		Overall travel distance	2	2	1	1	1	1	1
		Average network speed	1	1	1	1	1	1	1
12	Environment	Vehicle emissions	2	1	2	1	2	2	2
13	Operational efficiency of N15	V/C ratios of junctions on N15	1	2	1	1	2	1	1
14	Operational efficiency of key centre centre junctions	V/C ratios of key junctions within Sligo City Centre	1	1	1	1	1	1	1
15	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City	1	2	1	2	2	2	2
		Overall Score	15	16	14	12	15	12	12

	Option 1A_S1A	Option 1B_S1B	Option 2A_S2A	Option 2B_S2B	Option 3	Option 5	Option 8
Overall Score	27	30	26	25	26	21	21

As can be seen the best ranked options were Option 5 and Option 8 with a score of 21 points each. This KPI assessment provided input to the SCC option sifting process which took into account a multi-criteria assessment, and not just the traffic implications of each option. During this stage of the process SCC made minor adjustments to Option 8 and named this refined option "Option 12". The only difference between Option 8 and Option 12 was the length of one section of road was 145m longer in Option 12. This refinement was coded into the model. Following the option sifting process the following route options were selected for further assessment.

- Option 1A_S1A;
- Option 5; and
- Option 12.

8.3 Summary of N16 KPI Sensitivity Testing Technical Note (January 2017)

The KPI Sensitivity Testing Technical Note issued in January 2017 detailed the traffic assessment of the Do Minimum scenario and the three emerging options for three Sensitivity Tests in relation to the N16 scheme. The Sensitivity Tests undertaken were;

1. No Eastern Garavogue Bridge Sensitivity Test;
2. City Centre Pedestrian / Cycle Priority Sensitivity Test; and
3. N16 Abbvie Roundabout to Elm Gardens (East / West Link) Sensitivity Test.

8.3.1 Sensitivity Test 1 - No Eastern Garavogue Bridge

This sensitivity test considered the Do Minimum and three emerging scheme options without the proposed Eastern Garavogue Bridge in place. This sensitivity test was also undertaken for the N4-N15 Urban Improvement Scheme. The KPIs associated with this sensitivity test are listed below in Table 8.5. The KPIs were undertaken for the Do Minimum and the emerging three options in the 2047 forecast year only.

Table 8.5: No Eastern Garavogue Bridge Sensitivity Test 1 KPIs

	Objective	KPI
1	Effectively cater for strategic traffic	AADTs on N16, N15 and N4
2	Efficiently cater for strategic National Road traffic	Journey times from N16 at Leitrim Boundary to N4/N16/N15 junction
3	Efficiently cater for strategic traffic to Sligo City Gateway (NSS)	Journey times from N16 at Leitrim Boundary to Sligo City Centre
4	Road network to cater for future traffic	Number of V/C ratios broken into bands throughout Sligo modelled network E.g.: number of junctions >85%, 50%-85%, <50%
5	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City Centre

8.3.2 Sensitivity Test 2 - City Centre Pedestrian / Cycle Priority

This sensitivity test considered the Do Minimum and three emerging scheme options with pedestrian and cycle priority measures included in Sligo City Centre. The KPIs associated with this sensitivity test are listed below in Table 8.6. The KPIs were undertaken for the Do Minimum and the emerging three options in the 2047 forecast year only.

The following taken from the Sligo and Environs Development Plan lists the pedestrian and cycle priority measures included in Sensitivity Test 2;

1. Pedestrianised O'Connell Street (PED-1);
2. Pedestrian prioritisation and environmental improvements to include Castle Street, Grattan Street, Market Street, High Street and John Street (PED-2); and
3. Reduce traffic lanes crossing Markievicz Bridge southbound in City Centre from 2 to 1, providing footpath and cycle lane (eliminating need for additional bridge outlined in PED-8).

Table 8.6: City Centre Pedestrian / Cycle Priority Sensitivity Test 2 KPIs

	Objective	KPI
1	Effectively cater for strategic traffic	AADTs on N16, N15 and N4
2	Efficiently cater for strategic traffic to Sligo City Gateway (NSS)	Journey times from N16 at Leitrim Boundary to Sligo City Centre
3	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City Centre
4	Operational efficiency of key City Centre junctions	V/C ratios of key junctions within Sligo City Centre

8.3.3 Sensitivity Test 3 - N16 Abbvie Roundabout to Elm Gardens East / West Link

This sensitivity test considered the Do Minimum and three emerging scheme options with the East / West Link between the N16 Abbvie Roundabout and Elm Gardens in place. The sensitivity test focussed on determining the likely usage of the potential link. The KPIs associated with this sensitivity test are listed below in Table 8.7. The KPIs were undertaken for the Do Minimum and the emerging three options in the 2047 forecast year only.

Table 8.7: N16 Abbvie Roundabout / Cycle Priority Sensitivity Test 3 KPIs

	Objective	KPI
1	Effectively cater for strategic traffic	AADTs on N16, N15 and East / West Link

The KPI scoring for each of the three emerging sensitivity options were assessed and are summarised in Table 8.4 to Table 8.11 below.

Table 8.8: Sensitivity Test 1 – No Eastern Garavogue Bridge

	Objective	KPI	Option 1A_S1A	Option 5	Option 12
1	Effectively cater for strategic traffic	AADT on N16	3	1	2
		AADT on N15	1	2	2
		AADT on N4	1	1	1
2	Efficiently cater for strategic national traffic	Journey Times from N16 at Leitrim Boundary to N4/N16/N15 Junction	1	2	2
3	Efficiently cater for strategic traffic to Sligo City Gateway (NSS)	Journey Times from N16 at Leitrim Boundary to Sligo City Centre	2	1	1
4	Road network to cater for future traffic	Number of V/C ratios broken into bands throughout entire Sligo modelled network. E.g. number of junctions >85%, 50% - 85% and <50%	1	1	1
5	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City Centre	1	1	1
		Overall Score	10	9	10

Table 8.9: Sensitivity Test 2 – City Centre Pedestrian / Cycle Priority

	Objective	KPI	Option 1A_S1A	Option 5	Option 12
1	Effectively cater for strategic traffic	AADT on N16	3	1	2
		AADT on N15	1	2	2
		AADT on N4	1	1	1
2	Efficiently cater for strategic traffic to Sligo City Gateway (NSS)	Journey Times from N16 at Leitrim Boundary to Sligo City Centre	1	1	1
3	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City Centre	1	2	2
4	Operational efficiency of key City Centre junctions	V/C ratios of key junctions within Sligo City Centre	1	1	1
		Overall Score	8	8	9

Table 8.10: Sensitivity Test 3 – N16 Abbvie Roundabout to Elm Gardens (East / West Link)

	Objective	KPI	Option 1A_S1A	Option 5	Option 12
1	Effectively cater for strategic traffic	AADT on N16	3	1	1
		AADT on N15	1	2	2
		AADT on East / West Link	3	1	1
		Overall Score	7	4	4

Table 8.11: Combined Summary

	Option 1A_S1A	Option 5	Option 12
Overall Score	25	21	23

As can be seen the best ranked option in the sensitivity testing was Option 5 with a score of 21 points.

8.4 Route Selection Assessment

This section sets out the route selection assessment for the three remaining sifted route options. Each of the three options were refined in terms of the traffic growth matrices used from the TII NTpM forecasts and the implementation of bespoke Speed Flow Curves. These refined models were then used to assess AADT, journey times, queuing, overall network operations and vehicle emissions. Once the scheme assessment was completed an economic appraisal was undertaken, the details of which are specified in Section 9 of this report.

8.4.1 Model Refinements

At the end of the initial option sifting stage of the process SCC made minor adjustments to Option 8 and named this refined option "Option 12". The only difference between Option 8 and Option 12 was the length of one section of road was 145m longer in Option 12. This refinement was coded into the model. Following the option sifting process the following route options were selected for further assessment.

After the initial KPI Testing Technical Note was submitted, network coding refinements of the proposed schemes were programmed. At this stage, through discussions with SCC, it was deemed appropriate to undertake a slight revision to the loading of traffic growth matrices used in the emerging options taken forward, to better reflect the loading of demand from the high level TII NTpM forecasts onto the N16 network at a more disaggregate level. Following these discussions, matrix modifications were undertaken on the zones to the east of the N16, which is represented only by one large zone in the NTpM (6904). In particular, Zone 102 was identified as a low trip generator and was reduced to 10%. The remaining 90% was split evenly across Zone 100 and Zone 66 where trip origins and destinations are greater. These modifications were applied only to the traffic growth and not to the underlying calibrated matrices, therefore not affecting the robustness of the modelling, but adding a more realistic loading pattern to the proposed traffic growth received from the TII NTpM.

After the initial KPI and sensitivity KPI scheme assessments were completed the three emerging option models underwent further refinement by inserting a more bespoke Speed Flow Curve for the proposed N16 route alignments, from the "standard" ones used up to this point. The refinement of the Speed Flow Curve was undertaken by reducing the bendiness to 25 degrees/km in line with the proposed N16 alignments and by reducing the HGV rate to 6% to correlate with the HGV flow in the N16 models. These bespoke amendments increased the Speed Flow Curve capacity from 1463 to 1605 and provided a nominal increase in maximum speed from 90 km/h to 91 km/h. This Speed Flow Curve amendment now better represents the proposed N16 benefits of the three emerging options for which some further KPI testing was undertaken to assess AADT, journey times, queuing, overall network operations and vehicle emissions.

8.4.2 AADT on the N16

The 2047 AADT at various critical locations on N16 alignment are presented in Table 8.12. The locations of the N16 AADT values are illustrated in Figure 8.1 to Figure 8.4 showing the different option arrangements and configurations for the Do Minimum and the three emerging options considered.

It can be seen that in the Do Minimum traffic volumes increase on the approach to Sligo, but reduce slightly to the south of the N16 junction with the L-3407-22 due to traffic using the L-7422-0 as an alternative route to the N16.

Option 1A_S1A only shows similar patterns of traffic using the N16 at points 1 - 3 with a greater reduction in traffic at point 4 as it gets closer to the N15. This highlights that traffic demand on the N16 is focussed more within Sligo and results in this demand utilising the existing N16 route as an alternative to the proposed alignments.

Options 5 and 12 showed similar traffic patterns with traffic volumes on the proposed N16 alignments at points 1 – 3. Option 12 southbound traffic flow on the N16 is lower than Option 5 the closer it gets to Sligo, this is due to the larger number of vehicles diverting to Rathbraughan Park and Old Bundoran Road in this option when compared with Option 5. This diverting traffic was observed in the Select Link Analysis during the IP and PM peak periods and indicates that the longer N16 in Option 12 is less desirable for some trips during most of the day. The Option 5 two-way flow on the N16 increases as it gets closer to Sligo. This demonstrates that Option 5 generally caters for the demand to Sligo, with limited use of the alternative routes to the N16. Option 5 caters for the highest demand levels of the three emerging options.

Table 8.12: Refined Models - N16 2047 AADT Comparisons

Map Reference	Direction	N16 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
1	NB	1839	1839	1839	1839
1	SB	1813	1813	1813	1813
2	NB	1839	1839	1839	1839
2	SB	1813	1813	1813	1813
3	NB	1738	1839	1784	1773
3	SB	1723	1813	1743	1741
4	NB	2623	450	1724	2155
4	SB	2463	1536	1700	1644
5	NB	2452	-	2742	2323
5	SB	1469	-	2527	1745
6	NB	-	-	-	2531
6	SB	-	-	-	1822

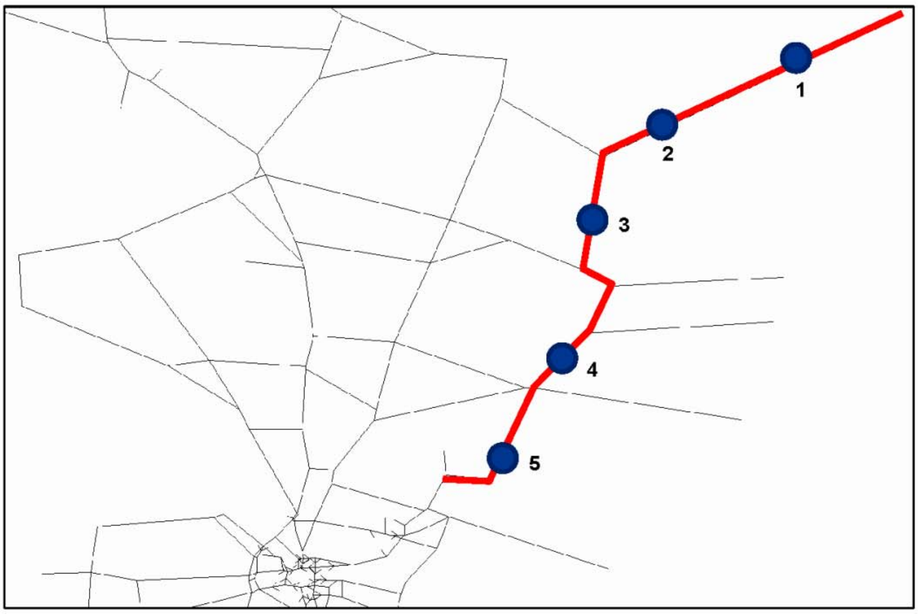


Figure 8.1: SATURN Model Do Minimum

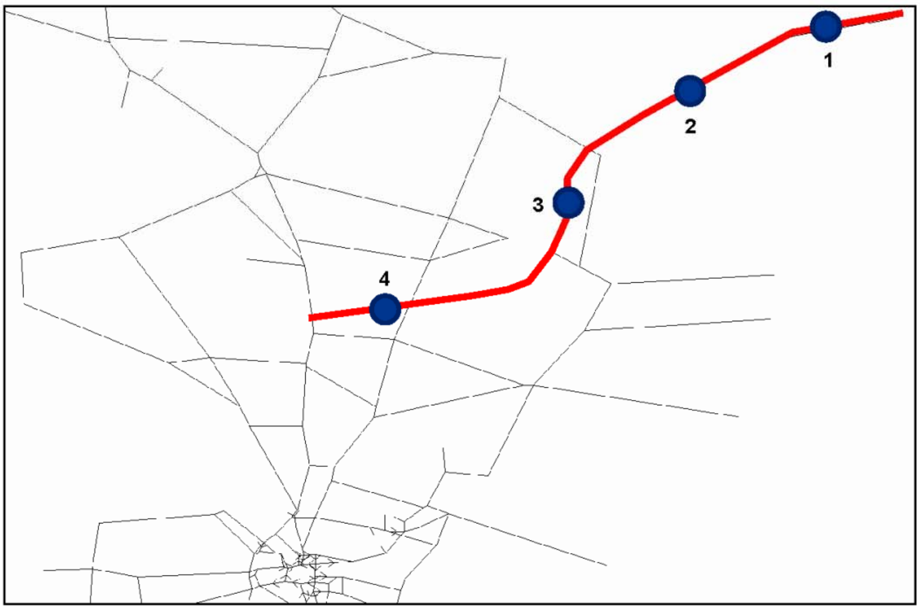


Figure 8.2: SATURN Model Option 1A_S1A

N16 Route Selection Study Final Report

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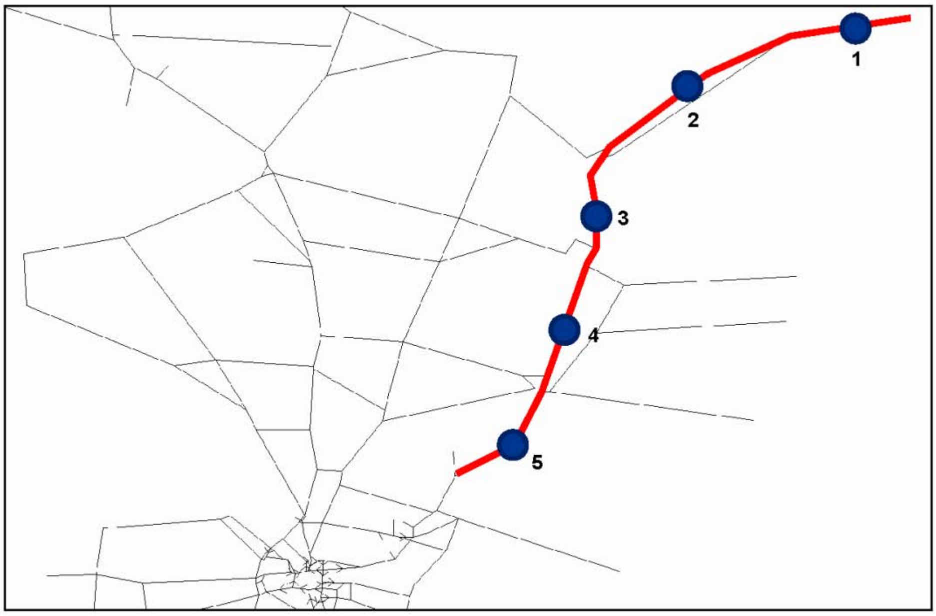

Figure 8.3: SATURN Model Option 5

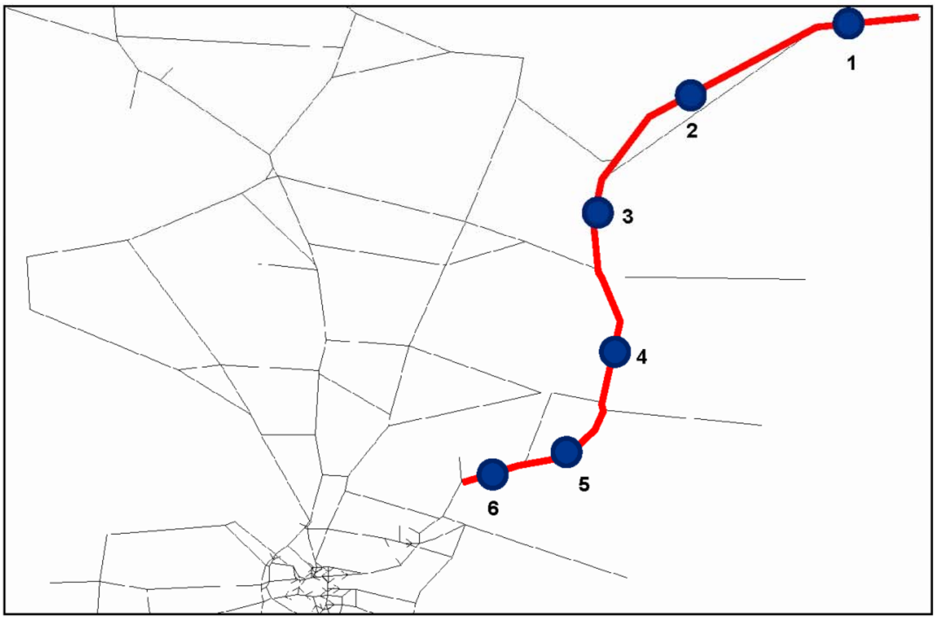

Figure 8.4: SATURN Model Option 12

8.4.3 AADT on the N15

The AADT values on the section of N15 adjacent to the N16 alignment are presented in Table 8.13 below. The locations of the N15 AADT values are illustrated in Figure 8.5 below. The section of the N15 in question spans just north of where the proposed N16 intercepts in Option 1A_S1A to the signalised junction of the R291 Rosses Point Road.

It can be seen that on the N15 north of where the proposed N16 intercepts it (AADT 1), the northbound and southbound flows are relatively constant across all the scenarios.

The northbound and southbound flows on the N15 immediately south of where the proposed Option 1 N16 intercepts it (AADT 2) have been included indicating that the southbound AADT is approximately 900 greater than the northbound in Option 1A_S1A. Throughout all the reference points on the N15, Option 1A_S1A has the highest AADT owing to the proposed N16 intercepting the N15 in this option, while Option 5 and 12 show similar AADT levels with the Do Minimum scenario.

Table 8.13: Refined Models – N15 2047 AADT Comparisons

Map Reference	Direction	N15 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
1	NB	8257	8299	8262	8242
1	SB	8107	8144	8119	8083
2	NB	-	8566	-	-
2	SB	-	9498	-	-
3	NB	8315	8562	8319	8306
3	SB	8128	9461	8146	8136
4	NB	7953	8257	8158	7968
4	SB	7669	8946	8105	7670
5	NB	8465	8670	8558	8389
5	SB	8437	9778	8888	8457
6	NB	7951	7973	7639	7761
6	SB	7935	9038	7806	8096

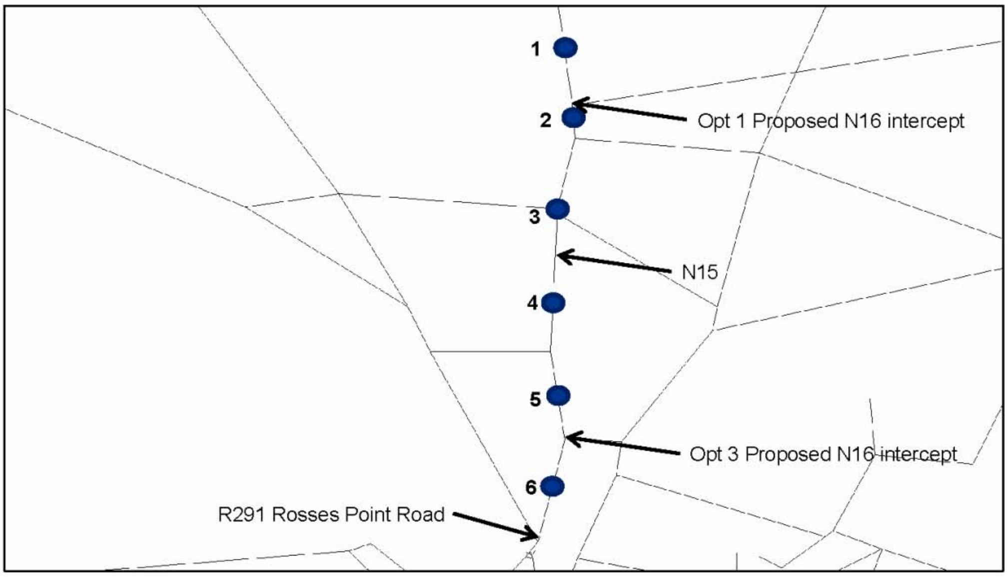

Figure 8.5: N15 AADT Locations

8.4.4 AADT on the N4

The AADT values at locations on the N4 are presented in Table 8.14 below. The locations of the N4 AADT values are illustrated in Figure 8.6 below.

The locations of the AADTs are on the section of the N4 spanning above the signalised junction of Upper John Street to the south, and just below where the existing N16 / Duck Street intercepts to the north.

Throughout the three reference points on the N4, Option 1A_S1A, 5 and 12 all show similar AADT levels with the Do Minimum scenario, with Option 1A_S1A recording the highest AADT at each point.

Table 8.14: Refined Models – N4 2047 AADT Comparisons

Map Reference	Direction	N4 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
1	NB	12072	13741	13574	13667
1	SB	9867	10740	10525	10713
2	NB	9605	10454	10390	10046
2	SB	10308	11534	11443	11604
3	NB	12992	13209	12796	12938
3	SB	15870	16024	14918	15473

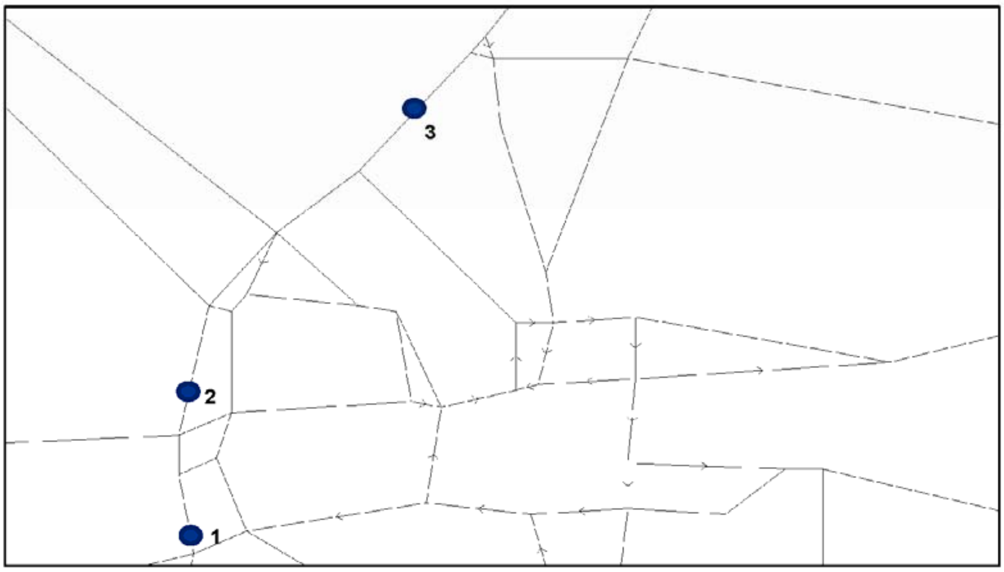

Figure 8.6: N4 AADT Locations

8.4.5 Journey Times from the Leitrim county boundary to the N4 / N15 / N16 junction

This journey time route assessment was used to see how efficiently the different scenarios cater for strategic national road traffic and was assessed using journey times from the N16 at the Leitrim boundary to the N4 / N16 / N15 junction for the Do Minimum and the three emerging scheme options.

The 2047 AM, IP and PM peak journey time comparisons for the Do Minimum and three emerging route options between the Leitrim county boundary and the N4 / N16 / N15 junction are presented in Table 8.15. For information purposes, Option 1A_S1A includes two journey times. The two journey times are when using the proposed N16 and using the existing N16. These indicate that the journey times when using the proposed N16 are between 2-3 minutes quicker than when using the existing N16 in Option 1A_S1A. Overall, Option 1A_S1A recorded the shortest journey time (when using the proposed N16) followed by Option 5 and 12, respectively. It is has been noted that Option 5 whilst carrying the highest AADTs into Sligo City Centre still recorded journey times which were approximately 20 seconds faster than Option 12.

Although Option 5 and 12 have slightly longer journey times it is important to stress that the Select Link Analysis has indicated that there is a low level of strategic traffic on the N16 travelling to the N4/N16/N15 junction. Figure 8.7 below illustrates the Select Link Analysis for the Do Minimum and the three emerging options. Each of the diagrams show that most of the southbound N16 flow in the AM period is travelling to Sligo City Centre.

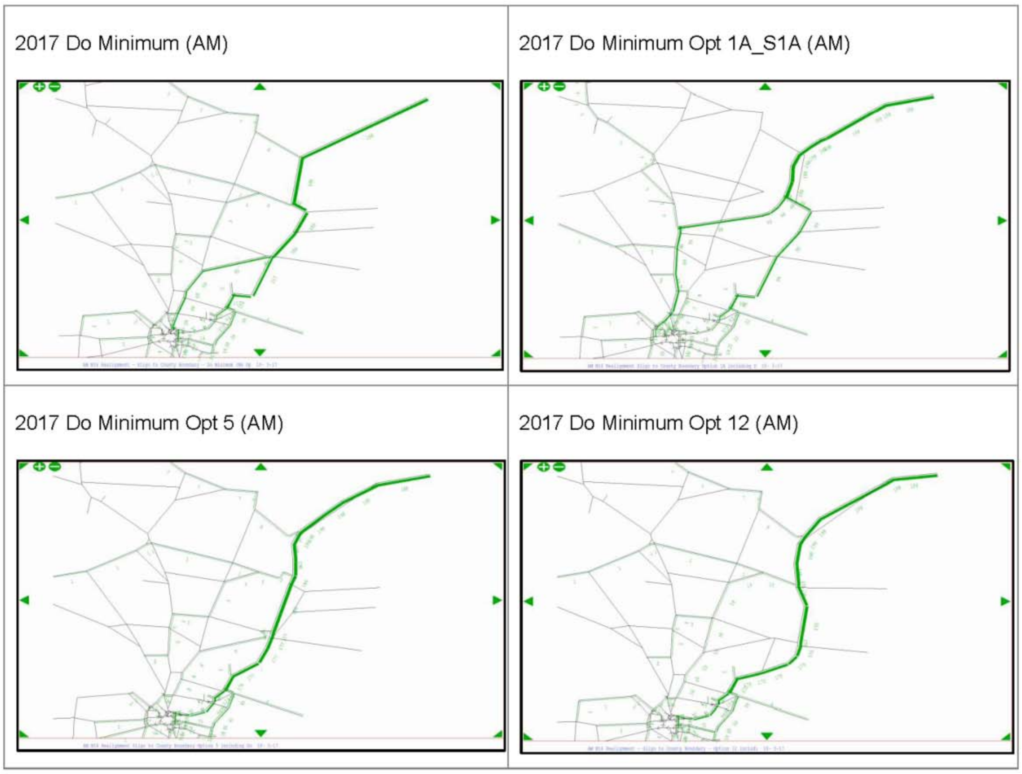

Figure 8.7: Select Link Analysis

For illustration purposes the Opt 1A_S1A routes using the proposed N16 (green) and existing N16 (red) are shown in Figure 8.8 below. In this example the length of the green route using the proposed N16 to the N4/N16/N15 junction is 9.51 km, while the length of the red route using the existing N16 is 10.62 km.

Figure 8.8: Journey Time routes illustration (Opt 1A_S1A) for the proposed N16 (green) and the existing N16 (red)

Table 8.15: Refined Models - Journey Time Comparison for 2047 AM, IP and PM peak inbound

Scenario	Modelled Journey Time (mins) Leitrim county boundary to the N4 / N16 / N15 junction		
	2047 AM	2047 IP	2047 PM
Do Minimum	9:44	9:28	9:39
Do Minimum Opt 1A_S1A (Proposed N16)	7:27	7:04	7:13
Do Minimum Opt 1A_S1A (Existing N16)	9:32	9:22	10:25
Do Minimum Opt 5	8:18	8:09	9:10
Do Minimum Opt 12	8:43	8:35	9:31

8.4.6 Journey Times from the Leitrim county boundary to Sligo City Centre

This journey time route assessment was used to see how efficiently the different scenarios cater for strategic traffic to Sligo City Gateway (NSS). This KPI was assessed using journey times from the N16 at the Leitrim boundary to Sligo city centre for the Do Minimum and the three emerging scheme options.

The 2047 AM, IP and PM peak journey time comparisons for the Do Minimum and three emerging route options between the Leitrim county boundary and Sligo City Centre are presented in Table 8.16. Again, for information purposes, Option 1A_S1A includes two journey times. The two journey times are when using the proposed N16 and using the existing N16. These indicate that there is not much difference in the AM journey time to the city centre when using the proposed N16 or the existing N16 in Option 1A_S1A. There is however a greater journey time saving experienced in the 2047 IP and PM peak periods between the two routes, when compared to the Do Minimum.

Option 5 has the best journey times to the city centre but owing to the fact it also delivers the most traffic to the city centre this has created some delays in the city centre streets as they cope with this increase in traffic demand, thus increasing journeys times on the final links within the city centre. Overall, Option 5 recorded the shortest journey times in the AM and IP periods followed by Option 12 and Option 1A_S1A. Option 5 has slightly longer journey times that Option 1A_S1A in the PM peak. This was due to Option 5 delivering the largest volume of traffic directly to Sligo City Centre, which resulted in a slight increase in delays southbound on Lake Isle Road towards the junction of Bridge Street and Stephen Street. The Select Link Analysis undertaken indicated that Option 5 catered effectively for the delivery of the largest volume of traffic to Sligo City Centre.

For illustration purposes the Opt 1A_S1A routes using the proposed N16 (green) and existing N16 (red) are shown in Figure 8.9 below. In this example the length of the green route using the proposed N16 to the city centre is 10.54 km, while the length of the red route using the existing N16 is 10.70 km.

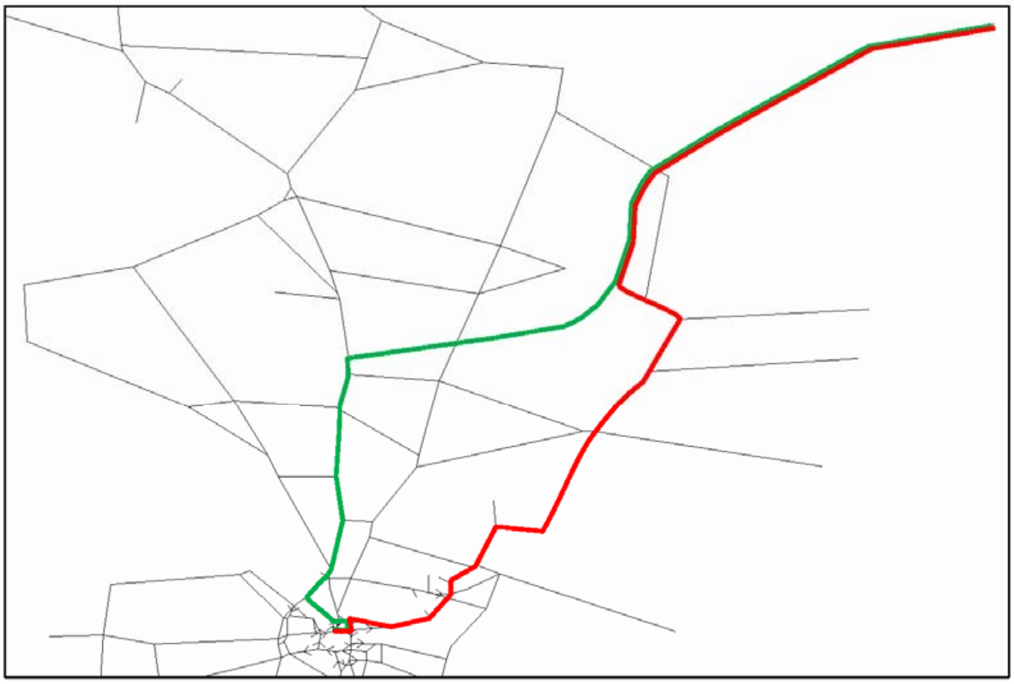

Figure 8.9: Journey Time routes illustration (Opt 1A_S1A) for the proposed N16 (green) and the existing N16 (red)

Table 8.16: Refined Models - Journey Time Comparison for 2047 AM, IP and PM peak inbound

Scenario	Modelled Journey Time (mins) Leitrim county boundary to Sligo City Centre		
	2047 AM	2047 IP	2047 PM
Do Minimum	10:12	10:04	10:34
Do Minimum Opt 1A_S1A (Proposed N16)	9:51	9:07	9:25
Do Minimum Opt 1A_S1A (Existing N16)	9:59	9:55	10:47
Do Minimum Opt 5	8:47	8:45	9:42
Do Minimum Opt 12	9:13	9:11	9:47

8.4.7 Network Queuing

The KPIs assessed for this were transient and over-capacity queuing. Transient queuing relates to the overall level of queuing throughout the entire model network that occurs associated with typical under-capacity junction operation, but ultimately can be accommodated by the network. Over-capacity queuing relates to the level of queuing associated with junctions that have reached capacity.

The results of these KPIs are presented in Table 8.17 to Table 8.19 below. As can be seen the transient queuing recorded is fairly constant in each of the three peak periods (AM 218.1 – 224.3, (IP 156.4 – 165.8) and (PM 269.0 – 280.8). Overall, Option 12 has the least amount of transient queuing averaged across the three peak time periods.

Over-capacity queuing is minimal in each of the three peak periods (0 – 15.7 PCU Hrs / Hr).

Table 8.17: 2047 AM Network Queuing

	2047 AM Congestion			
	DM	OP1A_S1A	OP5	OP12
Transient Queues (PCU Hrs / Hr)	219.3	224.3	220.7	218.1
Over-Capacity Queues (PCU Hrs / Hr)	1.2	1.3	1.5	1.6

Table 8.18: 2047 IP Network Queuing

	2047 IP Congestion			
	DM	OP1A_S1A	OP5	OP12
Transient Queues (PCU Hrs / Hr)	165.8	157.2	156.4	156.4
Over-Capacity Queues (PCU Hrs / Hr)	0	0	0	0

Table 8.19: 2047 PM Network Queuing

	2047 PM Congestion			
	DM	OP1A_S1A	OP5	OP12
Transient Queues (PCU Hrs / Hr)	280.8	274.5	270.9	269.0
Over-Capacity Queues (PCU Hrs / Hr)	0.2	15.2	15.7	8.7

8.4.8 Overall Network Operations

The KPIs assessed for this were total travel time, travel distance and average speed. Total travel time is the total amount of travel time summed for all trips made on the entire model network. The travel distance is the total distance travelled summed for all trips made on the network. The average speed relates to the average vehicle speed of traffic over the entire network.

The results of these KPIs are presented in Table 8.20 to Table 8.22 below. Overall, Option 12 recorded the lowest total travel time and highest average speed across the three peak periods. While Option 5 recorded the lowest travel distance.

Table 8.20: 2047 AM Overall Network Operations

	2047 AM Overall Network Operations			
	DM	OP1A_S1A	OP5	OP12
Total Travel Time (PCU Hrs / Hr)	913.6	915.8	908.1	908.0
Travel Distance (PCU KMs / Hr)	45623.7	45616.8	45081.0	45583.5
Average Speed (Kph)	49.9	49.8	49.6	50.2

Table 8.21: 2047 IP Overall Network Operations

	2047 IP Overall Network Operations			
	DM	OP1A_S1A	OP5	OP12
Total Travel Time (PCU Hrs / Hr)	655.2	641.5	639.7	641.4
Travel Distance (PCU KMs / Hr)	32336.8	32312.0	32025.4	32340.4
Average Speed (Kph)	49.4	50.4	50.1	50.4

Table 8.22: 2047 PM Overall Network Operations

	2047 PM Overall Network Operations			
	DM	OP1A_S1A	OP5	OP12
Total Travel Time (PCU Hrs / Hr)	1039.7	1042.6	1030.9	1026.1
Travel Distance (PCU KMs / Hr)	49019.0	48923.3	48405.1	48877.4
Average Speed (Kph)	47.1	46.9	47.0	47.6

8.4.9 Vehicle Emissions

The KPIs assessed for this were vehicle emissions in terms of Carbon Monoxide, Carbon Dioxide, Nitrous Oxides and Hydro Carbons. These are model network wide vehicle emissions resulting from the proposed scheme as modelled in the SATURN model. The results of these KPIs are presented in Table 8.23 below which detail the proposed 2047 daily emissions for each option. The results indicate that each of the three emerging options have fewer emissions than the Do Minimum with Option 5 recording the least emissions, largely due to the fact that Option 5 provides the most direct route into Sligo City Centre.

Table 8.23: 2047 Daily Vehicle Emissions

	2047 Daily Vehicle Emissions			
	DM	OP1A_S1A	OP5	OP12
Carbon Monoxide (Kg)	3805	3739	3714	3725
Carbon Dioxide (Kg)	47342	47018	46558	46933
Nitrous Oxides (Kg)	992	981	976	978
Hydro Carbons (Kg)	692	681	676	678

8.4.10 Summary of Route Selection Assessment

This Route Selection Assessment section has considered AADTs, journey times, network queuing, overall network operations and vehicle emissions for each of the three emerging options that undergone model refinements. In terms of AADTs Option 5 performed the best for N16 traffic into Sligo City Centre, it also performed second best on the strategic journey time to the N4/N15/N16 junction and best on the journey time to Sligo City Centre. Option 12 performed the most resilient in terms of network queuing, total travel time and average speeds while Option 5 benefited from lower travel distance and vehicle emissions. This is likely due to the fact that Option 12 has more diverting traffic from the N16 to the Old Bundoran Road, spreading the impact, whereas Option 5 maintains most of the traffic on the N16 the closer it gets to Sligo. The longer N16 route in Option 12 appears less desirable for some trips to the city centre and the N15 during most periods of the day as reflected in the Option 12 AADT on the N16, however this diverting traffic has had a slightly positive impact on overall transient queuing, total travel time and average speeds in Option 12.

9. Economic Analysis

9.1 Introduction

The economic appraisal for the proposed scheme was carried out using TUBA (Transport User Benefit Analysis) software. This uses SATURN model run outputs from the scheme assessment process resulting in a user benefit analysis.

In TUBA software, scheme data is extracted directly from the traffic models as outlined in Section 2 of Unit 6.3 in the PAG. The software uses AM, Interpeak and PM model runs from the Opening Year (2017), the Design Year (2032) and the Forecast Year (2047) as inputs and applies these separately for the two scenarios being assessed. The Interpeak was also used to approximate the weekend peak period. This 30 year appraisal accounts for traffic growth over the lifetime of the scheme.

The scenarios assessed were three Do Something options (Option 1A_S1A, Option 5 and Option 12) compared against the Do Minimum. In the assessments the Net Present Value (NPV) and Benefit to Cost Ratio (BCR) were calculated for each option.

9.2 Key Appraisal Parameters and Assumptions

The economic appraisal has been undertaken using the Transport User Benefit Appraisal (TUBA) software, Version 1.9.7. TUBA carries out economic appraisal of transport schemes, based on outputs from transport models. An Irish version of the TUBA economics file has been received from TII and used for the appraisal.

The following key assumptions have been used in the economic appraisal:

- Scenario = N16_Scheme;
- Forecast = Central Growth;
- Traffic Model = SATURN;
- Present Value Year = 2011;
- Modelled years = 2017, 2032, 2047;
- Peak Periods = AM, IP, PM & WE (approximated by IP)
- Opening Year = 2017;
- Forecast Year = 2047;
- Appraisal Period = 30 years, from 2017 to 2047; and
- Discount rate = 5%.

9.3 Cost Estimates

This section outlines the base costs associated with the Do Minimum and Do Something schemes which have been used in the economic analysis.

9.3.1 Do Minimum Costs

A Do Minimum scenario maintenance cost of €3,111,750 provided by Sligo County Council has been included for the section of the N16 between the Abbvie roundabout and the county boundary with Leitrim. This represents the cost of maintaining the Do Minimum scenario when compared with the Do Something emerging options. This Do Minimum cost has been spread at 10% per year over the ten year period 2017 - 2026.

9.3.2 Do Something Costs

Option Comparison Estimate (OCE) base costs provided by Sligo County Council were input to the TII Phase 2 Option Selection spreadsheet as outlined in Unit 6.2 of the PAG. These costs for each of the three emerging options are detailed in Table 9.1 below.

Table 9.1: Option Comparison Estimate (OCE) Base Costs

Base Costs (Incl. VAT and Incl. Project-specific contingency)	Option 1A_S1A	Option 5	Option 12
Mainline Length (km)	7.6	7.7	8.3
Underbridges (no.)	2	1	0
Riverbridges – Mainline (no.)	2	4	3
Riverbridges – Local Road (no.)	0	1	0
Main Contract Construction	€18,364,224	€18,800,512	€18,781,801
Main Contract Supervision	€815,385	€825,876	€888,046
Archaeology	€598,922	€628,851	€676,099
Advance Works and other contracts	€1,540,640	€1,560,461	€1,677,929
Residual Network	€288,563	€517,008	€456,891
Land & Property	€3,293,898	€5,246,946	€3,603,417
Planning and Design	€937,540	€949,602	€1,021,086
Subtotal	€25,839,171	€28,529,256	€27,105,270
Total Inflation Allowance	€1,581,564	€1,746,219	€1,659,059
TII Programme Risk	€1,291,959	€1,426,463	€1,355,263
Option Comparison Cost Estimate	**€28,712,694**	**€31,701,937**	**€30,119,593**

9.4 Economic Appraisal to Forecast Year 2047

Each of the three emerging options has been compared against the Do Minimum as part of the TUBA economic appraisal. This section of the report outlines the economic appraisal results for the three emerging options in the context of the Do Minimum scenario.

9.4.1 Summary of Benefits

The economic benefits associated with the preliminary proposed scheme options take account of:

- Travel time;
- Vehicle operating costs;
- Greenhouse gas emissions; and
- Wider Economic Benefits.

They do not include accident, reliability and wider economic benefits which are not included in the assessment of economic efficiency.

Scheme benefits are forecast over the entire appraisal period and discounted to the price base year of 2011. The Present Value of Benefits (PVB) is presented in Table 9.2 below.

Table 9.2: Present Value of Benefits for the N16 Scheme to Forecast Year 2047 (€000, 2011 values)

	Monetised Benefits, Scheme Option 1A_S1A	Monetised Benefits, Scheme Option 5	Monetised Benefits, Scheme Option 12
Greenhouse Gases	7	9	11
Economic Efficiency: Consumer Users (Commuting)	1,336	6,548	5,163
Economic Efficiency: Consumer Users (Other)	2,395	9,540	7,595
Economic Efficiency: Business Users and Providers	3,046	8,721	7,039
Wider Economic Benefits (10% of Business Users and Providers)	305	872	704
Wider Public Finances (Indirect Taxation Revenues)	-8	-72	-41
Present Value of Benefits (PVB)	**7,081**	**25,618**	**20,471**

In this instance the PVB assessment has included wider economic benefits. As outlined in Section 4.1 of Unit 6.9 in the PAG business and freight user benefits are defined as the change in consumer surplus for the business and freight modes over all types of use benefit (time savings, vehicle operating cost savings, toll/fare changes, reliability benefits, etc).

The recommended appraisal method of the wider impact of increased output by firms is 10% of the business and freight user benefits. This calculation has been undertaken in row five of Table 9.2 and included in the value of the PVB for the three emerging options.

9.4.2 Economic Appraisal Results

The economic appraisal compares the proposed scheme costs against the forecast monetised benefits in order to determine overall value for money based on the BCR. The BCR is the ratio of the Present Value of Benefits to the Present Value of Costs, i.e. PVB / PVC. The Net Present Value (NPV) represents the difference between the Present Value of Benefits and the Present Value of Costs, i.e. PVB minus PVC.

Table 9.3 summarises the total benefits, total costs and provides the NPV and BCR for the proposed scheme.

Table 9.3: N16 Scheme Economic Appraisal Results to Forecast Year 2047(€000)

	Option 1A_S1A	Option 5	Option 12
Present Value of Benefits (PVB)	7,081	25,618	20,471
Present Value of Costs (PVC)	22,887	25,827	24,140
Net Present Value (NPV)	**-15,806**	**-209**	**-3,669**
Benefit to Cost Ratio (BCR)	**0.309**	**0.992**	**0.848**

The results of the appraisal indicate that Option 1A_S1A and Option 12 do not generate an appropriate amount of PVB when compared to their associated PVC. Option 1A_S1A has a PVB of €7.081 million and a PVC of €22.887 million, which has indicated a BCR of 0.309. Option 12 has a PVB of €20.471 million and a PVC of €24.14 million, which has indicated a BCR of 0.848.

Option 5 performs better with a PVB of €25.618 million and a PVC of €25.827 million, which has indicated a BCR of 0.992.

It is important to note that this analysis does not take account of safety benefits or other environmental benefits.

9.5 Economic Appraisal including Residual Period to 2077

In accordance with Section 14 of PAG Unit 6.1, where the lifespan of infrastructure is significantly in excess of 30 years, it is necessary to acknowledge this in the scheme appraisal. Table 6.1.2 in Section 14 of PAG Unit 6.1 states that bridges, structures, tunnels, earthworks and other major investment in offline improvements should include a thirty year period for the calculation of residual value. The residual period is the thirty year period beyond the appraisal period. As the N16 scheme would be a long life major investment in an offline infrastructure improvement, the thirty year residual period from 2047 to 2077 has been included in the below appraisal.

Scheme benefits are forecast over the sixty year period (2017 to 2077) and discounted to the price base year of 2011. The Present Value of Benefits (PVB) which includes the wider economic benefits is presented in Table 9.4 below.

Table 9.4: Present Value of Benefits for the N16 Scheme – Including Residual Period to 2077 (€000, 2011 values)

	Monetised Benefits, Scheme Option 1A_S1A	Monetised Benefits, Scheme Option 5	Monetised Benefits, Scheme Option 12
Greenhouse Gases	30	35	48
Economic Efficiency: Consumer Users (Commuting)	2,338	8,688	7,309
Economic Efficiency: Consumer Users (Other)	4,099	12,729	10,755
Economic Efficiency: Business Users and Providers	5,069	11,878	10,041
Wider Economic Benefits (10% of Business Users and Providers)	507	1,188	1,004
Wider Public Finances (Indirect Taxation Revenues)	-12	-86	-50
Present Value of Benefits (PVB)	**12,031**	**34,432**	**29,107**

Table 9.5 summarises the total benefits, total costs and provides the NPV and BCR for the scheme over the sixty year period to 2077.

Table 9.5: N16 Scheme Economic Appraisal Results – Including Residual Period to 2077 (€000)

	Option 1A_S1A	Option 5	Option 12
Present Value of Benefits (PVB)	12,031	34,432	29,107
Present Value of Costs (PVC)	22,887	25,827	24,140
Net Present Value (NPV)	**-10,856**	**8,605**	**4,967**
Benefit to Cost Ratio (BCR)	**0.526**	**1.333**	**1.206**

The results of the appraisal including the residual period indicate that Option 5 has a PVB of €34.432 million, a PVC of €25.827 million and a BCR of 1.333.

9.6 Economic Appraisal Summary

The economic appraisal has shown that Option 1A_S1A and Option 12 will not provide economic benefits. Option 5, while not quite providing economic benefits, does preform the best with a NPV of -€0.209m and a BCR of 0.992 compared against the Do Minimum. It therefore means that the economic benefits of Option 5 are projected to be similar to the costs. The residual period appraisal to the year 2077 indicates that the further benefits of Option 5 increase the NPV to €8.605m and the BCR to 1.333. It is noted that this was an economic assessment only and therefore does not include other benefits such as safety or environmental.

10. Summary and Conclusions

Base SATURN traffic models were developed for Sligo to assess the implications of the proposed scheme. The models were calibrated and validated to PAG standards and provided a robust basis on which to assess the proposed N16 scheme options.

Traffic demand forecasts were obtained from the National Transport Model and utilised to develop forecasts for the Sligo models for an Opening Year of 2017, Design Year of 2032 and Forecast Year of 2047.

Seven N16 alignment option models were developed for the route selection study, which involved varying combinations of road widening, lane provision, cycle and pedestrian crossing provision, and signal optimisation. The seven options assessed in this study were derived from a wider number of options, but of those options a number were grouped and an approximate route used. The EGB was included as part of all the proposed scenarios but was removed for Sensitivity Test 1 which tested the impact of the removal of this bridge on the three emerging options.

The initial traffic modelling Technical Note issued in December 2016 showed that Options 5 and 12 were seen to provide the best local and network-side operational efficiency, in terms of traffic volumes, journey times, junction capacity, network level operations and vehicle emissions. From this Technical Note three options were sifted based on the varying objectives and KPIs. The three emerging options (Option 1A_S1A, Option 5 and Option 12) were taken forward and considered in greater detail through sensitivity testing and TUBA economic appraisal.

The sensitivity testing Technical Note issued in January 2017 showed that Option 5 was the best ranked scenario in the sensitivity testing, followed by Option 12 and Option 1A_S1A.

A further assessment of the three refined models in Section 8.4 of this report also indicated that Option 5 was the best performing option.

The economic appraisal detailed in Section 9 of this report was undertaken using TUBA and showed that Option 1A_S1A and Option 12 would not deliver a positive Net Present Value (NPV) or a Benefit to Cost Ratio (BCR) of greater than 1. Although Option 5 also did not provide economic benefits it did deliver the greatest NPV of -€0.209m and a BCR of 0.992 when compared against the Do Minimum, which means that the economic benefits of Option 5 are projected to be similar to the costs. The benefits of Option 5 did increase further when the thirty year residual period was included in the appraisal, delivering a NPV of €8.605m and a BCR of 1.333.

Appendix A. AM Calibration Data

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
502_1_512	829	544	10.9	Fail	Fail
502_1_523	292	261	1.9	Pass	Pass
502_1_565	54	82	3.4	Pass	Pass
512_1_502	943	879	2.1	Pass	Pass
512_1_523	9	0	4.2	Pass	Pass
512_1_565	4	0	2.8	Pass	Pass
523_1_502	352	184	10.2	Fail	Fail
523_1_512	46	0	9.6	Pass	Fail
523_1_565	46	0	9.5	Pass	Fail
565_1_502	13	10	1.0	Pass	Pass
565_1_512	2	0	2.0	Pass	Pass
565_1_523	6	2	2.0	Pass	Pass
6_3_567	804	719	3.1	Pass	Pass
6_3_568	12	5	2.2	Pass	Pass
567_3_6	513	488	1.1	Pass	Pass
568_3_6	38	5	7.3	Pass	Fail
568_3_567	317	304	0.7	Pass	Pass
501_4_550	75	7	10.7	Pass	Fail
501_4_601	26	30	0.8	Pass	Pass
501_4_624	657	578	3.2	Pass	Pass
550_4_501	30	0	7.7	Pass	Fail
550_4_601	85	89	0.4	Pass	Pass
550_4_624	33	43	1.6	Pass	Pass
601_4_501	92	52	4.8	Pass	Pass
601_4_550	102	156	4.8	Pass	Pass
601_4_624	71	92	2.3	Pass	Pass
624_4_501	418	315	5.4	Fail	Fail
624_4_550	14	0	5.3	Pass	Fail
624_4_601	23	23	0.1	Pass	Pass
3_6_	483	493	0.4	Pass	Pass
42_38_	719	719	0.0	Pass	Pass
38_42_	269	269	0.0	Pass	Pass
1_502_2	1123	1052	2.1	Pass	Pass
1_502_504	170	21	15.3	Fail	Fail
2_502_1	1118	998	3.7	Pass	Pass
2_502_504	177	152	2.0	Pass	Pass
504_502_1	48	23	4.2	Pass	Pass
504_502_2	49	48	0.2	Pass	Pass
521_506_522	9	0	4.2	Pass	Pass
521_506_623	164	48	11.3	Fail	Fail

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
521_506_627	164	180	1.2	Pass	Pass
522_506_521	4	0	2.8	Pass	Pass
522_506_623	188	117	5.7	Pass	Fail
522_506_627	130	224	7.1	Pass	Fail
623_506_521	130	91	3.8	Pass	Pass
623_506_522	31	31	0.1	Pass	Pass
623_506_627	52	0	10.2	Pass	Fail
627_506_521	109	112	0.3	Pass	Pass
627_506_522	49	148	10.0	Pass	Fail
627_506_623	106	52	6.1	Pass	Fail
505_507_627	398	459	3.0	Pass	Pass
508_507_505	27	0	7.3	Pass	Fail
508_507_627	20	0	6.3	Pass	Fail
627_507_505	359	451	4.6	Pass	Pass
509_510_504	92	89	0.3	Pass	Pass
619_510_504	839	910	2.4	Pass	Pass
512_511_	459	354	5.2	Fail	Fail
1_512_511	129	0	16.1	Fail	Fail
1_512_513	1	0	1.4	Pass	Pass
1_512_514	609	544	2.7	Pass	Pass
511_512_1	47	0	9.7	Pass	Fail
511_512_513	61	37	3.5	Pass	Pass
511_512_514	136	52	8.7	Pass	Fail
513_512_1	8	20	3.2	Pass	Pass
513_512_511	54	85	3.7	Pass	Pass
513_512_514	5	5	0.0	Pass	Pass
514_512_1	975	859	3.8	Pass	Pass
514_512_511	315	270	2.7	Pass	Pass
514_512_513	34	0	8.2	Pass	Fail
512_513_515	38	37	0.2	Pass	Pass
512_513_564	60	0	11.0	Pass	Fail
515_513_512	39	109	8.2	Pass	Fail
515_513_564	16	0	5.7	Pass	Fail
564_513_512	30	0	7.7	Pass	Fail
564_513_515	59	134	7.7	Pass	Fail
512_514_515	8	25	4.2	Pass	Pass
512_514_526	124	108	1.5	Pass	Pass
512_514_557	555	467	3.9	Pass	Pass
515_514_512	9	0	4.2	Pass	Pass
515_514_526	21	0	6.5	Pass	Fail
515_514_557	10	0	4.5	Pass	Pass
526_514_512	97	50	5.5	Pass	Fail

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
526_514_515	205	227	1.5	Pass	Pass
526_514_557	89	72	1.9	Pass	Pass
557_514_512	1063	1079	0.5	Pass	Pass
557_514_515	222	215	0.5	Pass	Pass
557_514_526	22	34	2.3	Pass	Pass
513_515_516	47	78	3.9	Pass	Pass
513_515_558	43	98	6.6	Pass	Fail
514_515_513	14	41	5.1	Pass	Fail
514_515_516	412	423	0.5	Pass	Pass
514_515_558	21	0	6.5	Pass	Fail
516_515_513	3	0	2.4	Pass	Pass
516_515_514	19	0	6.2	Pass	Fail
516_515_558	4	0	2.8	Pass	Pass
558_515_513	40	135	10.2	Pass	Fail
558_515_514	12	0	4.9	Pass	Pass
558_515_516	137	166	2.4	Pass	Pass
515_516_619	489	565	3.3	Pass	Pass
515_516_620	17	17	0.0	Pass	Pass
620_516_515	30	0	7.7	Pass	Fail
620_516_619	50	24	4.2	Pass	Pass
508_517_518	125	125	0.0	Pass	Pass
508_517_533	503	612	4.6	Fail	Pass
508_517_518	117	125	0.7	Pass	Pass
520_519_	16	18	0.4	Pass	Pass
519_520_	42	80	4.9	Pass	Pass
1_523_	219	263	2.8	Pass	Pass
514_526_525	156	38	12.0	Fail	Fail
514_526_527	51	105	6.1	Pass	Fail
525_526_514	321	272	2.9	Pass	Pass
525_526_527	146	25	13.0	Fail	Fail
527_526_514	66	78	1.4	Pass	Pass
527_526_525	197	177	1.4	Pass	Pass
526_527_530	109	100	0.9	Pass	Pass
526_527_552	86	101	1.6	Pass	Pass
526_527_600	13	13	0.0	Pass	Pass
530_527_526	60	75	1.8	Pass	Pass
530_527_552	20	24	0.8	Pass	Pass
530_527_600	101	99	0.2	Pass	Pass
552_527_526	193	179	1.0	Pass	Pass
552_527_530	47	48	0.1	Pass	Pass
552_527_600	63	77	1.7	Pass	Pass

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
600_527_526	30	6	5.8	Pass	Fail
600_527_530	127	101	2.5	Pass	Pass
600_527_552	53	62	1.2	Pass	Pass
527_530_531	114	117	0.3	Pass	Pass
527_530_557	97	96	0.1	Pass	Pass
527_530_570	94	35	7.3	Pass	Fail
531_530_527	122	138	1.4	Pass	Pass
531_530_557	158	159	0.1	Pass	Pass
531_530_570	8	6	0.8	Pass	Pass
557_530_527	24	59	5.4	Pass	Fail
557_530_531	70	46	3.2	Pass	Pass
557_530_570	635	431	8.8	Fail	Fail
570_530_527	78	1	12.3	Pass	Fail
570_530_531	9	12	0.9	Pass	Pass
570_530_557	1251	1140	3.2	Pass	Pass
530_531_540	188	175	1.0	Pass	Pass
540_531_530	257	260	0.2	Pass	Pass
540_531_558	141	162	1.7	Pass	Pass
558_531_540	75	139	6.2	Pass	Fail
618_531_530	34	43	1.4	Pass	Pass
618_531_540	10	1	3.6	Pass	Pass
618_531_558	79	105	2.8	Pass	Pass
517_533_534	54	0	10.4	Pass	Fail
536_535_559	102	7	12.8	Pass	Fail
536_535_560	48	48	0.0	Pass	Pass
559_535_536	69	58	1.4	Pass	Pass
559_535_560	29	29	0.0	Pass	Pass
560_535_536	76	22	7.6	Pass	Fail
560_535_559	37	37	0.1	Pass	Pass
519_536_535	10	47	6.9	Pass	Fail
519_536_537	37	37	0.0	Pass	Pass
535_536_519	15	14	0.2	Pass	Pass
535_536_537	112	66	4.9	Pass	Pass
537_536_519	36	50	2.1	Pass	Pass
537_536_535	174	9	17.3	Fail	Fail
534_537_536	48	9	7.4	Pass	Fail
534_537_569	11	11	0.0	Pass	Pass
536_537_534	59	8	8.8	Pass	Fail
536_537_569	99	95	0.4	Pass	Pass
538_537_534	33	0	8.1	Pass	Fail
538_537_536	123	0	15.7	Fail	Fail

N16 Route Selection Study Final Report

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Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
538_537_569	16	0	5.7	Pass	Fail
569_537_534	30	40	1.7	Pass	Pass
569_537_536	94	50	5.2	Pass	Fail
542_540_531	115	166	4.3	Pass	Pass
542_540_539	135	172	3.0	Pass	Pass
542_540_541	49	11	6.9	Pass	Fail
531_540_542	15	19	1.0	Pass	Pass
531_540_539	56	55	0.2	Pass	Pass
531_540_541	151	163	1.0	Pass	Pass
539_540_542	73	75	0.3	Pass	Pass
539_540_531	44	46	0.3	Pass	Pass
539_540_541	8	8	0.0	Pass	Pass
541_540_542	15	15	0.0	Pass	Pass
541_540_531	327	263	3.8	Pass	Pass
541_540_539	26	13	2.9	Pass	Pass
561_541_549	241	334	5.5	Pass	Fail
540_542_543	29	30	0.2	Pass	Pass
540_542_545	34	34	0.1	Pass	Pass
540_542_549	22	22	0.0	Pass	Pass
543_542_540	110	139	2.6	Pass	Pass
543_542_545	81	53	3.4	Pass	Pass
543_542_549	50	50	0.0	Pass	Pass
545_542_540	383	371	0.6	Pass	Pass
545_542_543	37	54	2.5	Pass	Pass
545_542_549	61	51	1.4	Pass	Pass
549_542_540	81	99	1.9	Pass	Pass
549_542_543	24	28	0.7	Pass	Pass
549_542_545	56	36	2.9	Pass	Pass
542_545_546	95	50	5.2	Pass	Fail
542_545_548	73	73	0.0	Pass	Pass
544_545_542	85	81	0.5	Pass	Pass
544_545_546	2	6	1.9	Pass	Pass
546_545_542	397	394	0.1	Pass	Pass
546_545_548	5	0	3.2	Pass	Pass
545_546_544	68	32	5.1	Pass	Fail
545_546_547	2	24	6.1	Pass	Fail
545_546_552	23	0	6.8	Pass	Fail
547_546_544	1	0	1.4	Pass	Pass
547_546_545	3	16	4.3	Pass	Pass
547_546_552	1	0	1.4	Pass	Pass
548_546_544	22	0	6.6	Pass	Fail

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
548_546_545	381	378	0.2	Pass	Pass
548_546_547	1	0	1.4	Pass	Pass
548_546_552	3	0	2.4	Pass	Pass
552_546_544	2	0	2.0	Pass	Pass
552_546_545	36	0	8.5	Pass	Fail
4_550_503	111	157	4.0	Pass	Pass
4_550_556	1	6	2.7	Pass	Pass
503_550_4	139	130	0.8	Pass	Pass
503_550_556	120	118	0.2	Pass	Pass
556_550_4	2	2	0.0	Pass	Pass
556_550_503	11	14	0.8	Pass	Pass
527_552_	215	151	4.7	Pass	Pass
562_553_	131	131	0.0	Pass	Pass
514_557_530	690	529	6.5	Fail	Fail
514_557_558	7	10	1.1	Pass	Pass
530_557_514	1471	1321	4.0	Pass	Pass
530_557_558	13	74	9.3	Pass	Fail
558_557_514	7	7	0.1	Pass	Pass
558_557_530	7	7	0.1	Pass	Pass
515_558_531	66	98	3.5	Pass	Pass
515_558_557	2	0	2.0	Pass	Pass
531_558_515	184	241	3.9	Pass	Pass
531_558_557	11	14	1.0	Pass	Pass
557_558_515	8	61	9.1	Pass	Fail
557_558_531	6	23	4.4	Pass	Pass
535_559_	36	44	1.3	Pass	Pass
535_560_561	62	214	13.0	Fail	Fail
535_560_566	27	17	2.2	Pass	Pass
561_560_535	48	124	8.2	Pass	Fail
561_560_566	59	51	1.1	Pass	Pass
566_560_535	92	82	1.0	Pass	Pass
566_560_561	133	144	0.9	Pass	Pass
569_561_560	64	29	5.2	Pass	Fail
553_562_	74	74	0.0	Pass	Pass
1_564_513	59	134	7.7	Pass	Fail
1_564_565	19	0	6.2	Pass	Fail
513_564_565	76	0	12.3	Pass	Fail
565_564_513	31	0	7.9	Pass	Fail
560_566_	49	68	2.4	Pass	Pass
530_570_544	416	472	2.7	Pass	Pass
544_570_530	1075	1153	2.3	Pass	Pass

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
552_571_572	13	0	5.1	Pass	Fail
552_571_573	170	172	0.1	Pass	Pass
573_571_552	294	266	1.7	Pass	Pass
573_571_572	256	254	0.1	Pass	Pass
551_573_571	521	520	0.1	Pass	Pass
571_573_551	173	172	0.1	Pass	Pass
572_573_551	140	138	0.1	Pass	Pass
605_604_	437	439	0.1	Pass	Pass
604_605_	237	237	0.0	Pass	Pass
603_606_621	72	78	0.7	Pass	Pass
603_606_622	48	146	10.0	Pass	Fail
621_606_603	290	285	0.3	Pass	Pass
621_606_622	13	13	0.1	Pass	Pass
622_606_603	14	30	3.5	Pass	Pass
622_606_621	2	2	0.0	Pass	Pass
22_607_608	26	33	1.3	Pass	Pass
22_607_617	17	17	0.0	Pass	Pass
22_607_621	8	8	0.1	Pass	Pass
608_607_22	14	15	0.2	Pass	Pass
608_607_617	10	9	0.3	Pass	Pass
608_607_621	257	252	0.3	Pass	Pass
617_607_22	10	10	0.1	Pass	Pass
617_607_608	11	9	0.5	Pass	Pass
617_607_621	38	38	0.0	Pass	Pass
621_607_22	3	3	0.0	Pass	Pass
621_607_608	70	70	0.0	Pass	Pass
621_607_617	7	7	0.0	Pass	Pass
614_613_	191	191	0.0	Pass	Pass
613_614_	88	91	0.3	Pass	Pass
532_618_531	72	150	7.4	Pass	Fail
532_618_619	366	337	1.5	Pass	Pass
516_619_510	522	590	2.9	Pass	Pass
516_619_620	14	0	5.3	Pass	Fail
618_619_510	340	337	0.1	Pass	Pass
620_619_510	42	0	9.2	Pass	Fail
516_620_619	2	0	2.0	Pass	Pass
516_620_565	10	12	0.5	Pass	Pass
619_620_516	12	0	4.9	Pass	Pass
619_620_565	28	0	7.5	Pass	Fail
565_620_516	84	82	0.2	Pass	Pass
565_620_619	66	0	11.5	Pass	Fail

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
607_621_	292	298	0.3	Pass	Pass
4_624_623	582	585	0.1	Pass	Pass
4_624_626	168	128	3.3	Pass	Pass
623_624_4	405	294	5.9	Fail	Fail
623_624_626	37	37	0.1	Pass	Pass
626_624_4	57	43	2.0	Pass	Pass
626_624_623	12	12	0.0	Pass	Pass
506_627_507	319	404	4.5	Pass	Pass
506_627_628	41	0	9.1	Pass	Fail
507_627_506	306	312	0.3	Pass	Pass
507_627_628	27	149	13.0	Fail	Fail
628_627_506	18	0	6.0	Pass	Fail

Appendix B. IP Calibration Data

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
502_1_565	71	89	2.0	Pass	Pass
512_1_502	647	560	3.5	Pass	Pass
512_1_523	18	0	6.0	Pass	Fail
512_1_565	5	0	3.2	Pass	Pass
523_1_502	205	145	4.5	Pass	Pass
523_1_512	43	0	9.3	Pass	Fail
523_1_565	21	0	6.5	Pass	Fail
565_1_502	24	32	1.5	Pass	Pass
565_1_512	13	0	5.1	Pass	Fail
565_1_523	14	20	1.5	Pass	Pass
6_3_567	451	376	3.7	Pass	Pass
6_3_568	17	0	5.8	Pass	Fail
567_3_6	459	493	1.6	Pass	Pass
568_3_6	25	11	3.3	Pass	Pass
568_3_567	232	211	1.4	Pass	Pass
6_3_	493	376	5.6	Fail	Fail
501_4_550	63	3	10.4	Pass	Fail
501_4_601	43	39	0.6	Pass	Pass
501_4_624	328	265	3.7	Pass	Pass
550_4_501	50	0	10.0	Pass	Fail
550_4_601	73	113	4.1	Pass	Pass
550_4_624	19	20	0.2	Pass	Pass
601_4_501	84	48	4.4	Pass	Pass
601_4_550	69	161	8.6	Pass	Fail
601_4_624	26	9	3.9	Pass	Pass
624_4_501	358	268	5.1	Pass	Fail
624_4_550	20	0	6.3	Pass	Fail
624_4_601	19	20	0.1	Pass	Pass
3_6_	527	504	1.0	Pass	Pass
42_38_	329	329	0.0	Pass	Pass
38_42_	334	330	0.2	Pass	Pass
1_502_2	750	690	2.2	Pass	Pass
1_502_504	125	47	8.4	Pass	Fail
2_502_1	759	647	4.2	Pass	Pass
2_502_504	141	114	2.3	Pass	Pass
504_502_1	123	105	1.7	Pass	Pass
504_502_2	108	102	0.6	Pass	Pass
521_506_522	17	0	5.8	Pass	Fail
521_506_623	90	17	9.9	Pass	Fail
521_506_627	97	130	3.1	Pass	Pass

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
522_506_521	11	0	4.7	Pass	Pass
522_506_623	93	52	4.9	Pass	Pass
522_506_627	78	122	4.4	Pass	Pass
623_506_521	84	34	6.4	Pass	Fail
623_506_522	88	86	0.2	Pass	Pass
623_506_627	51	0	10.1	Pass	Fail
627_506_521	79	83	0.4	Pass	Pass
627_506_522	81	92	1.1	Pass	Pass
627_506_623	67	13	8.5	Pass	Fail
505_507_627	233	276	2.7	Pass	Pass
508_507_505	38	0	8.7	Pass	Fail
508_507_627	41	0	9.1	Pass	Fail
627_507_505	264	325	3.5	Pass	Pass
509_510_504	293	226	4.2	Pass	Pass
619_510_504	720	767	1.7	Pass	Pass
512_511_	212	181	2.2	Pass	Pass
1_512_511	32	0	8.0	Pass	Fail
1_512_513	5	0	3.2	Pass	Pass
1_512_514	534	409	5.8	Fail	Fail
511_512_1	32	0	8.0	Pass	Fail
511_512_513	46	55	1.2	Pass	Pass
511_512_514	95	81	1.5	Pass	Pass
513_512_1	35	29	1.1	Pass	Pass
513_512_511	43	28	2.5	Pass	Pass
513_512_514	35	0	8.4	Pass	Fail
514_512_1	651	531	4.9	Fail	Pass
514_512_511	166	153	1.0	Pass	Pass
514_512_513	28	0	7.5	Pass	Fail
512_513_515	35	55	2.9	Pass	Pass
512_513_564	43	0	9.3	Pass	Fail
515_513_512	45	57	1.7	Pass	Pass
515_513_564	50	0	10.0	Pass	Fail
564_513_512	67	0	11.6	Pass	Fail
564_513_515	92	88	0.4	Pass	Pass
512_514_515	28	0	7.5	Pass	Fail
512_514_526	133	73	5.9	Pass	Fail
512_514_557	508	417	4.2	Pass	Pass
515_514_512	25	0	7.0	Pass	Fail
515_514_526	56	76	2.5	Pass	Pass
515_514_557	34	0	8.2	Pass	Fail
526_514_512	76	61	1.9	Pass	Pass
526_514_515	143	156	1.0	Pass	Pass

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
526_514_557	54	0	10.4	Pass	Fail
557_514_512	736	623	4.3	Fail	Pass
557_514_515	85	136	4.8	Pass	Pass
557_514_526	34	33	0.2	Pass	Pass
526_514_	244	216	1.8	Pass	Pass
513_515_516	70	105	3.7	Pass	Pass
513_515_558	59	84	2.9	Pass	Pass
514_515_513	21	29	1.6	Pass	Pass
514_515_516	201	262	4.0	Pass	Pass
514_515_558	22	0	6.6	Pass	Fail
516_515_513	12	0	4.9	Pass	Pass
516_515_514	97	20	10.0	Pass	Fail
516_515_558	25	0	7.1	Pass	Fail
558_515_513	64	92	3.2	Pass	Pass
558_515_514	19	56	6.1	Pass	Fail
558_515_516	165	77	8.0	Pass	Fail
515_516_619	304	398	5.0	Pass	Pass
515_516_620	27	47	3.3	Pass	Pass
620_516_515	72	20	7.7	Pass	Fail
620_516_619	69	70	0.1	Pass	Pass
508_517_518	135	166	2.5	Pass	Pass
508_517_533	648	799	5.6	Fail	Fail
520_519_	56	61	0.7	Pass	Pass
519_520_	103	78	2.6	Pass	Pass
1_523_	162	187	1.9	Pass	Pass
514_526_525	171	105	5.7	Pass	Fail
514_526_527	26	77	7.1	Pass	Fail
525_526_514	179	191	0.9	Pass	Pass
525_526_527	81	17	9.2	Pass	Fail
527_526_514	22	26	0.8	Pass	Pass
527_526_525	109	48	6.9	Pass	Fail
526_527_530	57	60	0.5	Pass	Pass
526_527_552	42	43	0.2	Pass	Pass
526_527_600	9	0	4.1	Pass	Pass
530_527_526	78	78	0.0	Pass	Pass
530_527_552	28	66	5.5	Pass	Fail
530_527_600	100	120	1.9	Pass	Pass
552_527_526	44	62	2.5	Pass	Pass
552_527_530	19	22	0.6	Pass	Pass
552_527_600	15	16	0.3	Pass	Pass
600_527_526	13	2	3.9	Pass	Pass

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
600_527_530	70	94	2.7	Pass	Pass
600_527_552	22	25	0.6	Pass	Pass
552_527_	89	74	1.7	Pass	Pass
570_530_	633	736	3.9	Fail	Pass
527_530_531	100	94	0.6	Pass	Pass
527_530_557	75	61	1.7	Pass	Pass
527_530_570	39	21	3.3	Pass	Pass
531_530_527	194	208	1.0	Pass	Pass
531_530_557	189	191	0.2	Pass	Pass
531_530_570	36	40	0.7	Pass	Pass
557_530_527	47	50	0.4	Pass	Pass
557_530_531	52	0	10.2	Pass	Fail
557_530_570	505	417	4.1	Pass	Pass
570_530_527	51	5	8.6	Pass	Fail
570_530_531	20	44	4.3	Pass	Pass
570_530_557	582	687	4.2	Fail	Pass
527_530_	162	176	1.1	Pass	Pass
530_531_540	171	139	2.6	Pass	Pass
540_531_530	305	315	0.6	Pass	Pass
540_531_558	165	152	1.0	Pass	Pass
558_531_540	119	109	0.9	Pass	Pass
618_531_530	118	124	0.6	Pass	Pass
618_531_540	27	16	2.5	Pass	Pass
618_531_558	104	131	2.5	Pass	Pass
560_535_	118	50	7.4	Pass	Fail
542_540_531	42	42	0.0	Pass	Pass
542_540_539	51	62	1.4	Pass	Pass
542_540_541	25	3	5.8	Pass	Fail
531_540_542	28	29	0.1	Pass	Pass
531_540_539	53	53	0.0	Pass	Pass
531_540_541	256	222	2.2	Pass	Pass
539_540_542	35	43	1.3	Pass	Pass
539_540_531	53	76	2.9	Pass	Pass
539_540_541	29	8	4.8	Pass	Pass
541_540_542	14	14	0.0	Pass	Pass
541_540_531	353	327	1.4	Pass	Pass
541_540_539	35	32	0.5	Pass	Pass
540_542_543	39	46	1.1	Pass	Pass
540_542_545	39	33	0.9	Pass	Pass
540_542_549	21	21	0.0	Pass	Pass
543_542_540	44	46	0.3	Pass	Pass

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
543_542_545	30	33	0.6	Pass	Pass
543_542_549	31	32	0.1	Pass	Pass
545_542_540	47	38	1.4	Pass	Pass
545_542_543	27	29	0.3	Pass	Pass
545_542_549	41	29	2.1	Pass	Pass
549_542_540	27	28	0.3	Pass	Pass
549_542_543	38	33	0.9	Pass	Pass
549_542_545	42	41	0.2	Pass	Pass
542_545_546	64	61	0.3	Pass	Pass
542_545_548	46	46	0.0	Pass	Pass
544_545_542	63	49	1.9	Pass	Pass
544_545_546	2	0	1.9	Pass	Pass
544_545_548	1	0	1.4	Pass	Pass
546_545_542	46	46	0.0	Pass	Pass
546_545_548	2	0	2.0	Pass	Pass
545_546_544	59	56	0.3	Pass	Pass
545_546_547	3	5	1.0	Pass	Pass
545_546_552	5	0	3.2	Pass	Pass
547_546_544	1	17	5.3	Pass	Fail
547_546_545	3	6	1.5	Pass	Pass
548_546_545	40	40	0.0	Pass	Pass
548_546_547	1	0	1.4	Pass	Pass
552_546_544	1	0	1.4	Pass	Pass
552_546_545	4	0	2.8	Pass	Pass
4_550_503	109	161	4.5	Pass	Pass
4_550_556	3	3	0.0	Pass	Pass
503_550_4	112	130	1.7	Pass	Pass
503_550_556	130	130	0.0	Pass	Pass
556_550_4	2	2	0.0	Pass	Pass
556_550_503	46	56	1.5	Pass	Pass
527_552_	104	67	4.0	Pass	Pass
562_553_	76	76	0.0	Pass	Pass
514_557_530	577	417	7.2	Fail	Fail
514_557_558	14	0	5.3	Pass	Fail
530_557_514	804	792	0.4	Pass	Pass
530_557_558	32	147	12.2	Fail	Fail
558_557_514	36	0	8.5	Pass	Fail
558_557_530	27	50	3.7	Pass	Pass
515_558_531	95	64	3.4	Pass	Pass
515_558_557	10	19	2.4	Pass	Pass
531_558_515	217	225	0.5	Pass	Pass

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
531_558_557	30	30	0.1	Pass	Pass
557_558_515	19	0	6.1	Pass	Fail
557_558_531	10	147	15.5	Fail	Fail
535_560_	141	28	12.3	Fail	Fail
553_562_	79	79	0.0	Pass	Pass
1_564_513	68	88	2.3	Pass	Pass
1_564_565	34	0	8.2	Pass	Fail
513_564_565	95	0	13.8	Pass	Fail
565_564_513	94	0	13.7	Pass	Fail
530_570_	589	478	4.8	Fail	Pass
530_570_544	533	478	2.5	Pass	Pass
544_570_530	602	736	5.2	Fail	Fail
552_571_572	9	0	4.2	Pass	Pass
552_571_573	96	96	0.1	Pass	Pass
573_571_552	91	91	0.0	Pass	Pass
573_571_572	142	259	8.3	Fail	Fail
551_573_571	234	350	6.8	Fail	Fail
571_573_551	95	96	0.1	Pass	Pass
572_573_551	146	143	0.2	Pass	Pass
605_604_	186	189	0.2	Pass	Pass
604_605_	198	199	0.1	Pass	Pass
603_606_621	129	124	0.5	Pass	Pass
603_606_622	12	30	4.0	Pass	Pass
621_606_603	127	107	1.8	Pass	Pass
621_606_622	2	2	0.2	Pass	Pass
622_606_603	13	35	4.5	Pass	Pass
622_606_621	4	4	0.0	Pass	Pass
22_607_608	9	25	3.9	Pass	Pass
22_607_617	8	12	1.2	Pass	Pass
22_607_621	3	3	0.0	Pass	Pass
608_607_22	7	27	4.8	Pass	Pass
608_607_617	5	5	0.0	Pass	Pass
608_607_621	112	99	1.3	Pass	Pass
617_607_22	8	14	1.9	Pass	Pass
617_607_608	5	5	0.0	Pass	Pass
617_607_621	13	8	1.5	Pass	Pass
621_607_22	4	4	0.0	Pass	Pass
621_607_608	111	111	0.0	Pass	Pass
621_607_617	13	13	0.0	Pass	Pass
621_607_	135	128	0.6	Pass	Pass
614_613_	97	97	0.0	Pass	Pass

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
613_614_	95	95	0.0	Pass	Pass
532_618_531	209	271	4.0	Pass	Pass
532_618_619	336	308	1.5	Pass	Pass
516_619_510	357	468	5.4	Fail	Fail
516_619_620	16	0	5.7	Pass	Fail
618_619_510	266	308	2.5	Pass	Pass
620_619_510	35	0	8.4	Pass	Fail
516_620_619	3	0	2.4	Pass	Pass
516_620_565	24	52	4.5	Pass	Pass
619_620_516	42	0	9.2	Pass	Fail
619_620_565	52	0	10.2	Pass	Fail
565_620_516	98	89	1.0	Pass	Pass
565_620_619	43	0	9.3	Pass	Fail
607_621_	131	110	1.9	Pass	Pass
4_624_623	278	256	1.3	Pass	Pass
4_624_626	97	38	7.2	Pass	Fail
623_624_4	302	214	5.5	Pass	Fail
623_624_626	11	12	0.3	Pass	Pass
626_624_4	97	73	2.6	Pass	Pass
626_624_623	12	14	0.5	Pass	Pass
506_627_507	207	252	3.0	Pass	Pass
506_627_628	14	0	5.3	Pass	Fail
507_627_506	204	187	1.2	Pass	Pass
507_627_628	22	89	9.0	Pass	Fail
628_627_506	21	0	6.5	Pass	Fail
628_627_507	37	73	4.8	Pass	Pass

Appendix C. PM Calibration Data

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
6_3_567	612	728	4.5	Fail	Pass
6_3_568	34	3	7.1	Pass	Fail
567_3_6	781	744	1.3	Pass	Pass
568_3_6	24	6	4.6	Pass	Pass
568_3_567	215	214	0.1	Pass	Pass
501_4_550	57	1	10.3	Pass	Fail
501_4_601	42	38	0.6	Pass	Pass
501_4_624	377	317	3.2	Pass	Pass
550_4_501	72	0	12.0	Pass	Fail
550_4_601	120	130	0.9	Pass	Pass
550_4_624	19	42	4.2	Pass	Pass
601_4_501	144	99	4.0	Pass	Pass
601_4_550	123	144	1.8	Pass	Pass
601_4_624	24	34	1.8	Pass	Pass
624_4_501	550	458	4.1	Pass	Pass
624_4_550	29	24	1.0	Pass	Pass
624_4_601	30	65	5.0	Pass	Fail
4_624_623	377	364	0.7	Pass	Pass
4_624_626	49	29	3.2	Pass	Pass
623_624_4	456	391	3.2	Pass	Pass
623_624_626	34	34	0.0	Pass	Pass
626_624_4	155	155	0.0	Pass	Pass
626_624_623	45	46	0.2	Pass	Pass
505_507_627	338	392	2.8	Pass	Pass
508_507_505	27	0	7.3	Pass	Fail
508_507_627	64	0	11.3	Pass	Fail
627_507_505	316	246	4.2	Pass	Pass
545_546_544	101	89	1.2	Pass	Pass
545_546_547	3	10	2.8	Pass	Pass
545_546_552	16	0	5.7	Pass	Fail
547_546_544	1	28	7.1	Pass	Fail
547_546_545	1	11	4.2	Pass	Pass
548_546_545	59	84	3.0	Pass	Pass
552_546_544	1	0	1.4	Pass	Pass
552_546_545	12	0	4.9	Pass	Pass
542_545_546	117	99	1.7	Pass	Pass
542_545_548	237	207	2.0	Pass	Pass
544_545_542	122	111	1.0	Pass	Pass
544_545_546	4	0	2.7	Pass	Pass
544_545_548	3	0	2.4	Pass	Pass

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
546_545_542	70	96	2.8	Pass	Pass
546_545_548	2	0	2.0	Pass	Pass
540_542_543	80	110	3.1	Pass	Pass
540_542_545	200	161	2.9	Pass	Pass
540_542_549	40	41	0.1	Pass	Pass
543_542_540	37	44	1.1	Pass	Pass
543_542_545	70	63	0.8	Pass	Pass
543_542_549	48	48	0.0	Pass	Pass
545_542_540	38	64	3.6	Pass	Pass
545_542_543	76	74	0.2	Pass	Pass
545_542_549	77	69	1.0	Pass	Pass
549_542_540	29	40	1.9	Pass	Pass
549_542_543	59	34	3.7	Pass	Pass
549_542_545	90	81	0.9	Pass	Pass
531_540_539	69	93	2.7	Pass	Pass
531_540_541	326	162	10.5	Fail	Fail
539_540_531	106	85	2.2	Pass	Pass
539_540_541	34	9	5.5	Pass	Fail
541_540_531	386	421	1.8	Pass	Pass
541_540_539	30	12	4.1	Pass	Pass
530_570_	1124	1086	1.1	Pass	Pass
570_530_	716	628	3.4	Pass	Pass
527_530_	224	230	0.4	Pass	Pass
530_527_	372	392	1.0	Pass	Pass
514_526_525	352	179	10.6	Fail	Fail
514_526_527	28	161	13.7	Fail	Fail
525_526_514	233	197	2.4	Pass	Pass
525_526_527	267	50	17.3	Fail	Fail
527_526_514	19	32	2.5	Pass	Pass
527_526_525	192	80	9.6	Fail	Fail
514_526_	327	340	0.7	Pass	Pass
526_514_	239	229	0.7	Pass	Pass
514_557_530	1052	951	3.2	Pass	Pass
514_557_558	11	0	4.7	Pass	Pass
530_557_514	865	710	5.5	Fail	Fail
530_557_558	22	27	1.0	Pass	Pass
558_557_514	53	72	2.4	Pass	Pass
558_557_530	48	53	0.8	Pass	Pass
515_558_531	110	133	2.0	Pass	Pass
515_558_557	17	0	5.8	Pass	Fail
531_558_515	225	306	5.0	Pass	Pass

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
531_558_557	54	125	7.5	Pass	Fail
557_558_515	17	0	5.8	Pass	Fail
557_558_531	9	27	4.3	Pass	Pass
513_515_516	73	83	1.1	Pass	Pass
513_515_558	65	85	2.3	Pass	Pass
514_515_513	9	9	0.0	Pass	Pass
514_515_516	191	219	2.0	Pass	Pass
514_515_558	33	48	2.3	Pass	Pass
516_515_513	5	0	3.2	Pass	Pass
516_515_514	132	25	12.0	Fail	Fail
516_515_558	33	0	8.1	Pass	Fail
558_515_513	62	245	14.8	Fail	Fail
558_515_514	47	0	9.7	Pass	Fail
558_515_516	141	61	8.0	Pass	Fail
530_531_540	189	134	4.4	Pass	Pass
540_531_530	440	340	5.1	Pass	Fail
540_531_558	159	325	10.7	Fail	Fail
558_531_540	129	177	3.9	Pass	Pass
618_531_530	177	146	2.4	Pass	Pass
618_531_540	34	30	0.6	Pass	Pass
618_531_558	126	111	1.4	Pass	Pass
515_516_619	301	355	3.0	Pass	Pass
515_516_620	20	56	5.9	Pass	Fail
620_516_515	74	25	6.9	Pass	Fail
620_516_619	62	150	8.6	Pass	Fail
516_619_510	349	505	7.6	Fail	Fail
516_619_620	18	0	6.0	Pass	Fail
618_619_510	316	338	1.2	Pass	Pass
620_619_510	41	0	9.1	Pass	Fail
532_618_531	264	287	1.4	Pass	Pass
532_618_619	371	338	1.7	Pass	Pass
4_550_503	191	129	4.9	Pass	Pass
4_550_556	7	40	6.8	Pass	Fail
503_550_4	158	171	1.0	Pass	Pass
503_550_556	91	21	9.4	Pass	Fail
556_550_4	2	2	0.2	Pass	Pass
556_550_503	52	83	3.8	Pass	Pass
527_530_531	118	123	0.4	Pass	Pass
527_530_557	80	71	1.0	Pass	Pass
527_530_570	79	36	5.7	Pass	Fail
531_530_527	330	301	1.7	Pass	Pass

N16 Route Selection Study Final Report

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Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
531_530_557	219	88	10.6	Fail	Fail
531_530_570	63	98	3.9	Pass	Pass
557_530_527	80	52	3.5	Pass	Pass
557_530_531	53	0	10.3	Pass	Fail
557_530_570	983	952	1.0	Pass	Pass
570_530_527	109	39	8.1	Pass	Fail
570_530_531	22	11	2.7	Pass	Pass
570_530_557	595	578	0.7	Pass	Pass
526_527_530	95	100	0.5	Pass	Pass
526_527_552	192	190	0.2	Pass	Pass
526_527_600	12	10	0.7	Pass	Pass
530_527_526	141	145	0.4	Pass	Pass
530_527_552	46	73	3.5	Pass	Pass
530_527_600	165	174	0.7	Pass	Pass
552_527_526	81	81	0.0	Pass	Pass
552_527_530	26	31	1.0	Pass	Pass
552_527_600	32	35	0.5	Pass	Pass
600_527_526	16	23	1.6	Pass	Pass
600_527_530	81	98	1.8	Pass	Pass
600_527_552	58	59	0.2	Pass	Pass
508_517_533	917	946	0.9	Pass	Pass
552_571_572	7	0	3.7	Pass	Pass
552_571_573	267	269	0.1	Pass	Pass
573_571_552	166	157	0.7	Pass	Pass
573_571_572	154	156	0.1	Pass	Pass
551_573_571	313	313	0.0	Pass	Pass
571_573_551	275	269	0.3	Pass	Pass
572_573_551	249	255	0.4	Pass	Pass
603_606_621	245	245	0.0	Pass	Pass
603_606_622	8	26	4.3	Pass	Pass
621_606_603	122	54	7.2	Pass	Fail
621_606_622	1	2	0.6	Pass	Pass
622_606_603	50	50	0.0	Pass	Pass
622_606_621	8	8	0.1	Pass	Pass
1_523_	244	187	3.9	Pass	Pass
523_1_	417	355	3.1	Pass	Pass
22_607_608	21	57	5.8	Pass	Fail
22_607_617	7	11	1.3	Pass	Pass
22_607_621	2	1	0.6	Pass	Pass
608_607_22	33	105	8.7	Pass	Fail
608_607_617	5	5	0.0	Pass	Pass

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
608_607_621	111	47	7.2	Pass	Fail
617_607_22	7	11	1.3	Pass	Pass
617_607_608	5	5	0.0	Pass	Pass
617_607_621	12	8	1.2	Pass	Pass
621_607_22	16	15	0.2	Pass	Pass
621_607_608	220	219	0.0	Pass	Pass
621_607_617	19	18	0.2	Pass	Pass
511_512_	219	315	5.9	Pass	Fail
512_511_	149	146	0.2	Pass	Pass
1_512_511	35	0	8.4	Pass	Fail
1_512_513	20	0	6.3	Pass	Fail
1_512_514	957	891	2.2	Pass	Pass
511_512_1	32	0	8.0	Pass	Fail
511_512_513	50	96	5.4	Pass	Fail
511_512_514	170	220	3.6	Pass	Pass
513_512_1	46	232	15.8	Fail	Fail
513_512_511	49	57	1.1	Pass	Pass
513_512_514	70	40	4.1	Pass	Pass
514_512_1	806	531	10.7	Fail	Fail
514_512_511	98	89	0.9	Pass	Pass
514_512_513	3	0	2.4	Pass	Pass
512_513_515	46	18	4.9	Pass	Pass
512_513_564	27	78	7.0	Pass	Fail
515_513_512	53	302	18.7	Fail	Fail
515_513_564	24	0	6.9	Pass	Fail
564_513_512	108	27	9.9	Pass	Fail
564_513_515	87	93	0.7	Pass	Pass
1_564_513	61	93	3.7	Pass	Pass
1_564_565	12	0	4.9	Pass	Pass
513_564_565	51	78	3.3	Pass	Pass
565_564_513	136	27	12.1	Fail	Fail
516_620_565	26	50	3.9	Pass	Pass
565_620_516	92	161	6.1	Pass	Fail
512_514_515	27	52	3.9	Pass	Pass
512_514_526	262	158	7.2	Fail	Fail
512_514_557	984	941	1.4	Pass	Pass
515_514_512	19	0	6.2	Pass	Fail
515_514_526	74	26	6.9	Pass	Fail
515_514_557	49	0	9.9	Pass	Fail
526_514_512	86	61	2.9	Pass	Pass
526_514_515	135	158	1.9	Pass	Pass

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Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
526_514_557	61	10	8.6	Pass	Fail
557_514_512	819	559	9.9	Fail	Fail
557_514_515	69	66	0.3	Pass	Pass
557_514_526	47	157	10.9	Fail	Fail
530_570_544	1042	1086	1.4	Pass	Pass
544_570_530	622	628	0.2	Pass	Pass
521_506_522	38	0	8.7	Pass	Fail
521_506_623	100	36	7.7	Pass	Fail
521_506_627	95	48	5.6	Pass	Fail
522_506_521	24	0	6.9	Pass	Fail
522_506_623	158	148	0.8	Pass	Pass
522_506_627	94	153	5.3	Pass	Fail
623_506_521	132	62	7.1	Pass	Fail
623_506_522	176	165	0.8	Pass	Pass
623_506_627	64	0	11.3	Pass	Fail
627_506_521	169	138	2.5	Pass	Pass
627_506_522	160	175	1.1	Pass	Pass
627_506_623	86	32	7.0	Pass	Fail
509_510_504	280	193	5.6	Pass	Fail
619_510_504	779	825	1.6	Pass	Pass
508_517_518	163	194	2.3	Pass	Pass
535_560_561	124	357	15.0	Fail	Fail
535_560_566	134	83	4.9	Pass	Pass
561_560_535	79	98	2.0	Pass	Pass
561_560_566	119	110	0.8	Pass	Pass
566_560_535	69	57	1.5	Pass	Pass
566_560_561	123	101	2.1	Pass	Pass
560_566_	135	194	4.6	Pass	Pass
566_560_	125	158	2.8	Pass	Pass
561_541_549	632	623	0.4	Pass	Pass
517_533_534	184	0	19.2	Fail	Fail
534_537_536	104	62	4.6	Pass	Pass
534_537_569	63	106	4.7	Pass	Pass
536_537_534	101	15	11.4	Pass	Fail
536_537_569	319	205	7.0	Fail	Fail
538_537_534	31	0	7.9	Pass	Fail
538_537_536	108	0	14.7	Fail	Fail
538_537_569	18	0	6.0	Pass	Fail
569_537_534	26	26	0.0	Pass	Pass
569_537_536	116	39	8.8	Pass	Fail
519_536_535	38	91	6.6	Pass	Fail
519_536_537	54	101	5.3	Pass	Fail

Movement	Observed Total Flow	Modelled Total Flow	GEH	Observed v Modelled Flow Within 15%	GEH Statistic Guideline
535_536_519	13	10	0.8	Pass	Pass
535_536_537	242	118	9.2	Fail	Fail
537_536_519	19	39	3.7	Pass	Pass
537_536_535	216	62	13.0	Fail	Fail
536_535_559	155	10	15.9	Fail	Fail
536_535_560	143	144	0.1	Pass	Pass
559_535_536	150	103	4.1	Pass	Pass
559_535_560	76	61	1.8	Pass	Pass
560_535_536	102	25	9.7	Pass	Fail
560_535_559	35	28	1.3	Pass	Pass
535_559_	77	38	5.1	Pass	Fail
559_535_	128	164	3.0	Pass	Pass
519_520_	102	146	3.9	Pass	Pass
520_519_	51	64	1.7	Pass	Pass
569_561_560	111	91	2.0	Pass	Pass
1_502_2	1163	1120	1.3	Pass	Pass
1_502_504	97	0	13.9	Pass	Fail
2_502_1	1128	1105	0.7	Pass	Pass
2_502_504	109	203	7.5	Pass	Fail
504_502_1	145	129	1.4	Pass	Pass
504_502_2	171	62	10.1	Fail	Fail
506_627_507	256	200	3.7	Pass	Pass
506_627_628	7	0	3.7	Pass	Pass
507_627_506	332	345	0.7	Pass	Pass
507_627_628	21	50	4.8	Pass	Pass
628_627_506	41	0	9.1	Pass	Fail
628_627_507	36	45	1.5	Pass	Pass
502_1_512	1044	891	4.9	Pass	Pass
502_1_523	181	186	0.3	Pass	Pass
502_1_565	66	64	0.2	Pass	Pass
512_1_502	867	762	3.7	Pass	Pass
512_1_523	13	0	5.1	Pass	Fail

2 Interim Technical Note

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Technical Note

Date	26th May 2016
Attention	Fergus Meehan
From	John Paul FitzGerald
Subject	**N16 Traffic Modelling - Interim Technical Note**
Copies to	Emer Concannon, Dinesh Bhardwaj, Paul Carroll

1. N16 Traffic Modelling - Interim Technical Note

1.1 Introduction

This Technical Note presents the approach, methods, processes and outcomes from the SATURN model development for the N16 National Road Upgrade Scheme appraisal. The strategic options for the N16 upgrade scheme have been modelled using a base model calibrated and validated to a base year of 2015. The N16 model was developed to cover a range of options for the realignment of the N16 from the junction of the N4 and N15 in Sligo to the Leitrim county boundary further north. These options have been based on the options provided by SCC as developed during the route option selection stage. The resulting traffic model has been developed for three peak time periods of AM, Inter-Peak (IP) and PM and covers the two primary user classes of Light Vehicles ('Lights') and Heavy Vehicles ('Heavies').

The potential to extend the modelled network to Manorhamilton had been considered but based on timeframe implications and limited use of the alternative route to the N16 it was agreed not to extend the model any further east than the Leitrim County boundary.

As well as the Do Nothing, separate SATURN model options have been coded and developed for the assessment of a Do-Minimum option along with eight distinct routes across four separate strategic route options as agreed with SCC and further set out below:

- **Do Nothing**
- **Do Minimum**
- **Strategic Option 1**
  - Option 1A
  - Option 1B
- **Strategic Option 2**
  - Option 2A
  - Option 2B
- **Strategic Option 3**
  - Option 3 (3 and 4 combined).
- **Strategic Option 4**
  - Option 5
  - Option 6
  - Option 8 (7, 8 and 9 combined)

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1.2 Do Nothing

The Do-Nothing Scenario is based on the network used in the calibrated base year model. This scenario assumes that no changes are made to the road network in the study area and network performance in 2017, 2032 and 2047 future years is modelled.

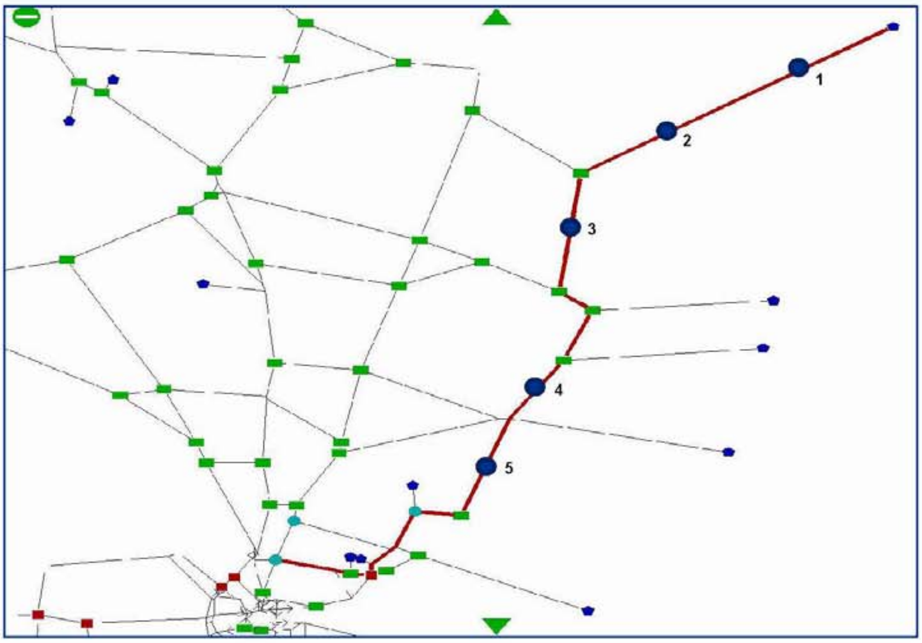

Figure 1.1 : Do-Nothing model

1.3 Do Minimum

The Do Minimum scenario includes the Eastern Garavogue Bridge (EGB) and the N4-N15 Sligo Urban Improvement Scheme (UIS). The N16 model development and assessment has considered the same Opening, Design and Forecast years as the N4-N15 UIS, namely 2017, 2032 and 2047 respectively. The model has laid the foundation to facilitate the route option refinement from thirteen overall options to limited preferred options that shall be carried forward as the project is further developed.

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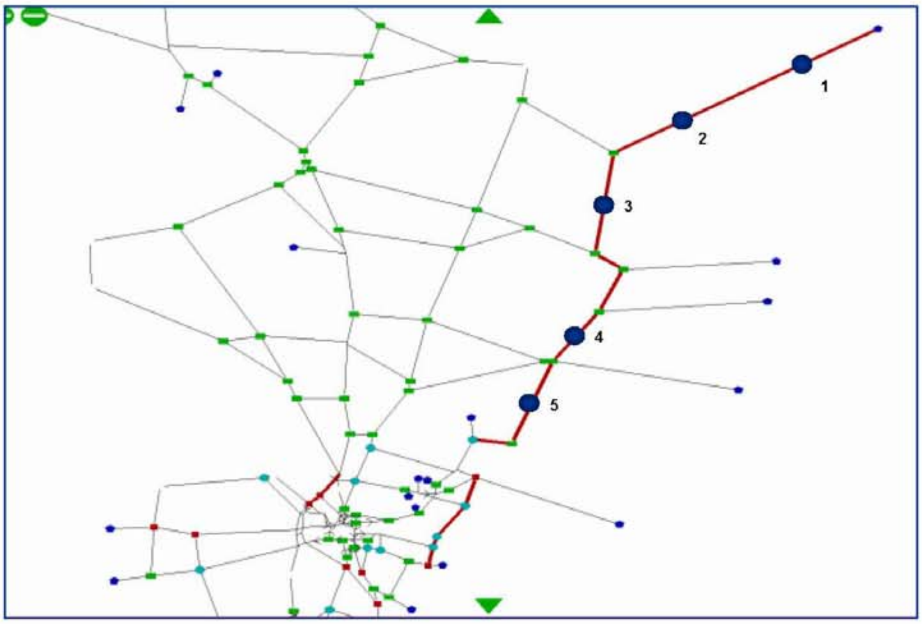

Figure 1.2: Do-Minimum model with committed schemes, EGB and UIS

1.4 Strategic Options

The four strategic options comprise of different alignment arrangements for N16, varying in lengths, junction configurations and tie-in points to the existing road network. The N16 route corridor alignment ends at Leitrim county boundary near Glencar in the north. Each model has the Speed Flow Curve (SFC) upgraded on the new alignment to standard single carriageway one lane rural road with free flow speed of 90 kph.

The four options are described below:

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Strategic Option 1

1.4.1 Option 1A

The new alignment emerges from the existing N15 section between Lisnalurg and Teesan and co-aligns with the existing N16 at Drumkilsellagh. It routes further north-east to terminate at the Leitrim County border. The total length is 7.15 km and has 11 new or redesigned junctions. 5 of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst 3 of them are related to the realignment of existing local road junctions to facilitate the new N16 alignment. The remaining 3 junctions are on widened N15 section.

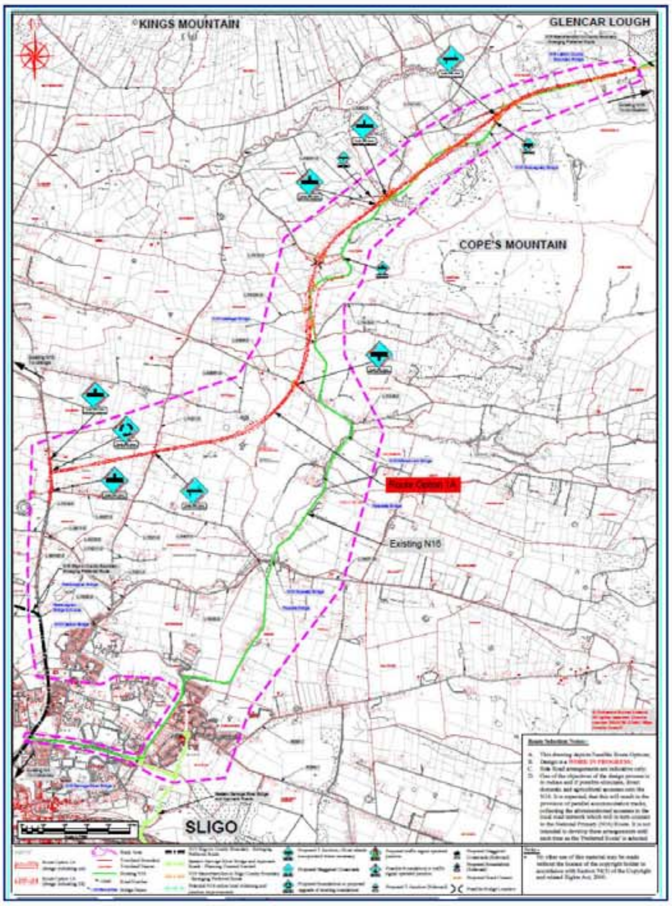

Figure 1.3: Feasible route selection; Option 1A

4

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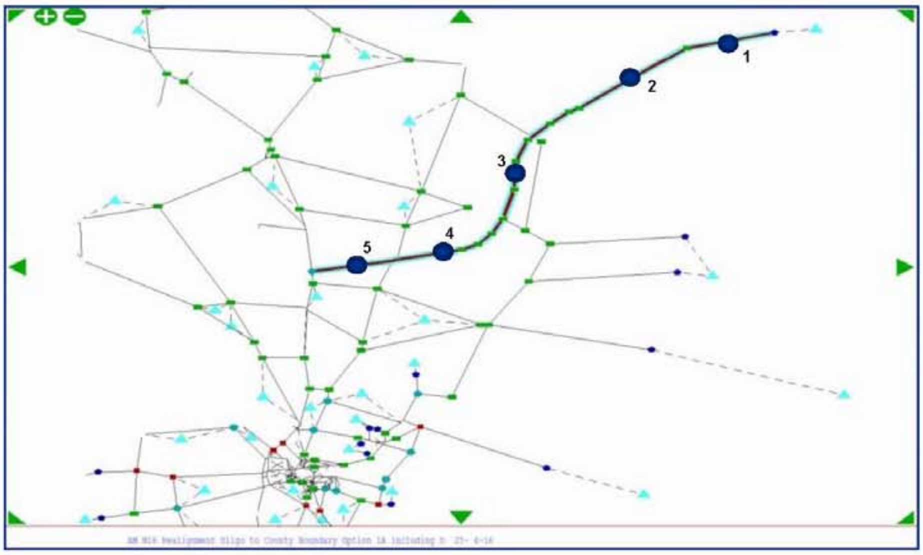

Figure 1.4: SATURN Model Option 1A

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1.4.2 Option 1B

Option 1B is a replication of Option 1A with extended improvement on the N15 from its proposed intersection with the new N16 in north to its junction with existing N16 in south. The total length of the upgraded N16 is 9.64 km. This option incorporates 21 new or redesigned junctions. 5 of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst 6 of them are related to the realignment of existing local road junctions to facilitate the new N16 alignment. The remaining 10 junctions are on widened N15 section which is part of the proposed development option 1B.

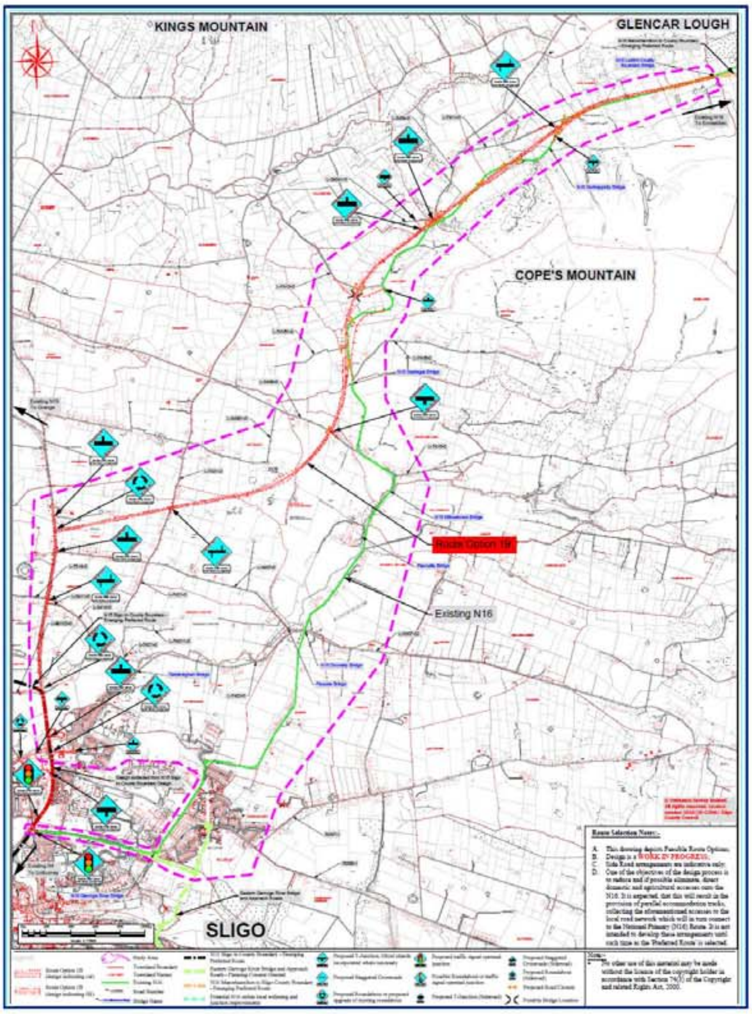

Figure 1.5: Feasible route selection; Option 1B

6

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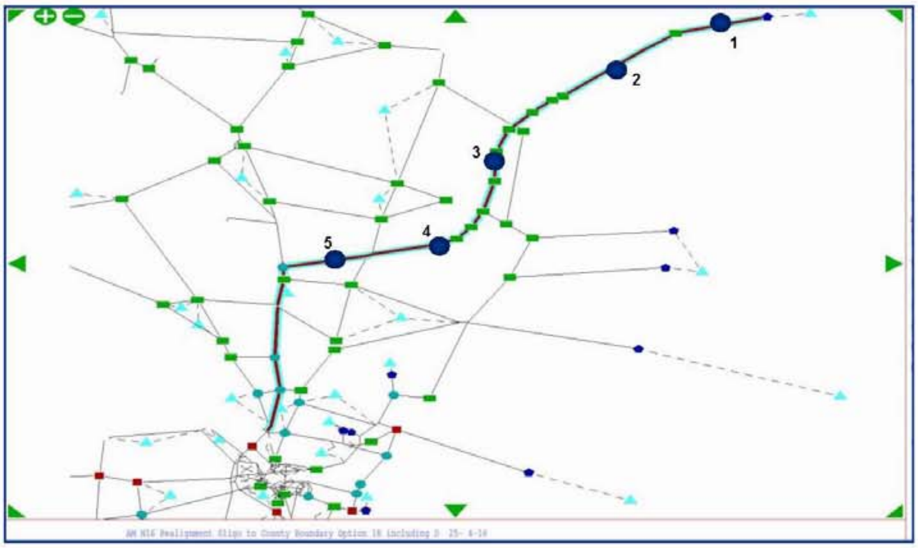

Figure 1.6: SATURN Model Option 1B

7

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1.5 Strategic Option 2

1.5.1 Option 2A

Option 2A branches off the N15 at its junction with the L-90102-0 near Shannon Eighter meeting with the existing N16 near Drumkilsellagh. It moves further northeast as far as the Leitrim county boundary. The total length of the proposed alignment is 8.13 km with 10 new or redesigned junctions. 8 of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst the remaining 2 are related to the realignment of existing local road junctions to facilitate the alignment.

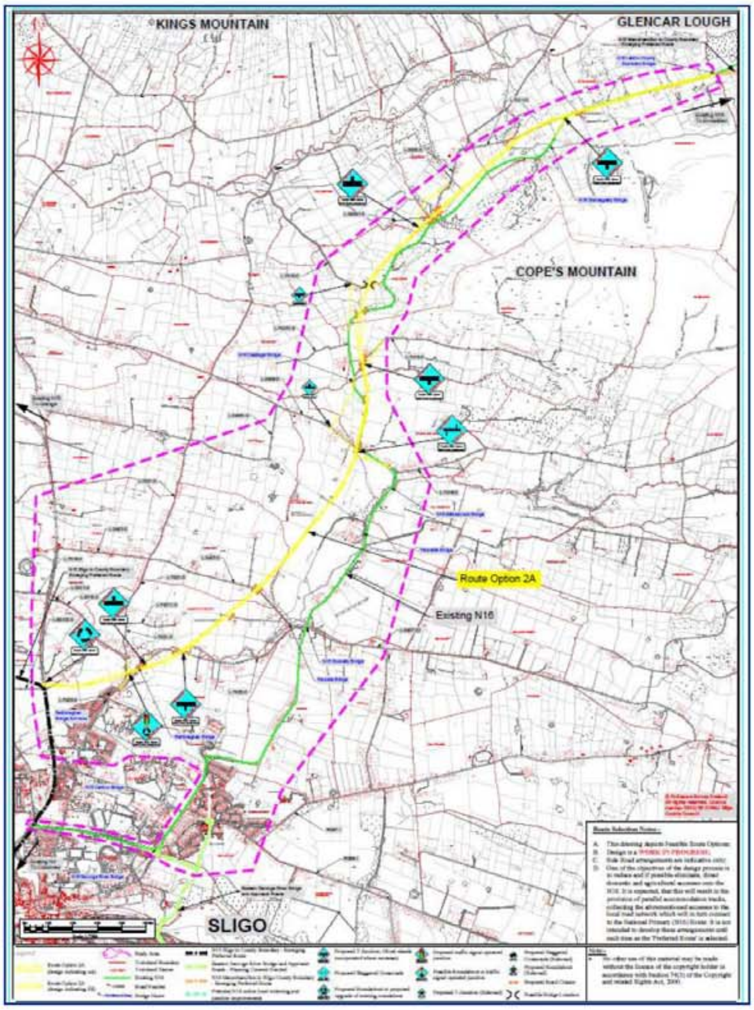

Figure 1.7: Feasible route selection; Option 2A

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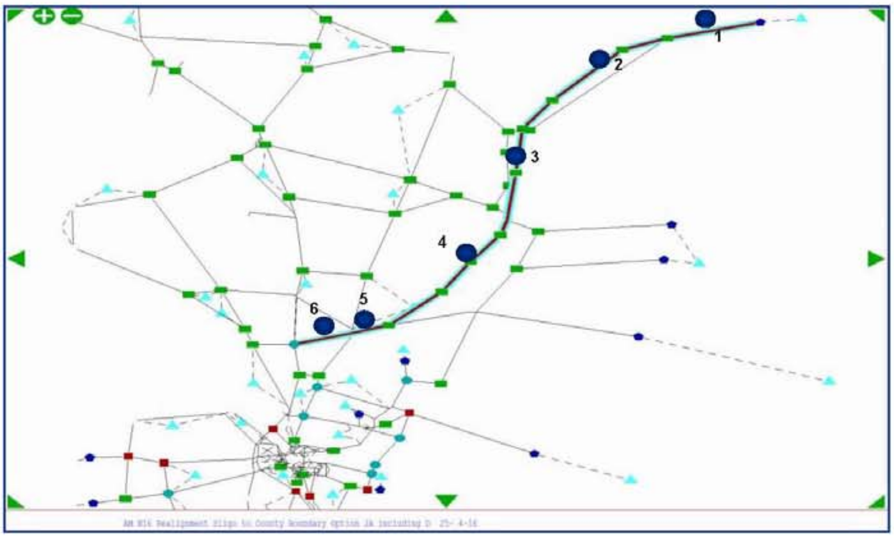

Figure 1.8: SATURN Model Option 2A

9

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1.5.2 Option 2B:

Option 2B is an extended version of option 2A that includes extended improvements on the N15 from its proposed intersection with the upgraded N16 in the north to its junction with the existing N16 in the south. The total length is 9.3 km including 18 new or redesigned junctions, 7 of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst 5 of them are related to the realignment of existing local road junctions to facilitate the new N16 alignment. The remaining 6 junctions are on widened N15 section which is part of the proposed development option 2B.

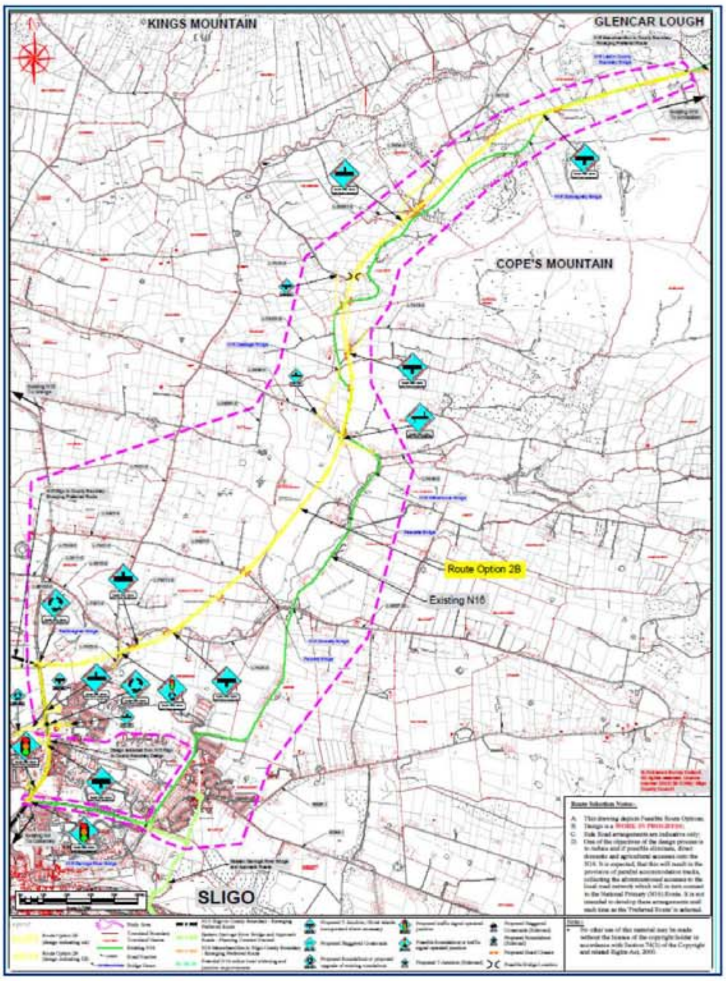

Figure 1.9: Feasible route selection; Option 2B

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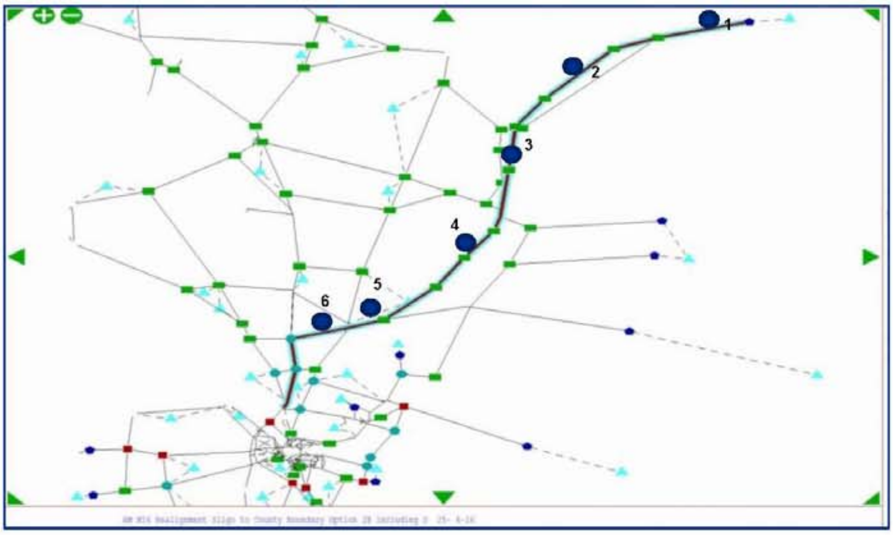

Figure 1.10: SATURN Model Option 2B

11

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1.6 Strategic Option 3

1.6.1 Option 3 (3 and 4 combined):

Option 3 includes a new east-west link road between Elm Gardens and the Abbvie Roundabout connecting to the new N16 alignment. The alignment moves further northeast and meets the existing N16 near Drumkilsellagh before terminating at Leitrim county boundary. The total length is 8.72 km with 19 new or redesigned junctions.

10 of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst the remaining 9 are related to the realignment of existing local road junctions to facilitate the alignment.

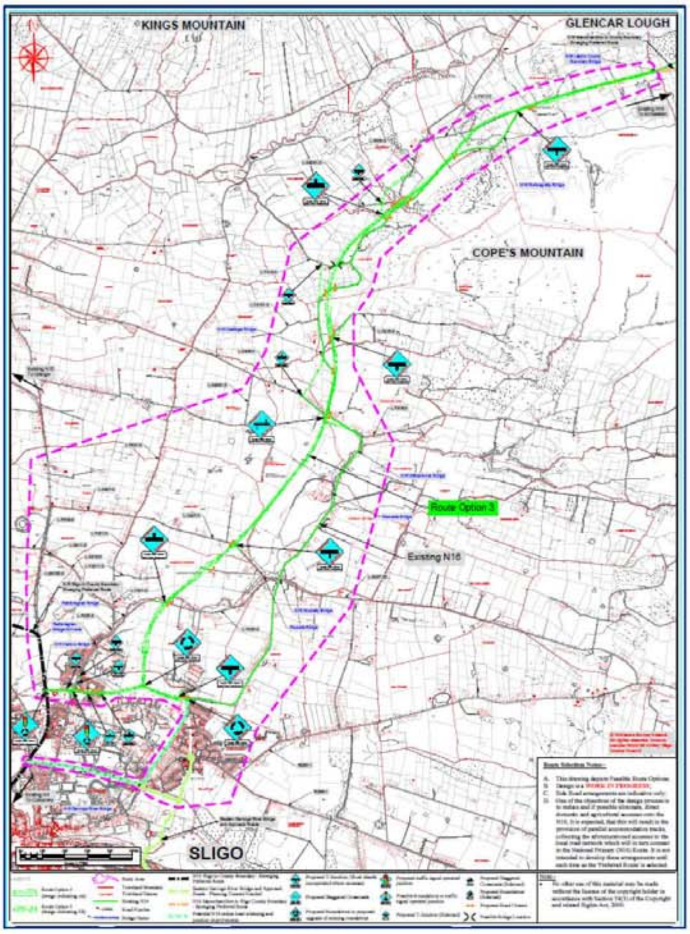

Figure 1.11: Feasible route selection; Option 3

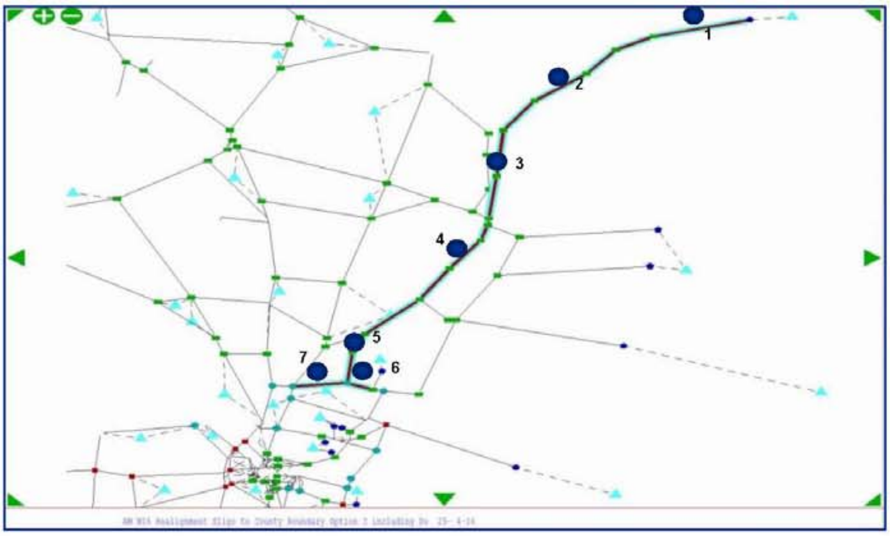

Figure 1.12: SATURN Model Option 3

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1.7 Strategic Option 4

1.7.1 Option 5:

Option 5 has a new N16 alignment terminating at the AbbVie Ireland roundabout at the same point as the existing N16 meets the roundabout. The total length is 8.1 km and 16 new or redesigned junctions. 9 of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst the remaining 7 are related to the realignment of existing local road junctions to facilitate the alignment.

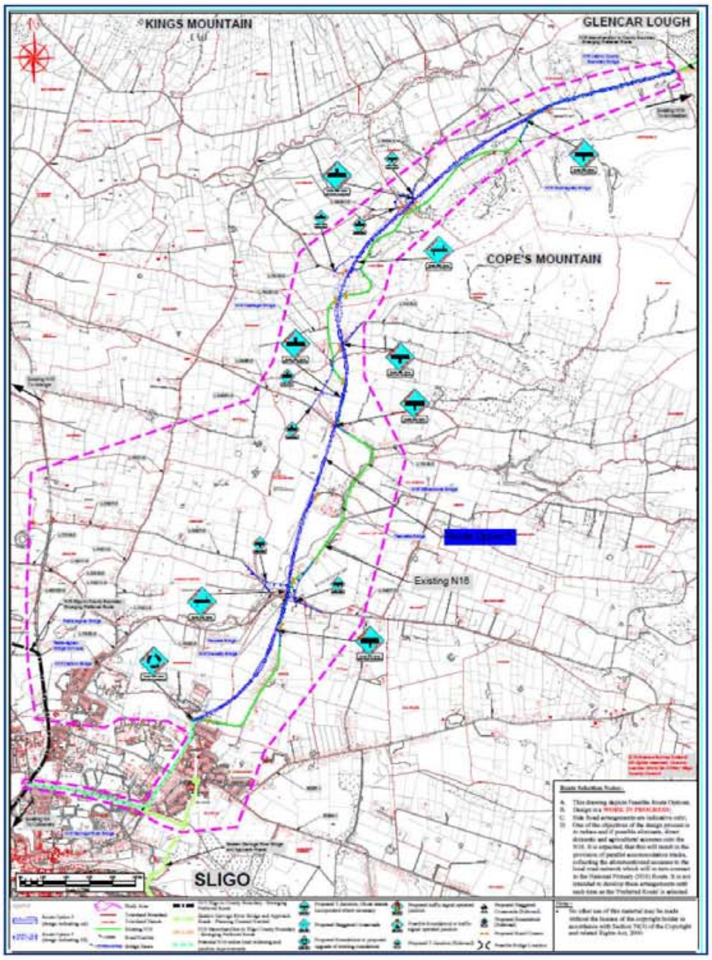

Figure 1.13: Feasible route selection; Option 5

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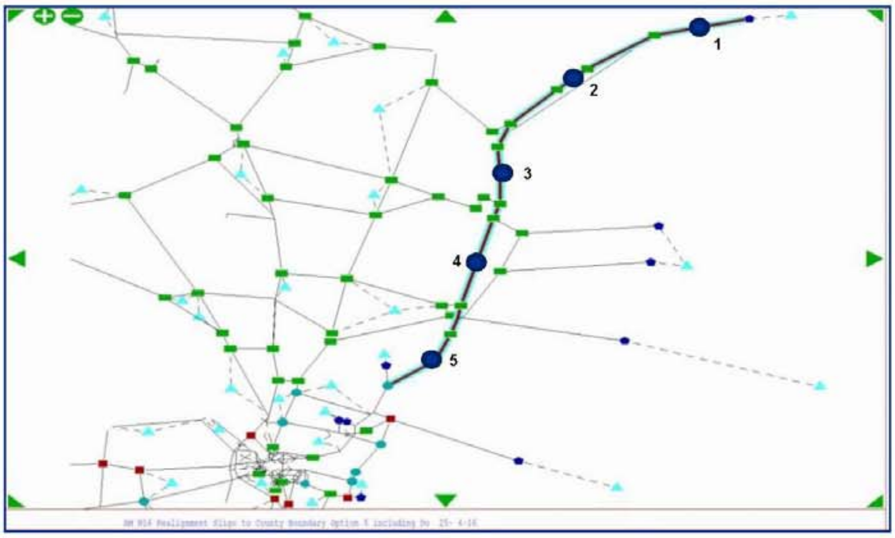

Figure 1.14: SATURN Model Option 5

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1.7.2 Option 6:

Option 6 is a variant of Option 5 where the new N16 alignment merges with the existing N16 just before the AbbVie Ireland roundabout. The total length is 7.7 km incorporating 17 new or redesigned junctions. 10 of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst the remaining 7 are related to the realignment of existing local road junctions to facilitate the alignment.

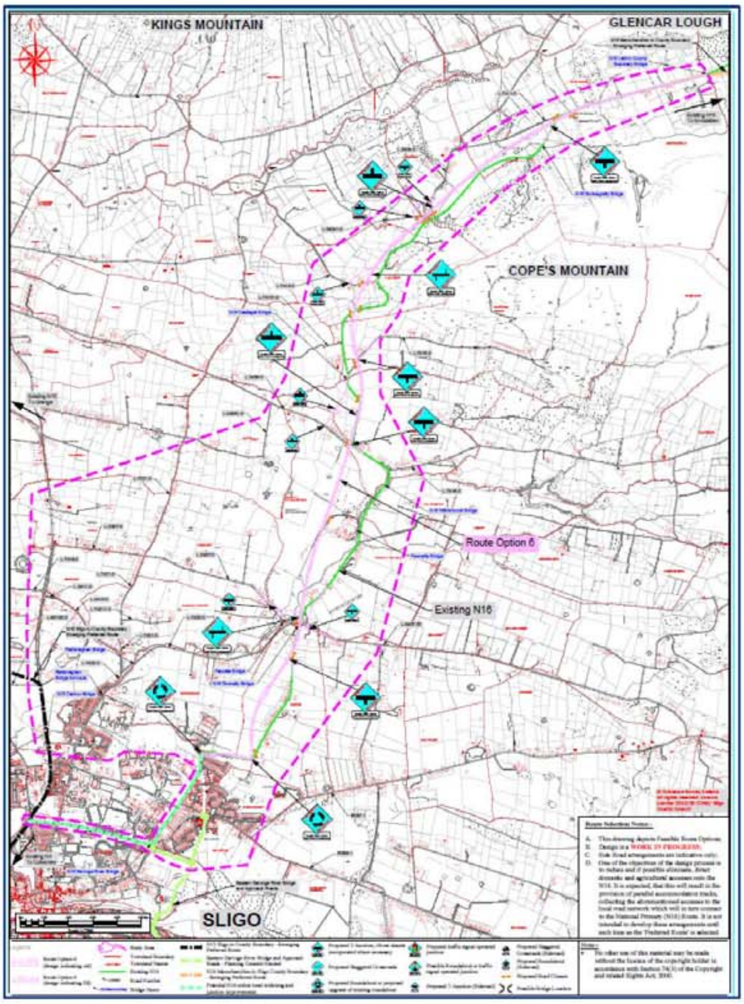

Figure 1.15: Feasible route selection; Option 6

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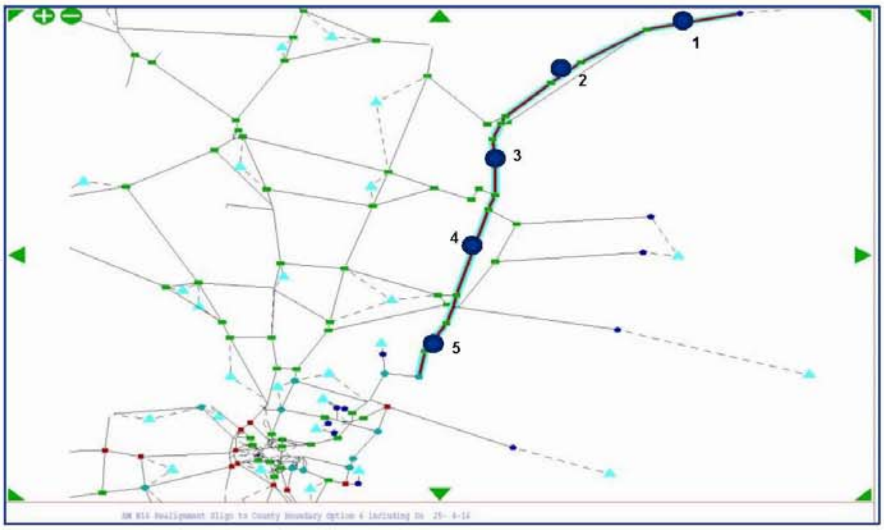

Figure 1.16: SATURN Model Option 6

1.7.3 Option 8:

Option 8 is a variant of Option 5 with the new N16 alignment tapering off the existing N16 just after Willowbrook Bridge and meeting the existing N16 again before connecting into the AbbVie Ireland roundabout. The total length is 8.16 km including 12 new or redesigned junctions. 9 of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst the remaining 3 are related to the realignment of existing local road junctions to facilitate the alignment.

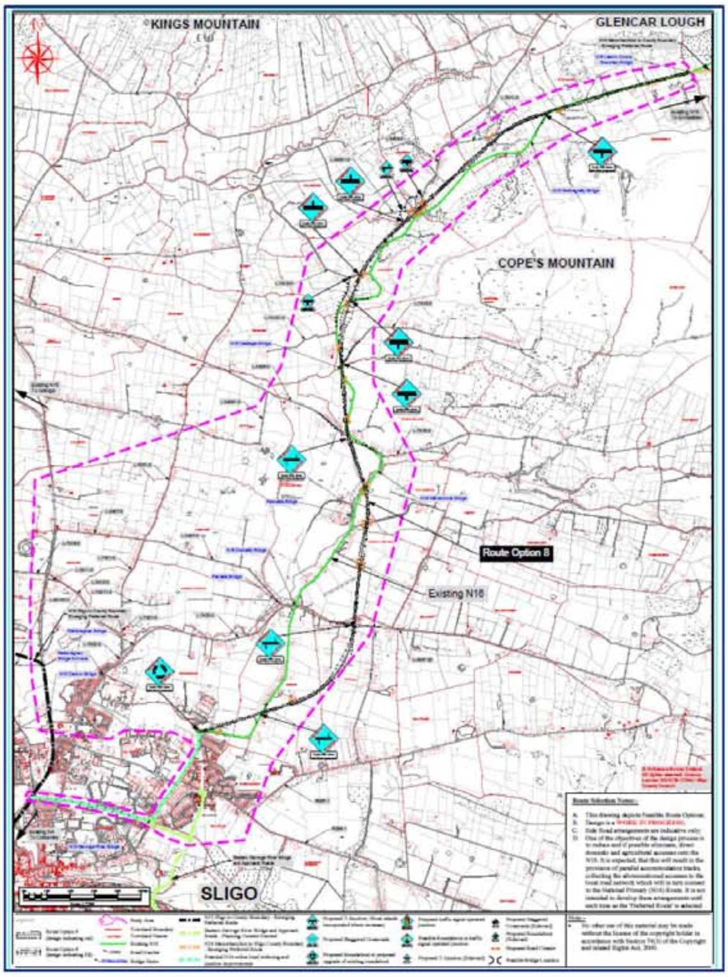

Figure 1.17: Feasible route selection; Option 8

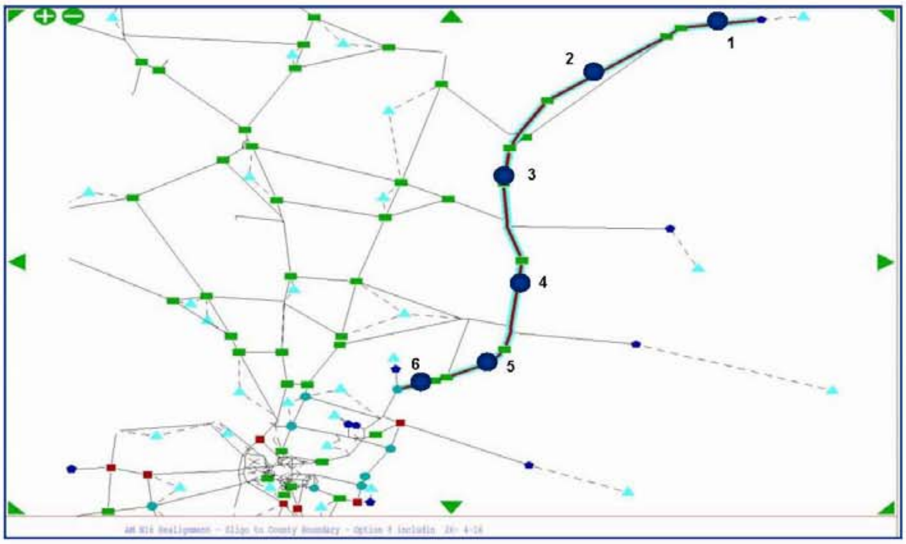

Figure 1.18: SATURN Model Option 8

19

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1.8 SATURN Modelling Analysis of Options

The following section of the Technical Note describes the analysis undertaken on the feasible options. Each option has been analysed with respect to Annual Average Daily traffic (AADT), routing pattern, speeds, journey times, junction capacities, overall network statistics and emissions.

1.8.1 Value of Time update:

The Value of Time (VoT) for each user class in Opening, Design and Forecast years has been updated from Project Appraisal Guidelines Unit 6.11. The annual growth factors, as presented in Table 1.1 below, have been utilised to arrive at the values of time presented in Table 1.2.

Table 1.1 : Value of Time growth factors, PAG Unit 6.11, July 2011

Year	Work	Commuting	Leisure
2010	1.000	0.99	0.99
2011	1.000	1.016	1.016
2012 to 2020	1.025	1.020	1.020
2021+	1.020	1.016	1.016

Table 1.2 : Value of Time for Opening, Design and Forecast years

Use Class	2017	2032	2047
VoT, Lights (Cents/minute)	14.63	19.17	24.81
VoT, Heavies (Cents/minute)	42.91	58.60	78.87

The annual growth factors are based on journey purposes of Work, Commuting and Leisure that are more appropriate to Lights user class and therefore the values for Lights have been averaged across all journey purposes. On the other hand, the values for Heavies have been derived solely from Work journey purpose only. Vehicle Operating Costs (VOC), meanwhile, have not been updated and assumed unchanged throughout the years.

1.8.2 N16 Options Annual Average Daily Traffic

The AADT at various critical locations on N16 alignment are presented in Table 1.3, Table 1.4 and Table 1.5. The location of the AADT values are based on the locations identified in Figure 1.1 to Figure 1.18, showing the different option arrangements and configurations for the 8 options considered.

It can be seen that in the Do Minimum traffic volumes increase on the approach to Sligo, but reduce slightly to the south of the N16 junction with the L-3407-22 due to traffic using the L-7422-0 as an alternative route to the N16.

Options 1A and 1B and Option 2A and 2B show similar patterns of traffic using the N16, with significant reductions in traffic on the N16 the closer it gets to the N15. This highlights that traffic demand on the N16 is focussed more within Sligo and results in this demand utilising the existing N16 route and the L-7421-0 as alternative routes to the proposed alignments. Option 3 retains more of the traffic demand on the proposed N16 alignment than Options 1 and 2, however, again to the south of the Option 3 connection with the L-7422-0 there is a reduction in traffic using the N16, showing that the demand is utilising the alternative route.

Options 5, 6 and 8, show similar traffic patterns, with traffic volumes on the proposed N16 alignments increasing closer to Sligo. This suggests that these routes generally cater for the demand to Sligo, with limited use of the alternative routes to the N16. Option 5 caters for the highest demand levels of all of the alignment options, followed by Option 8.

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Table 1.3 : 2017 AADT Comparisons

Map Reference	Direction	2017 AADT (Per Direction)									
		DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
1	NB	1721	1721	1721	1721	1721	1721	1721	1721	1721	1721
1	SB	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
2	NB	1721	1721	1721	1721	1643	1643	1721	1721	1721	1721
2	SB	1700	1700	1700	1700	1630	1630	1700	1700	1700	1700
3	NB	1632	1632	1721	1721	1643	1643	1721	1661	1642	1657
3	SB	1627	1625	1700	1700	1630	1630	1700	1632	1631	1631
4	NB	2356	2356	797	774	533	534	1652	1618	1599	2136
4	SB	2210	2210	1601	1601	1455	1455	1643	1597	1597	2075
5	NB	2061	2257	115	22	813	814	1116	2543	2185	2311
5	SB	1714	1215	92	73	1746	1742	189	2398	1224	2252
6	NB	-	-	-	-	634	22	954 (EB)	-	-	2476
6	SB	-	-	-	-	63	23	1658 (WB)	-	-	2310
7	EB	-	-	-	-	-	-	766	-	-	-
7	WB	-	-	-	-	-	-	542	-	-	-

21

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Table 1.4 : 2032 AADT Comparisons

Map Reference	Direction	2032 AADT (Per Direction)									
		DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
1	NB	1834	1834	1834	1834	1834	1834	1834	1834	1834	1834
1	SB	1816	1816	1816	1816	1816	1816	1816	1816	1816	1816
2	NB	1834	1834	1834	1834	1753	1753	1834	1834	1834	1834
2	SB	1816	1816	1816	1816	1742	1742	1816	1816	1816	1816
3	NB	1735	1735	1834	1834	1753	1753	1834	1789	1767	1768
3	SB	1726	1726	1816	1816	1742	1742	1816	1754	1751	1744
4	NB	2599	2599	839	824	610	611	1774	1732	1710	2342
4	SB	2446	2446	1696	1709	1537	1536	1760	1698	1696	2227
5	NB	2186	2434	142	32	1071	1064	1169	2879	2414	2585
5	SB	1780	1432	207	158	2003	2006	276	2651	1419	2426
6	NB	-	-	-	-	769	35	1206 (EB)	-	-	2791
6	SB	-	-	-	-	278	64	1958 (WB)	-	-	2502
7	EB	-	-	-	-	-	-	932	-	-	-
7	WB	-	-	-	-	-	-	791	-	-	-

22

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Table 1.5 : 2047 AADT Comparisons

Map Reference	Direction	2047 AADT (Per Direction)									
		DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
1	NB	1839	1839	1839	1839	1839	1839	1839	1839	1839	1839
1	SB	1813	1813	1813	1813	1813	1813	1813	1813	1813	1813
2	NB	1839	1839	1839	1839	1757	1757	1839	1839	1839	1839
2	SB	1813	1813	1813	1813	1739	1739	1813	1813	1813	1813
3	NB	1738	1738	1839	1839	1757	1757	1839	1795	1773	1773
3	SB	1723	1723	1813	1813	1739	1739	1813	1755	1752	1742
4	NB	2623	2623	784	785	611	612	1781	1735	1712	2347
4	SB	2463	2463	1707	1709	1532	1530	1758	1695	1693	2242
5	NB	2210	2452	143	33	1130	1123	1264	2904	2433	2533
5	SB	1696	1469	223	164	2026	2034	282	2679	1451	2469
6	NB	-	-	-	-	847	38	1267 (EB)	-	-	2739
6	SB	-	-	-	-	357	66	2007 (WB)	-	-	2548
7	EB	-	-	-	-	-	-	1061	-	-	-
7	WB	-	-	-	-	-	-	819	-	-	-

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1.8.3 Wider Sligo Network Annual Average Daily Traffic

Figure 1.19 and Figure 1.20 outline the locations considered on the wider Sligo network in the context of the introduction of the different N16 option alignments. The findings are presented in Table 1.6, Table 1.7 and Table 1.8.

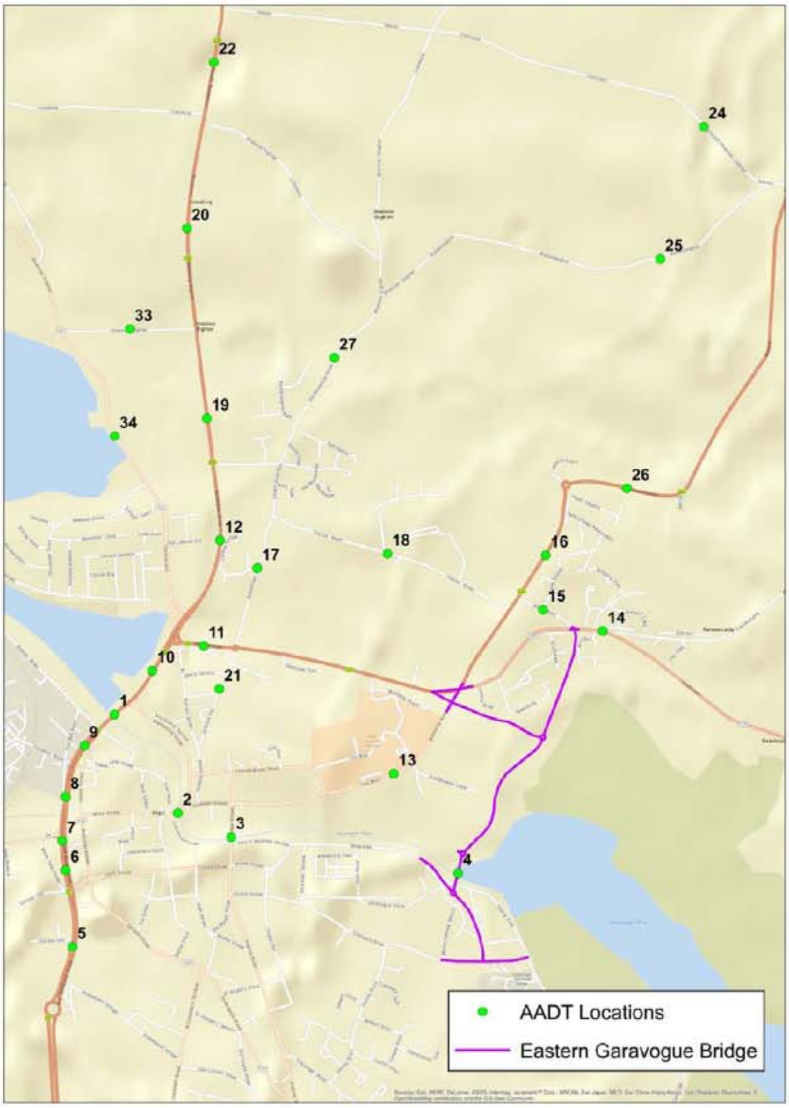

Figure 1.19: AADT Location Map – Sligo Town

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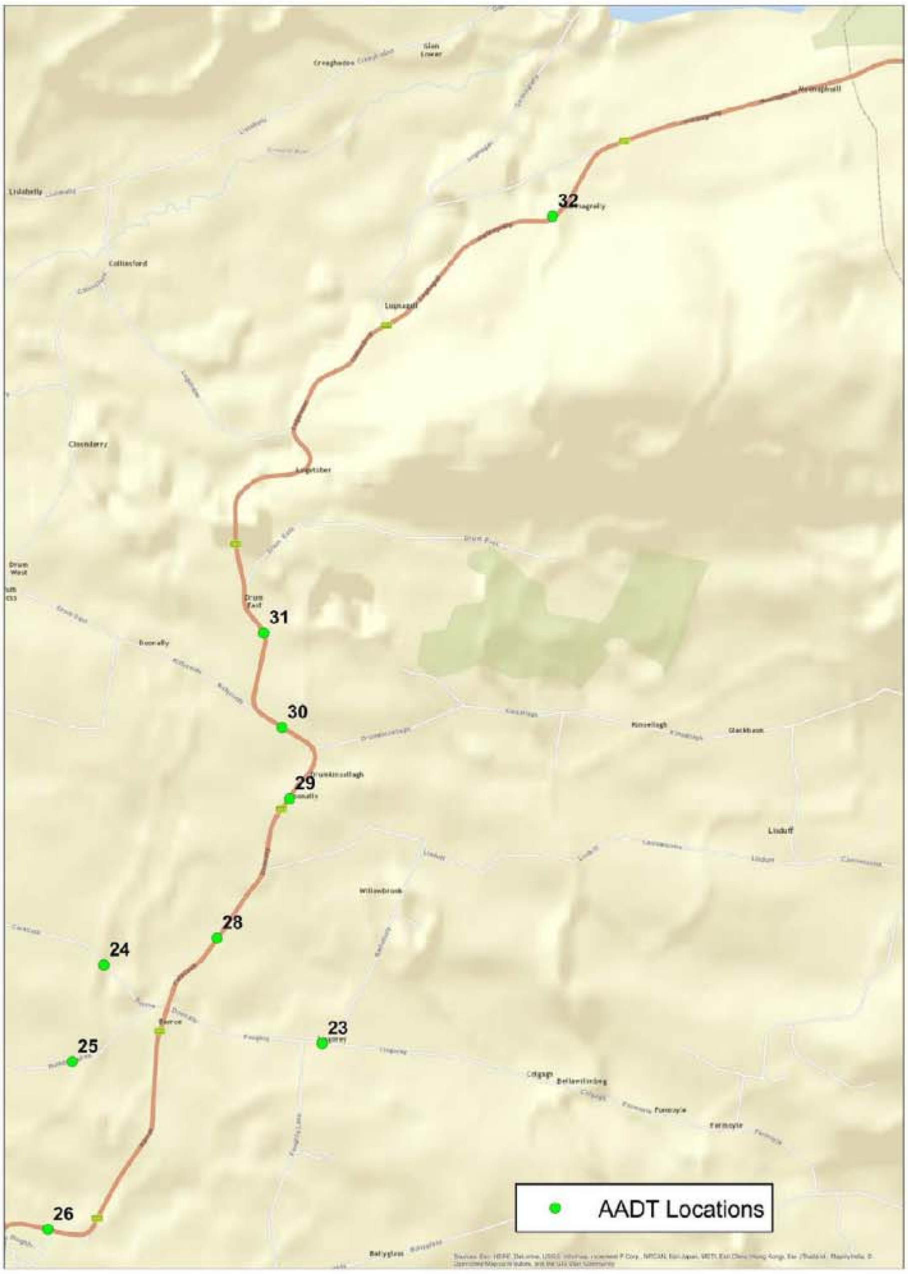

Figure 1.20: AADT Location Map – N16 Corridor

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Table 1.6 : 2017 Wider AADT Comparisons

AADT Comparison (2017)	Map Reference	Direction	2017 AADT (Per Direction)									
Link Name			DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
Hughes Bridge	1	NB	12380	10464	10390	10107	10420	10134	10485	10431	10442	10443
Hughes Bridge	1	SB	13005	13230	13324	13305	13290	13297	13254	13044	13235	13065
Hyde Bridge	2	NB	10975	9092	9149	9378	9119	9359	9215	9015	9079	9018
Bridge Street	3	SB	13008	11300	11422	11424	11424	11400	11470	11359	11315	11361
Garavogue Bridge	4	NB	N/A	4071	4083	4140	4083	4132	3928	4189	4108	4175
Garavogue Bridge	4	SB	N/A	1755	1534	1553	1567	1585	1561	1890	1736	1867
N4 North of Summerhill R'bout	5	NB	10164	9077	9109	9001	9152	9043	9181	9039	9128	9060
N4 North of Summerhill R'bout	5	SB	9196	8897	8992	9231	8982	9233	9116	8690	8904	8705
N4 Church Hill/John Street to Sráid an Fhiona (S5-S6)	6	NB	12779	10956	10970	10828	11002	10856	11038	10885	10949	10902
N4 Sráid an Fhiona to Church Hill/John Street (S6-S5)	6	SB	8671	8819	8834	8899	8827	8898	8884	8636	8786	8655
N4 Sráid an Fhiona to Wine Street (S6-S7)	7	NB	12287	10368	10376	10284	10392	10308	10536	10284	10347	10301
N4 Wine Street to Sráid an Fhiona (S7-S6)	7	SB	8043	8164	8179	8245	8172	8243	8229	7982	8131	8000
N4 Wine Street to Finiskin Road	8	NB	10428	9134	9127	9034	9136	9064	9320	9059	9109	9070
N4 Finiskin Road to Wine Street	8	SB	9376	9349	9363	9578	9355	9577	9561	9147	9304	9162
N4 Finiskin Road to Ballast Quay	9	NB	9090	7290	7274	7094	7290	7126	7377	7218	7261	7227

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AADT Comparison (2017)	Map Reference	Direction	2017 AADT (Per Direction)									
Link Name			DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
N4 Ballast Quay to Finiskin Road	9	SB	7766	7814	7830	8047	7822	8048	8034	7627	7776	7642
N4 Marckievicz Road to Duck Street	10	NB	13157	11685	11684	9903	11711	9930	10266	11582	11660	11594
N4 Duck Street to Marckievicz Road	10	SB	13364	14407	14545	14094	14544	14114	13857	13755	14405	13798
N16 Duck Street (N4 to R'bout)	11	EB	5246	4681	4634	4506	4622	4590	4658	4705	4667	4656
N16 Duck Street (R'bout to N4)	11	WB	5333	6923	6958	5937	6958	5913	6186	6729	6903	6767
N15 Rosses Point to Elm Gardens	12	NB	7834	7232	7276	5012	7257	5041	5598	6999	7151	7095
N15 Elm Gardens to Rosses Point	12	SB	7161	7193	7267	6677	7270	6705	6324	6626	7167	6659
R 286 - The Mall	13	NB	4259	3025	2950	2889	3023	2939	2855	3068	3024	3062
R 286 - The Mall	13	SB	4218	2372	2322	2437	2332	2435	2385	3090	2433	3089
R286 - Hazelwood Road	14	EB	3319	3319	3319	3319	3319	3319	3319	3319	3319	3319
R286 - Hazelwood Road	14	WB	3511	3511	3511	3511	3511	3511	3511	3511	3511	3511
Short walk	15	EB	418	1137	916	1054	949	1086	944	1310	1118	1286
Short Walk	15	WB	461	1951	1994	2158	1982	2167	1916	2096	1990	2080
N16 South of Abbvie R'bout	16	NB	2626	2822	2512	2529	2526	2526	2022	3107	2806	3041
N16 South of Abbvie R'bout	16	SB	1996	1497	1095	1145	1166	1169	900	2679	1562	2592
Ballytivnan Road	17	NB	1585	1200	1415	3475	1305	3374	3323	1128	1165	1122
Ballytivnan Road	17	SB	2539	3100	3477	3871	3428	3737	4088	2618	3065	2614
Clarion Road	18	EB	342	517	518	656	574	685	459	485	570	467
Clarion Road	18	WB	469	1458	1531	2205	1668	2315	1950	1593	1591	1504

AADT Comparison (2017)	Map Reference	Direction	2017 AADT (Per Direction)									
Link Name			DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
N15 Shannon Eighter to Elm Gardens	19	NB	7847	7931	7988	8063	8486	8063	8767	8027	7958	8012
N15 Shannon Eighter to Elm Gardens	19	SB	8133	8127	8125	7816	8089	8198	7995	8127	8164	8127
N15 Lisnalurg to Shannon Eighter	20	NB	7367	7472	7528	7510	7476	7510	7535	7568	7569	7532
N15 Lisnalurg to Shannon Eighter	20	SB	7361	7353	7327	6981	7284	7363	7201	7368	7405	7359
Holborn Hill	21	NB	1984	1382	1460	3214	1358	3128	3107	1328	1373	1336
Holborn Hill	21	SB	2314	1873	2045	2373	2002	2322	2662	1663	1863	1640
N15 Lisnalurg to Teesan	22	NB	7475	7484	7600	7561	7495	7494	7500	7551	7571	7516
N15 Lisnalurg to Teesan	22	SB	7330	7321	7350	7343	7314	7314	7312	7336	7373	7327
L - 3407 - 22 (Lisgorey)	23	EB	482	482	482	482	482	482	482	482	482	482
L - 3407 - 22 (Lisgorey)	23	WB	477	477	477	477	477	477	477	477	477	477
L - 3407 - 0 (Carncash)	24	EB	80	80	117	117	-	-	43	148	111	51
L - 3407 - 0 (Carncash)	24	WB	94	91	137	83	-	-	32	106	86	73
L - 7422 - 0 (Rathbraughan Lane)	25	EB	665	535	267	274	280	280	-	199	419	91
L - 7422 - 0 (Rathbraughan Lane)	25	WB	823	1330	270	274	291	288	-	135	1254	78
N16 East of Abbvie R'bout	26	EB	2061	2257	1948	1916	1868	1868	1037	2543	2185	2476
N16 East of Abbvie R'bout	26	WB	1714	1215	813	814	790	793	900	2398	1224	2310
Old Bundoran Road	27	NB	1697	1396	1650	1700	1160	1748	1437	1015	1372	1117
Old Bundoran Road	27	SB	1494	2001	2404	2774	2453	2413	2280	803	1941	900
N16 North of Doonally Cross	28	NB	2356	2356	1814	1838	1867	1867	758	-	-	-

AADT Comparison (2017)	Map Reference	Direction	2017 AADT (Per Direction)									
Link Name			DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
N16 North of Doonally Cross	28	SB	2210	2210	794	794	805	805	614	-	-	-
N16 Willowbrook Bridge	29	NB	1599	1599	1019	1043	1109	1109	0	0	0	-
N16 Willowbrook Bridge	29	SB	1594	1594	132	132	189	189	0	0	0	-
N16 (L - 3406 - 0 to L - 7416 - 0)	30	NB	1682	1682	1057	1081	-	-	-	-	-	-
N16 (L - 3406 - 0 to L - 7416 - 0)	30	SB	1749	1749	249	249	-	-	-	-	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	31	NB	1632	1632	6	6	-	-	-	-	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	31	SB	1627	1625	22	22	-	-	-	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	32	NB	1721	1721	-	-	-	-	-	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	32	SB	1700	1700	-	-	-	-	-	-	-	-
L - 90102 - (Scotsman Walk)	33	EB	188	209	209	1	284	13	190	278	278	242
L - 90102 - (Scotsman Walk)	33	WB	177	174	151	0	200	13	908	260	189	234
R291 Rosses Point Road	34	NB	1024	1023	1022	1095	1024	1094	537	952	1023	969
R291 Rosses Point Road	34	SB	1418	1420	1420	1475	1416	1475	1420	1420	1420	1420

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Table 1.7 : 2032 Wider AADT Comparisons

AADT Comparison (2032)	Map Reference	Direction	2032 AADT (Per Direction)									
Link Name			DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
Hughes Bridge	1	NB	13404	11437	11443	11280	11471	11304	11542	11310	11399	11310
Hughes Bridge	1	SB	14223	14522	14603	14667	14646	14670	14673	14265	14515	14264
Hyde Bridge	2	NB	11340	9391	9388	9462	9373	9434	9409	9331	9376	9334
Bridge Street	3	SB	13291	11490	11633	11595	11572	11561	11613	11578	11511	11583
Garavogue Bridge	4	NB	N/A	4304	4296	4395	4281	4396	4175	4520	4358	4514
Garavogue Bridge	4	SB	N/A	1890	1662	1646	1678	1673	1611	2089	1876	2081
N4 North of Summerhill R'bout	5	NB	11244	10254	10273	10270	10284	10280	10309	10125	10244	10146
N4 North of Summerhill R'bout	5	SB	10515	10290	10367	10491	10418	10541	10544	10018	10304	9987
N4 Church Hill/John Street to Sráid an Fhiona (S5-S6)	6	NB	13792	12074	12099	12074	12140	12078	12151	11944	12062	11940
N4 Sráid an Fhiona to Church Hill/John Street (S6-S5)	6	SB	9634	9757	9804	9907	9848	9902	9928	9546	9765	9550
N4 Sráid an Fhiona to Wine Street (S6-S7)	7	NB	13169	11351	11369	11321	11409	11331	11437	11175	11320	11177
N4 Wine Street to Sráid an Fhiona (S7-S6)	7	SB	8970	9048	9100	9208	9140	9207	9219	8836	9055	8840
N4 Wine Street to Finiskin Road	8	NB	11382	9569	9577	9619	9609	9644	9804	9420	9542	9416
N4 Finiskin Road to Wine Street	8	SB	10370	10161	10200	10510	10237	10513	10371	9974	10165	9957
N4 Finiskin Road to Ballast Quay	9	NB	9690	7640	7645	7616	7681	7633	7808	7506	7603	7499
N4 Ballast Quay to Finiskin Road	9	SB	8542	8490	8527	8837	8560	8845	8696	8304	8498	8289

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AADT Comparison (2032)	Map Reference	Direction	2032 AADT (Per Direction)									
Link Name			DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
N4 Marckievicz Road to Duck Street	10	NB	14264	12817	12825	11125	12871	11137	11450	12651	12780	12654
N4 Duck Street to Marckievicz Road	10	SB	14650	15599	15724	15518	15785	15539	15191	15077	15595	15069
N16 Duck Street (N4 to R'bout)	11	EB	5416	5002	4968	4379	4883	4410	4923	5028	4968	4966
N16 Duck Street (R'bout to N4)	11	WB	5422	7366	7364	6479	7430	6475	6865	7301	7376	7317
N15 Rosses Point to Elm Gardens	12	NB	8588	7957	7996	5757	7980	5780	6227	7696	7884	7795
N15 Elm Gardens to Rosses Point	12	SB	8068	7903	7985	7354	7899	7389	6965	7419	7888	7429
R 286 - The Mall	13	NB	4064	3125	3100	3055	3088	3064	3020	3164	3121	3159
R 286 - The Mall	13	SB	4264	2492	2417	2455	2390	2451	2533	3071	2546	3064
R286 - Hazelwood Road	14	EB	3373	3373	3373	3373	3373	3373	3373	3373	3373	3373
R286 - Hazelwood Road	14	WB	3576	3576	3576	3576	3576	3576	3576	3576	3576	3576
Short walk	15	EB	461	1302	1074	1185	1092	1213	1025	1502	1288	1494
Short Walk	15	WB	610	2159	2245	2356	2227	2370	2155	2281	2220	2286
N16 South of Abbvie R'bout	16	NB	2787	3035	2768	2772	2726	2734	2210	3479	3072	3392
N16 South of Abbvie R'bout	16	SB	2111	1764	1300	1346	1376	1374	1035	2982	1807	2834
Ballytivnan Road	17	NB	2032	1461	1639	3531	1504	3492	3431	1368	1396	1315
Ballytivnan Road	17	SB	2800	3394	3856	4501	3838	4437	4555	2774	3341	2785
Clarion Road	18	EB	595	647	647	807	722	859	478	724	719	645
Clarion Road	18	WB	626	1626	1729	2477	1899	2606	2084	1709	1711	1547
N15 Shannon Eighter to Elm Gardens	19	NB	8400	8447	8520	8761	9061	8771	9300	8624	8481	8602

AADT Comparison (2032)	Map Reference	Direction	2032 AADT (Per Direction)									
Link Name			DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
N15 Shannon Eighter to Elm Gardens	19	SB	8496	8482	8497	8181	8529	8731	8432	8673	8508	8588
N15 Lisnalurg to Shannon Eighter	20	NB	7937	7983	8056	8189	8064	8216	8221	8183	8086	8146
N15 Lisnalurg to Shannon Eighter	20	SB	7735	7716	7703	7329	7705	7866	7634	7911	7747	7817
Holborn Hill	21	NB	2466	1389	1409	3102	1394	3064	3072	1330	1375	1333
Holborn Hill	21	SB	2540	1921	2133	2357	2097	2304	2660	1673	1879	1685
N15 Lisnalurg to Teesan	22	NB	8113	8144	8288	8253	8116	8186	8170	8210	8225	8181
N15 Lisnalurg to Teesan	22	SB	8026	8026	8068	8060	8014	8013	8019	8042	8097	8033
L - 3407 - 22 (Lisgorey)	23	EB	655	655	655	655	655	655	655	655	655	655
L - 3407 - 22 (Lisgorey)	23	WB	640	640	640	640	640	640	640	640	640	640
L - 3407 - 0 (Carncash)	24	EB	124	125	171	170	-	-	73	199	147	79
L - 3407 - 0 (Carncash)	24	WB	142	143	202	133	-	-	57	161	156	107
L - 7422 - 0 (Rathbraughan Lane)	25	EB	925	745	426	437	460	453	-	260	596	132
L - 7422 - 0 (Rathbraughan Lane)	25	WB	1122	1475	399	422	466	470	-	240	1400	153
N16 East of Abbvie R'bout	26	EB	2186	2434	2167	2115	1996	2003	1306	2879	2414	2791
N16 East of Abbvie R'bout	26	WB	1780	1432	969	959	915	914	1153	2651	1419	2502
Old Bundoran Road	27	NB	2150	1823	2016	1934	1575	2036	1544	1178	1740	1303
Old Bundoran Road	27	SB	2177	2543	2988	3404	3016	2900	2632	1130	2526	1373
N16 North of Doonally Cross	28	NB	2599	2599	2053	2067	2039	2038	905	-	-	-
N16 North of Doonally Cross	28	SB	2446	2446	962	962	978	979	751	-	-	-

32

AADT Comparison (2032)	Map Reference	Direction	2032 AADT (Per Direction)									
Link Name			DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
N16 Willowbrook Bridge	29	NB	1694	1694	1101	1115	1134	1133	0	0	0	-
N16 Willowbrook Bridge	29	SB	1691	1691	152	152	225	226	0	0	0	-
N16 (L - 3406 - 0 to L - 7416 - 0)	30	NB	1802	1802	1154	1169	-	-	-	-	-	-
N16 (L - 3406 - 0 to L - 7416 - 0)	30	SB	1871	1871	286	286	-	-	-	-	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	31	NB	1735	1735	22	9	-	-	-	-	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	31	SB	1726	1726	28	28	-	-	-	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	32	NB	1834	1834	-	-	-	-	-	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	32	SB	1816	1816	-	-	-	-	-	-	-	-
L - 90102 - (Scotsman Walk)	33	EB	227	258	257	2	297	24	222	326	326	291
L - 90102 - (Scotsman Walk)	33	WB	241	235	206	0	259	24	782	286	240	255
R291 Rosses Point Road	34	NB	1220	1221	1223	1321	1224	1321	858	1176	1221	1196
R291 Rosses Point Road	34	SB	1617	1617	1618	1693	1611	1693	1621	1617	1617	1617

33

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Table 1.8 : 2047 Wider AADT Comparisons

AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)									
Link Name			DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
Hughes Bridge	1	NB	13629	11704	11733	11524	11776	11483	11917	11613	11671	11656
Hughes Bridge	1	SB	14496	14811	14911	15015	14939	15005	15022	14542	14814	14579
Hyde Bridge	2	NB	11285	9141	9135	9311	9116	9331	9141	9097	9100	9096
Bridge Street	3	SB	13152	11496	11613	11538	11569	11521	11558	11568	11502	11567
Garavogue Bridge	4	NB	N/A	4629	4594	4629	4563	4638	4396	4775	4706	4754
Garavogue Bridge	4	SB	N/A	1901	1671	1643	1681	1661	1608	2109	1894	2094
N4 North of Summerhill R'bout	5	NB	11610	10518	10514	10540	10533	10541	10721	10382	10468	10404
N4 North of Summerhill R'bout	5	SB	10639	10485	10538	10741	10598	10725	10726	10149	10434	10137
N4 Church Hill/John Street to Sráid an Fhiona (S5-S6)	6	NB	13409	12072	12049	11875	11917	11906	12090	11951	11814	11966
N4 Sráid an Fhiona to Church Hill/John Street (S6-S5)	6	SB	9681	9867	9944	10043	9908	10020	10047	9602	9869	9615
N4 Sráid an Fhiona to Wine Street (S6-S7)	7	NB	12783	11307	11298	11059	11144	11117	11392	11157	11126	11186
N4 Wine Street to Sráid an Fhiona (S7-S6)	7	SB	9033	9175	9274	9356	9224	9355	9355	8909	9177	8923
N4 Wine Street to Finiskin Road	8	NB	11354	9605	9643	9606	9641	9669	9955	9489	9588	9504
N4 Finiskin Road to Wine Street	8	SB	10433	10308	10392	10599	10312	10614	10471	10039	10308	10047
N4 Finiskin Road to Ballast Quay	9	NB	9892	7728	7766	7718	7839	7701	8024	7617	7715	7656
N4 Ballast Quay to Finiskin Road	9	SB	8573	8610	8697	8945	8610	8957	8802	8379	8613	8387

34

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AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)									
Link Name			DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
N4 Marckievicz Road to Duck Street	10	NB	14465	12992	13011	11366	13070	11358	11786	12793	12934	12848
N4 Duck Street to Marckievicz Road	10	SB	14855	15870	16013	15839	16055	15868	15515	15243	15865	15296
N16 Duck Street (N4 to R'bout)	11	EB	5483	5102	5094	4370	5025	4378	4970	5142	5106	5083
N16 Duck Street (R'bout to N4)	11	WB	5512	7477	7493	6709	7642	6695	7058	7341	7499	7381
N15 Rosses Point to Elm Gardens	12	NB	8689	7951	7957	5924	8003	5913	6498	7715	7902	7830
N15 Elm Gardens to Rosses Point	12	SB	8117	7935	8026	7363	7931	7416	6988	7403	7940	7418
R 286 - The Mall	13	NB	3787	3024	3015	3078	3004	3084	2998	3094	3007	3052
R 286 - The Mall	13	SB	3979	2482	2451	2474	2463	2472	2544	3079	2507	3072
R286 - Hazelwood Road	14	EB	3383	3383	3383	3383	3383	3383	3383	3383	3383	3383
R286 - Hazelwood Road	14	WB	3583	3583	3583	3583	3583	3583	3583	3583	3583	3583
Short walk	15	EB	471	1322	1092	1203	1104	1221	1040	1529	1313	1515
Short Walk	15	WB	656	2362	2455	2467	2433	2460	2229	2347	2365	2326
N16 South of Abbvie R'bout	16	NB	2817	3059	2805	2812	2746	2754	2219	3511	3094	3346
N16 South of Abbvie R'bout	16	SB	2036	1809	1330	1354	1407	1405	1059	3020	1846	2888
Ballytivnan Road	17	NB	2344	1456	1636	3439	1528	3431	3249	1402	1435	1373
Ballytivnan Road	17	SB	2966	3538	4006	4652	4011	4560	4655	2880	3427	2886
Clarion Road	18	EB	919	653	657	856	723	909	476	757	736	663
Clarion Road	18	WB	721	1931	2043	2640	2115	2787	2230	1977	1968	1850
N15 Shannon Eighter to Elm Gardens	19	NB	8432	8465	8542	8804	9081	8835	9411	8656	8477	8627

35

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AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)									
Link Name			DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
N15 Shannon Eighter to Elm Gardens	19	SB	8459	8437	8517	8189	8551	8583	8449	8513	8457	8464
N15 Lisnalurg to Shannon Eighter	20	NB	7936	7953	8040	8228	8078	8274	8278	8059	7977	8033
N15 Lisnalurg to Shannon Eighter	20	SB	7690	7669	7717	7315	7719	7696	7648	7744	7689	7696
Holborn Hill	21	NB	2703	1390	1394	3001	1389	2993	2878	1319	1389	1350
Holborn Hill	21	SB	2744	2007	2130	2356	2091	2302	2664	1736	1989	1729
N15 Lisnalurg to Teesan	22	NB	8154	8261	8413	8296	8176	8253	8225	8269	8284	8268
N15 Lisnalurg to Teesan	22	SB	8042	8043	8089	8075	8053	8052	8028	8056	8113	8045
L - 3407 - 22 (Lisgorey)	23	EB	681	681	681	681	681	681	681	681	681	681
L - 3407 - 22 (Lisgorey)	23	WB	667	667	667	667	667	667	667	667	667	667
L - 3407 - 0 (Carncash)	24	EB	128	188	247	177	-	-	79	204	153	108
L - 3407 - 0 (Carncash)	24	WB	148	148	211	161	-	-	63	168	164	115
L - 7422 - 0 (Rathbraughan Lane)	25	EB	947	714	380	463	519	511	-	274	617	180
L - 7422 - 0 (Rathbraughan Lane)	25	WB	1238	1470	416	441	494	504	-	244	1401	139
N16 East of Abbvie R'bout	26	EB	2210	2452	2198	2169	2011	2019	1344	2904	2433	2739
N16 East of Abbvie R'bout	26	WB	1696	1469	989	978	939	937	1192	2679	1451	2548
Old Bundoran Road	27	NB	2242	1948	2114	1953	1662	2073	1466	1389	1942	1580
Old Bundoran Road	27	SB	2368	2614	3013	3458	3035	3105	2631	1327	2611	1508
N16 North of Doonally Cross	28	NB	2623	2623	2093	2093	2058	2053	927	-	-	-
N16 North of Doonally Cross	28	SB	2463	2463	987	986	975	978	772	-	-	-
N16 Willowbrook Bridge	29	NB	1696	1696	1118	1118	1131	1127	0	0	0	-

36

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AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)									
Link Name			DN	DM	OP1A	OP1B	OP2A	OP2B	OP3	OP5	OP6	OP8
N16 Willowbrook Bridge	29	SB	1687	1687	154	153	200	203	0	0	0	-
N16 (L - 3406 - 0 to L - 7416 - 0)	30	NB	1809	1809	1174	1174	-	-	-	-	-	-
N16 (L - 3406 - 0 to L - 7416 - 0)	30	SB	1872	1872	289	288	-	-	-	-	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	31	NB	1738	1738	8	7	-	-	-	-	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	31	SB	1723	1723	72	72	-	-	-	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	32	NB	1839	1839	-	-	-	-	-	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	32	SB	1813	1813	-	-	-	-	-	-	-	-
L - 90102 - (Scotsman Walk)	33	EB	235	322	333	21	308	45	225	333	333	326
L - 90102 - (Scotsman Walk)	33	WB	274	344	314	0	270	26	835	440	344	431
R291 Rosses Point Road	34	NB	1246	1157	1156	1363	1257	1363	863	1063	1159	1072
R291 Rosses Point Road	34	SB	1648	1652	1652	1715	1647	1715	1658	1652	1652	1652

37

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1.8.4 Select Link Analysis

A select Link Analysis (SLA) has been carried out on each model variant to present the routing pattern for traffic using the N16 in the inbound direction for the AM peak. The routing along the N16 for each option is presented in Figure 1.21 below. Each of these images are also included in Appendix A.

It is apparent that the introduction of the EGB in the Do Minimum scenario causes changes to the routing of traffic using the N16 inbound. The EGB provides an alternative crossing of the Garavogue River to the current crossings in the City Centre. This reduces traffic using the City Centre part of the network, making the routes to and from the current crossings more desirable than in the existing situation. This results in traffic routing from the N16 onto the L-7422-0 to enter Sligo via the Ballytivnan Road, in the Do Minimum scenario.

The increase in attractiveness of the Ballytivnan Road on traffic accessing Sligo results in the under-utilisation of the proposed N16 alignment on a number of the option alignments. Options 1A, 1B, 2A, 2B, 3 and 6 are observed to have similar routing towards the City Centre via Avondale and Ballytivnan Road, whereas option 5 and option 8 are observed to retain the demand along the N16 option alignment.

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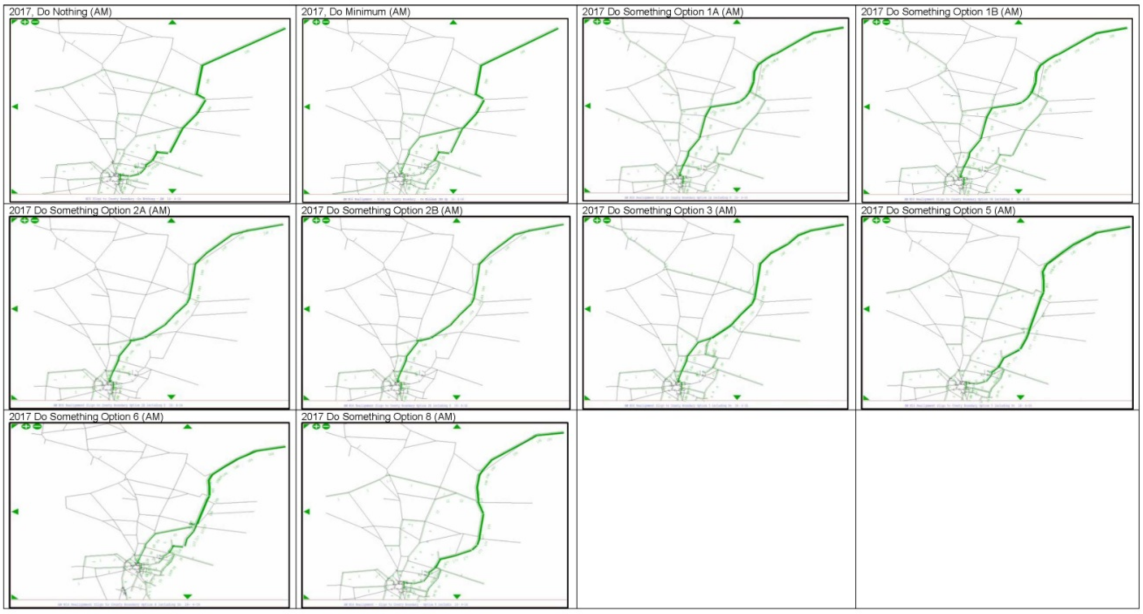

Figure 1.21: Select Link Analysis

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1.8.5 Option 1B Routing

During the course of the analysis some counterintuitive routing was noted in Option 1B, when compared to the Do Minimum, Option 1A, Option 2A and Option 2B. In Option 1B there was an increase in traffic diverting from the N15 southbound to access the City Centre via the L-3410-0 and Ballytivnan Road, instead on continuing south and utilising the N15 and N4 network. This was not seen to happen in Option 1 A or in Option 2B with relatively similar N15 alignment configurations.

The routing along the N15 in Option 1B is observed to be different from the various other modelled options due to the inclusion of a number of roundabouts on the N15. The addition of these roundabouts, albeit not significantly affecting capacity, adds to delays and results in traffic reassignment to other routes on the adjacent road network. Option 1A does not reflect this trip reassignment pattern due to the retention of the existing priority junctions on the N15.

This again highlights the increase in attractiveness of the Ballytivnan Road route to Sligo City Centre following the introduction of the EGB, which reduces traffic volumes in the City Centre and delivers associated reductions in travel times. It also highlights the sensitivities around the junction configurations on the N16 and N15 interface in Options 1A, 1B, 2A and 2B.

Figure 1.22 outlines the routing observed in Option 1B when compared with Option 1A.

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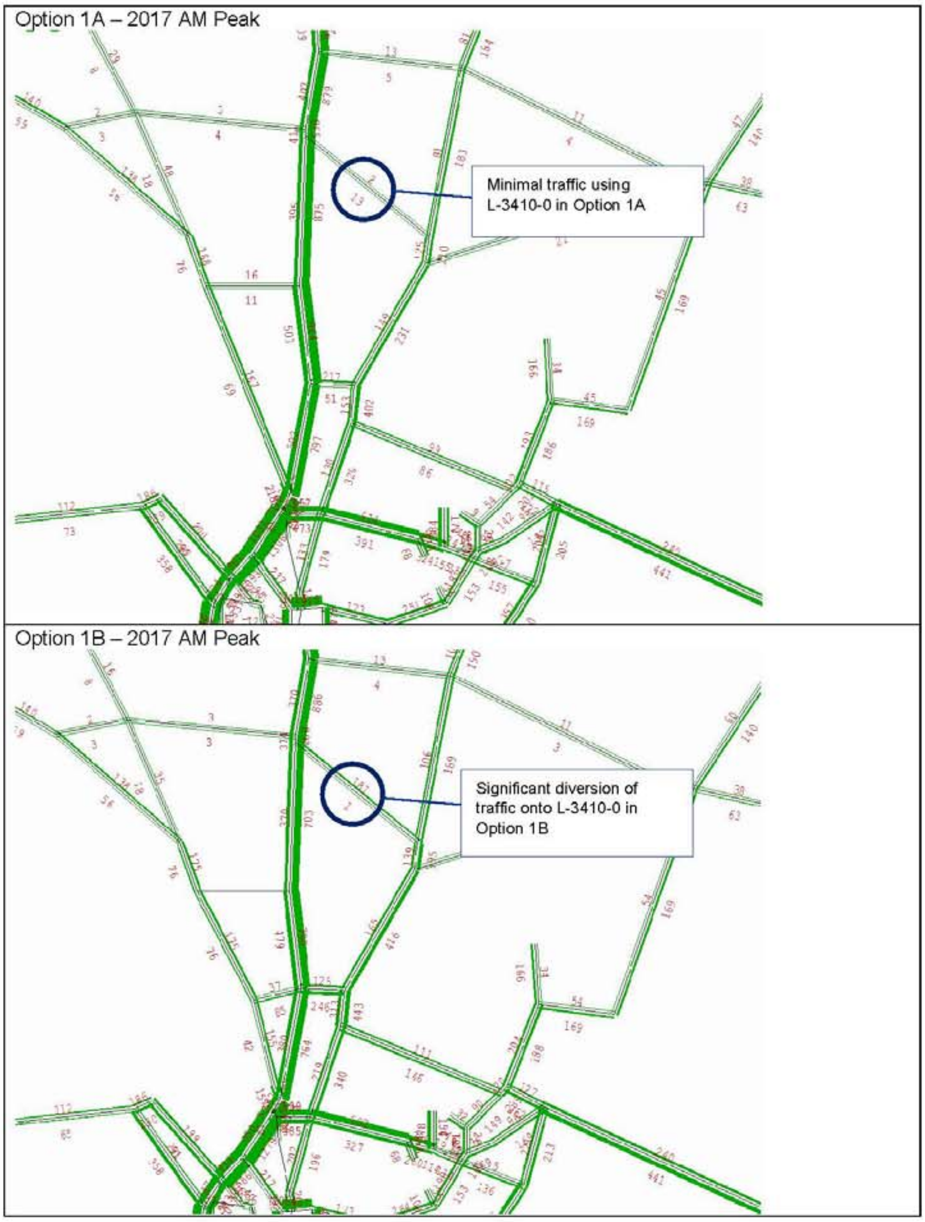

Figure 1.22: Routing Issue in Option 1B

41

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1.8.6 Journey Time Comparison

The AM, IP and PM peak journey time comparisons for the N16 route options between the junction of the N15 and N4 in Sligo as far as the Leitrim county boundary across Opening, Design and Forecast years is presented in Table 1.9, Table 1.10 and Table 1.11. The results show a marked reduction in journey time for the Do Something options compared to the Do Nothing and Do Minimum scenarios across all time periods. Option 2B and 3 offer the minimum journey times in both directions across all options. In general, northbound journey times are relatively less than southbound due to high inbound traffic volumes during the AM peak. The Design year 2032 and Forecast year 2047 journey times are only marginally different owing to expected tapering of demand from 2032 onwards and thus minimal growth in demand for travel.

Table 1.9 : Journey Time Comparison in AM peak, 2017, 2032, 2047

Scenario	Modelled Journey Time (sec.)					
	Leitrim county boundary to N15 and N4 Junction in Sligo					
	Northbound			Southbound		
	2017	2032	2047	2017	2032	2047
Do Nothing	596	607	607	553	556	558
Do Minimum	566	569	569	575	578	579
Do Something Option 1A	429	436	436	441	444	444
Do Something Option 1B	439	441	441	447	454	453
Do Something Option 2A	457	460	461	505	496	496
Do Something Option 2B	415	416	417	420	422	421
Do Something Option 3	412	414	415	433	443	445
Do Something Option 5	520	522	522	503	507	507
Do Something Option 6	538	540	540	521	523	522
Do Something Option 8	485	487	487	520	522	523

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Table 1.10 : Journey Time Comparison in IP peak, 2017, 2032, 2047

Scenario	Modelled Journey Time (sec.)					
	Leitrim county boundary to N15 and N4 Junction in Sligo					
	Northbound			Southbound		
	2017	2032	2047	2017	2032	2047
Do Nothing	570	570	570	536	536	536
Do Minimum	558	557	557	563	563	563
Do Something Option 1A	432	433	434	425	426	426
Do Something Option 1B	445	447	448	429	430	430
Do Something Option 2A	458	461	462	470	471	471
Do Something Option 2B	418	420	420	413	413	413
Do Something Option 3	413	416	416	411	412	412
Do Something Option 5	513	513	513	492	493	493
Do Something Option 6	532	532	532	514	514	514
Do Something Option 8	478	478	478	511	512	512

Table 1.11 : Journey Time Comparison in PM peak, 2017, 2032, 2047

Scenario	Modelled Journey Time (sec.)					
	Leitrim county boundary to N15 and N4 Junction in Sligo					
	Northbound			Southbound		
	2017	2032	2047	2017	2032	2047
Do Nothing	579	585	587	585	638	650
Do Minimum	570	577	579	573	574	574
Do Something Option 1A	440	447	446	429	431	431
Do Something Option 1B	455	464	463	435	435	436
Do Something Option 2A	478	490	490	474	478	478
Do Something Option 2B	422	426	425	415	416	416
Do Something Option 3	431	435	435	430	442	445
Do Something Option 5	520	523	523	502	505	505
Do Something Option 6	539	542	542	523	525	525
Do Something Option 8	485	487	487	521	524	524

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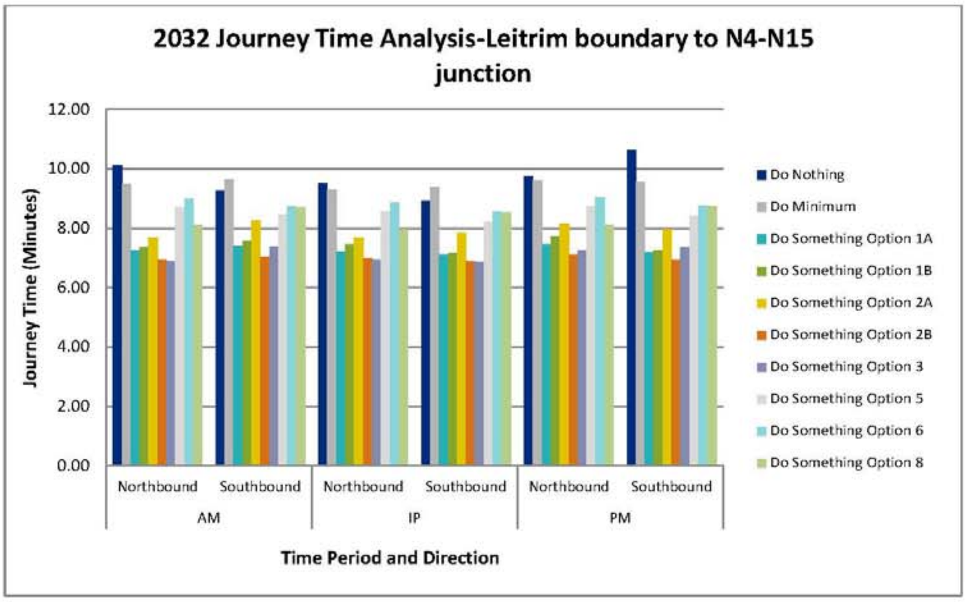

Figure 1.23: Journey Time Analysis 2032 (AM)

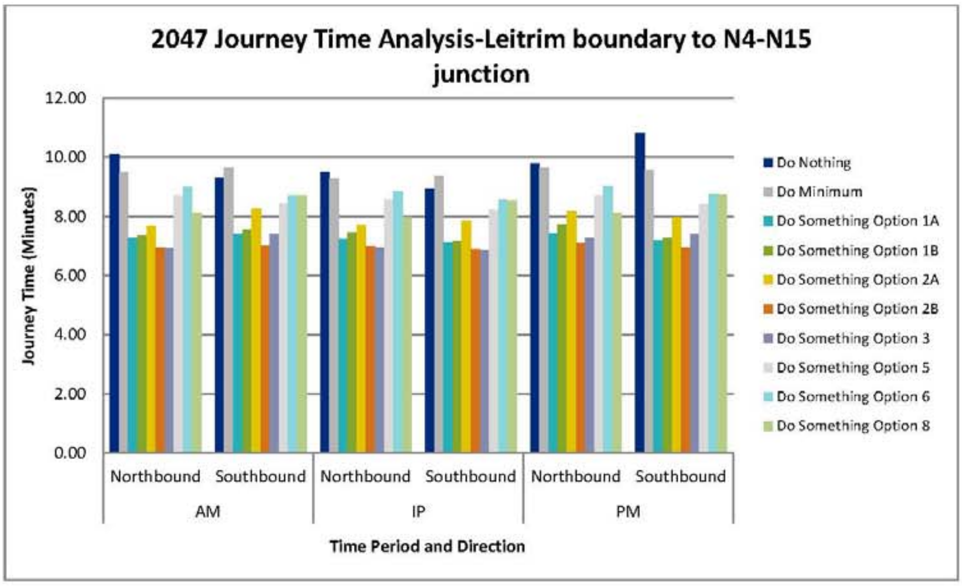

Figure 1.24: Journey Time Analysis 2047 (AM)

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1.8.7 Junction Capacity:

This section details the Volume Capacity (V/C) ratios of key junctions throughout the Sligo urban area for 2047. Table 1.12, Table 1.13 and Table 1.14 outline the V/C ratios for 2047 AM, IP and PM peaks, respectively. The V/C ratio is a measure of sufficiency of capacity relative to demand. These tables show that for the Do-Minimum scenario, the V/C ratios reduce in the centre of Sligo as traffic is attracted away from Hyde Bridge and Bridge Street as a result of both the EGB and UIS, when compared to the Do Nothing scenario.

In the Do-Something scenario the V/C ratios along the proposed scheme reduce while the V/C ratios in the centre of the town remain relatively close to those in the Do-Minimum scenario due to the improved capacity associated with the proposed scheme.

Table 1.12 : 2047 AM Volume / Capacity Ratio Summary

Junction Name	Node Number	DN	DM	Opt1 A	Opt1 B	Opt2 A	Opt2 B	Opt3	Opt5	Opt6	Opt8
N4 / Rosses Point Road	3	33.7	29.7	30.5	27.1	30.7	27.3	30.4	28.9	30.0	29.0
N4 / N16	2	45.8	38.5	39.3	35.6	39.7	35.9	37.4	38.2	38.9	38.3
N4 / Markievicz Road	502	42.5	32.5	33.2	32.2	33.2	32.3	33.5	32.2	32.8	32.2
N4 / Ballast Quay	1	44.9	42.2	42.8	42.6	42.6	42.7	43.5	41.8	42.3	41.8
N4 / Finisklin Road	512	48.9	45.7	46.5	46.8	45.6	46.4	47.2	45.3	46.0	45.3
N4 / Lord Edward Street	514	55.1	52.2	52.9	52.0	51.9	52.8	53.7	52.0	52.5	52.0
N4 / John Street	530	64.8	60.6	61.0	61.0	59.8	60.9	62.2	60.2	60.5	60.2
O'Connell Street / Wine Street	619	85.8	65.4	65.1	65.6	64.7	65.6	62.7	63.5	65.3	63.5
Hyde Bridge / Marckievicz Road	510	56.5	43.1	42.9	43.2	42.6	43.3	41.2	41.8	43.1	41.8
Bridge Street / The Mall	508	21.5	16.2	16.5	16.3	16.4	16.3	17.0	16.2	16.4	16.2
Bridge Street / JFK Parade	517	19.9	14.3	14.6	14.4	14.5	14.4	15.1	14.3	14.5	14.3
N16 / R286	506	27.8	14.8	12.5	12.3	13.0	12.3	12.3	16.2	13.0	16.2
N16 / R286 / EBG	304	N/A	16.2	14.4	13.6	14.6	13.6	13.7	17.4	16.3	17.4

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Table 1.13 : 2047 IP Volume / Capacity Ratio Summary

Junction Name	Node Number	DN	DM	Opt1 A	Opt1 B	Opt2 A	Opt2 B	Opt3	Opt5	Opt6	Opt8
N4 / Rosses Point Road	3	20.7	20.7	20.7	17.0	21.0	17.0	17.9	19.5	20.7	19.7
N4 / N16	2	32.1	26.6	26.6	24.1	26.7	24.1	24.0	25.4	26.6	25.5
N4 / Markievicz Road	502	31.7	25.0	25.0	23.6	25.1	23.5	23.4	24.1	25.0	24.2
N4 / Ballast Quay	1	34.3	33.1	33.1	33.2	33.1	33.1	33.5	32.5	33.0	32.6
N4 / Finisklin Road	512	32.3	29.4	29.5	29.5	29.5	29.5	29.9	28.7	29.4	28.8
N4 / Lord Edward Street	514	39.1	35.5	35.6	35.5	35.6	35.5	35.9	34.7	35.5	34.7
N4 / John Street	530	42.7	39.5	39.5	39.6	39.6	39.6	39.9	38.8	39.4	38.8
O'Connell Street / Wine Street	619	62.0	50.5	50.5	50.8	50.8	50.8	50.8	50.5	50.5	50.6
Hyde Bridge / Marckievicz Road	510	47.2	40.8	40.9	41.0	41.0	41.0	41.0	40.8	40.9	40.9
Bridge Street / The Mall	508	29.9	28.2	28.4	28.3	28.4	28.2	28.3	28.3	28.2	28.4
Bridge Street / JFK Parade	517	24.8	22.1	22.3	22.2	22.3	22.2	22.2	22.3	22.1	22.3
N16 / R286	506	17.6	9.2	8.6	8.6	8.6	8.6	8.9	11.5	9.4	11.4
N16 / R286 / EBG	304	N/A	10.5	10.1	10.0	10.1	10.1	10.2	12.5	10.7	12.5

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Table 1.14 : 2047 PM Volume / Capacity Ratio Summary

Junction Name	Node Number	DN	DM	Opt1 A	Opt1 B	Opt2 A	Opt2 B	Opt3	Opt5	Opt6	Opt8
N4 / Rosses Point Road	3	36.3	32.7	32.6	25.4	31.9	25.6	27.0	32.6	32.6	32.6
N4 / N16	2	64.3	52.5	52.6	39.6	51.9	39.8	43.5	52.0	52.5	52.1
N4 / Markievicz Road	502	48.2	36.4	36.6	33.9	36.6	33.8	34.4	35.9	36.3	36.0
N4 / Ballast Quay	1	53.7	48.1	48.5	47.9	48.9	47.8	48.7	47.5	48.2	47.6
N4 / Finisklin Road	512	56.5	47.7	48.5	50.5	48.9	50.6	49.6	47.5	48.3	47.5
N4 / Lord Edward Street	514	52.5	50.2	50.3	50.8	50.0	50.8	50.5	49.3	49.3	49.5
N4 / John Street	530	74.7	65.5	65.3	70.9	67.1	70.7	70.6	65.1	65.5	64.4
O'Connell Street / Wine Street	619	71.0	59.8	59.6	63.6	58.6	64.2	60.7	59.6	58.5	59.4
Hyde Bridge / Marckievicz Road	510	50.6	45.8	45.7	46.4	45.0	46.6	44.7	45.6	44.9	45.6
Bridge Street / The Mall	508	34.4	33.8	33.9	32.5	33.8	32.4	32.6	33.9	33.9	33.9
Bridge Street / JFK Parade	517	30.7	28.5	28.7	28.5	28.5	28.5	28.4	28.6	28.6	28.6
N16 / R286	506	28.8	14.4	12.4	13.0	12.2	13.0	13.6	16.2	14.4	15.9
N16 / R286 / EBG	304	N/A	14.4	12.9	14.2	12.9	14.4	14.2	16.9	15.0	16.5

1.8.8 Network Statistics:

This section outlines overall network summary statistics from the SATURN model indicating network wide changes resulting from the Do Minimum and Do Something options. Table 1.15, Table 1.16 and Table 1.17 outline the transient queuing, over-capacity queuing, total travel time, travel distance and average speed in the AM, IP and PM periods respectively for the strategic option scenarios in 2047.

Transient queuing relates to the overall level of queuing throughout the network that occurs associated with typical under-capacity junction operation, but ultimately can be accommodated by the network. Over-capacity queuing relates to the level of queuing associated with junctions that have reached capacity. Total travel time is the total amount of travel time summed for all trips made on the network. The travel distance is the total distance travelled summed for all trips made on the network. The average speed relates to the average vehicle speed of traffic over the entire network.

The introduction of the Do Something options is shown to generally improve network operations further when compared to the Do Minimum, with queuing levels and travel times reducing. The travel distance is generally seen to increase above the Do Minimum as the proposed scheme improvements make it a more attractive route than the potentially shorter routes through the city for certain trips. Average vehicle speeds are also seen to increase due to the improvements to the N4 network operation. It should be noted however that the values given are averages based on the entire network. The cruise speeds remain the same but demand increases reducing the network speeds.

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Table 1.15 : 2047 AM Summary Statistics

Type	Units	DN	DM	Opt1A	Opt1B	Opt2A	Opt2B	Opt3	Opt5	Opt6	Opt8
Transient Queues	PCU Hrs./ Hr	226.1	219.4	225.2	223.8	223.4	221.8	224.1	218.4	219.1	218.2
Over-Capacity Queues	PCU Hrs./ Hr	19.9	1.2	1.2	1.2	1.3	1.4	1.3	1.5	1.6	1.5
Total Travel Time	PCU Hrs./ Hr	955.9	913.8	916.2	915.9	911	910.1	910.7	908.3	910.7	909.3
Travel Distance	PCU Kms	45871	45626	45588	45592	45399	45465	45529	45456	45661	45648
Average Speed	Km/ Hr	48	49.9	49.8	49.8	49.8	50	50	50	50.1	50.2

Table 1.16 : 2047 IP Summary Statistics

Type	Units	DN	DM	Opt1A	Opt1B	Opt2A	Opt2B	Opt3	Opt5	Opt6	Opt8
Transient Queues	PCU Hrs./ Hr	171.5	165.8	168.5	166.8	167.5	164.6	164.6	165.4	166	165.3
Over-Capacity Queues	PCU Hrs./ Hr	4.3	0	0	0	0	0	0	0	0	0
Total Travel Time	PCU Hrs./ Hr	675.2	655.2	655.6	654.5	653.6	651.6	650.7	652.8	654.6	653.5
Travel Distance	PCU Kms	32460	32337	32304	32349	32211	32271	32290	32263	32406	32348
Average Speed	Km/ Hr	48.1	49.4	49.3	49.4	49.3	49.5	49.6	49.4	49.5	49.5

Table 1.17 : 2047 PM Summary Statistics

Type	Units	DN	DM	Opt1A	Opt1B	Opt2A	Opt2B	Opt3	Opt5	Opt6	Opt8
Transient Queues	PCU Hrs./ Hr	313.1	280.9	285.4	272.3	282.9	269.1	275.8	280.6	281.1	280.8
Over-Capacity Queues	PCU Hrs./ Hr	51.7	0.2	0	0	0	0	0	0.3	0	0.3
Total Travel Time	PCU Hrs./ Hr	1137.6	1039.7	1040.3	1027.4	1034.8	1019.9	1025.9	1035.3	1037.5	1034.5
Travel Distance	PCU Kms	49441	49019	48998	49102	48917	48920	48924	48970	49182	48992
Average Speed	Km/ Hr	43.5	47.1	47.1	47.8	47.3	48	47.7	47.3	47.4	47.4

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1.8.9 Emissions:

Table 1.18, Table 1.19 and Table 1.20 detail the vehicle pollutant emissions from the 2047 forecasts experienced for Carbon Monoxide, Carbon Dioxide, Nitrous Oxides and Hydro Carbons. These are network wide vehicle emissions resulting from the proposed scheme as modelled in the SATURN model. As the tabulated data shows, the Do Minimum scenario reduces emissions when compared with the Do Nothing scenario. The introduction of the Do Something options is seen to reduce emission levels further below the Do Minimum level.

Table 1.18 : 2047 AM Emissions

Scenario	Carbon Monoxide (kg)	Carbon Dioxide (kg)	Nitrous Oxides (kg)	Hydro Carbons (kg)
DN	314.7	3896.9	82.67	57.31
DM	303.92	3841.35	80.66	55.31
Option 1A	303.67	3844.68	80.42	55.25
Option 1B	303.96	3844.38	80.55	55.32
Option 2A	302.79	3833.29	80.12	55.15
Option 2B	302.99	3837.85	80.11	55.23
Option 3	306.47	3871.7	80.39	55.76
Option 5	302.13	3827.09	80.04	55.09
Option 6	304.2	3859.36	80.59	55.37
Option 8	302.41	3840.52	80.12	55.13

Table 1.19 : 2047 IP Emissions

Scenario	Carbon Monoxide (kg)	Carbon Dioxide (kg)	Nitrous Oxides (kg)	Hydro Carbons (kg)
DN	228.38	2805.85	58.9	41.4
DM	220.41	2760.76	57.38	39.99
Option 1A	219.77	2758.9	57.24	39.91
Option 1B	219.33	2757.71	57.26	39.77
Option 2A	219.89	2755.49	57.14	39.86
Option 2B	219.22	2753.35	57.19	39.7
Option 3	219.42	2757.89	57.09	39.74
Option 5	220.15	2757.32	57.29	39.85
Option 6	220.12	2765.3	57.27	39.92
Option 8	219.86	2760.15	57.32	39.85

Table 1.20 : 2047 PM Emissions

Scenario	Carbon Monoxide (kg)	Carbon Dioxide (kg)	Nitrous Oxides (kg)	Hydro Carbons (kg)
DN	376.57	4464.97	93.22	68.2
DM	352.13	4284.08	90.75	64.02
Option 1A	351.25	4284.35	90.34	63.79
Option 1B	345.18	4246.51	89.68	62.69
Option 2A	350.52	4280.07	90.15	63.62
Option 2B	344.55	4238.05	89.26	62.71
Option 3	348.11	4268.56	89.67	63.24
Option 5	350.89	4280.73	90.29	63.74
Option 6	351.23	4293.34	90.44	63.71
Option 8	350.79	4283	90.18	63.75

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1.9 Next Steps:

The next step entails selection of three preferred options for further refinement and evaluation. These can be further discussed with SCC and evaluated under the various other Environmental Impact Assessment criteria.

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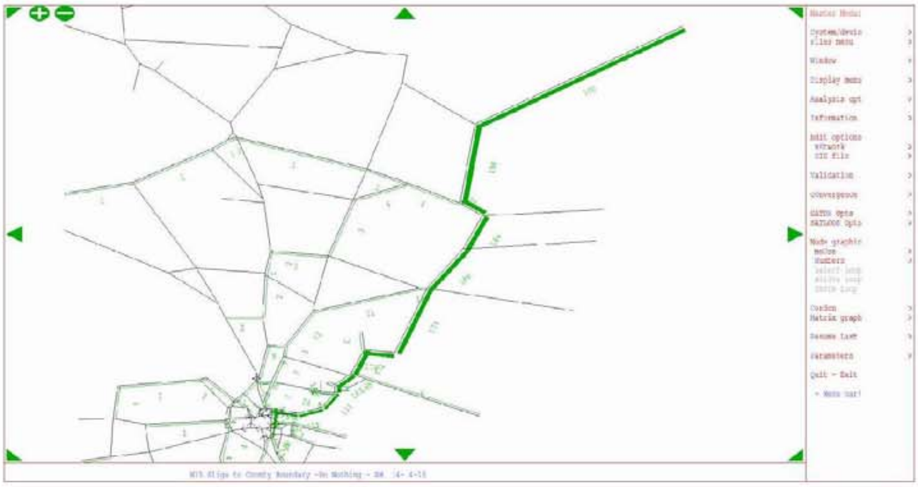
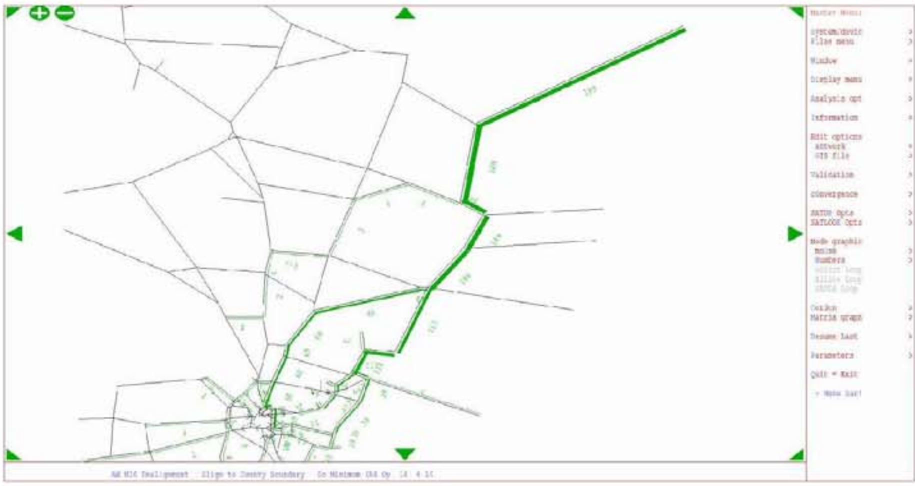
Appendix A – Larger images for Select Link Analysis (Figure 1.21)



2017 AM Do Nothing Inbound



2017 AM Do Minimum Inbound

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2017 AM Option 1A Inbound

2017 AM Option 1B Inbound

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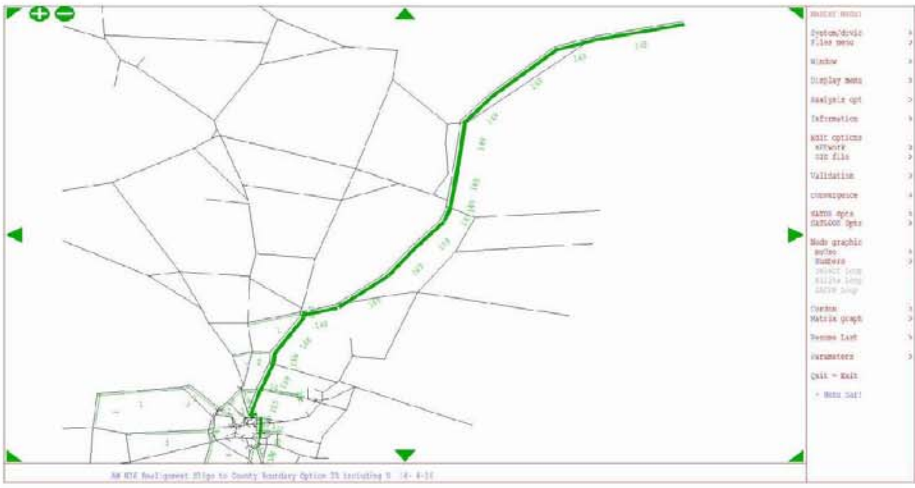
2017 AM Option 2A Inbound



2017 AM Option 2B Inbound

2017 AM Option 3 Inbound

2017 AM Option 5 Inbound

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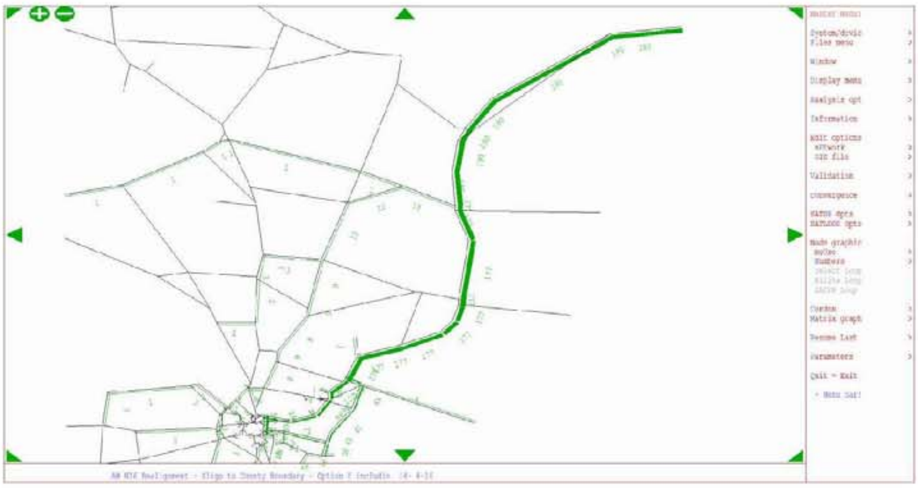
2017 AM Option 6 Inbound



2017 AM Option 8 Inbound

3 Key Performance Indicator Testing

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N16 Key Performance Indicator Testing

Sligo County Council

Technical Note

32106101 Report 28

December 2016

N16 Key Performance Indicator Testing

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1	November 2016	Client comments	LB	DB	JPF	PC
2	December 2016	Journey Time route 2 amendment & comments	LB	DB	JPF	PC

N16 Key Performance Indicator Testing

Contents

N16 Key Performance Indicator Testing

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1. Introduction

1.1 Background

Sligo County Council (SCC) is undertaking a route selection for the N16 between the Leitrim County boundary and Sligo City and the N4/N15. SCC has commissioned Jacobs Engineering Ireland Ltd. (Jacobs) to undertake the traffic and transport element of the route selection process. The N16 upgrade comprises an off-line single carriageway arrangement which will provide an improved alignment to the existing sub-standard N16 route. The various route options that have been considered are shown in Figure 2.1 to Figure 2.8.

1.2 N16 Study Objectives

This technical note details the traffic assessment for the route selection focussing on the Strategic and Specific Study Objectives for the N16 scheme. Key Performance Indicators (KPIs) have been outlined so as to quantify how each option is considered to have achieved the objective in question. The KPIs have been considered for all options including Do Nothing and Do Minimum.

1.2.1 Strategic Objectives

Table 1.1 outlines the strategic objectives of the N16 route selection study as well as the KPIs developed to quantify how well each option achieved the objective.

Table 1.1: Strategic Objectives and KPIs

	Objective	KPI
1	Meet the policy objectives of National/Regional/County/Local policy documents including both TII and SCC	Qualitative
2	Meet the specific objectives of National/Regional/County/Local policy documents including both TII and SCC	Qualitative
3	Effectively cater for strategic traffic	A: AADTs on N16 B: Select Link Analysis of traffic on N16 at Leitrim Boundary
4	Effectively cater for strategic traffic	AADTs on N15 and N4
5	Efficiently cater for strategic National Road traffic	Journey times from N16 at Leitrim Boundary to N4/N16/N15 junction
6	Efficiently cater for strategic traffic to Sligo City Gateway (NSS)	Journey times from N16 at Leitrim Boundary to Sligo City Centre
7	Operational efficiency of N16	A: V/C ratio of junctions on N16 B: Turn delays at junctions on N16

1.2.2 Specific Objectives

Table 1.2 outlines the specific objectives of the N16 route selection study as well as the KPIs developed to quantify how well each option achieved the objective.

Table 1.2: Specific Objectives and KPIs

	Objective	KPI
8	Ensure local roads cater for local movement	AADTs on local and regional roads within study area to north of Sligo City appropriate to local levels.
9	Road network to cater for future traffic	A: Number of V/C ratios broken into bands throughout Sligo modelled network. E.g.: number of junctions >85%, 50%-85%, <50%. B: GIS map indicating these locations
10	Reduce congestion on network	Transient and overcapacity queuing
11	Overall network operations	A: Overall travel distance B: Overall travel time C: Average network speed
12	Environment	Vehicle emissions
13	Operational efficiency of N15	V/C ratio of junctions on N15
14	Operational efficiency of key City Centre junctions	V/C ratio of key junctions within Sligo City Centre
15	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City Centre

1.2.3 Options and KPI Assessment

The following Table 1.3 lists KPI assessment undertaken. For the Strategic Objectives the KPIs are focused on all three forecast years of 2017, 2032 and 2047 (with the exception of the SLA in Objective 3B), whereas for the Specific Objectives the forecast year of 2047 has been considered, unless the values are obtained regardless as part of the process (see Objective 7). The N16 scheme options are described in more detail in Chapter 2.

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Table 1.3: Options and KPI Assessment

		Strategic Objectives								Specific Objectives										
	1	2	3A	3B	4	5	6	7A	7B	8	9A	9B	10	11A	11B	11C	12	13	14	15
Do Nothing	Qualitative	Qualitative	2017 2032 2047	2017	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2047	2047	2047	2047	2047	2047	2047	2047	2047	2047
Do Minimum	Qualitative	Qualitative	2017 2032 2047	2017	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2047	2047	2047	2047	2047	2047	2047	2047	2047	2047
Option 1A_S1A	Qualitative	Qualitative	2017 2032 2047	2017	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2047	2047	2047	2047	2047	2047	2047	2047	2047	2047
Option 1B_S1B	Qualitative	Qualitative	2017 2032 2047	2017	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2047	2047	2047	2047	2047	2047	2047	2047	2047	2047
Option 2A_S2A	Qualitative	Qualitative	2017 2032 2047	2017	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2047	2047	2047	2047	2047	2047	2047	2047	2047	2047
Option 2B_S2B	Qualitative	Qualitative	2017 2032 2047	2017	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2047	2047	2047	2047	2047	2047	2047	2047	2047	2047
Option 3	Qualitative	Qualitative	2017 2032 2047	2017	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2047	2047	2047	2047	2047	2047	2047	2047	2047	2047
Option 5	Qualitative	Qualitative	2017 2032 2047	2017	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2047	2047	2047	2047	2047	2047	2047	2047	2047	2047
Option 8	Qualitative	Qualitative	2017 2032 2047	2017	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2017 2032 2047	2047	2047	2047	2047	2047	2047	2047	2047	2047	2047

3

2. Options Undertaken

2.1 Summary of Options

As well as the Do Nothing, this study assessed a Do-Minimum option along with six distinct route option alignments across three separate strategic route options as agreed with SCC and for information purposes outlined below:

- **Do Nothing**
- **Do Minimum**
- **Strategic Option 1**
  - Option 1A_S1A
  - Option 1B_S1B
- **Strategic Option 2**
  - Option 2A_S2A
  - Option 2B_S2B
- **Strategic Option 4**
  - Option 5
  - Option 8 (7, 8, 9 and 12 combined)

2.2 Do Nothing

The Do Nothing scenario was based on the network used in the calibrated base year model. This scenario assumed that no changes were made to the road network in the study area and network performance in the 2017, 2032 and 2047 future years were modelled.

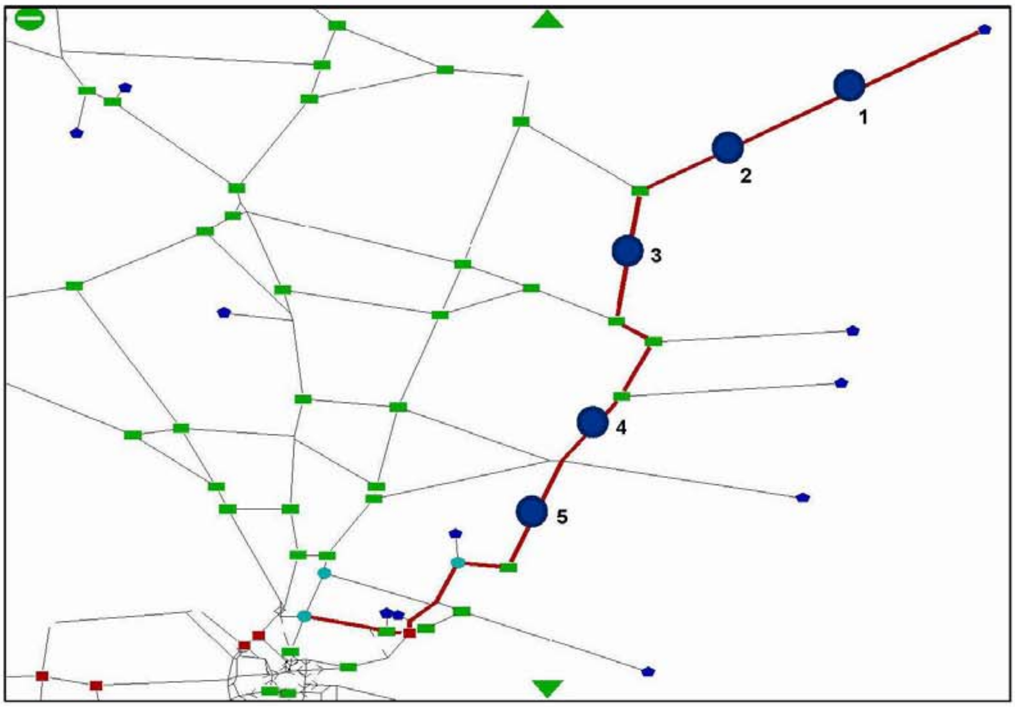

Figure 2.1: Do Nothing model

2.3 Do Minimum

The Do Minimum scenario included the Eastern Garavogue Bridge (EGB) and the N4-N15 Sligo Urban Improvement Scheme (UIS). The N16 model development and assessment has considered the same Opening, Design and Forecast years as the N4-N15 UIS, namely 2017, 2032 and 2047 respectively.

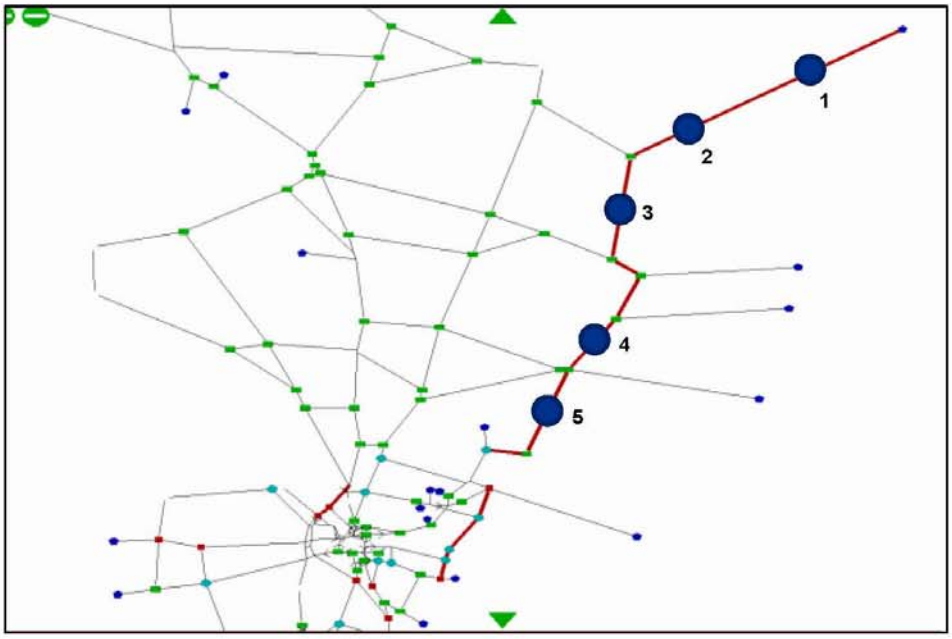

Figure 2.2: Do Minimum model with committed schemes, EGB and UIS

2.4 Strategic Options

The four strategic options comprised of different alignment arrangements for the N16, varying in lengths, junction configurations and tie-in points to the existing road network. The N16 route corridor alignment ends at Leitrim county boundary near Glencar in the north. Each model had the Speed Flow Curve (SFC) upgraded on the new alignment to standard single carriageway one lane rural road with free flow speed of 90 kph.

The four options are described below:

2.4.1 Strategic Option 1

2.4.1.1 Option 1A_S1A

The new alignment emerges from the existing N15 section between Lisnalurg and Teesan and co-aligns with the existing N16 at Drumkilsellagh. It routes further northeast to terminate at the Leitrim County border. The total length is 7.15 km and has 11 new or redesigned junctions. Five of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst 3 of them are related to the realignment of existing local road junctions to facilitate the new N16 alignment. Option 1A_S1A differs slightly from previous Option 1A scenarios as it has a bridge over the L-7421-0 in effect closing off access to the Ballytivnan Road into Sligo city centre from the proposed N16. The remaining 3 junctions are on the widened N15 section.

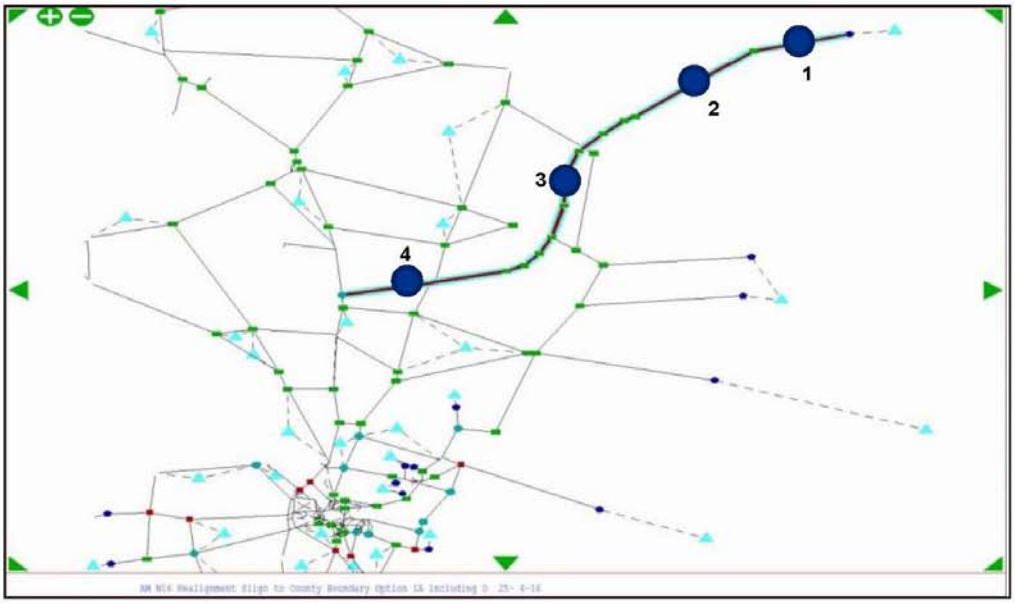

Figure 2.3: SATURN Model Option 1A_S1A

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2.4.1.2 Option 1B_S1B

Option 1B_S1B is a replication of Option 1A_S1A with extended improvement on the N15 from its proposed intersection with the new N16 in the north to its junction with the existing N16 in the south. The section of the N15 between the R291 Scotsman's Walk and the existing N16 includes the proposed dual carriage upgrade. The total length of the upgraded N16 is 9.64 km. This option incorporates 21 new or redesigned junctions. Five of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst 6 of them are related to the realignment of existing local road junctions to facilitate the new N16 alignment. Option 1B_S1B differs slightly from previous Option 1B scenarios as it has a bridge over the L-7421-0 in effect closing off access to the Ballytivnan Road into Sligo city centre from the proposed N16. The remaining 10 junctions are on the widened N15 section which is part of the proposed development Option 1B_S1B.

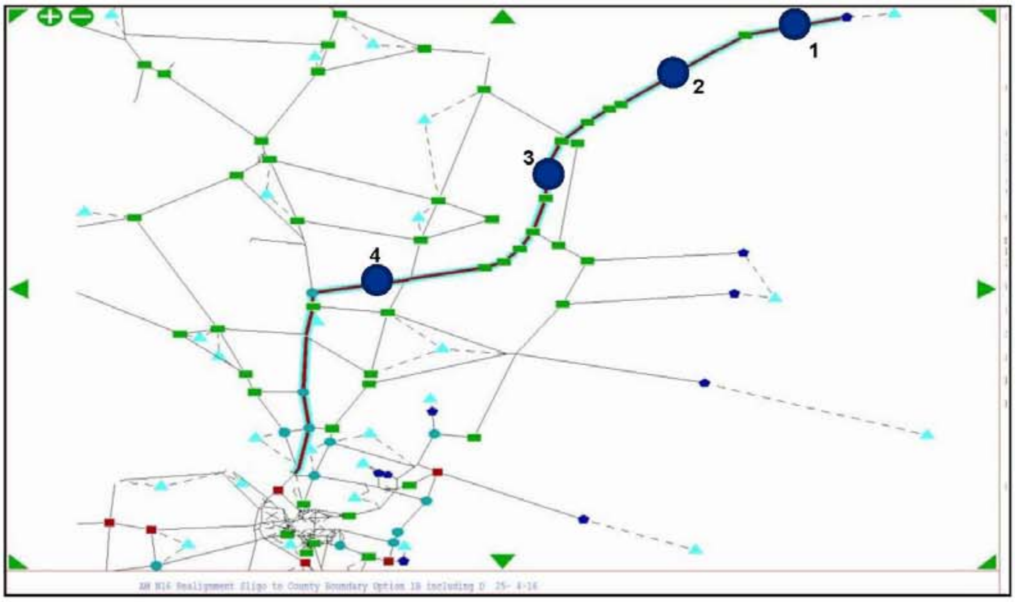

Figure 2.4: SATURN Model Option 1B_S1B

2.4.2 Strategic Option 2

2.4.2.1 Option 2A_S2A

Option 2A_S2A branches off the N15 at its junction with the L-90102-0 near Shannon Eighter meeting with the existing N16 near Drumkilsellagh. It moves further northeast as far as the Leitrim county boundary. The total length of the proposed alignment is 8.13 km with 10 new or redesigned junctions. Eight of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst the remaining 2 are related to the realignment of existing local road junctions to facilitate the alignment. Option 2A_S2A differs slightly from previous Option 2A scenarios as it has a bridge over the Old Bundoran Road in effect closing off access to the Ballytivnan Road into Sligo city centre from the proposed N16.

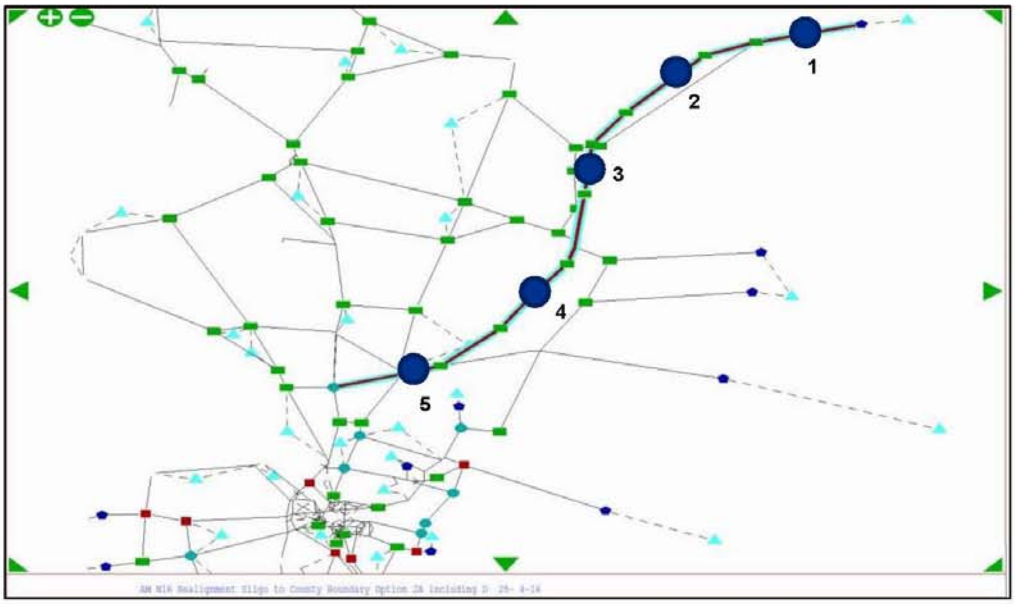

Figure 2.5: SATURN Model Option 2A_S2A

2.4.2.2 Option 2B_S2B

Option 2B_S2B is an extended version of Option 2A_S2A that includes extended improvements on the N15 from its proposed intersection with the upgraded N16 in the north to its junction with the existing N16 in the south. The section of the N15 between the R291 Scotsman's Walk and the existing N16 includes the proposed dual carriage upgrade. The total length is 9.3 km including 18 new or redesigned junctions, seven of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst five of them are related to the realignment of existing local road junctions to facilitate the new N16 alignment. Option 2B_S2B differs slightly from previous Option 2B scenarios as it has a bridge over the Old Bundoran Road in effect closing off access to the Ballytivnan Road into Sligo city centre from the proposed N16. The remaining 6 junctions are on the widened N15 section which is part of the proposed development Option 2B_S2B.

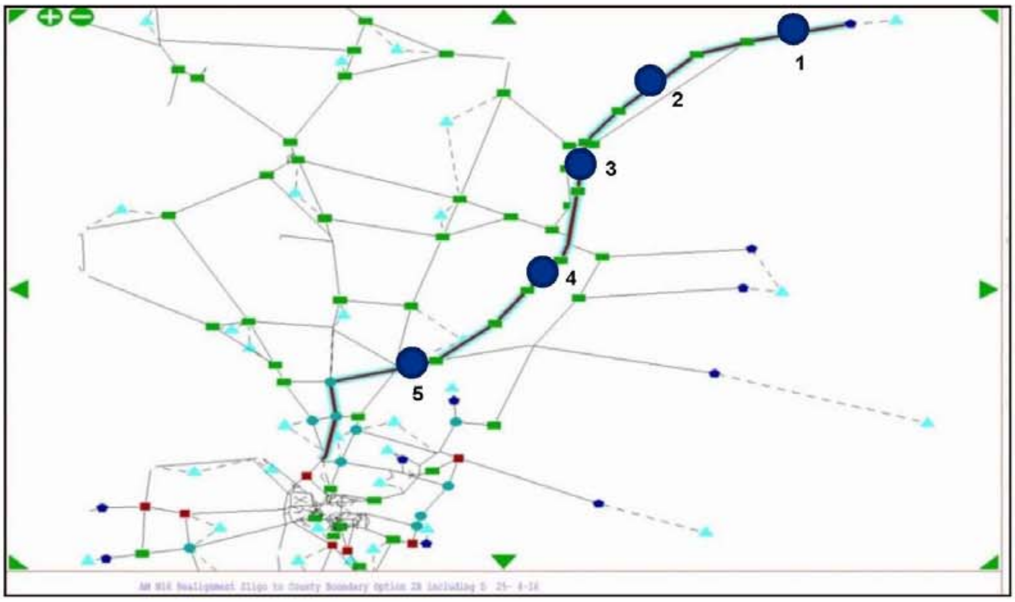

Figure 2.6: SATURN Model Option 2B_S2B

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2.4.3 Strategic Option 4

2.4.3.1 Option 5

Option 5 has a new N16 alignment terminating at the AbbVie roundabout at the same point as the existing N16 meets the roundabout. The total length is 7.7 km with 16 new or redesigned junctions. Nine of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst the remaining 7 are related to the realignment of existing local road junctions to facilitate the alignment.

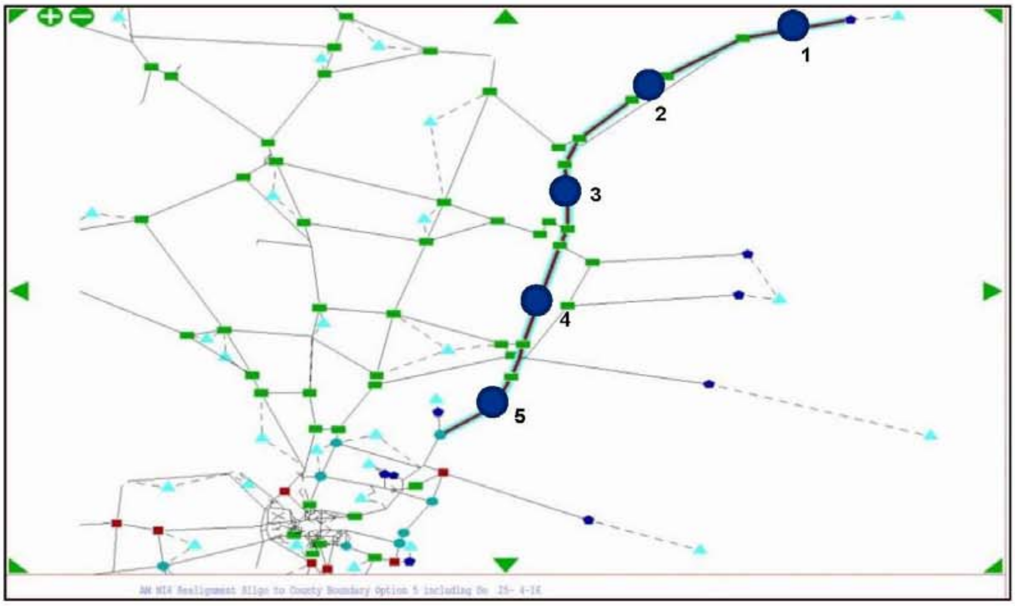

Figure 2.7: SATURN Model Option 5

2.4.3.2 Option 8 (7, 8, 9 and 12 combined)

Option 8 is a variant of Option 5 with the new N16 alignment tapering off the existing N16 just after Willowbrook Bridge and meeting the existing N16 again before connecting into the AbbVie roundabout. The total length is 8.16 km including 12 new or redesigned junctions. Nine of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst the remaining 3 are related to the realignment of existing local road junctions to facilitate the alignment.

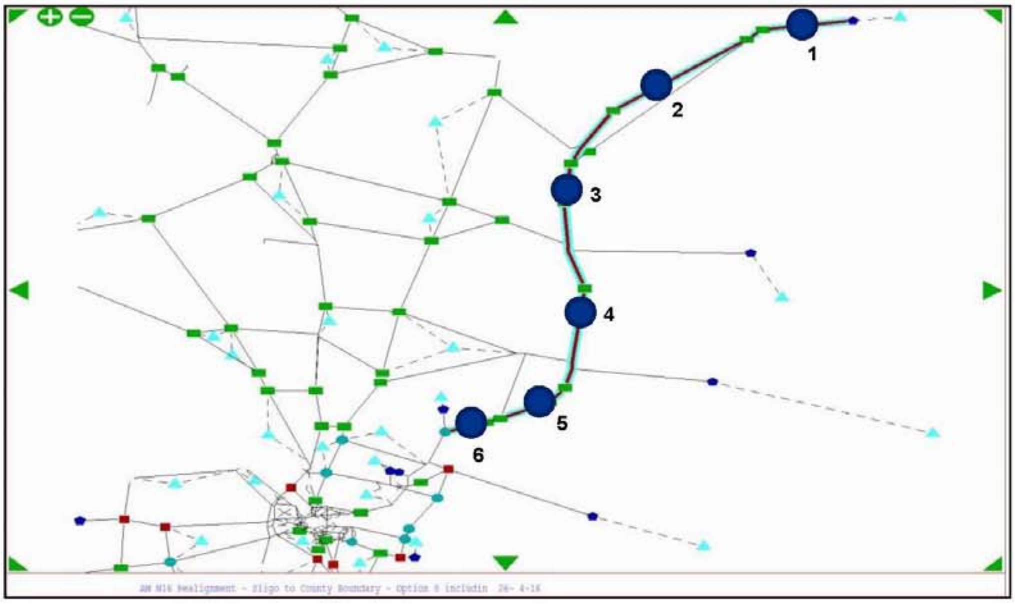

Figure 2.8: SATURN Model Option 8

3. Strategic Objectives and KPIs

3.1 Introduction

This section details the Strategic Objectives and the results of the KPIs as described in Table 1.1. The comparison of KPIs achieved in this route selection study will quantify how well each option achieves the objective.

3.2 Objective 1

Objective 1 was to meet the high level objectives of National / Regional / County and Local policy documents.

3.2.1 National Policy Documents

The National Spatial Strategy proposes that the national spatial structure be supported by a national transport framework, providing an improved network of roads and public transport services, enhancing access and connections throughout the country. This framework will be internationally connected through key points such as airports and ports with links to Northern Ireland, the UK, EU and the broader global economy. With Sligo being identified as a border region gateway an improved N16 to Fermanagh is in keeping with current national policy.

3.2.2 Regional Policy Documents

The Border Regional Authority details a number of key strategic goals to achieve its 2022 vision set out in the Regional Planning Guidelines for the Border Region. The more relevant goals have been summarised below in Objective 2.

There are also a number of objectives for the North Region in various regional policy documents which would at a high level be in support of an improved N16. These include the National Development Plan (NDP), the Framework for Sustainable Economic Renewal, the National Spatial Strategy (NSS), Smarter Travel – A Sustainable Transport Future and Transport 21.

3.2.3 County and Local Policy Documents

The Sligo County Development Plan outlines an objective to realign the N16 Sligo City to Leitrim County boundary while the Sligo and Environs Development Plan (SEDP) describes a number of strategic goals including the build-up of linkages between Sligo and the other Gateways and Hubs within the Border Region.

In summary, it has been determined that overall the proposed N16 would be consistent with high level objectives described in National, Regional, County and Local policy documents.

3.3 Objective 2

Objective 2 was to meet the specific objectives of National / Regional / County and Local policy documents.

3.3.1 National Policy Documents

The National Spatial Strategy has identified Sligo as one of three broad areas to be considered in a more detailed manner within the national structure. Sligo is one of three gateways in the border region as illustrated in Figure 3.1 below. These gateways are to drive development through enhanced critical mass, accessibility and capacity for development. This in turn will assist the need of other towns, villages and rural areas to develop roles complementary to those of the gateways to ensure that a wider area will benefit from the critical mass in the region provided by the gateways.

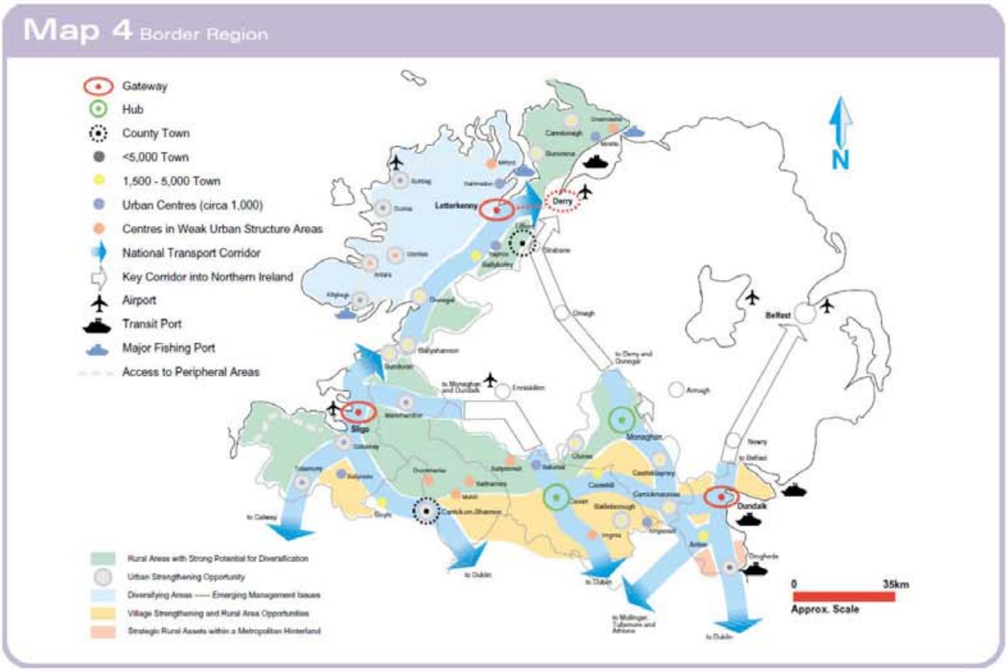

Figure 3.1: The Border Region from the National Spatial Strategy

An enhanced N16 would strengthen the development in the border region by providing an improved road link with counties Leitrim and Cavan as well as on one of the key corridors to Northern Ireland.

3.3.2 Regional Policy Documents

The Regional Planning Guidelines for the Border Region states that its vision is "By 2022, the Border Region will be a competitive area recognised as, and prospering from, its unique interface between two economies, where economic success will benefit all, through the implementation of the balanced development model, which will provide an outstanding natural environment, innovative people, which in themselves, will be our most valuable asset". It has set out key strategic goals to achieve this vision, which include;

- To improve intra and inter regional connectivity and mobility throughout the Region through the development of Strategic Radial Corridors and Strategic Links.
- To co-ordinate and integrate key issues in National and Regional Spatial Planning Strategies and in particular, the National Spatial Strategy and the National Development Plan, and associated inter-regional development initiatives that support and promote strategic links.
- To co-ordinate and integrate key aspects of cross border spatial planning strategies, and in particular, the Regional Development Strategy for Northern Ireland and associated inter-regional development initiatives, that support and promote strategic links between the two economies.
- To exploit the Regions unique location at the interface between two economies, by putting in place the drivers for economic growth, through the development of the Eastern Corridor, Atlantic Arc and the Central Border Area.

3.3.3 County and Local Policy Documents

Sligo County Development Plan 2005 - 2011

It is the objective of Sligo County Council to bring National Roads up to appropriate standards, as resources become available, and to continue improvement works on non-national roads so as to develop a safe and comprehensive road system for the county. As part of this there is an objective to facilitate programmed improvements to the National Road network including the realignment of the N16 Sligo City to Leitrim County boundary. So the realignment of the N16 is in accordance with the Sligo County Development Plan as it has been specifically identified as a national road to be improved under the plan.

Sligo and Environs Development Plan 2010 - 2016

The Sligo and Environs Development Plan (SEDP) has a number of strategic goals including the build-up of linkages between Sligo and the other Gateways and Hubs within the Border Region and adjoining regions, such as the Western Region and Northern Ireland, by supporting the implementation of the RPGs, collaborating on support for critical enabling of infrastructure such as road and rail connections, and cooperating in areas of mutual planning interest.

The SEDP also details a number of broad aims including the supporting of balanced economic development and improved mobility in the city centre. This is to be achieved by;

- Facilitating and encouraging the sustainable development of the Gateway City of Sligo as an economic growth driver for the North-West, in accordance with the NSS.
- Integrating business locations with the surrounding land use and transportation network.
- Working with the providers of infrastructure to ensure adequate provision in terms of road, rail, aviation, energy and telecommunications.
- Policies for city centre traffic management and pedestrian priority objectives for a pedestrian friendly city centre.

In terms of city centre traffic management, Figure 3.2 below from the SEDP illustrates that the R286 Connaughton Road, R870 Markievicz Road, Lord Edward Street, Upper John Street and the R870 Pearse Road should facilitate vehicular access to and from the city centre.

Figure 3.2 also presents proposals to introduce pedestrian friendly measures south of the River Garavogue in the areas of O'Connell Street, John Street, Grattan Street, Market Street and High Street.

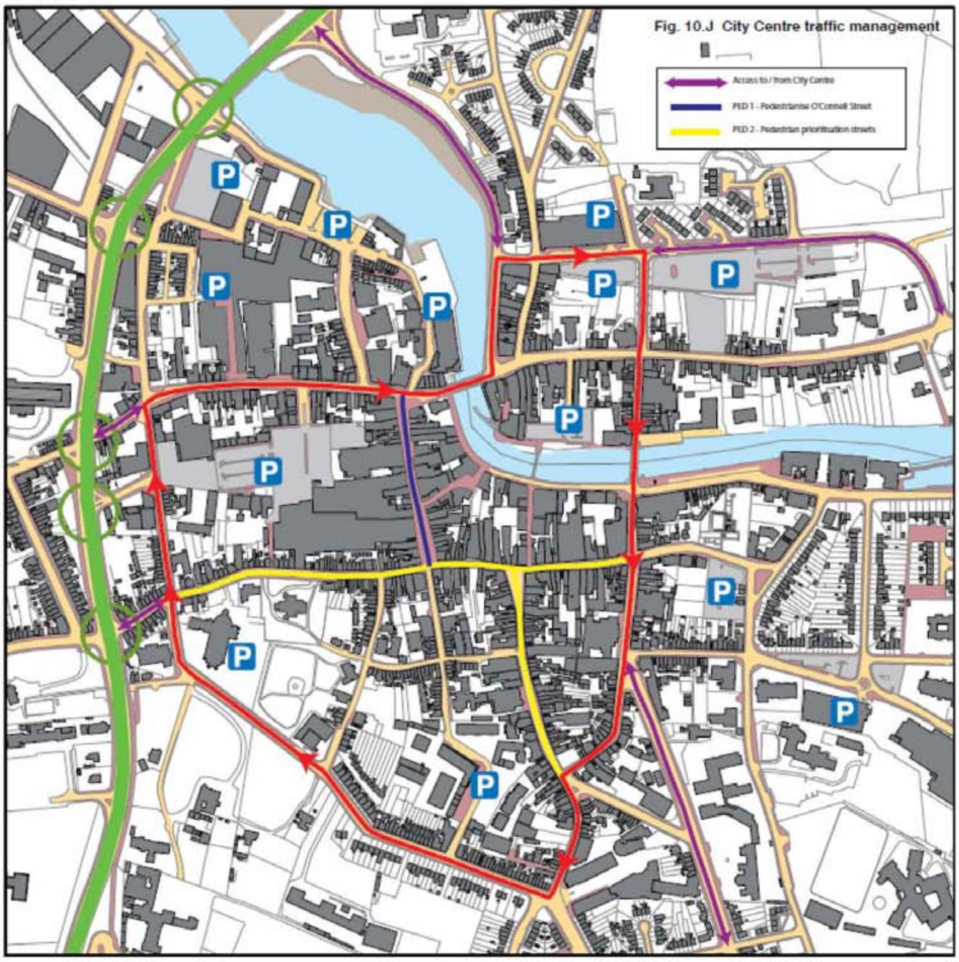

Figure 3.2: City Centre Traffic Management and Pedestrian Prioritisation

Objective 15 in this Technical Note assesses the impact of each option on the future pedestrianisation of Sligo city centre through traffic volume changes on links within Sligo city centre. Retaining vehicles on the main access routes in purple and away from areas of higher pedestrian numbers in blue and yellow has been considered.

3.4 Objective 3

Objective 3 was to effectively cater for strategic traffic. Two KPIs were assessed as part of this objective. The first was the AADT on the N16, N15 and N4. The second was the Select Link Analysis of AM peak inbound traffic on the N16 at the Leitrim boundary. The results of these KPIs are detailed below.

3.4.1 AADT on the N16

The AADT at various critical locations on N16 alignment are presented in Table 3.1 to Table 3.3. The locations of the N16 AADT values are illustrated in Figure 2.1 to Figure 2.8, showing the different option arrangements and configurations for the seven options considered.

It can be seen that in the Do Minimum traffic volumes increase on the approach to Sligo, but reduce slightly to the south of the N16 junction with the L-3407-22 due to traffic using the L-7422-0 as an alternative route to the N16.

Options 1A_S1A, 1B_S1B, 2A_S2A and 2B_S2B show similar patterns of traffic using the N16, with greater reductions in traffic on the N16 as it gets closer to the N15. This highlights that traffic demand on the N16 is focussed more within Sligo and results in this demand utilising the existing N16 route as an alternative to the proposed alignments.

Options 5 and 8 showed similar traffic patterns with traffic volumes on the proposed N16 alignments increasing closer to Sligo. This suggests that these routes generally cater for the demand to Sligo, with limited use of the alternative routes to the N16. Option 5 caters for the highest demand levels of all of the alignment options, followed by Option 8.

Table 3.1: N16 2017 AADT Comparisons

Map Reference	Direction	N16 2017 AADT (Per Direction)							
		DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
1	NB	1721	1721	1721	1721	1721	1721	1721	1721
1	SB	1700	1700	1700	1700	1700	1700	1700	1700
2	NB	1721	1721	1721	1721	1643	1643	1721	1721
2	SB	1700	1700	1700	1700	1630	1630	1700	1700
3	NB	1632	1632	1721	1721	1643	1643	1661	1657
3	SB	1627	1625	1700	1700	1630	1630	1632	1631
4	NB	2356	2356	387	392	298	304	1618	2136
4	SB	2210	2210	1319	1284	1204	1232	1597	2075
5	NB	2061	2257	-	-	543	546	2543	2311
5	SB	1714	1215	-	-	1433	1467	2398	2252
6	NB	-	-	-	-	-	-	-	2476
6	SB	-	-	-	-	-	-	-	2310

N16 Key Performance Indicator Testing

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Table 3.2: N16 2032 AADT Comparisons

Map Reference	Direction	N16 2032 AADT (Per Direction)							
		DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
1	NB	1834	1834	1834	1834	1834	1834	1834	1834
1	SB	1816	1816	1816	1816	1816	1816	1816	1816
2	NB	1834	1834	1834	1834	1753	1753	1834	1834
2	SB	1816	1816	1816	1816	1742	1742	1816	1816
3	NB	1735	1735	1834	1834	1753	1753	1789	1768
3	SB	1726	1726	1816	1816	1742	1742	1754	1744
4	NB	2599	2599	450	462	342	367	1732	2342
4	SB	2446	2446	1535	1511	1234	1291	1698	2227
5	NB	2186	2434	-	-	742	760	2879	2585
5	SB	1780	1432	-	-	1654	1675	2651	2426
6	NB	-	-	-	-	-	-	-	2791
6	EB	-	-	-	-	-	-	-	2502

Table 3.3: N16 2047 AADT Comparisons

Map Reference	Direction	N16 2047 AADT (Per Direction)							
		DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
1	NB	1839	1839	1839	1839	1839	1839	1839	1839
1	SB	1813	1813	1813	1813	1813	1813	1813	1813
2	NB	1839	1839	1839	1839	1757	1757	1839	1839
2	SB	1813	1813	1813	1813	1739	1739	1813	1813
3	NB	1738	1738	1839	1839	1757	1757	1795	1773
3	SB	1723	1723	1813	1813	1739	1739	1755	1742
4	NB	2623	2623	450	464	343	370	1735	2347
4	SB	2463	2463	1535	1513	1230	1366	1695	2242
5	NB	2210	2452	-	-	763	784	2904	2533
5	SB	1696	1469	-	-	1673	1771	2679	2469
6	NB	-	-	-	-	-	-	-	2739
6	SB	-	-	-	-	-	-	-	2548

3.4.2 Select Link Analysis

A Select Link Analysis (SLA) was undertaken for each model variant to present the routing pattern for traffic using the N16 in the inbound direction for the AM peak. The routing along the N16 for each option is presented in Figure 3.3 below. Each of these images is included in Appendix A.

It is apparent that the introduction of the EGB in the Do Minimum scenario causes changes to the routing of traffic using the N16 inbound. The EGB provides an alternative crossing of the Garavogue River to the current crossings in the city centre. This reduces traffic using the city centre part of the network, making the routes to and from the current crossings more desirable than in the existing situation. This results in traffic routing from the N16 onto the L-7422-0 to enter Sligo via the Ballytivnan Road, in the Do Minimum scenario.

In the revised Option 1A_S1A, 1B_S1B, 2A_S2A and 2B_S2B scenarios the proposed N16 is bridged over the L-7421-0 and L-7422-0 preventing access to Sligo via the Ballytivnan Road. This ensures traffic remains on the proposed N16 and continues to the N15 to access Sligo city centre in these four scenarios. However, the Select Link Analysis has indicted that there is a relatively low traffic flow using the western section of the proposed N16 in Option 1A_S1A, 1B_S1B, 2A_S2A and 2B_S2B as up to 50% of vehicles find the existing N16 route more desirable in these four options. Option 5 and 8 perform better in terms of retaining the demand along their N16 option alignments.

N16 Key Performance Indicator Testing

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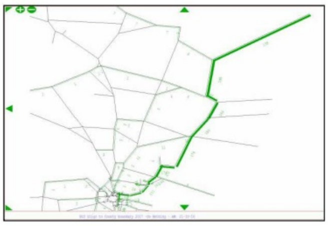
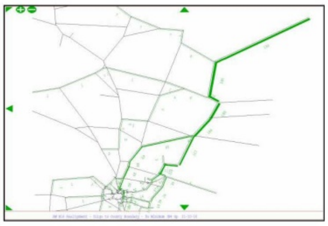
2017 Do Nothing (AM)

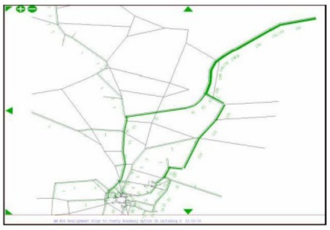


2017 Do Minimum (AM)

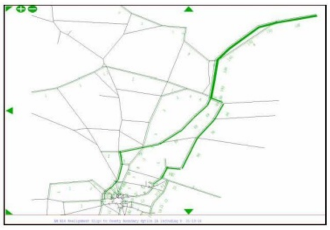


2017 Do Minimum Opt 1A_S1A (AM)

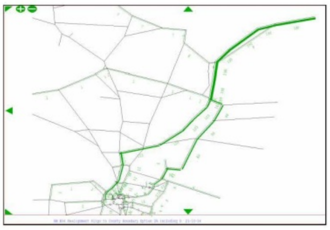
2017 Do Minimum Opt 1B_S1B (AM)



2017 Do Minimum Opt 2A_S2A (AM)



2017 Do Minimum Opt 2B_S2B (AM)



20

N16 Key Performance Indicator Testing

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2017 Do Minimum Opt 5 (AM)

2017 Do Minimum Opt 8 (AM)

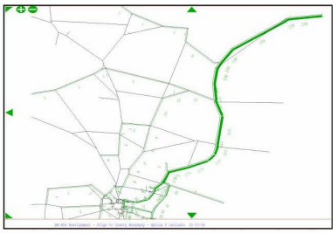

Figure 3.3: Select Link Analysis

21

3.5 Objective 4

Objective 4 was to effectively cater for strategic traffic. The KPIs assessed as part of this objective were the AADTs on the N15 and N4. The results of these KPIs are detailed below.

3.5.1 AADT on the N15

The AADT values on the section of N15 adjacent to the N16 alignment are presented in Table 3.4 to Table 3.6 below. The locations of the N15 AADT values are illustrated in Figure 3.4 below. The section of the N15 in question spans just north of where the proposed N16 intercepts in Option 1 to the signalised junction of the R291 Rosses Point road.

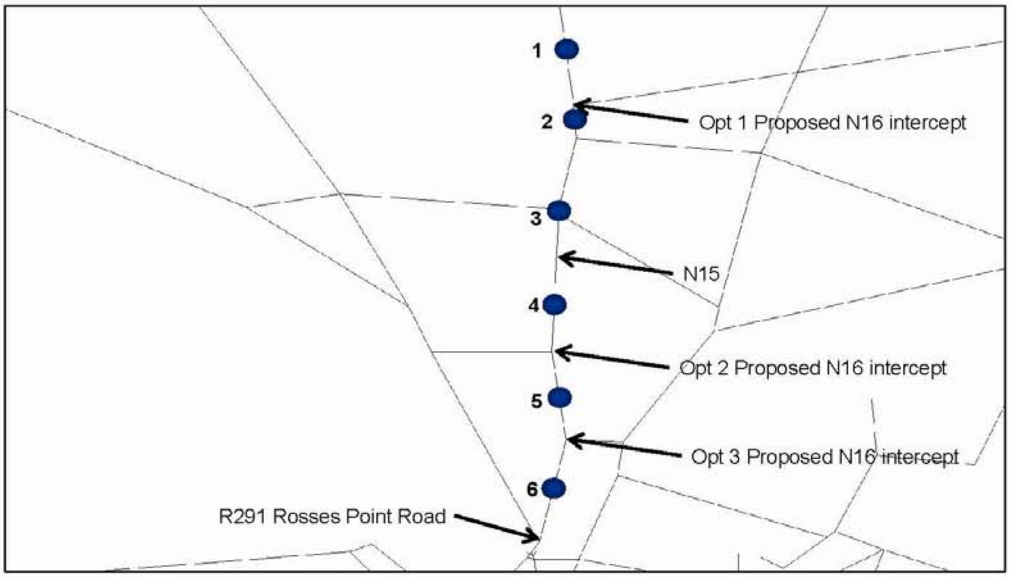

Figure 3.4: N15 AADT Locations

It can be seen that on the N15 north of where the proposed N16 intercepts it (AADT 1), the northbound and southbound flows are relatively constant across all the scenarios.

The northbound and southbound flows on the N15 immediately south of where the proposed Option 1 N16 intercepts it (AADT 2) have been included indicating that the southbound flow is approximately 700 vehicles greater than the northbound in Options 1A_S1A and 1B_S2B.

The flows at AADT 3 and 4 are over one thousand vehicles less in Options 2A_S2A and 2B_S2B when compared with Options 1A_S1A and 1B_S1B owing to the Option 2 proposed N16 intercepting the N15 further south of AADT 4. AADTs 5 and 6 then restore to more equal levels between Options 1 and 2. However, it has been noted that the flows at AADT 6 are lower in the 1B_S1B and 2B_S2B options than the 1A_S1A and 2A_S2A options as vehicles utilise Elm Gardens to and from Sligo city centre rather than using the N15 / N16 junction. The traffic model indicates that the proposed roundabout junctions on the N15 in Options 1B_S1B and 2B_S2B are causing delay and vehicles are diverting to avoid this.

Option 5 and 8 show very similar N15 AADT flows with the Do Minimum scenario.

Table 3.4: N15 2017 AADT Comparisons

Map Reference	Direction	N15 2017 AADT (Per Direction)							
		DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
1	NB	7516	7525	7610	7631	7507	7526	7523	7512
1	SB	7380	7375	7418	7442	7346	7345	7375	7349
2	NB	-	-	7819	7845	-	-	-	-
2	SB	-	-	8558	8547	-	-	-	-
3	NB	7513	7523	7778	7848	7538	7555	7590	7555
3	SB	7401	7393	8542	8523	7399	7395	7408	7399
4	NB	7367	7472	7657	7804	7157	7520	7568	7532
4	SB	7361	7353	8506	8085	6973	7066	7368	7359
5	NB	7847	7931	8097	8356	8035	8585	8027	8012
5	SB	8133	8127	9300	8920	9138	9332	8127	8127
6	NB	7834	7232	7217	5303	7243	5311	6999	7095
6	SB	7161	7193	8260	7200	8235	7355	6626	6659

Table 3.5: N15 2032 AADT Comparisons

Map Reference	Direction	N15 2032 AADT (Per Direction)							
		DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
1	NB	8195	8201	8237	8324	8188	8214	8190	8178
1	SB	8105	8094	8141	8158	8053	8050	8091	8054
2	NB	-	-	8504	8604	-	-	-	-
2	SB	-	-	9494	9487	-	-	-	-
3	NB	8164	8196	8449	8612	8186	8262	8262	8232
3	SB	8108	8109	9452	9439	8122	8116	8125	8116
4	NB	7937	7983	8162	8556	7726	8221	8183	8146
4	SB	7735	7716	8955	8562	7496	7483	7911	7817
5	NB	8400	8447	8604	9127	8743	9491	8624	8602
5	SB	8496	8482	9749	9414	9817	9949	8673	8588
6	NB	8588	7957	8000	6096	8016	6085	7696	7795
6	SB	8068	7903	9105	7968	9135	8158	7419	7429

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Table 3.6: N15 2047 AADT Comparisons

Map Reference	Direction	N15 2047 AADT (Per Direction)							
		DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
1	NB	8245	8257	8289	8382	8245	8271	8246	8236
1	SB	8118	8107	8127	8170	8064	8062	8100	8060
2	NB	-	-	8554	8654	-	-	-	-
2	SB	-	-	9478	9492	-	-	-	-
3	NB	8208	8315	8554	8663	8247	8324	8323	8321
3	SB	8127	8128	9438	9444	8138	8133	8140	8129
4	NB	7936	7953	8255	8604	7767	8281	8059	8033
4	SB	7690	7669	8934	8342	7478	6997	7744	7696
5	NB	8432	8465	8644	9180	8807	9575	8656	8627
5	SB	8459	8437	9750	9217	9820	9558	8513	8464
6	NB	8689	7951	8009	6167	8097	6176	7715	7830
6	SB	8117	7935	9054	7945	9165	8182	7403	7418

3.5.2 AADT on the N4

The AADT values at locations on the N4 are presented in Table 3.7 to Table 3.9 below. The locations of the N4 AADT values are illustrated in Figure 3.5 below.

The locations of the AADTs are on the section of the N4 spanning above the signalised junction of Upper John Street to the south, and just below where the existing N16 intercepts to the north.

The flows at AADT 1 indicate a marked increase across Options 1 and 2 when compared with the Do Minimum scenario, with no significant changes experienced on Options 5 and 8.

AADT 2 also indicates an increase in flows across Options 1 and 2 when compared to the Do Minimum, more so in the southbound direction. Again, there were no significant changes experienced on Options 5 and 8.

AADT 3 indicates a decrease in northbound flows in Option 1B_S1B and 2B_S2B, with the remaining options having relatively unchanged northbound flows. Southbound flows are fairly constant across all options.

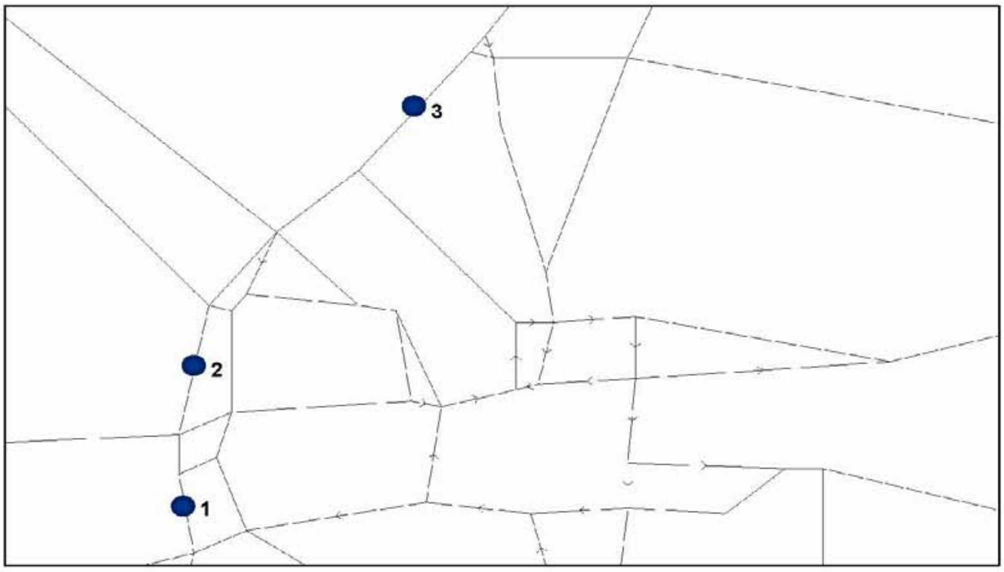

Figure 3.5: N4 AADT Locations

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Table 3.7: N4 2017 AADT Comparisons

Map Reference	Direction	N4 2017 AADT (Per Direction)							
		DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
1	NB	12779	10956	11637	12327	12554	12331	10885	10902
1	SB	8671	8819	8814	9934	9628	9908	8636	8655
2	NB	10428	9134	9684	9378	9785	9372	9059	9070
2	SB	9376	9349	9236	11100	10643	11072	9147	9162
3	NB	13157	11685	11814	10250	11869	10252	11582	11594
3	SB	13364	14407	14599	14639	14726	14591	13755	13798

Table 3.8: N4 2032 AADT Comparisons

Map Reference	Direction	N4 2032 AADT (Per Direction)							
		DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
1	NB	13792	12074	13696	13628	13721	13608	11944	11940
1	SB	9634	9757	10665	10936	10616	10903	9546	9550
2	NB	11382	9569	10400	10306	10421	10283	9420	9416
2	SB	10370	10161	11378	11952	11368	11932	9974	9957
3	NB	14264	12817	13076	11494	13100	11485	12651	12654
3	SB	14650	15599	15947	16058	15821	15962	15077	15069

Table 3.9: N4 2047 AADT Comparisons

Map Reference	Direction	N4 2047 AADT (Per Direction)							
		DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
1	NB	13409	12072	13751	13749	13832	13744	11951	11966
1	SB	9681	9867	10782	10968	10680	10940	9602	9615
2	NB	11354	9605	10470	10416	10512	10425	9489	9504
2	SB	10433	10308	11573	12082	11455	12059	10039	10047
3	NB	14465	12992	13229	11728	13223	11732	12793	12848
3	SB	14855	15870	16081	16233	15921	16148	15243	15296

3.5.3 Wider Sligo Network AADT

Figure 3.6 and Figure 3.7 outline the locations considered on the wider Sligo network in the context of the introduction of the different N16 option alignments. The findings are presented in Table 3.10 to Table 3.12.

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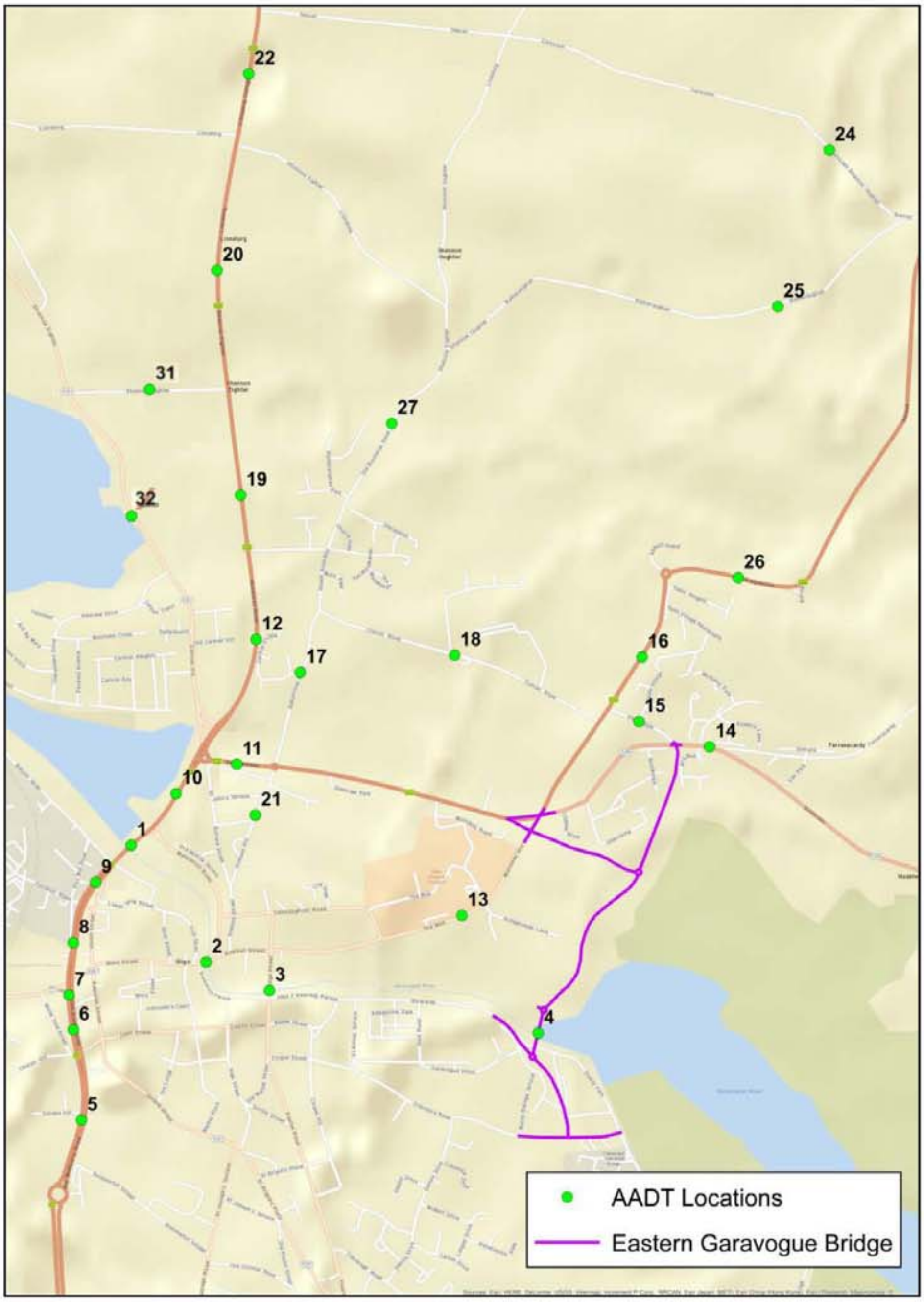

Figure 3.6: AADT Location Map – Sligo Town

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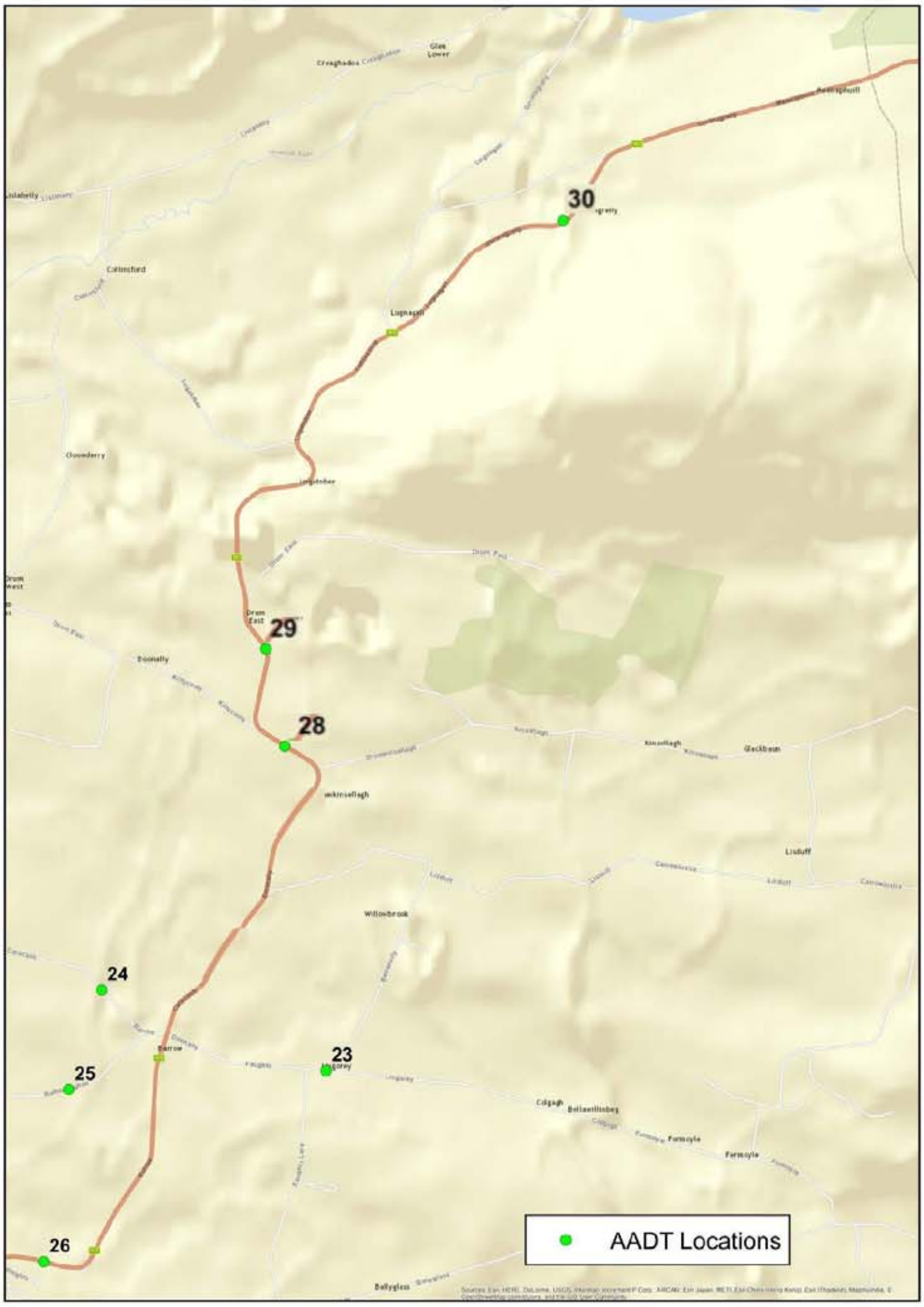

Figure 3.7: AADT Location Map – N16 Corridor

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Table 3.10: 2017 AADT Comparisons N16, N15 and N4

AADT Comparison (2017) Link Name	Map Reference	Direction	2017 AADT (Per Direction) DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
Hughes Bridge	1	NB	12380	10464	10823	10725	10972	10724	10431	10443
Hughes Bridge	1	SB	13005	13230	13530	14280	13897	14259	13044	13065
Hyde Bridge	2	NB	10975	9092	8715	8917	8725	8910	9015	9018
Bridge Street	3	SB	13008	11300	11133	10365	10714	10372	11359	11361
Garavogue Bridge	4	NB	N/A	4071	4052	3852	3805	3860	4189	4175
Garavogue Bridge	4	SB	N/A	1755	1586	1506	1547	1519	1890	1867
N4 North of Summerhill R'bout	5	NB	10164	9077	9305	9653	9681	9660	9039	9060
N4 North of Summerhill R'bout	5	SB	9196	8897	9338	10498	10222	10473	8690	8705
N4 Church Hill/John Street to Sráid an Fhiona (S5-S6)	6	NB	12779	10956	11637	12327	12554	12331	10885	10902
N4 Sráid an Fhiona to Church Hill/John Street (S6-S5)	6	SB	8671	8819	8814	9934	9628	9908	8636	8655
N4 Sráid an Fhiona to Wine Street (S6-S7)	7	NB	12287	10368	11185	11774	12192	11769	10284	10301
N4 Wine Street to Sráid an Fhiona (S7-S6)	7	SB	8043	8164	8200	9610	9331	9581	7982	8000
N4 Wine Street to Finiskin Road	8	NB	10428	9134	9684	9378	9785	9372	9059	9070
N4 Finiskin Road to Wine Street	8	SB	9376	9349	9236	11100	10643	11072	9147	9162
N4 Finiskin Road to Ballast Quay	9	NB	9090	7290	7424	6870	7162	6868	7218	7227

30

N16 Key Performance Indicator Testing

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AADT Comparison (2017) Link Name	Map Reference	Direction	2017 AADT (Per Direction) DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
N4 Ballast Quay to Finiskin Road	9	SB	7766	7814	7642	8748	8294	8719	7627	7642
N4 Markievicz Road to Duck Street	10	NB	13157	11685	11814	10250	11869	10252	11582	11594
N4 Duck Street to Markievicz Road	10	SB	13364	14407	14599	14639	14726	14591	13755	13798
N16 Duck Street (N4 to R'bout)	11	EB	5246	4681	4702	4157	4581	4143	4705	4656
N16 Duck Street (R'bout to N4)	11	WB	5333	6923	5906	5731	5785	5534	6729	6767
N15 Rosses Point to Elm Gardens	12	NB	7834	7232	7217	5303	7243	5311	6999	7095
N15 Elm Gardens to Rosses Point	12	SB	7161	7193	8260	7200	8235	7355	6626	6659
R 286 - The Mall	13	NB	4259	3025	3073	2965	3083	2995	3068	3062
R 286 - The Mall	13	SB	4218	2372	2468	2214	2473	2265	3090	3089
R286 - Hazelwood Road	14	EB	3319	3319	3319	3319	3319	3319	3319	3319
R286 - Hazelwood Road	14	WB	3511	3511	3511	3511	3511	3511	3511	3511
Short walk	15	EB	418	1137	933	1039	963	1053	1310	1286
Short walk	15	WB	461	1951	1961	2115	1907	2129	2096	2080
N16 South of Abbvie R'bout	16	NB	2626	2822	2812	2807	2788	2792	3107	3041
N16 South of Abbvie R'bout	16	SB	1996	1497	1305	1373	1474	1451	2679	2592
Ballytivnan Road	17	NB	1585	1200	1236	3014	1130	2970	1128	1122
Ballytivnan Road	17	SB	2539	3100	2257	3540	2178	3346	2618	2614

31

N16 Key Performance Indicator Testing

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AADT Comparison (2017) Link Name	Map Reference	Direction	2017 AADT (Per Direction) DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
Clarion Road	18	EB	342	517	516	635	553	681	485	467
Clarion Road	18	WB	469	1458	1486	2202	1623	2322	1593	1504
N15 Shannon Eighter to Elm Gardens	19	NB	7847	7931	8097	8356	8035	8585	8027	8012
N15 Shannon Eighter to Elm Gardens	19	SB	8133	8127	9300	8920	9138	9332	8127	8127
N15 Lisnalurg to Shannon Eighter	20	NB	7367	7472	7657	7804	7157	7520	7568	7532
N15 Lisnalurg to Shannon Eighter	20	SB	7361	7353	8506	8085	6973	7066	7368	7359
Holborn Hill	21	NB	1984	1382	1255	2890	1199	2848	1328	1336
Holborn Hill	21	SB	2314	1873	1795	2054	1655	2038	1663	1640
N15 Lisnalurg to Teesan	22	NB	7475	7484	7786	7855	7487	7502	7551	7516
N15 Lisnalurg to Teesan	22	SB	7330	7321	8524	8504	7314	7309	7336	7327
L - 3407 - 22 (Lisgorey)	23	EB	482	482	482	482	482	482	482	482
L - 3407 - 22 (Lisgorey)	23	WB	477	477	477	477	477	477	477	477
L - 3407 - 0 (Carncash)	24	EB	80	80	121	120	-	-	148	51
L - 3407 - 0 (Carncash)	24	WB	94	91	140	87	-	-	106	73
L - 7422 - 0 (Rathbraughan Lane)	25	EB	665	535	274	276	246	242	199	91
L - 7422 - 0 (Rathbraughan Lane)	25	WB	823	1330	337	357	229	235	135	78
N16 East of Abbvie R'bout	26	EB	2061	2257	2248	2193	2130	2134	2543	2476

32

N16 Key Performance Indicator Testing

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AADT Comparison (2017) Link Name	Map Reference	Direction	2017 AADT (Per Direction) DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
N16 East of Abbvie R'bout	26	WB	1714	1215	1023	1042	1099	1075	2398	2310
Old Bundoran Road	27	NB	1697	1396	1244	1128	1349	960	1015	1117
Old Bundoran Road	27	SB	1494	2001	1016	1441	1095	997	803	900
N16 (L - 3406 - 0 to L - 7416 - 0)	28	NB	1682	1682	1363	1358	-	-	-	-
N16 (L - 3406 - 0 to L - 7416 - 0)	28	SB	1749	1749	524	559	-	-	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	29	NB	1632	1632	7	7	-	-	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	29	SB	1627	1625	120	120	-	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	30	NB	1721	1721	-	-	-	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	30	SB	1700	1700	-	-	-	-	-	-
L - 90102 - (Scotsman Walk)	31	EB	188	209	208	2	293	14	278	242
L - 90102 - (Scotsman Walk)	31	WB	177	174	158	0	202	14	260	234
R291 Rosses Point Road	32	NB	1024	1023	1018	1094	1023	1094	952	969
R291 Rosses Point Road	32	SB	1418	1420	1421	1475	1416	1475	1420	1420

33

N16 Key Performance Indicator Testing

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Table 3.11: 2032 AADT Comparisons N16, N15 and N4

AADT Comparison (2032)	Map Reference	Direction	2032 AADT (Per Direction)							
Link Name			DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
Hughes Bridge	1	NB	13404	11437	11942	11824	12028	11820	11310	11310
Hughes Bridge	1	SB	14223	14522	15032	15587	15025	15582	14265	14264
Hyde Bridge	2	NB	11340	9391	8971	8937	8883	8941	9331	9334
Bridge Street	3	SB	13291	11490	10974	10584	10968	10579	11578	11583
Garavogue Bridge	4	NB	N/A	4304	4101	4239	4109	4262	4520	4514
Garavogue Bridge	4	SB	N/A	1890	1779	1600	1797	1633	2089	2081
N4 North of Summerhill R'bout	5	NB	11244	10254	11175	11158	11188	11148	10125	10146
N4 North of Summerhill R'bout	5	SB	10515	10290	11385	11758	11381	11745	10018	9987
N4 Church Hill/John Street to Sráid an Fhiona (S5-S6)	6	NB	13792	12074	13696	13628	13721	13608	11944	11940
N4 Sráid an Fhiona to Church Hill/John Street (S6-S5)	6	SB	9634	9757	10665	10936	10616	10903	9546	9550
N4 Sráid an Fhiona to Wine Street (S6-S7)	7	NB	13169	11351	13093	13033	13111	13005	11175	11177
N4 Wine Street to Sráid an Fhiona (S7-S6)	7	SB	8970	9048	10301	10643	10273	10612	8836	8840
N4 Wine Street to Finiskin Road	8	NB	11382	9569	10400	10306	10421	10283	9420	9416
N4 Finiskin Road to Wine Street	8	SB	10370	10161	11378	11952	11368	11932	9974	9957
N4 Finiskin Road to Ballast Quay	9	NB	9690	7640	7795	7705	7826	7683	7506	7499

34

N16 Key Performance Indicator Testing

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AADT Comparison (2032)	Map Reference	Direction	2032 AADT (Per Direction)							
Link Name			DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
N4 Ballast Quay to Finiskin Road	9	SB	8542	8490	8942	9552	8934	9553	8304	8289
N4 Markievicz Road to Duck Street	10	NB	14264	12817	13076	11494	13100	11485	12651	12654
N4 Duck Street to Markievicz Road	10	SB	14650	15599	15947	16058	15821	15962	15077	15069
N16 Duck Street (N4 to R'bout)	11	EB	5416	5002	5002	4335	4917	4308	5028	4966
N16 Duck Street (R'bout to N4)	11	WB	5422	7366	6062	6343	5905	6046	7301	7317
N15 Rosses Point to Elm Gardens	12	NB	8588	7957	8000	6096	8016	6085	7696	7795
N15 Elm Gardens to Rosses Point	12	SB	8068	7903	9105	7968	9135	8158	7419	7429
R 286 - The Mall	13	NB	4064	3125	3125	2999	3134	3025	3164	3159
R 286 - The Mall	13	SB	4264	2492	2330	2237	2458	2313	3071	3064
R286 - Hazelwood Road	14	EB	3373	3373	3373	3373	3373	3373	3373	3373
R286 - Hazelwood Road	14	WB	3576	3576	3576	3576	3576	3576	3576	3576
Short walk	15	EB	461	1302	1030	1141	1116	1174	1502	1494
Short walk	15	WB	610	2159	2149	2353	2103	2363	2281	2286
N16 South of Abbvie R'bout	16	NB	2787	3035	3015	3010	3028	3036	3479	3392
N16 South of Abbvie R'bout	16	SB	2111	1764	1381	1467	1702	1702	2982	2834
Ballytivnan Road	17	NB	2032	1461	1464	3128	1325	3090	1368	1315
Ballytivnan Road	17	SB	2800	3394	2631	3941	2267	3586	2774	2785

35

N16 Key Performance Indicator Testing

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AADT Comparison (2032) Link Name	Map Reference	Direction	2032 AADT (Per Direction) DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
Clarion Road	18	EB	595	647	648	778	739	854	724	645
Clarion Road	18	WB	626	1626	1666	2410	1789	2560	1709	1547
N15 Shannon Eighter to Elm Gardens	19	NB	8400	8447	8604	9127	8743	9491	8624	8602
N15 Shannon Eighter to Elm Gardens	19	SB	8496	8482	9749	9414	9817	9949	8673	8588
N15 Lisnalurg to Shannon Eighter	20	NB	7937	7983	8162	8556	7726	8221	8183	8146
N15 Lisnalurg to Shannon Eighter	20	SB	7735	7716	8955	8562	7496	7483	7911	7817
Holborn Hill	21	NB	2466	1389	1240	2856	1193	2819	1330	1333
Holborn Hill	21	SB	2540	1921	1976	2047	1931	2037	1673	1685
N15 Lisnalurg to Teesan	22	NB	8113	8144	8460	8622	8115	8187	8210	8181
N15 Lisnalurg to Teesan	22	SB	8026	8026	9438	9425	8015	8009	8042	8033
L - 3407 - 22 (Lisgorey)	23	EB	655	655	655	655	655	655	655	655
L - 3407 - 22 (Lisgorey)	23	WB	640	640	640	640	640	640	640	640
L - 3407 - 0 (Carncash)	24	EB	124	125	180	179	-	-	199	79
L - 3407 - 0 (Carncash)	24	WB	142	143	195	127	-	-	161	107
L - 7422 - 0 (Rathbraughan Lane)	25	EB	925	745	444	442	400	393	260	132
L - 7422 - 0 (Rathbraughan Lane)	25	WB	1122	1475	479	484	420	384	240	153
N16 East of Abbvie R'bout	26	EB	2186	2434	2413	2344	2339	2305	2879	2791

36

N16 Key Performance Indicator Testing

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AADT Comparison (2032) Link Name	Map Reference	Direction	2032 AADT (Per Direction) DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
N16 East of Abbvie R'bout	26	WB	1780	1432	1048	1070	1282	1241	2651	2502
Old Bundoran Road	27	NB	2150	1823	1692	1340	1562	1014	1178	1303
Old Bundoran Road	27	SB	2177	2543	1656	2060	1361	1354	1130	1373
N16 (L - 3406 - 0 to L - 7416 - 0)	28	NB	1802	1802	1428	1410	-	-	-	-
N16 (L - 3406 - 0 to L - 7416 - 0)	28	SB	1871	1871	437	456	-	-	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	29	NB	1735	1735	23	23	-	-	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	29	SB	1726	1726	136	136	-	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	30	NB	1834	1834	-	-	-	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	30	SB	1816	1816	-	-	-	-	-	-
L - 90102 - (Scotsman Walk)	31	EB	227	258	255	2	350	26	326	291
L - 90102 - (Scotsman Walk)	31	WB	241	235	210	0	265	23	286	255
R291 Rosses Point Road	32	NB	1220	1221	1219	1321	1218	1321	1176	1196
R291 Rosses Point Road	32	SB	1617	1617	1618	1693	1611	1693	1617	1617

37

N16 Key Performance Indicator Testing

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Table 3.12: 2047 AADT Comparisons N16, N15 and N4

AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)							
Link Name			DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
Hughes Bridge	1	NB	13629	11704	12081	12018	12149	12041	11613	11656
Hughes Bridge	1	SB	14496	14811	15267	15775	15153	15775	14542	14579
Hyde Bridge	2	NB	11285	9141	8958	8820	8900	8799	9097	9096
Bridge Street	3	SB	13152	11496	10945	10576	10938	10580	11568	11567
Garavogue Bridge	4	NB	N/A	4629	4222	4400	4126	4420	4775	4754
Garavogue Bridge	4	SB	N/A	1901	1783	1620	1817	1639	2109	2094
N4 North of Summerhill R'bout	5	NB	11610	10518	11478	11519	11284	11510	10382	10404
N4 North of Summerhill R'bout	5	SB	10639	10485	11527	11793	11441	11791	10149	10137
N4 Church Hill/John Street to Sráid an Fhiona (S5-S6)	6	NB	13409	12072	13751	13749	13832	13744	11951	11966
N4 Sráid an Fhiona to Church Hill/John Street (S6-S5)	6	SB	9681	9867	10782	10968	10680	10940	9602	9615
N4 Sráid an Fhiona to Wine Street (S6-S7)	7	NB	12783	11307	13207	13188	13238	13191	11157	11186
N4 Wine Street to Sráid an Fhiona (S7-S6)	7	SB	9033	9175	10461	10685	10372	10661	8909	8923
N4 Wine Street to Finiskin Road	8	NB	11354	9605	10470	10416	10512	10425	9489	9504
N4 Finiskin Road to Wine Street	8	SB	10433	10308	11573	12082	11455	12059	10039	10047
N4 Finiskin Road to Ballast Quay	9	NB	9892	7728	7881	7858	7928	7851	7617	7656

38

N16 Key Performance Indicator Testing

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AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)							
Link Name			DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
N4 Ballast Quay to Finiskin Road	9	SB	8573	8610	9146	9684	9026	9685	8379	8387
N4 Markievicz Road to Duck Street	10	NB	14465	12992	13229	11728	13223	11732	12793	12848
N4 Duck Street to Markievicz Road	10	SB	14855	15870	16081	16233	15921	16148	15243	15296
N16 Duck Street (N4 to R'bout)	11	EB	5483	5102	5051	4313	4925	4293	5142	5083
N16 Duck Street (R'bout to N4)	11	WB	5512	7477	6208	6436	5941	6125	7341	7381
N15 Rosses Point to Elm Gardens	12	NB	8689	7951	8009	6167	8097	6176	7715	7830
N15 Elm Gardens to Rosses Point	12	SB	8117	7935	9054	7945	9165	8182	7403	7418
R 286 - The Mall	13	NB	3787	3024	3110	2940	3150	2953	3094	3052
R 286 - The Mall	13	SB	3979	2482	2326	2221	2437	2322	3079	3072
R286 - Hazelwood Road	14	EB	3383	3383	3383	3383	3383	3383	3383	3383
R286 - Hazelwood Road	14	WB	3583	3583	3583	3583	3583	3583	3583	3583
Short walk	15	EB	471	1322	1051	1169	1132	1188	1529	1515
Short walk	15	WB	656	2362	2310	2460	2107	2400	2347	2326
N16 South of Abbvie R'bout	16	NB	2817	3059	3045	3038	3056	3061	3511	3346
N16 South of Abbvie R'bout	16	SB	2036	1809	1413	1499	1730	1653	3020	2888
Ballytivnan Road	17	NB	2344	1456	1492	3160	1338	3122	1402	1373
Ballytivnan Road	17	SB	2966	3538	2879	4182	2277	3788	2880	2886

39

N16 Key Performance Indicator Testing

JACOBS

AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)							
Link Name			DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
Clarion Road	18	EB	919	653	658	781	747	886	757	663
Clarion Road	18	WB	721	1931	1825	2583	1787	2659	1977	1850
N15 Shannon Eighter to Elm Gardens	19	NB	8432	8465	8644	9180	8807	9575	8656	8627
N15 Shannon Eighter to Elm Gardens	19	SB	8459	8437	9750	9217	9820	9558	8513	8464
N15 Lisnalurg to Shannon Eighter	20	NB	7936	7953	8255	8604	7767	8281	8059	8033
N15 Lisnalurg to Shannon Eighter	20	SB	7690	7669	8934	8342	7478	6997	7744	7696
Holborn Hill	21	NB	2703	1390	1232	2864	1195	2827	1319	1350
Holborn Hill	21	SB	2744	2007	2054	2085	1949	2050	1736	1729
N15 Lisnalurg to Teesan	22	NB	8154	8261	8566	8674	8170	8244	8269	8268
N15 Lisnalurg to Teesan	22	SB	8042	8043	9425	9434	8026	8021	8056	8045
L - 3407 - 22 (Lisgorey)	23	EB	681	681	681	681	681	681	681	681
L - 3407 - 22 (Lisgorey)	23	WB	667	667	667	667	667	667	667	667
L - 3407 - 0 (Carncash)	24	EB	128	188	243	186	-	-	204	108
L - 3407 - 0 (Carncash)	24	WB	148	148	203	138	-	-	168	115
L - 7422 - 0 (Rathbraughan Lane)	25	EB	947	714	413	463	420	414	274	180
L - 7422 - 0 (Rathbraughan Lane)	25	WB	1238	1470	494	502	442	405	244	139
N16 East of Abbvie R'bout	26	EB	2210	2452	2437	2368	2362	2326	2904	2739

40

N16 Key Performance Indicator Testing

JACOBS

AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)							
Link Name			DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
N16 East of Abbvie R'bout	26	WB	1696	1469	1073	1096	1303	1184	2679	2548
Old Bundoran Road	27	NB	2242	1948	1689	1379	1594	1027	1389	1580
Old Bundoran Road	27	SB	2368	2614	1697	2313	1404	1864	1327	1508
N16 (L - 3406 - 0 to L - 7416 - 0)	28	NB	1809	1809	1437	1416	-	-	-	-
N16 (L - 3406 - 0 to L - 7416 - 0)	28	SB	1872	1872	440	462	-	-	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	29	NB	1738	1738	23	16	-	-	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	29	SB	1723	1723	138	138	-	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	30	NB	1839	1839	-	-	-	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	30	SB	1813	1813	-	-	-	-	-	-
L - 90102 - (Scotsman Walk)	31	EB	235	322	319	24	360	28	333	326
L - 90102 - (Scotsman Walk)	31	WB	274	344	199	0	275	26	440	431
R291 Rosses Point Road	32	NB	1246	1157	1254	1363	1252	1363	1063	1072
R291 Rosses Point Road	32	SB	1648	1652	1652	1714	1645	1733	1652	1652

41

3.6 Objective 5

Objective 5 was to efficiently cater for strategic national road traffic. This KPI was assessed using journey times from the N16 at the Leitrim boundary to the N4 / N16 / N15 junction.

The AM, IP and PM peak journey time comparisons for the route options between the Leitrim county boundary and the N4 / N16 / N15 junction across 2017, 2032 and 2047 are presented in Table 3.13 to Table 3.15. The results show a marked reduction in journey time for the Option 1A_S1A, 1B_S1B, 2A_S2A and 2B_S2B compared to the Do Nothing and Do Minimum scenarios across all time periods. Option 2A_S2A and 2B_S2B offer the quickest journey times across all options. For information purposes, Option 1A_S1A, 1B_S1B, 2A_S2A and 2B_S2A include two journey times for each option. These journey times are when using the proposed N16 and using the existing N16. These indicate that the journey times when using the proposed N16 are approximately two minutes quicker than when using the existing N16 in each time period and year.

Although Option 5 and 8 have slightly longer journey times it is important to stress that the Select Link Analysis has indicated that there is a low level of strategic traffic on the N16 travelling to the N4/N16/N15 junction.

For illustration purposes the Opt 1A_S1A routes using the proposed N16 (green) and existing N16 (red) are shown in Figure 3.8 below. In this example the length of the green route using the proposed N16 to the N4/N16/N15 junction is 9.51 km, while the length of the red route using the existing N16 is 10.62 km.

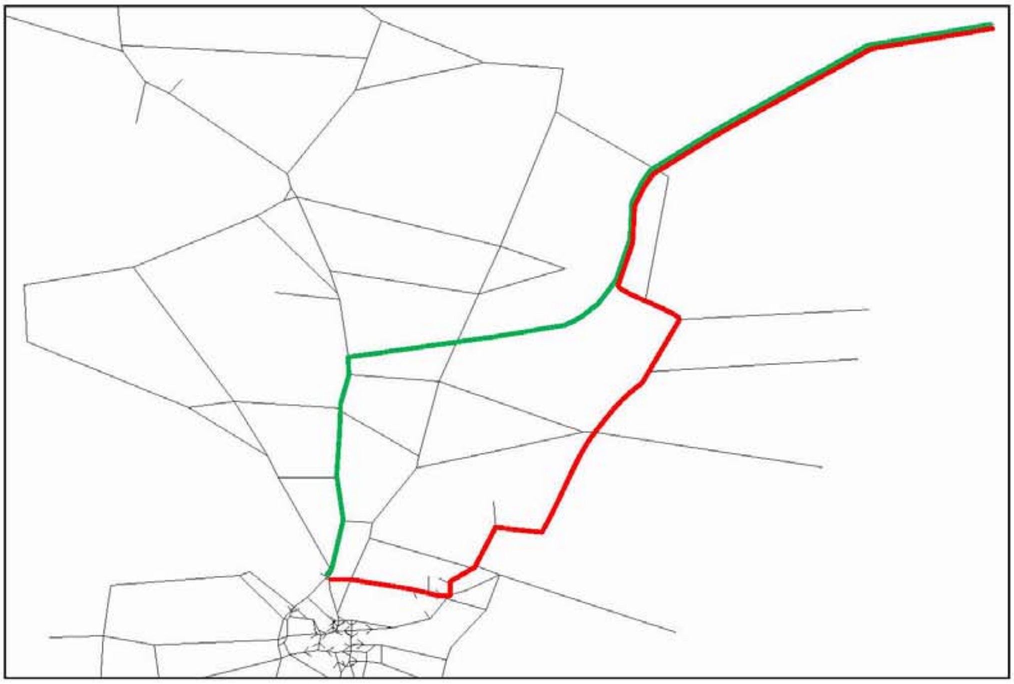

Figure 3.8: Journey Time routes illustration (Opt 1A_S1A) for the proposed N16 (green) and the existing N16 (red)

Across all options, the Design year 2032 and Forecast year 2047 journey times are only marginally different owing to expected tapering of demand from 2032 onwards and thus minimal growth in demand for travel.

N16 Key Performance Indicator Testing

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Table 3.13: Journey Time Comparison for AM peak inbound, 2017, 2032, 2047

Scenario	Modelled Journey Time (mins) Leitrim county boundary to the N4 / N16 / N15 junction		
	2017	2032	2047
Do Nothing	9:15	9:20	9:21
Do Minimum	9:40	9:44	9:44
Do Minimum Opt 1A_S1A (Proposed N16)	7:27	7:32	7:30
Do Minimum Opt 1A_S1A (Existing N16)	9:21	9:35	9:35
Do Minimum Opt 1B_S1B (Proposed N16)	7:31	7:42	7:41
Do Minimum Opt 1B_S1B (Existing N16)	9:21	9:34	9:34
Do Minimum Opt 2A_S2A (Proposed N16)	7:02	7:10	7:09
Do Minimum Opt 2A_S2A (Existing N16)	9:01	9:04	9:04
Do Minimum Opt 2B_S2B (Proposed N16)	6:49	6:50	6:50
Do Minimum Opt 2B_S2B (Existing N16)	8:59	9:01	9:01
Do Minimum Opt 5	8:23	8:27	8:27
Do Minimum Opt 8	8:40	8:42	8:43

Table 3.14: Journey Time Comparison for IP peak inbound, 2017, 2032, 2047

Scenario	Modelled Journey Time (mins) Leitrim county boundary to the N4 / N16 / N15 junction		
	2017	2032	2047
Do Nothing	8:59	8:59	8:59
Do Minimum	9:28	9:28	9:28
Do Minimum Opt 1A_S1A (Proposed N16)	7:06	7:07	7:07
Do Minimum Opt 1A_S1A (Existing N16)	9:12	9:24	9:24
Do Minimum Opt 1B_S1B (Proposed N16)	7:11	7:13	7:13
Do Minimum Opt 1B_S1B (Existing N16)	9:12	9:24	9:24
Do Minimum Opt 2A_S2A (Proposed N16)	6:44	6:46	6:46
Do Minimum Opt 2A_S2A (Existing N16)	8:51	8:52	8:52
Do Minimum Opt 2B_S2B (Proposed N16)	6:44	6:44	6:44
Do Minimum Opt 2B_S2B (Existing N16)	8:51	8:52	8:52
Do Minimum Opt 5	8:12	8:13	8:13
Do Minimum Opt 8	8:31	8:32	8:32

Table 3.15: Journey Time Comparison for PM peak inbound, 2017, 2032, 2047

Scenario	Modelled Journey Time (mins)		
	Leitrim county boundary to the N4 / N16 / N15 junction		
	2017	2032	2047
Do Nothing	9:49	10:41	10:53
Do Minimum	9:37	9:39	9:39
Do Minimum Opt 1A_S1A (Proposed N16)	7:13	7:16	7:16
Do Minimum Opt 1A_S1A (Existing N16)	9:51	10:37	10:32
Do Minimum Opt 1B_S1B (Proposed N16)	7:19	7:21	7:20
Do Minimum Opt 1B_S1B (Existing N16)	9:19	9:32	9:31
Do Minimum Opt 2A_S2A (Proposed N16)	6:53	6:57	6:57
Do Minimum Opt 2A_S2A (Existing N16)	9:18	9:48	9:45
Do Minimum Opt 2B_S2B (Proposed N16)	6:46	6:47	6:46
Do Minimum Opt 2B_S2B (Existing N16)	8:59	9:00	9:00
Do Minimum Opt 5	8:22	8:25	8:25
Do Minimum Opt 8	8:41	8:44	8:44

3.7 Objective 6

Objective 6 was to efficiently cater for strategic traffic to Sligo City Gateway (NSS). This KPI was assessed using journey times from the N16 at the Leitrim boundary to Sligo city centre.

The AM, IP and PM peak journey time comparisons for the route options between the Leitrim county boundary and Sligo city centre across 2017, 2032 and 2047 are presented in Table 3.16 to Table 3.18. The results show a reduction in journey times in all options when compared to the Do Nothing and Do Minimum scenarios across all time periods. For information purposes, Option 1A_S1A, 1B_S1B, 2A_S2A and 2B_S2B include two journey times for each option. These journey times are when using the proposed N16 and using the existing N16. The models indicate that in most cases in these four options the proposed N16 route to the city centre is slightly quicker than the existing N16 route.

For consistency the same city centre junction has been used as the end point of the journey time route for all options. This location is node 510 which is the priority junction on the east side of the R292 Hyde Bridge where it meets with the R286 Stephen Street. The Do Nothing, Do Minimum, Option 5 and 8 each access the city centre via Molloway Hill, Connaughton Road, Lake Isle Road and Stephen Street. Option 1A_S1A, 1B_S1B, 2A_S2A and 2B_S2B each access the city via the proposed N16, N15, N4, Markievicz Road, Connaughton Road, Lake Isle Road and Stephen Street. For each of these four options a second journey time was recorded using the existing N16, Molloway Hill, Connaughton Road, Lake Isle Road and Stephen Street to access the city centre.

For illustration purposes the Opt 1A_S1A routes using the proposed N16 (green) and existing N16 (red) are shown in Figure 3.9 below. In this example the length of the green route using the proposed N16 to the city centre is 10.54 km, while the length of the red route using the existing N16 is 10.70 km.

N16 Key Performance Indicator Testing

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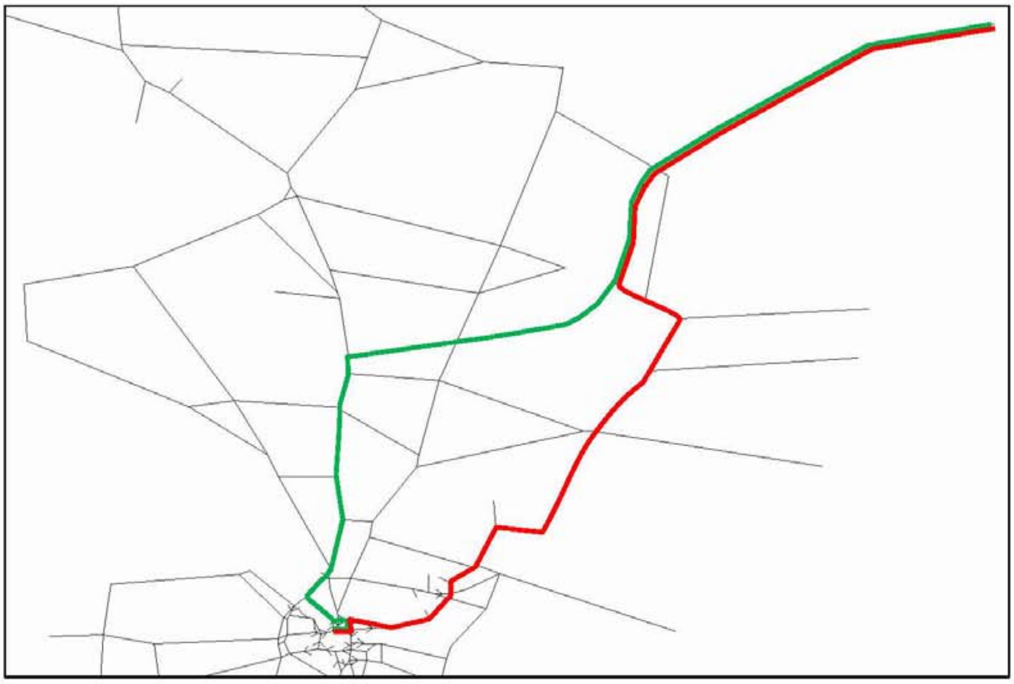

Figure 3.9: Journey Time routes illustration (Opt 1A_S1A) for the proposed N16 (green) and the existing N16 (red)

Across all options, the Design year 2032 and Forecast year 2047 journey times are only marginally different owing to expected tapering of demand from 2032 onwards and thus minimal growth in demand for travel.

N16 Key Performance Indicator Testing

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Table 3.16: Journey Time Comparison for AM peak inbound, 2017, 2032, 2047

Scenario	Modelled Journey Time (mins) Leitrim county boundary to Sligo City Centre		
	2017	2032	2047
Do Nothing	10:10	10:16	10:13
Do Minimum	10:07	10:11	10:12
Do Minimum Opt 1A_S1A (Proposed N16)	9:45	9:58	9:54
Do Minimum Opt 1A_S1A (Existing N16)	9:48	10:01	10:02
Do Minimum Opt 1B_S1B (Proposed N16)	9:50	10:04	10:01
Do Minimum Opt 1B_S1B (Existing N16)	9:49	10:02	10:02
Do Minimum Opt 2A_S2A (Proposed N16)	9:19	9:29	9:29
Do Minimum Opt 2A_S2A (Existing N16)	9:28	9:32	9:32
Do Minimum Opt 2B_S2B (Proposed N16)	9:09	9:14	9:11
Do Minimum Opt 2B_S2B (Existing N16)	9:27	9:30	9:30
Do Minimum Opt 5	8:53	8:56	8:56
Do Minimum Opt 8	9:10	9:12	9:12

Table 3.17: Journey Time Comparison for IP peak inbound, 2017, 2032, 2047

Scenario	Modelled Journey Time (mins) Leitrim county boundary to Sligo City Centre		
	2017	2032	2047
Do Nothing	9:53	9:54	9:53
Do Minimum	10:03	10:04	10:04
Do Minimum Opt 1A_S1A (Proposed N16)	9:12	9:11	9:11
Do Minimum Opt 1A_S1A (Existing N16)	9:46	9:57	9:57
Do Minimum Opt 1B_S1B (Proposed N16)	9:16	9:17	9:17
Do Minimum Opt 1B_S1B (Existing N16)	9:45	9:57	9:57
Do Minimum Opt 2A_S2A (Proposed N16)	8:47	8:49	8:49
Do Minimum Opt 2A_S2A (Existing N16)	9:25	9:26	9:26
Do Minimum Opt 2B_S2B (Proposed N16)	8:48	8:48	8:47
Do Minimum Opt 2B_S2B (Existing N16)	9:25	9:25	9:25
Do Minimum Opt 5	8:49	8:50	8:50
Do Minimum Opt 8	9:09	9:09	9:09

Table 3.18: Journey Time Comparison for PM peak inbound, 2017, 2032, 2047

Scenario	Modelled Journey Time (mins)		
	Leitrim county boundary to Sligo City Centre		
	2017	2032	2047
Do Nothing	11:09	12:00	12:01
Do Minimum	10:18	10:36	10:34
Do Minimum Opt 1A_S1A (Proposed N16)	9:26	9:29	9:28
Do Minimum Opt 1A_S1A (Existing N16)	10:14	10:50	10:53
Do Minimum Opt 1B_S1B (Proposed N16)	9:31	9:38	9:36
Do Minimum Opt 1B_S1B (Existing N16)	9:51	10:05	10:07
Do Minimum Opt 2A_S2A (Proposed N16)	9:06	9:11	9:10
Do Minimum Opt 2A_S2A (Existing N16)	9:42	10:07	10:09
Do Minimum Opt 2B_S2B (Proposed N16)	8:58	9:04	9:01
Do Minimum Opt 2B_S2B (Existing N16)	9:31	9:34	9:36
Do Minimum Opt 5	9:06	9:20	9:19
Do Minimum Opt 8	9:26	9:40	9:39

3.8 Objective 7

Objective 7 was to assess the operational efficiency of the N16. Two KPIs were assessed as part of this objective. The first was the Volume/Capacity ratios on the N16. The second was the right turn delay at junctions on the N16. The results of these KPIs are detailed below.

3.8.1 Volume / Capacity ratios on the N16

The Volume / Capacity ratios of junctions on the N16 are presented below in Table 3.19 to Table 3.27. These nine tables detail the AM, IP and PM peak periods for the years 2017, 2032 and 2047. For each scenario the Volume / Capacity ratios along the whole of the N16 begin at node 614 (at Leitrim County boundary) and continue to node 2 (at the N4 / N16 / N15 junction). Each model option has a varying number of nodes used which is reflected in the tables. For ease of reading, Volume / Capacity ratios of less than 50% were coloured green, between 50% – 85% were coloured amber and over 85% were coloured red.

Across all scenarios most of the Volume / Capacity ratios of junctions on the N16 were under 50% with a small number of junctions between 50% - 85%. No junctions on the N16 had a Volume / Capacity ratio of over 85%.

It is also worth noting that Option 1B_S1B had four consecutive junctions with an amber Volume / Capacity ratio. Node 1101 (the roundabout junction with the Proposed N16 and N15), node 18 (N15), node 19 (N15) and node 148 (N15) each recorded a Volume / Capacity ratio of between 52.8% and 67.0% in the 2047 PM peak model. Although these ratios are well within 100% it has been identified as the worst preforming section of any model scenario with these four consecutive junctions experiencing congestion, albeit at no more than two thirds of the capacity available.

N16 Key Performance Indicator Testing

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Table 3.19: 2017 AM – N16 Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	7.5	614	7.6	614	13.3	614	7.6	614	6.4	614	6.4	614	7.6	614	6.4
	613	9.2	613	9.3	1116	10.0	1116	10.0	1213	8.7	1213	8.7	1515	8.1	1816	7.5
	610	9.4	610	9.4	1115	10.0	1115	10.0	1212	9.4	1212	9.4	1514	10.0	1815	10.0
	609	9.3	609	9.3	1114	10.0	1114	10.0	1211	9.4	1211	9.4	1516	10.0	1813	10.0
	608	13.2	608	13.2	1113	10.0	1113	10.0	1216	9.4	1216	9.4	1512	8.2	1812	8.2
	607	17.2	607	17.3	1112	10.6	1112	10.6	1214	9.4	1214	9.4	1518	7.8	1810	7.7
	621	27.4	621	23.7	1111	10.0	1111	10.0	1207	8.4	1207	8.4	1513	9.5	1809	10.1
	606	20.4	606	18.7	1110	10.0	1110	10.0	1206	8.0	1206	8.2	1510	9.5	1808	8.4
	603	23.0	603	22.2	1109	10.0	1109	10.0	1205	3.9	1205	4.4	1507	8.3	1807	11.6
	602	29.3	602	20.6	1108	10.0	1108	10.0	1204	3.9	1204	4.4	1506	8.2	1806	13.1
	521	24.0	521	17.8	1107	8.5	1107	8.4	1203	3.9	1203	4.4	1505	8.7	1805	11.8
	506	30.5	506	14.2	1106	4.7	1106	4.1	1202	4.5	1202	5.0	1502	13.9	1804	13.4
	623	31.1	304	15.1	1105	4.7	1105	4.1	7	46.7	7	24.2	1501	15.4	1817	14.2
	624	36.8	305	5.4	1104	4.7	1104	4.1	6	33.9	6	30.0	1517	15.4	1803	14.2
	4	35.9	623	23.7	1101	55.7	1101	55.9	3	28.1	3	24.8	606	23.1	1802	13.3

48

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	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	501	20.9	624	32.2	18	33.4	18	45.5	567	23.5	567	20.8	603	26.1	1801	14.8
	2	41.9	4	35.8	19	31.1	19	41.6	2	35.2	2	31.9	602	22.2	606	19.9
			501	22.3	148	31.8	148	42.5					521	19.4	603	25.5
			2	35.2	7	37.2	7	30.1					506	16.1	602	21.6
					6	39.5	6	27.7					304	17.1	521	19.4
					3	27.8	3	24.6					305	5.3	506	16.0
					567	23.1	567	20.5					623	24.8	304	17.1
					2	36.2	2	31.8					624	33.3	305	5.3
													4	35.7	623	24.7
													501	21.9	624	33.3
													2	34.3	4	35.4
															501	21.9
															2	34.4

49

N16 Key Performance Indicator Testing

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Table 3.20: 2017 IP – N16 Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	7.7	614	7.7	614	13.6	614	7.7	614	6.6	614	6.6	614	7.7	614	6.6
	613	6.2	613	6.2	1116	6.7	1116	6.7	1213	5.7	1213	5.7	1515	5.4	1816	4.8
	610	7.0	610	7.0	1115	6.7	1115	6.7	1212	6.5	1212	6.5	1514	6.7	1815	6.7
	609	7.0	609	7.0	1114	6.7	1114	6.7	1211	6.5	1211	6.5	1516	6.7	1813	6.7
	608	8.8	608	8.8	1113	6.7	1113	6.7	1216	6.5	1216	6.5	1512	5.5	1812	5.5
	607	11.3	607	11.7	1112	7.1	1112	7.1	1214	6.5	1214	6.5	1518	5.3	1810	5.3
	621	16.9	621	14.1	1111	6.7	1111	6.7	1207	6.3	1207	6.3	1513	6.5	1809	6.9
	606	10.3	606	8.9	1110	6.7	1110	6.7	1206	6.1	1206	6.1	1510	6.5	1808	6.3
	603	10.1	603	11.8	1109	6.7	1109	6.7	1205	3.3	1205	3.3	1507	6.2	1807	8.2
	602	13.6	602	13.0	1108	6.7	1108	6.7	1204	3.3	1204	3.3	1506	6.1	1806	9.0
	521	14.3	521	8.6	1107	5.7	1107	5.7	1203	3.3	1203	3.3	1505	6.1	1805	8.0
	506	18.5	506	9.7	1106	3.6	1106	3.6	1202	3.8	1202	3.8	1502	9.2	1804	8.9
	623	18.0	304	10.1	1105	3.6	1105	3.6	7	36.3	7	17.8	1501	10.6	1817	9.8
	624	22.6	305	5.8	1104	3.6	1104	3.6	6	27.1	6	21.6	1517	10.6	1803	9.8
	4	23.8	623	17.0	1101	37.7	1101	37.7	3	20.0	3	15.8	606	13.0	1802	8.9
	501	14.1	624	22.5	18	25.3	18	33.9	567	16.6	567	13.2	603	15.3	1801	10.2

50

N16 Key Performance Indicator Testing

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	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	2	29.3	4	24.1	19	24.1	19	33.2	2	24.7	2	22.1	602	17.1	606	11.1
			501	15.5	148	23.1	148	31.4					521	12.3	603	14.9
			2	24.2	7	26.1	7	25.2					506	11.6	602	16.7
					6	27.0	6	21.4					304	11.6	521	12.1
					3	19.9	3	15.7					305	5.2	506	11.5
					567	16.4	567	13.1					623	16.7	304	11.6
					2	26.0	2	22.2					624	22.7	305	5.1
													4	22.8	623	16.6
													501	15.2	624	22.6
													2	24.2	4	22.8
															501	15.2
															2	24.3

51

N16 Key Performance Indicator Testing

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Table 3.21: 2017 PM – N16 Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	19.0	614	19.1	614	33.6	614	19.1	614	16.3	614	16.3	614	19.1	614	16.3
	613	13.0	613	13.0	1116	13.5	1116	13.5	1213	11.9	1213	11.9	1515	11.0	1816	10.1
	610	12.6	610	12.6	1115	13.5	1115	13.5	1212	12.7	1212	12.7	1514	13.5	1815	13.5
	609	12.7	609	12.7	1114	13.5	1114	13.5	1211	12.7	1211	12.7	1516	13.5	1813	13.5
	608	14.7	608	14.7	1113	13.5	1113	13.5	1216	12.7	1216	12.7	1512	11.5	1812	11.4
	607	20.5	607	20.1	1112	14.3	1112	14.3	1214	12.7	1214	12.7	1518	10.4	1810	10.4
	621	21.9	621	26.1	1111	13.5	1111	13.5	1207	11.2	1207	11.3	1513	12.8	1809	13.5
	606	15.0	606	17.5	1110	13.5	1110	13.5	1206	10.8	1206	10.9	1510	12.8	1808	11.1
	603	14.4	603	19.5	1109	13.5	1109	13.5	1205	5.2	1205	5.2	1507	11.2	1807	11.5
	602	19.6	602	21.9	1108	13.5	1108	13.5	1204	5.2	1204	5.2	1506	11.2	1806	13.5
	521	16.6	521	14.2	1107	11.6	1107	11.6	1203	5.2	1203	5.2	1505	11.5	1805	11.8
	506	29.9	506	15.1	1106	6.1	1106	6.1	1202	5.0	1202	5.1	1502	13.4	1804	12.9
	623	28.8	304	13.9	1105	6.1	1105	6.1	7	59.5	7	28.7	1501	15.7	1817	14.5
	624	35.1	305	7.9	1104	6.1	1104	6.1	6	41.2	6	36.1	1517	15.7	1803	14.5
	4	36.2	623	21.2	1101	58.6	1101	58.9	3	30.9	3	24.8	606	21.3	1802	13.8
	501	31.8	624	28.3	18	37.2	18	51.2	567	25.5	567	20.7	603	22.5	1801	15.4

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	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	2	58.8	4	37.2	19	35.3	19	49.6	2	44.0	2	33.6	602	24.9	606	18.5
			501	23.7	148	34.8	148	48.1					521	16.7	603	22.1
			2	44.6	7	37.4	7	37.5					506	16.6	602	24.5
					6	42.4	6	36.0					304	15.2	521	16.6
					3	31.6	3	24.6					305	7.6	506	16.6
					567	26.0	567	20.5					623	21.3	304	15.2
					2	44.0	2	34.3					624	28.9	305	7.5
													4	36.1	623	21.3
													501	23.5	624	28.9
													2	46.1	4	36.1
															501	23.4
															2	46.2

N16 Key Performance Indicator Testing

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Table 3.22: 2032 AM – N16 Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	8.3	614	8.4	614	8.4	614	8.4	614	7.1	614	7.1	614	8.4	614	7.1
	613	10.3	613	10.3	1116	11.1	1116	11.1	1213	9.7	1213	9.7	1515	9.0	1816	8.4
	610	10.6	610	10.6	1115	11.1	1115	11.1	1212	10.5	1212	10.5	1514	11.1	1815	11.1
	609	10.5	609	10.5	1114	11.1	1114	11.1	1211	10.5	1211	10.5	1516	11.1	1813	11.1
	608	15.1	608	15.2	1113	11.1	1113	11.1	1216	10.5	1216	10.5	1512	9.6	1812	9.2
	607	20.7	607	21.0	1112	11.7	1112	11.7	1214	10.5	1214	10.5	1518	8.8	1810	8.6
	621	30.0	621	27.6	1111	11.1	1111	11.1	1207	9.6	1207	9.6	1513	10.8	1809	11.2
	606	22.5	606	21.5	1110	11.1	1110	11.1	1206	8.8	1206	9.2	1510	10.8	1808	9.5
	603	25.0	603	24.8	1109	11.1	1109	11.1	1205	3.9	1205	4.9	1507	9.3	1807	13.4
	602	30.1	602	23.6	1108	11.1	1108	11.1	1204	3.9	1204	4.9	1506	9.3	1806	14.7
	521	20.7	521	19.3	1107	9.5	1107	9.5	1203	3.9	1203	4.9	1505	9.9	1805	13.3
	506	28.4	506	14.8	1106	5.7	1106	5.3	1202	5.2	1202	6.3	1502	16.7	1804	15.6
	623	30.8	304	16.2	1105	5.7	1105	5.3	7	52.7	7	25.0	1501	17.8	1817	15.9
	624	35.7	305	5.7	1104	5.7	1104	5.3	6	36.5	6	32.7	1517	17.8	1803	15.9
	4	40.2	623	24.6	1101	64.1	1101	64.5	3	30.7	3	27.3	606	26.6	1802	15.0
	501	21.3	624	33.7	18	37.7	18	51.6	567	25.6	567	22.8	603	29.1	1801	16.7

54

N16 Key Performance Indicator Testing

JACOBS

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	2	45.3	4	40.7	19	34.4	19	47.3	2	39.0	2	35.4	602	26.1	606	22.5
			501	24.7	148	35.5	148	48.2					521	21.2	603	27.9
			2	38.8	7	34.6	7	32.1					506	16.6	602	24.9
					6	37.0	6	31.7					304	17.9	521	21.4
					3	30.7	3	27.0					305	5.7	506	16.5
					567	25.6	567	22.5					623	25.5	304	17.9
					2	39.9	2	35.2					624	34.7	305	5.7
													4	40.5	623	25.2
													501	24.7	624	34.4
													2	38.0	4	40.2
															501	24.5
															2	37.9

55

N16 Key Performance Indicator Testing

JACOBS

Table 3.23: 2032 IP – N16 Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	8.0	614	8.0	614	8.0	614	8.0	614	6.8	614	6.8	614	8.0	614	6.8
	613	6.5	613	6.5	1116	7.0	1116	7.0	1213	6.0	1213	6.0	1515	5.7	1816	5.0
	610	7.4	610	7.4	1115	7.0	1115	7.0	1212	6.8	1212	6.8	1514	7.0	1815	7.0
	609	7.3	609	7.3	1114	7.0	1114	7.0	1211	6.8	1211	6.8	1516	7.0	1813	7.0
	608	9.6	608	9.6	1113	7.0	1113	7.0	1216	6.8	1216	6.8	1512	5.8	1812	5.7
	607	12.9	607	13.3	1112	7.4	1112	7.4	1214	6.8	1214	6.8	1518	5.6	1810	5.5
	621	17.3	621	15.4	1111	7.0	1111	7.0	1207	6.7	1207	6.7	1513	6.8	1809	7.2
	606	10.8	606	9.9	1110	7.0	1110	7.0	1206	6.5	1206	6.5	1510	6.8	1808	6.7
	603	10.5	603	12.8	1109	7.0	1109	7.0	1205	3.4	1205	3.4	1507	6.6	1807	9.0
	602	14.0	602	13.4	1108	7.0	1108	7.0	1204	3.4	1204	3.4	1506	6.5	1806	9.7
	521	14.5	521	8.1	1107	5.9	1107	5.9	1203	3.4	1203	3.4	1505	6.5	1805	8.8
	506	18.6	506	9.4	1106	4.0	1106	4.0	1202	4.5	1202	4.5	1502	10.4	1804	9.9
	623	19.3	304	10.3	1105	4.0	1105	4.0	7	40.7	7	19.8	1501	11.7	1817	10.7
	624	24.1	305	5.6	1104	4.0	1104	4.0	6	29.7	6	24.2	1517	11.7	1803	10.7
	4	26.0	623	17.1	1101	41.7	1101	41.7	3	22.0	3	17.9	606	14.6	1802	9.8
	501	14.7	624	22.6	18	27.8	18	37.4	567	18.2	567	15.0	603	16.8	1801	11.2

56

N16 Key Performance Indicator Testing

JACOBS

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	2	31.8	4	25.6	19	26.5	19	36.7	2	28.6	2	24.4	602	17.8	606	12.3
			501	16.4	148	25.4	148	34.7					521	11.8	603	16.3
			2	26.3	7	28.3	7	27.4					506	11.3	602	17.1
					6	29.6	6	24.0					304	12.0	521	11.7
					3	21.9	3	17.8					305	5.2	506	11.3
					567	18.1	567	14.9					623	17.1	304	12.0
					2	27.1	2	24.6					624	23.5	305	5.2
													4	24.7	623	17.2
													501	16.4	624	23.5
													2	25.3	4	24.7
															501	16.3
															2	25.1

57

N16 Key Performance Indicator Testing

JACOBS

Table 3.24: 2032 PM – N16 Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	20.8	614	20.9	614	20.9	614	20.9	614	17.8	614	17.8	614	20.9	614	17.8
	613	14.1	613	14.1	1116	14.6	1116	14.6	1213	13.0	1213	13.0	1515	11.9	1816	11.0
	610	13.8	610	13.9	1115	14.6	1115	14.6	1212	13.7	1212	13.8	1514	14.6	1815	14.6
	609	13.9	609	13.9	1114	14.6	1114	14.6	1211	13.7	1211	13.8	1516	14.6	1813	14.6
	608	16.5	608	16.6	1113	14.6	1113	14.6	1216	13.7	1216	13.8	1512	12.5	1812	12.5
	607	24.7	607	24.3	1112	15.4	1112	15.4	1214	13.7	1214	13.8	1518	11.3	1810	11.3
	621	23.6	621	29.0	1111	14.6	1111	14.6	1207	12.2	1207	12.4	1513	13.9	1809	14.6
	606	16.7	606	20.0	1110	14.6	1110	14.6	1206	11.7	1206	11.9	1510	13.9	1808	12.9
	603	16.6	603	22.3	1109	14.6	1109	14.6	1205	5.6	1205	5.9	1507	12.3	1807	12.5
	602	22.8	602	24.7	1108	14.6	1108	14.6	1204	5.6	1204	5.9	1506	12.2	1806	14.5
	521	16.8	521	16.1	1107	12.6	1107	12.5	1203	5.6	1203	5.9	1505	13.4	1805	12.8
	506	29.1	506	15.1	1106	7.4	1106	7.5	1202	6.6	1202	6.4	1502	15.2	1804	14.4
	623	29.9	304	14.9	1105	7.4	1105	7.5	7	69.1	7	33.4	1501	17.7	1817	16.0
	624	36.5	305	7.9	1104	7.4	1104	7.5	6	46.2	6	43.1	1517	17.7	1803	16.0
	4	40.6	623	21.9	1101	65.5	1101	66.9	3	34.9	3	27.2	606	24.7	1802	15.6
	501	33.3	624	30.1	18	41.3	18	57.7	567	28.8	567	22.7	603	25.3	1801	17.3

58

N16 Key Performance Indicator Testing

JACOBS

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	2	63.7	4	40.5	19	39.0	19	56.4	2	47.8	2	36.5	602	26.6	606	21.5
			501	25.4	148	38.5	148	53.6					521	17.7	603	24.9
			2	51.9	7	41.1	7	40.8					506	16.7	602	25.9
					6	47.1	6	41.4					304	16.8	521	17.6
					3	34.8	3	27.0					305	8.1	506	16.6
					567	28.7	567	22.5					623	22.6	304	16.8
					2	47.5	2	36.7					624	31.0	305	8.1
													4	37.9	623	22.6
													501	25.1	624	31.1
													2	51.7	4	38.0
															501	25.0
															2	51.7

59

N16 Key Performance Indicator Testing

JACOBS

Table 3.25: 2047 AM – N16 Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	8.1	614	8.1	614	8.1	614	8.1	614	6.9	614	6.9	614	8.1	614	6.9
	613	10.2	613	10.3	1116	11.1	1116	11.1	1213	9.7	1213	9.7	1515	9.0	1816	8.4
	610	10.6	610	10.7	1115	11.1	1115	11.1	1212	10.5	1212	10.5	1514	11.1	1815	11.1
	609	10.5	609	10.5	1114	11.1	1114	11.1	1211	10.5	1211	10.5	1516	11.1	1813	11.1
	608	15.2	608	15.2	1113	11.1	1113	11.1	1216	10.5	1216	10.5	1512	9.7	1812	9.2
	607	21.0	607	21.3	1112	11.7	1112	11.7	1214	10.5	1214	10.5	1518	8.8	1810	8.6
	621	30.2	621	28.3	1111	11.1	1111	11.1	1207	9.6	1207	9.6	1513	10.8	1809	11.2
	606	22.6	606	21.9	1110	11.1	1110	11.1	1206	8.8	1206	9.2	1510	10.8	1808	9.5
	603	25.2	603	25.4	1109	11.1	1109	11.1	1205	3.8	1205	4.9	1507	9.3	1807	13.5
	602	30.5	602	24.4	1108	11.1	1108	11.1	1204	3.8	1204	4.9	1506	9.3	1806	14.5
	521	19.5	521	19.7	1107	9.5	1107	9.4	1203	3.8	1203	4.9	1505	9.8	1805	12.8
	506	27.8	506	14.8	1106	5.7	1106	5.2	1202	5.3	1202	6.4	1502	16.9	1804	15.6
	623	33.6	304	16.2	1105	5.7	1105	5.2	7	53.0	7	25.0	1501	17.7	1817	16.2
	624	38.5	305	5.5	1104	5.7	1104	5.2	6	36.6	6	33.7	1517	17.7	1803	16.2
	4	43.9	623	24.4	1101	63.6	1101	64.1	3	30.9	3	27.1	606	26.6	1802	15.3
	501	22.6	624	33.5	18	37.6	18	51.4	567	25.8	567	22.6	603	29.0	1801	17.0

60

N16 Key Performance Indicator Testing

JACOBS

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	2	45.8	4	40.6	19	34.2	19	47.2	2	42.2	2	35.8	602	26.1	606	22.8
			501	24.4	148	35.3	148	48.1					521	20.8	603	28.3
			2	38.5	7	34.0	7	32.1					506	16.2	602	25.3
					6	36.5	6	32.9					304	17.4	521	20.8
					3	30.8	3	26.7					305	6.3	506	16.2
					567	25.7	567	22.3					623	26.1	304	17.4
					2	42.8	2	35.7					624	35.3	305	6.2
													4	41.2	623	26.0
													501	24.8	624	35.2
													2	38.2	4	41.0
															501	24.7
															2	38.3

61

N16 Key Performance Indicator Testing

JACOBS

Table 3.26: 2047 IP – N16 Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	8.1	614	8.1	614	8.1	614	8.1	614	6.9	614	6.9	614	8.1	614	6.9
	613	6.5	613	6.5	1116	7.0	1116	7.0	1213	6.0	1213	6.0	1515	5.7	1816	5.0
	610	7.4	610	7.4	1115	7.0	1115	7.0	1212	6.8	1212	6.8	1514	7.0	1815	7.0
	609	7.4	609	7.4	1114	7.0	1114	7.0	1211	6.8	1211	6.8	1516	7.0	1813	7.0
	608	9.7	608	9.7	1113	7.0	1113	7.0	1216	6.8	1216	6.8	1512	5.8	1812	5.7
	607	13.2	607	13.6	1112	7.4	1112	7.4	1214	6.8	1214	6.8	1518	5.6	1810	5.5
	621	16.7	621	15.6	1111	7.0	1111	7.0	1207	6.7	1207	6.7	1513	6.9	1809	7.2
	606	10.5	606	10.0	1110	7.0	1110	7.0	1206	6.5	1206	6.5	1510	6.9	1808	6.7
	603	10.2	603	13.5	1109	7.0	1109	7.0	1205	3.4	1205	3.5	1507	6.6	1807	9.2
	602	13.4	602	14.8	1108	7.0	1108	7.0	1204	3.4	1204	3.5	1506	6.5	1806	9.8
	521	12.0	521	8.6	1107	6.0	1107	6.0	1203	3.4	1203	3.5	1505	6.5	1805	8.8
	506	17.6	506	9.2	1106	4.0	1106	4.1	1202	4.7	1202	4.7	1502	10.6	1804	9.9
	623	20.5	304	10.5	1105	4.0	1105	4.1	7	41.2	7	20.0	1501	11.9	1817	10.6
	624	25.3	305	5.6	1104	4.0	1104	4.1	6	30.0	6	24.6	1517	11.9	1803	10.6
	4	28.2	623	17.2	1101	42.1	1101	42.1	3	22.2	3	18.1	606	14.8	1802	9.7
	501	14.7	624	23.2	18	28.2	18	37.7	567	18.5	567	15.1	603	17.0	1801	11.1

62

N16 Key Performance Indicator Testing

JACOBS

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	2	32.1	4	26.6	19	26.9	19	36.9	2	27.4	2	24.8	602	19.0	606	12.2
			501	16.9	148	25.8	148	35.0					521	12.9	603	16.3
			2	26.6	7	28.5	7	27.6					506	11.5	602	18.2
					6	29.7	6	24.4					304	12.5	521	12.7
					3	22.0	3	17.9					305	5.8	506	11.4
					567	18.3	567	14.9					623	17.3	304	12.5
					2	27.4	2	24.9					624	23.8	305	5.8
													4	25.2	623	17.3
													501	16.6	624	23.9
													2	25.4	4	25.2
															501	16.6
															2	25.5

63

N16 Key Performance Indicator Testing

JACOBS

Table 3.27: 2047 PM – N16 Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	21.0	614	21.1	614	21.1	614	21.1	614	18.0	614	18.0	614	21.1	614	18.0
	613	14.1	613	14.1	1116	14.5	1116	14.5	1213	12.9	1213	13.0	1515	11.9	1816	11.0
	610	13.8	610	13.9	1115	14.5	1115	14.5	1212	13.7	1212	13.7	1514	14.5	1815	14.5
	609	13.8	609	13.9	1114	14.5	1114	14.5	1211	13.7	1211	13.7	1516	14.5	1813	14.5
	608	16.6	608	16.6	1113	14.5	1113	14.5	1216	13.7	1216	13.7	1512	12.5	1812	12.5
	607	25.0	607	24.5	1112	15.4	1112	15.4	1214	13.7	1214	13.7	1518	11.3	1810	11.3
	621	23.9	621	29.4	1111	14.5	1111	14.5	1207	12.3	1207	12.5	1513	13.9	1809	14.6
	606	16.9	606	20.3	1110	14.5	1110	14.5	1206	11.7	1206	12.0	1510	13.9	1808	12.9
	603	17.1	603	23.1	1109	14.5	1109	14.5	1205	5.6	1205	6.5	1507	12.3	1807	12.5
	602	23.7	602	25.5	1108	14.5	1108	14.5	1204	5.6	1204	6.5	1506	12.2	1806	14.5
	521	16.6	521	15.8	1107	12.5	1107	12.6	1203	5.6	1203	6.5	1505	13.4	1805	12.9
	506	28.8	506	14.4	1106	7.3	1106	7.5	1202	6.7	1202	7.0	1502	15.4	1804	14.4
	623	31.0	304	14.4	1105	7.3	1105	7.5	7	68.3	7	29.8	1501	17.9	1817	15.9
	624	37.5	305	7.4	1104	7.3	1104	7.5	6	45.8	6	40.4	1517	17.9	1803	15.9
	4	42.2	623	21.8	1101	65.1	1101	67.0	3	34.9	3	27.1	606	25.0	1802	15.6
	501	34.1	624	30.1	18	41.0	18	57.6	567	28.9	567	22.7	603	26.1	1801	17.3

64

N16 Key Performance Indicator Testing

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	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	2	64.3	4	41.4	19	38.7	19	56.2	2	47.9	2	36.9	602	27.4	606	21.6
			501	25.9	148	38.4	148	52.8					521	17.7	603	25.6
			2	52.5	7	40.9	7	38.8					506	16.2	602	26.6
					6	46.9	6	39.8					304	16.9	521	17.2
					3	34.7	3	26.8					305	8.0	506	15.9
					567	28.7	567	22.4					623	22.7	304	16.5
					2	47.8	2	36.8					624	31.4	305	7.9
													4	38.7	623	22.6
													501	25.4	624	31.2
													2	52.0	4	39.2
															501	25.5
															2	52.1

65

3.8.2 Turn Delay at Junctions on the N16

The Turn Delay at junctions on the N16 is presented below in Table 3.28 to Table 3.36. These nine tables detail the AM, IP and PM peak periods for the years 2017, 2032 and 2047. For each scenario the Turn Delay at junctions along the whole of the N16 begins at node 614 (at Leitrim County boundary) and continues to node 2 (at the N4 / N16 / N15 junction). Each model option has a varying number of nodes used which is reflected in the tables.

The turn delay experienced on the N16 in most scenarios is less than ten seconds with this figure rising slightly at junctions closer to Sligo city centre. The only delays experienced greater than 30 seconds were in a future Do Nothing scenario at the N4 / N15 / N16 junction (nodes 501 & 2).

Discounting the Do Nothing scenario the greatest turn delay was again recorded at node 2 (N4 / N15 / N16 junction) where a delay of 23 seconds was experienced in the 2047 PM peak model in the Do Minimum, Option 1A_S1A, Option 2A_S2A, Option 5 and Option 8 scenarios.

N16 Key Performance Indicator Testing

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Table 3.28: 2017 AM – N16 Turn Delay at Junctions

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	0	614	0	614	0	614	0	614	0	614	0	614	0	614	0
	613	0	613	0	1116	0	1116	0	1213	0	1213	0	1515	0	1816	0
	610	0	610	0	1115	0	1115	0	1212	0	1212	0	1514	0	1815	0
	609	0	609	0	1114	0	1114	0	1211	0	1211	0	1516	0	1813	0
	608	2	608	2	1113	0	1113	0	1216	0	1216	0	1512	0	1812	0
	607	2	607	2	1112	0	1112	0	1214	0	1214	0	1518	0	1810	0
	621	0	621	0	1111	0	1111	0	1207	0	1207	0	1513	0	1809	0
	606	3	606	3	1110	0	1110	0	1206	1	1206	1	1510	0	1808	1
	603	1	603	3	1109	0	1109	0	1205	0	1205	0	1507	0	1807	2
	602	1	602	2	1108	0	1108	0	1204	0	1204	0	1506	0	1806	0
	521	1	521	2	1107	1	1107	1	1203	0	1203	0	1505	1	1805	0
	506	25	506	10	1106	0	1106	0	1202	1	1202	1	1502	2	1804	1
	623	2	304	18	1105	0	1105	0	7	5	7	3	1501	0	1817	0
	624	1	305	0	1104	0	1104	0	6	2	6	4	1517	0	1803	0
	4	15	623	1	1101	11	1101	11	3	16	3	15	606	3	1802	0

67

N16 Key Performance Indicator Testing

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	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
	501	1	624	1	18	0	18	0	567	0	567	0	603	4	1801	0
	2	28	4	14	19	0	19	0	2	17	2	16	602	2	606	3
			501	1	148	0	148	0					521	1	603	4
			2	18	7	0	7	3					506	12	602	1
					6	3	6	4					304	17	521	1
					3	16	3	15					305	0	506	12
					567	0	567	0					623	1	304	17
					2	18	2	16					624	1	305	0
													4	14	623	1
													501	1	624	1
													2	17	4	14
															501	1
															2	17

68

Table 3.29: 2017 IP – N16 Turn Delay at Junctions

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	0	614	0	614	0	614	0	614	0	614	0	614	0	614	0
	613	0	613	0	1116	0	1116	0	1213	0	1213	0	1515	0	1816	0
	610	0	610	0	1115	0	1115	0	1212	0	1212	0	1514	0	1815	0
	609	0	609	0	1114	0	1114	0	1211	0	1211	0	1516	0	1813	0
	608	1	608	1	1113	0	1113	0	1216	0	1216	0	1512	0	1812	0
	607	2	607	2	1112	0	1112	0	1214	0	1214	0	1518	0	1810	0
	621	0	621	0	1111	0	1111	0	1207	0	1207	0	1513	0	1809	0
	606	3	606	3	1110	0	1110	0	1206	2	1206	2	1510	0	1808	1
	603	0	603	2	1109	0	1109	0	1205	0	1205	0	1507	0	1807	1
	602	0	602	2	1108	0	1108	0	1204	0	1204	0	1506	0	1806	0
	521	1	521	1	1107	2	1107	2	1203	0	1203	0	1505	1	1805	0
	506	24	506	9	1106	0	1106	0	1202	1	1202	1	1502	1	1804	1
	623	2	304	18	1105	0	1105	0	7	4	7	3	1501	0	1817	0
	624	1	305	0	1104	0	1104	0	6	3	6	4	1517	0	1803	0
	4	12	623	2	1101	9	1101	9	3	16	3	15	606	3	1802	0
	501	1	624	2	18	0	18	0	567	0	567	0	603	2	1801	0

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
	2	22	4	12	19	0	19	0	2	14	2	13	602	2	606	3
			501	1	148	0	148	0					521	1	603	2
			2	14	7	0	7	3					506	12	602	1
					6	4	6	4					304	16	521	1
					3	16	3	15					305	0	506	12
					567	0	567	0					623	2	304	16
					2	14	2	12					624	1	305	0
													4	12	623	2
													501	1	624	1
													2	14	4	12
															501	1
															2	14

N16 Key Performance Indicator Testing

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Table 3.30: 2017 PM – N16 Turn Delay at Junctions

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	2	614	2	614	2	614	1	614	0	614	0	614	1	614	0
	613	0	613	0	1116	0	1116	0	1213	0	1213	0	1515	0	1816	0
	610	0	610	0	1115	0	1115	0	1212	0	1212	0	1514	0	1815	0
	609	0	609	0	1114	0	1114	0	1211	0	1211	0	1516	0	1813	0
	608	1	608	1	1113	0	1113	0	1216	0	1216	0	1512	0	1812	0
	607	2	607	2	1112	0	1112	0	1214	0	1214	0	1518	0	1810	0
	621	0	621	0	1111	0	1111	0	1207	0	1207	0	1513	0	1809	0
	606	3	606	3	1110	0	1110	0	1206	2	1206	2	1510	0	1808	1
	603	1	603	2	1109	0	1109	0	1205	0	1205	0	1507	0	1807	1
	602	1	602	2	1108	0	1108	0	1204	0	1204	0	1506	0	1806	0
	521	1	521	1	1107	3	1107	3	1203	0	1203	0	1505	1	1805	0
	506	24	506	9	1106	0	1106	0	1202	1	1202	1	1502	1	1804	1
	623	4	304	19	1105	0	1105	0	7	6	7	3	1501	0	1817	0
	624	4	305	0	1104	0	1104	0	6	5	6	6	1517	0	1803	0
	4	14	623	3	1101	9	1101	9	3	16	3	16	606	3	1802	0
	501	29	624	3	18	1	18	0	567	0	567	0	603	2	1801	0

71

N16 Key Performance Indicator Testing

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	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
	2	28	4	14	19	0	19	0	2	22	2	12	602	2	606	3
			501	1	148	2	148	0					521	1	603	2
			2	18	7	0	7	3					506	11	602	2
					6	7	6	6					304	18	521	1
					3	16	3	16					305	0	506	11
					567	0	567	0					623	3	304	18
					2	23	2	12					624	3	305	0
													4	14	623	3
													501	1	624	3
													2	22	4	14
															501	1
															2	21

72

N16 Key Performance Indicator Testing

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Table 3.31: 2032 AM – N16 Turn Delay at Junctions

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	0	614	0	614	0	614	0	614	0	614	0	614	0	614	0
	613	0	613	0	1116	0	1116	0	1213	0	1213	0	1515	0	1816	0
	610	0	610	0	1115	0	1115	0	1212	0	1212	0	1514	0	1815	0
	609	0	609	0	1114	0	1114	0	1211	0	1211	0	1516	0	1813	0
	608	2	608	2	1113	0	1113	0	1216	0	1216	0	1512	0	1812	0
	607	2	607	3	1112	0	1112	0	1214	0	1214	0	1518	0	1810	0
	621	0	621	0	1111	0	1111	0	1207	0	1207	0	1513	0	1809	0
	606	3	606	3	1110	0	1110	0	1206	1	1206	1	1510	0	1808	1
	603	2	603	3	1109	0	1109	0	1205	0	1205	0	1507	0	1807	2
	602	2	602	2	1108	0	1108	0	1204	0	1204	0	1506	0	1806	0
	521	1	521	2	1107	1	1107	1	1203	0	1203	0	1505	1	1805	0
	506	25	506	11	1106	0	1106	0	1202	1	1202	1	1502	2	1804	1
	623	2	304	18	1105	0	1105	0	7	6	7	3	1501	0	1817	0
	624	1	305	0	1104	0	1104	0	6	2	6	5	1517	0	1803	0
	4	16	623	1	1101	12	1101	12	3	16	3	15	606	3	1802	0
	501	1	624	2	18	0	18	0	567	0	567	0	603	5	1801	0

N16 Key Performance Indicator Testing

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	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
	2	31	4	15	19	0	19	0	2	18	2	16	602	2	606	3
			501	1	148	1	148	0					521	1	603	4
			2	18	7	1	7	3					506	12	602	2
					6	2	6	5					304	17	521	1
					3	16	3	15					305	0	506	12
					567	0	567	0					623	1	304	17
					2	18	2	16					624	1	305	0
													4	15	623	1
													501	1	624	1
													2	18	4	15
															501	1
															2	17

N16 Key Performance Indicator Testing

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Table 3.32: 2032 IP – N16 Turn Delay at Junctions

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	0	614	0	614	0	614	0	614	0	614	0	614	0	614	0
	613	0	613	0	1116	0	1116	0	1213	0	1213	0	1515	0	1816	0
	610	0	610	0	1115	0	1115	0	1212	0	1212	0	1514	0	1815	0
	609	0	609	0	1114	0	1114	0	1211	0	1211	0	1516	0	1813	0
	608	1	608	1	1113	0	1113	0	1216	0	1216	0	1512	0	1812	0
	607	2	607	2	1112	0	1112	0	1214	0	1214	0	1518	0	1810	0
	621	0	621	0	1111	0	1111	0	1207	0	1207	0	1513	0	1809	0
	606	3	606	3	1110	0	1110	0	1206	2	1206	2	1510	0	1808	1
	603	1	603	2	1109	0	1109	0	1205	0	1205	0	1507	0	1807	1
	602	1	602	2	1108	0	1108	0	1204	0	1204	0	1506	0	1806	0
	521	1	521	1	1107	2	1107	2	1203	0	1203	0	1505	1	1805	0
	506	24	506	8	1106	0	1106	0	1202	1	1202	1	1502	2	1804	1
	623	2	304	18	1105	0	1105	0	7	4	7	3	1501	0	1817	0
	624	1	305	0	1104	0	1104	0	6	3	6	4	1517	0	1803	0
	4	12	623	2	1101	9	1101	9	3	16	3	15	606	3	1802	0
	501	1	624	1	18	0	18	0	567	0	567	0	603	2	1801	0

75

N16 Key Performance Indicator Testing

JACOBS

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
	2	22	4	12	19	0	19	0	2	14	2	13	602	2	606	3
			501	1	148	0	148	0					521	1	603	2
			2	14	7	0	7	3					506	11	602	2
					6	4	6	4					304	16	521	1
					3	16	3	15					305	0	506	11
					567	0	567	0					623	2	304	16
					2	14	2	12					624	2	305	0
													4	12	623	2
													501	1	624	2
													2	14	4	12
															501	1
															2	13

76

Table 3.33: 2032 PM – N16 Turn Delay at Junctions

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	2	614	2	614	1	614	1	614	0	614	0	614	1	614	0
	613	0	613	0	1116	0	1116	0	1213	0	1213	0	1515	0	1816	0
	610	0	610	0	1115	0	1115	0	1212	0	1212	0	1514	0	1815	0
	609	0	609	0	1114	0	1114	0	1211	0	1211	0	1516	0	1813	0
	608	1	608	1	1113	0	1113	0	1216	0	1216	0	1512	0	1812	0
	607	3	607	2	1112	0	1112	0	1214	0	1214	0	1518	0	1810	0
	621	0	621	0	1111	0	1111	0	1207	0	1207	0	1513	0	1809	0
	606	3	606	3	1110	0	1110	0	1206	3	1206	3	1510	0	1808	1
	603	1	603	2	1109	0	1109	0	1205	0	1205	0	1507	0	1807	1
	602	2	602	2	1108	0	1108	0	1204	0	1204	0	1506	0	1806	0
	521	2	521	1	1107	3	1107	3	1203	0	1203	0	1505	1	1805	0
	506	23	506	9	1106	0	1106	0	1202	1	1202	1	1502	1	1804	1
	623	4	304	19	1105	0	1105	0	7	10	7	3	1501	0	1817	0
	624	4	305	0	1104	0	1104	0	6	10	6	8	1517	0	1803	0
	4	14	623	3	1101	10	1101	10	3	15	3	15	606	3	1802	0
	501	60	624	3	18	1	18	0	567	0	567	0	603	2	1801	0

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
	2	28	4	14	19	0	19	0	2	23	2	12	602	2	606	3
			501	1	148	3	148	0					521	1	603	2
			2	23	7	1	7	3					506	10	602	2
					6	14	6	8					304	18	521	1
					3	15	3	15					305	0	506	10
					567	0	567	0					623	3	304	18
					2	23	2	12					624	3	305	0
													4	14	623	3
													501	1	624	3
													2	23	4	14
															501	1
															2	23

N16 Key Performance Indicator Testing

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Table 3.34: 2047 AM – N16 Turn Delay at Junctions

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	0	614	0	614	0	614	0	614	0	614	0	614	0	614	0
	613	0	613	0	1116	0	1116	0	1213	0	1213	0	1515	0	1816	0
	610	0	610	0	1115	0	1115	0	1212	0	1212	0	1514	0	1815	0
	609	0	609	0	1114	0	1114	0	1211	0	1211	0	1516	0	1813	0
	608	2	608	2	1113	0	1113	0	1216	0	1216	0	1512	0	1812	0
	607	2	607	3	1112	0	1112	0	1214	0	1214	0	1518	0	1810	0
	621	0	621	0	1111	0	1111	0	1207	0	1207	0	1513	0	1809	0
	606	3	606	3	1110	0	1110	0	1206	1	1206	1	1510	0	1808	1
	603	2	603	4	1109	0	1109	0	1205	0	1205	0	1507	0	1807	2
	602	2	602	2	1108	0	1108	0	1204	0	1204	0	1506	0	1806	0
	521	1	521	2	1107	1	1107	1	1203	0	1203	0	1505	1	1805	0
	506	25	506	11	1106	0	1106	0	1202	1	1202	1	1502	2	1804	1
	623	2	304	17	1105	0	1105	0	7	6	7	3	1501	0	1817	0
	624	1	305	0	1104	0	1104	0	6	2	6	5	1517	0	1803	0
	4	16	623	1	1101	12	1101	12	3	16	3	15	606	3	1802	0
	501	1	624	2	18	0	18	0	567	0	567	0	603	5	1801	0

79

N16 Key Performance Indicator Testing

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	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
	2	28	4	15	19	0	19	0	2	19	2	16	602	2	606	3
			501	1	148	2	148	0					521	1	603	5
			2	17	7	1	7	3					506	13	602	2
					6	2	6	5					304	16	521	1
					3	16	3	15					305	0	506	13
					567	0	567	0					623	1	304	16
					2	19	2	15					624	1	305	0
													4	15	623	1
													501	1	624	2
													2	17	4	15
															501	1
															2	17

80

N16 Key Performance Indicator Testing

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Table 3.35: 2047 IP – N16 Turn Delay at Junctions

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	0	614	0	614	0	614	0	614	0	614	0	614	0	614	0
	613	0	613	0	1116	0	1116	0	1213	0	1213	0	1515	0	1816	0
	610	0	610	0	1115	0	1115	0	1212	0	1212	0	1514	0	1815	0
	609	0	609	0	1114	0	1114	0	1211	0	1211	0	1516	0	1813	0
	608	1	608	1	1113	0	1113	0	1216	0	1216	0	1512	0	1812	0
	607	2	607	2	1112	0	1112	0	1214	0	1214	0	1518	0	1810	0
	621	0	621	0	1111	0	1111	0	1207	1	1207	0	1513	0	1809	0
	606	3	606	3	1110	0	1110	0	1206	2	1206	2	1510	0	1808	1
	603	1	603	2	1109	0	1109	0	1205	0	1205	0	1507	0	1807	1
	602	1	602	2	1108	0	1108	0	1204	0	1204	0	1506	0	1806	0
	521	1	521	1	1107	2	1107	2	1203	0	1203	0	1505	1	1805	0
	506	22	506	8	1106	0	1106	0	1202	1	1202	1	1502	2	1804	1
	623	2	304	17	1105	0	1105	0	7	4	7	3	1501	0	1817	0
	624	1	305	0	1104	0	1104	0	6	3	6	4	1517	0	1803	0
	4	13	623	2	1101	9	1101	9	3	16	3	15	606	3	1802	0
	501	1	624	1	18	0	18	0	567	0	567	0	603	2	1801	0

81

N16 Key Performance Indicator Testing

JACOBS

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
	2	21	4	12	19	0	19	0	2	14	2	12	602	2	606	3
			501	1	148	0	148	0					521	1	603	2
			2	13	7	0	7	3					506	12	602	2
					6	4	6	4					304	16	521	1
					3	16	3	15					305	0	506	12
					567	0	567	0					623	2	304	16
					2	14	2	12					624	2	305	0
													4	12	623	2
													501	1	624	2
													2	13	4	12
															501	1
															2	13

82

N16 Key Performance Indicator Testing

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Table 3.36: 2047 PM – N16 Turn Delay at Junctions

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
N16 from Leitrim boundary to N4/N16/N15 Junction	614	2	614	2	614	1	614	1	614	0	614	0	614	2	614	0
	613	0	613	0	1116	0	1116	0	1213	0	1213	0	1515	0	1816	0
	610	0	610	0	1115	0	1115	0	1212	0	1212	0	1514	0	1815	0
	609	0	609	0	1114	0	1114	0	1211	0	1211	0	1516	0	1813	0
	608	1	608	1	1113	0	1113	0	1216	0	1216	0	1512	0	1812	0
	607	3	607	3	1112	0	1112	0	1214	0	1214	0	1518	0	1810	0
	621	0	621	0	1111	0	1111	0	1207	0	1207	0	1513	0	1809	0
	606	3	606	3	1110	0	1110	0	1206	3	1206	3	1510	0	1808	1
	603	1	603	2	1109	0	1109	0	1205	0	1205	0	1507	0	1807	1
	602	2	602	2	1108	0	1108	0	1204	0	1204	0	1506	0	1806	0
	521	2	521	1	1107	3	1107	3	1203	0	1203	0	1505	1	1805	0
	506	23	506	9	1106	0	1106	0	1202	1	1202	1	1502	1	1804	1
	623	4	304	18	1105	0	1105	0	7	10	7	3	1501	0	1817	0
	624	4	305	0	1104	0	1104	0	6	10	6	8	1517	0	1803	0
	4	15	623	3	1101	10	1101	10	3	16	3	15	606	3	1802	0
	501	65	624	3	18	1	18	0	567	0	567	0	603	2	1801	0

83

N16 Key Performance Indicator Testing

JACOBS

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)	Node no.	Delay (sec)
	2	28	4	14	19	0	19	0	2	23	2	12	602	2	606	3
			501	1	148	3	148	0					521	1	603	2
			2	23	7	0	7	3					506	10	602	2
					6	14	6	8					304	18	521	1
					3	16	3	15					305	0	506	9
					567	0	567	0					623	3	304	18
					2	23	2	12					624	3	305	0
													4	14	623	3
													501	1	624	3
													2	23	4	14
															501	1
															2	23

84

3.9 Strategic Objectives and KPIs Summary

To summarise the strategic objectives and identify the higher scoring options a summary table has been created. Table 3.37 below indicates that Options 5 and 8 perform the best at complying with the strategic objectives. Each of the options generally performs well against the objectives but in the circumstances in which it was deemed that an option did not score so well against an objective these are outlined below.

The proposed N16 AADT close to the junction with the N15 in Option 1A_S1A, 1B_S1B, 2A_S2A and 2B_S2B is quite low particularly in the northbound direction. This indicates that the proposed N16 is not well utilised in these options and that vehicles are using alternative routes.

The Select Link Analysis preformed on the existing N16 in the Do Minimum has shown that around 30% of southbound traffic diverts on to the Ballytivnan Road. In Option 1A_S1A, 1B_S1B, 2A_S2A and 2B_S2B the southbound traffic also splits itself (almost evenly in some scenarios) between the proposed N16 and existing N16 and so hasn't fulfilled this KPI.

The N15 experiences a reduction in AADT in Option 1B_S1B and 2B_S2B owing to the delay created with the roundabout proposals as part of the dual carriageway N15 upgrade in these two options. The delay experienced on this section of the N15 appears to be causing some vehicles to avoid the area by using Elm Gardens and Ballytivnan Road when travelling to and from Sligo city centre.

Journey times for route one to the N4/N16/N15 junction (Objective 5) were between 9-11 minutes for the Do Nothing and Do Minimum. The remaining options all performed better with journey times of between 7-11 minutes. Although Option 5 and 8 have been scored below the other options in Objective 5 it is important to stress that the Select Link Analysis has indicated there is a low level of strategic traffic on the N16 travelling to the N4/N16/N15 junction. Journey times for route two to Sligo city centre (Objective 6) were between 10-12 minutes for the Do Nothing and Do Minimum. Each of the options recorded comparable reduced journey times, but it was Option 5 which recorded the quickest journey times to the city centre. Options 2A_S2A, 2B_S2B and 8 were the next quickest, followed by Options 1A_S1A and 1B_S1B.

Option 1B_S1B has four consecutive junctions which have a Volume / Capacity ratio of between 52.8% and 67.0%. Although strictly speaking these junctions are on the N15 they are still part of the N16 route vehicles take to get to the N4/N16/N15 junction which was assessed consistently across all options.

A turn delay of over one minute was recorded in the Do Nothing 2047 PM peak at the junction of the existing N16 and N15. None of the other options recorded a turn delay greater than 23 seconds.

N16 Key Performance Indicator Testing

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Table 3.37: Strategic Objectives and KPIs Summary

	Objective	KPI	Option 1A_S1A	Option 1B_S1B	Option 2A_S2A	Option 2B_S2B	Option 5	Option 8
3	Effectively cater for strategic traffic on N16	AADT on N16	3	3	3	3	1	1
		Select Link Analysis of traffic on N16 at Leitrim Boundary	3	3	3	3	1	1
4	Effectively cater for strategic traffic on N15 &	AADT on N15	1	2	1	2	1	1
		AADT on N4	1	1	1	1	1	1
5	Efficiently cater for strategic national traffic	Journey Times from N16 at Leitrim Boundary to N4/N16/N15 Junction	1	1	1	1	2	2
6	Efficiently cater for strategic traffic to sligo city gateway (NSS)	Journey Times from N16 at Leitrim Boundary to Sligo City Centre	1	1	1	1	1	1
7	Operational efficiency of N16	V/C ratios of junctions on N16	1	2	1	1	1	1
		Turn Delay at Junctions on N16	1	1	1	1	1	1
		Overall Score	12	14	12	13	9	9

	Sample Scoring
Very High Preference	1
High Preference	2
Medium Preference	3
Not Applicable	N/A

86

4. Specific Objectives and KPIs

4.1 Introduction

This section details the Specific Objectives and the results of the KPIs as described in Table 1.2. The comparison of KPIs achieved in this route selection study will quantify how well each option achieves the objective.

4.2 Objective 8

Objective 8 was to ensure local roads cater for local movement. The KPI assessed as part of this objective was the AADTs on local and regional roads within the study area to the north of Sligo city to assess if they were appropriate to local levels. The results of these KPIs are detailed below.

The AADT levels on the local and regional roads selected are presented in Table 4.1 to Table 4.3 below for the year 2017, 2032 and 2047 respectively. As can be seen in each of the tables the R291 Rosses Point Road AADT levels remain fairly constant across all scenarios. The Old Bundoran Road AADT levels are generally lower than the Do Nothing apart from the Do Minimum southbound which increased by 34% in 2017. However, this increase is to a lesser extent in the 2032 (17%) and 2047 (10%) models. When compared with the Do Nothing the N16 north of Doonally Cross experienced a small reduction in northbound AADT in Options 1A_S1A, 1B_S1B, 2A_S2A and 2B_S2B. The southbound AADT on the N16 north of Doonally Cross had a greater reduction in AADT in Options 1A_S1A, 1B_S1B, 2A_S2A and 2B_S2B.

Table 4.1: 2017 AADT on Local Roads

AADT Comparison (2017)	Direction	2017 AADT (Per Direction)							
Link Name		DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
R291 Rosses Point Road	NB	1024	1023	1018	1094	1023	1094	952	969
R291 Rosses Point Road	SB	1418	1420	1421	1475	1416	1475	1420	1420
Old Bundoran Road	NB	1697	1396	1244	1128	1349	960	1015	1117
Old Bundoran Road	SB	1494	2001	1016	1441	1095	997	803	900
N16 North of Doonally Cross	NB	2356	2356	2126	2121	2091	2088	-	-
N16 North of Doonally Cross	SB	2210	2210	1074	1109	1049	1027	-	-
Total Screenline	**Two-way**	**10200**	**10406**	**7899**	**8370**	**8023**	**7641**	**4191**	**4406**

N16 Key Performance Indicator Testing

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Table 4.2: 2032 AADT on Local Roads

AADT Comparison (2032)	Direction	2032 AADT (Per Direction)							
Link Name		DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
R291 Rosses Point Road	NB	1220	1221	1219	1321	1218	1321	1176	1196
R291 Rosses Point Road	SB	1617	1617	1618	1693	1611	1693	1617	1617
Old Bundoran Road	NB	2150	1823	1692	1340	1562	1014	1178	1303
Old Bundoran Road	SB	2177	2543	1656	2060	1361	1354	1130	1373
N16 North of Doonally Cross	NB	2599	2599	2334	2321	2281	2281	-	-
N16 North of Doonally Cross	SB	2446	2446	1121	1145	1259	1222	-	-
Total Screenline	**Two-way**	**12210**	**12251**	**9639**	**9880**	**9292**	**8885**	**5101**	**5489**

Table 4.3: 2047 AADT on Local Roads

AADT Comparison (2047)	Direction	2047 AADT (Per Direction)							
Link Name		DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
R291 Rosses Point Road	NB	1246	1157	1254	1363	1252	1363	1063	1072
R291 Rosses Point Road	SB	1648	1652	1652	1714	1645	1733	1652	1652
Old Bundoran Road	NB	2242	1948	1689	1379	1594	1027	1389	1580
Old Bundoran Road	SB	2368	2614	1697	2313	1404	1864	1327	1508
N16 North of Doonally Cross	NB	2623	2623	2362	2349	2305	2303	-	-

AADT Comparison (2047)	Direction	2047 AADT (Per Direction)							
Link Name		DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
N16 North of Doonally Cross	SB	2463	2463	1144	1173	1282	1167	-	-
Total Screenline	Two-way	**12591**	**12456**	**9799**	**10291**	**9481**	**9457**	**5432**	**5811**

4.3 Objective 9

Objective 9 was to determine if the road network could cater for future traffic. The KPI assessed as part of this objective was the Volume / Capacity ratios throughout the entire Sligo modelled network. The result of this KPI has been broken into three bands (number of junctions with V/C >85%, 50% - 85% and <50%) and is presented in Table 4.4 to Table 4.6 below. The three bands have been colour coded red, amber and green. The results indicated that a high number of the junctions recorded a V/C ratio of less than 50% and in most cases the remaining junctions were between 50% - 85% inclusive. In one instance a V/C ratio of over 85% was recorded however this was in the 2047 AM Do Nothing scenario. The node in question was the city centre signalised junction of the R292 / O'Connell Street / Fish Quay.

In the AM and IP peak periods the number of V/C ratios between 50% - 85% is fairly constant with 4-6 and 1-2 junctions respectively. In the PM peak period the number is 6-11 with Option 2A_S2A, 5 and 8 performing the best, each with six junctions between 50% - 85%.

It should be noted that the SATURN model considers the peak hour and does not consider the profile of traffic within that peak hour. As such, capacity issues that can occur within the peak hour may not be represented in the model due to "flattening out" of the peak hour in the SATURN model, resulting in very few junctions having a V/C ratio of greater than 85%.

Maps illustrating the 2047 AM and PM Volume / Capacity locations are in Appendix B.

Table 4.4: 2047 AM Volume / Capacity Ratios

	2047 AM Volume / Capacity Ratios							
	DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
No. of Junctions	160	165	179	180	179	180	180	176
V / C Ratio >85%	1	0	0	0	0	0	0	0
V / C Ratio 50% - 85%	5	4	5	6	5	4	5	5
V / C Ratio <50%	154	161	174	174	174	176	175	171

Table 4.5: 2047 IP Volume / Capacity Ratios

	2047 IP Volume / Capacity Ratios							
	DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
No. of Junctions	160	165	179	180	179	180	180	176
V / C Ratio >85%	0	0	0	0	0	0	0	0
V / C Ratio 50% - 85%	2	1	2	1	2	0	1	1
V / C Ratio <50%	158	164	177	179	177	180	179	175

Table 4.6: 2047 PM Volume / Capacity Ratios

	2047 PM Volume / Capacity Ratios							
	DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
No. of Junctions	160	165	179	180	179	180	180	176
V / C Ratio >85%	0	0	0	0	0	0	0	0
V / C Ratio 50% - 85%	11	7	8	11	6	7	6	6
V / C Ratio <50%	149	158	171	169	173	173	174	170

4.4 Objective 10

Objective 10 was to reduce congestion on the network. The KPIs assessed as part of this objective were transient and over-capacity queuing. Transient queuing relates to the overall level of queuing throughout the entire model network that occurs associated with typical under-capacity junction operation, but ultimately can be accommodated by the network. Over-capacity queuing relates to the level of queuing associated with junctions that have reached capacity.

The results of these KPIs are presented in Table 4.7 to Table 4.9 below. As can be seen the transient queuing recorded is fairly constant in each of the three peak periods (AM 217.6 – 225.2), (IP 151.9 – 171.2) and (PM 243.7 – 309.6). OP2B_S2B has the least amount of transient queuing in all peak time periods.

Over-capacity queuing outside of the Do Nothing scenario is minimal in the AM and IP peak periods. In the PM peak period there is a noticeable increase in the OP1A_S1A and OP2A_S2A scenarios to 16.4 and 12.7 PCU Hrs / Hr, however this is not deemed excessive.

Table 4.7: 2047 AM Congestion

	2047 AM Congestion							
	DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
Transient Queues (PCU Hrs / Hr)	225.1	219.3	225.2	222.6	221.7	217.6	218.4	218.2
Over-Capacity Queues (PCU Hrs / Hr)	19.2	1.2	1.5	1.4	1.4	1.5	1.5	1.5

Table 4.8: 2047 IP Congestion

	2047 IP Congestion							
	DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
Transient Queues (PCU Hrs / Hr)	171.2	165.8	157	154.9	155.8	151.9	165.4	165.3
Over-Capacity Queues (PCU Hrs / Hr)	4.2	0	0	0	0	0	0	0

Table 4.9: 2047 PM Congestion

	2047 PM Congestion							
	DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
Transient Queues (PCU Hrs / Hr)	309.6	280.8	274.6	248.5	270.4	243.7	280.6	280.8
Over-Capacity Queues (PCU Hrs / Hr)	49.1	0.2	16.4	2.5	12.7	2.3	0.3	0.3

4.5 Objective 11

Objective 11 was to assess overall network operations. The KPIs assessed as part of this objective were total travel time, travel distance and average speed. Total travel time is the total amount of travel time summed for all trips made on the entire model network. The travel distance is the total distance travelled summed for all trips made on the network. The average speed relates to the average vehicle speed of traffic over the entire network.

The results of these KPIs are presented in Table 4.10 to Table 4.12 below. OP2B_S2B recorded the lowest total travel time and highest average speed in each of the three peak periods. Across the three peak periods OP2A_S2A recorded the lowest overall travel distance.

Table 4.10: 2047 AM Overall Network Operations

	2047 AM Overall Network Operations							
	DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
Total Travel Time (PCU Hrs / Hr)	952.7	913.6	918.2	917.4	909.9	906.6	908.2	909.1
Travel Distance (PCU KMs / Hr)	45783.4	45623.7	45719.1	45765.6	45493.1	45592.8	45452.1	45644.6
Average Speed (Kph)	48.1	49.9	49.8	49.9	50	50.3	50	50.2

Table 4.11: 2047 IP Overall Network Operations

	2047 IP Overall Network Operations							
	DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
Total Travel Time (PCU Hrs / Hr)	674.4	655.2	642.3	640.6	639	636.2	652.8	653.5
Travel Distance (PCU KMs / Hr)	32437.2	32336.8	32382.5	32440.9	32246.8	32343	32262.5	32347.6
Average Speed (Kph)	48.1	49.4	50.4	50.6	50.5	50.8	49.4	49.5

Table 4.12: 2047 PM Overall Network Operations

	2047 PM Overall Network Operations							
	DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
Total Travel Time (PCU Hrs / Hr)	1125.8	1039.7	1045.5	1003.9	1031.6	992.5	1035.2	1034.5
Travel Distance (PCU KMs / Hr)	49110.6	49019	49013.6	49155.1	48788.5	48939.6	48969.1	48991
Average Speed (Kph)	43.6	47.1	46.9	49	47.3	49.3	47.3	47.4

4.6 Objective 12

Objective 12 was to assess the environmental impact. The KPIs assessed as part of this objective were vehicle emissions in terms of Carbon Monoxide, Carbon Dioxide, Nitrous Oxides and Hydro Carbons. These are model network wide vehicle emissions resulting from the proposed scheme as modelled in the SATURN model. The results of these KPIs are presented in Table 4.13 below which detail the proposed 2047 daily emissions for each option. The results indicate that each of the proposed options have fewer emissions than the Do Nothing and Do Minimum with limited difference between them. However, the options with the least emissions were identified as Option 2B_S2B and 1B_S1B.

Table 4.13: 2047 Daily Vehicle Emissions

	2047 Daily Vehicle Emissions							
	DN	DM	OP1A_S1A	OP1B_S1B	OP2A_S2A	OP2B_S2B	OP5	OP8
Carbon Monoxide (Kg)	3978	3805	3745	3693	3732	3680	3794	3792
Carbon Dioxide (Kg)	48433	47342	47109	46782	46939	46649	47270	47332
Nitrous Oxides (Kg)	1019	992	983	979	978	974	988	988
Hydro Carbons (Kg)	722	692	682	676	679	670	690	690

4.7 Objective 13

Objective 13 was to assess the operational efficiency of the N15. The KPI assessed as part of this objective was the Volume / Capacity ratios of junctions on the N15 which are presented in Table 4.14 to Table 4.16 below. These tables detail the AM, IP and PM peak periods for 2047. For each scenario the Volume / Capacity ratios along the whole of the N15 began at node 51 (at Cashelgarran) and continued to node 2 (at the N4 / N16 / N15 junction). Model Option 1A_S1A and 1B_S1B have an additional node (node 1101) used which is reflected in the tables. For ease of reading, Volume / Capacity ratios of less than 50% were coloured green, between 50% – 85% inclusive were coloured amber and over 85% were coloured red.

Across all scenarios most of the Volume / Capacity ratios of junctions on the N15 were under 50% with a small number of junctions between 50% - 85%. No junctions on the N15 had a Volume / Capacity ratio of over 85%.

It is worth noting that Option 1B_S1B had four consecutive junctions with an amber Volume / Capacity ratio. Node 1101 (the roundabout junction with the Proposed N16 and N15), node 18 (N15), node 19 (N15) and node 148 (N15) each recorded a Volume / Capacity ratio of between 52.8% and 67.0% in the 2047 PM peak model. Although these ratios are well within 100% it has been identified as the worst preforming section of any model scenario with these four consecutive junctions experiencing congestion, albeit at no more than two thirds of the capacity available.

N16 Key Performance Indicator Testing

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Table 4.14: 2047 AM – N15 Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
N15	51	12.7	51	12.7	51	12.7	51	12.7	51	12.7	51	12.7	51	12.7	51	12.7
	50	26.3	50	26.4	50	26.3	50	26.3	50	26.4	50	26.3	50	26.3	50	26.3
	48	25.8	48	25.9	48	25.8	48	25.8	48	25.6	48	25.8	48	25.6	48	25.8
	43	26.9	43	27.0	43	27.0	43	27.0	43	26.9	43	26.9	43	26.8	43	26.9
	42	28.2	42	28.3	42	28.5	42	28.5	42	28.2	42	28.3	42	28.0	42	28.3
	38	28.7	38	28.7	38	29.0	38	29.0	38	28.6	38	28.7	38	28.5	38	28.7
	37	29.9	37	30.0	37	30.2	37	30.2	37	30.0	37	30.0	37	29.8	37	30.0
	36	31.0	36	31.0	36	31.3	36	31.3	36	31.0	36	31.0	36	30.9	36	31.0
	35	34.0	35	34.0	35	34.3	35	34.3	35	34.0	35	34.0	35	33.8	35	34.0
	29	33.9	29	33.9	29	33.9	29	34.0	29	33.9	29	33.9	29	33.6	29	33.8
	28	33.3	28	33.2	28	33.3	28	33.3	28	33.2	28	33.3	28	33.0	28	33.2
	26	0.4	26	0.4	26	0.1	26	0.1	26	0.5	26	0.5	26	0.3	26	0.6
	16	0.7	16	0.7	16	0.7	16	0.7	16	0.7	16	0.7	16	0.7	16	0.7
	119	33.4	119	33.4	119	33.2	119	33.7	119	33.3	119	33.3	119	33.3	119	33.2
	17	35.5	17	35.4	17	47.0	17	42.4	17	35.3	17	35.4	17	35.3	17	35.2

94

N16 Key Performance Indicator Testing

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	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	18	34.5	18	34.5	1101	63.6	1101	64.1	18	34.1	18	34.3	18	34.6	18	34.3
	19	31.6	19	31.5	18	37.6	18	51.4	19	31.9	19	31.8	19	31.7	19	31.6
	148	32.3	148	32.5	19	34.2	19	47.2	148	32.2	148	32.2	148	32.6	148	32.5
	7	30.7	7	32.0	148	35.3	148	48.1	7	53.0	7	25.0	7	33.4	7	32.7
	6	35.3	6	34.9	7	34.0	7	32.1	6	36.6	6	33.7	6	35.4	6	34.7
	3	33.7	3	29.7	6	36.5	6	32.9	3	30.9	3	27.1	3	28.9	3	29.0
	567	25.2	567	24.7	3	30.8	3	26.7	567	25.8	567	22.6	567	24.1	567	24.2
	2	45.8	2	38.5	567	25.7	567	22.3	2	42.2	2	35.8	2	38.2	2	38.3
					2	42.8	2	35.7								

95

Table 4.15: 2047 IP – N15 Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
N15	51	20.1	51	20.1	51	20.1	51	20.1	51	20.1	51	20.1	51	20.1	51	20.1
	50	15.2	50	15.2	50	15.5	50	15.5	50	15.2	50	15.2	50	15.2	50	15.2
	48	13.2	48	13.2	48	13.5	48	13.5	48	13.2	48	13.2	48	13.2	48	13.2
	43	13.9	43	13.9	43	13.7	43	13.7	43	13.9	43	13.9	43	13.9	43	13.9
	42	15.4	42	15.4	42	15.5	42	15.5	42	15.4	42	15.4	42	15.4	42	15.4
	38	15.3	38	15.3	38	15.4	38	15.4	38	15.3	38	15.3	38	15.3	38	15.3
	37	22.7	37	22.7	37	22.6	37	22.6	37	22.8	37	22.7	37	22.7	37	22.7
	36	24.3	36	24.3	36	24.1	36	24.1	36	24.3	36	24.3	36	24.3	36	24.3
	35	24.4	35	24.5	35	24.3	35	24.3	35	24.5	35	24.5	35	24.5	35	24.5
	29	24.0	29	24.0	29	23.8	29	23.8	29	24.0	29	24.0	29	24.0	29	24.0
	28	23.6	28	23.6	28	23.4	28	23.4	28	23.6	28	23.5	28	23.5	28	23.5
	26	0.7	26	0.7	26	0.2	26	0.2	26	0.8	26	0.8	26	0.7	26	0.8
	16	0.4	16	0.4	16	0.4	16	0.4	16	0.4	16	0.4	16	0.4	16	0.4
	119	23.3	119	23.3	119	23.5	119	23.5	119	23.2	119	23.2	119	23.3	119	23.2
	17	26.0	17	26.1	17	34.9	17	31.0	17	25.9	17	25.9	17	26.0	17	25.9

N16 Key Performance Indicator Testing

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	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	18	25.2	18	25.4	1101	42.1	1101	42.1	18	25.0	18	25.1	18	25.3	18	25.2
	19	24.2	19	24.4	18	28.2	18	37.7	19	24.6	19	24.6	19	24.4	19	24.4
	148	22.9	148	23.1	19	26.9	19	36.9	148	23.0	148	23.0	148	23.1	148	23.1
	7	26.3	7	25.8	148	25.8	148	35.0	7	41.2	7	20.0	7	26.3	7	26.2
	6	28.2	6	26.9	7	28.5	7	27.6	6	30.0	6	24.6	6	26.7	6	26.9
	3	20.7	3	20.7	6	29.7	6	24.4	3	22.2	3	18.1	3	19.5	3	19.7
	567	18.1	567	17.2	3	22.0	3	17.9	567	18.5	567	15.1	567	16.2	567	16.3
	2	32.1	2	26.6	567	18.3	567	14.9	2	27.4	2	24.8	2	25.4	2	25.5
					2	27.4	2	24.9								

N16 Key Performance Indicator Testing

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Table 4.16: 2047 PM – N15 Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
N15	51	30.3	51	30.6	51	30.4	51	30.6	51	30.4	51	30.6	51	30.6	51	30.6
	50	19.4	50	19.5	50	19.6	50	19.6	50	19.5	50	19.5	50	19.5	50	19.5
	48	18.1	48	18.2	48	18.2	48	18.2	48	18.1	48	18.2	48	18.2	48	18.2
	43	19.6	43	19.7	43	19.2	43	19.2	43	19.6	43	19.7	43	19.7	43	19.7
	42	20.6	42	20.7	42	21.1	42	21.1	42	20.7	42	20.7	42	20.7	42	20.7
	38	20.7	38	20.8	38	21.2	38	21.3	38	20.8	38	20.8	38	20.8	38	20.8
	37	33.1	37	33.3	37	33.6	37	33.8	37	33.2	37	33.3	37	33.3	37	33.3
	36	36.1	36	36.3	36	36.5	36	36.7	36	36.2	36	36.3	36	36.3	36	36.3
	35	35.8	35	36.0	35	36.2	35	36.4	35	35.9	35	36.0	35	36.0	35	36.0
	29	35.6	29	35.8	29	35.9	29	36.2	29	35.6	29	35.8	29	35.7	29	35.7
	28	35.1	28	35.2	28	35.4	28	35.6	28	35.1	28	35.2	28	35.1	28	35.1
	26	0.4	26	0.4	26	0.6	26	0.1	26	0.5	26	0.5	26	0.4	26	0.5
	16	0.7	16	0.6	16	1.1	16	0.6	16	0.6	16	0.6	16	0.6	16	0.6
	119	34.5	119	34.8	119	34.5	119	35.5	119	34.6	119	34.9	119	34.7	119	34.6
	17	37.8	17	38.1	17	50.5	17	46.0	17	38.0	17	38.3	17	38.1	17	38.0

98

N16 Key Performance Indicator Testing

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	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	18	36.9	18	37.2	1101	65.1	1101	67.0	18	36.9	18	37.0	18	37.3	18	37.2
	19	34.7	19	35.4	18	41.0	18	57.6	19	35.2	19	35.7	19	35.4	19	35.4
	148	34.8	148	34.4	19	38.7	19	56.2	148	34.1	148	34.2	148	34.5	148	34.4
	7	37.5	7	38.3	148	38.4	148	52.8	7	68.3	7	29.8	7	38.3	7	38.3
	6	45.6	6	42.0	7	40.9	7	38.8	6	45.8	6	40.4	6	42.0	6	42.0
	3	36.3	3	32.7	6	46.9	6	39.8	3	34.9	3	27.1	3	32.6	3	32.6
	567	29.4	567	26.9	3	34.7	3	26.8	567	28.9	567	22.7	567	26.9	567	26.9
	2	64.3	2	52.5	567	28.7	567	22.4	2	47.9	2	36.9	2	52.0	2	52.1
					2	47.8	2	36.8								

99

4.8 Objective 14

Objective 14 was to assess the operational efficiency of key city centre junctions. The KPI assessed as part of this objective was the Volume / Capacity ratios of the key city centre junctions which are presented in Table 4.17 to Table 4.19 below. These tables detail the AM, IP and PM peak periods for 2047. For ease of reading, Volume / Capacity ratios of less than 50% were coloured green, between 50% – 85% inclusive were coloured amber and over 85% were coloured red.

Across all scenarios most of the Volume / Capacity ratios of the key city centre junctions were under 50% with a small number of junctions between 50% - 85% inclusive. One key city centre junction had a Volume / Capacity ratio of over 85% however this was in the 2047 AM Do Nothing scenario.

Overall, the worst preforming junction is node 619 which across all the options recorded a varying Volume / Capacity ratio of between 50% - 85% inclusive in the 2047 AM, IP and PM peaks. Node 619 is the signalised junction of the R292 / O'Connell Street / Fish Quay in the centre of Sligo city.

Two further nodes on either side of node 619 also experienced volume / capacity ratios of between 50% - 85% inclusive in the Do Nothing AM and PM peak periods. However, both of these junctions (nodes 510 and 516) decreased to a less than 50% volume / capacity ratio in each of the proposed option models. Node 510 is the priority junction on the east side of the R292 Hyde Bridge where it meets with the R286 Stephen Street. Node 516 is the priority junction of the R292 Wine Street and Quay Street.

Figure 4.1 below illustrates the location of the nodes in Sligo city centre.

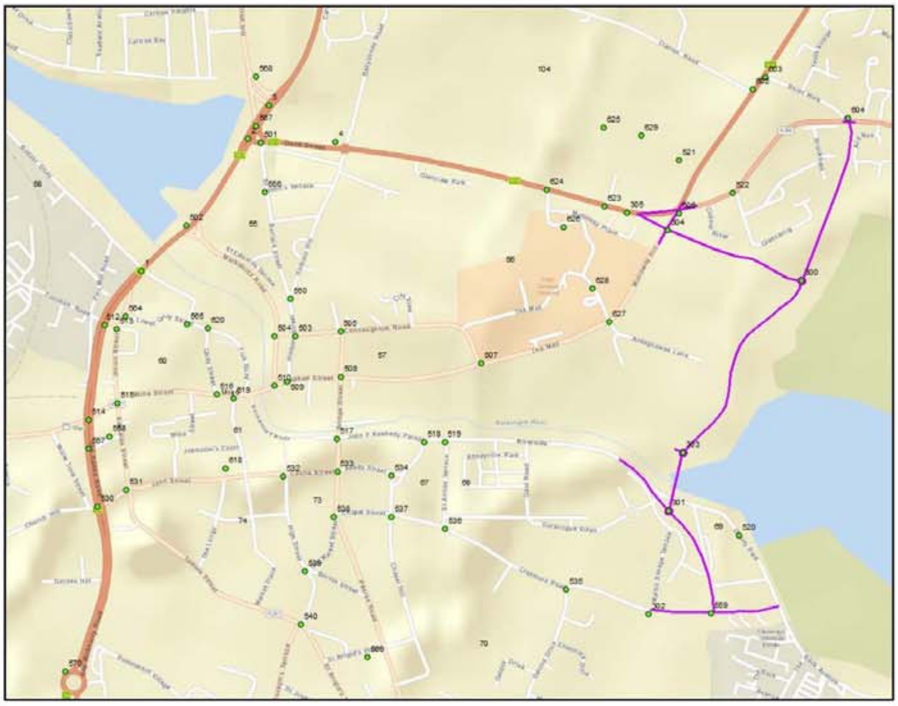

Figure 4.1: Sligo City Centre junction node numbers

N16 Key Performance Indicator Testing

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Table 4.17: 2047 AM – City Centre Junctions Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
City Centre Junctions			304	16.2	304	15.7	304	14.9	304	16.0	304	15.0	304	17.4	304	17.4
			305	5.5	305	5.7	305	4.3	305	5.5	305	4.3	305	6.3	305	6.2
	501	22.6	501	24.4	501	24.6	501	20.3	501	23.4	501	19.6	501	24.8	501	24.7
	502	42.5	502	32.5	502	33.3	502	32.5	502	33.3	502	32.5	502	32.2	502	32.2
	503	35.1	503	29.5	503	28.8	503	30.1	503	28.4	503	30.2	503	28.2	503	28.2
	504	29.9	504	25.7	504	25.2	504	24.7	504	24.8	504	24.8	504	24.9	504	24.9
	505	25.7	505	20.3	505	19.5	505	19.3	505	19.4	505	19.4	505	19.9	505	19.9
	506	27.8	506	14.8	506	14.2	506	13.9	506	14.8	506	14.0	506	16.2	506	16.2
	507	20.7	507	10.5	507	9.9	507	9.9	507	10.3	507	9.9	507	11.5	507	11.5
	508	21.5	508	16.2	508	15.3	508	15.0	508	15.0	508	15.3	508	16.2	508	16.2
	509	3.3	509	3.3	509	3.3	509	3.3	509	3.3	509	3.3	509	3.3	509	3.3
	510	56.5	510	43.1	510	42.6	510	42.0	510	41.5	510	42.3	510	41.8	510	41.8
	515	38.1	515	24.8	515	26.2	515	27.3	515	29.6	515	27.0	515	24.3	515	24.3
	516	69.4	516	43.1	516	42.4	516	41.8	516	43.1	516	42.0	516	41.1	516	41.1
	517	19.9	517	14.3	517	13.3	517	13.0	517	13.1	517	13.3	517	14.3	517	14.3

101

N16 Key Performance Indicator Testing

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	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	531	37.8	531	22.1	531	21.3	531	21.7	531	24.1	531	21.7	531	21.5	531	21.4
	532	20.0	532	15.2	532	15.4	532	15.3	532	15.1	532	15.3	532	15.2	532	15.2
	533	29.7	533	20.9	533	19.6	533	19.5	533	20.0	533	19.6	533	20.9	533	20.9
	534	5.4	534	6.1	534	5.6	534	5.9	534	6.0	534	5.6	534	6.4	534	6.4
	538	22.0	538	15.2	538	15.1	538	15.0	538	15.4	538	15.0	538	15.2	538	15.2
	550	13.9	550	10.3	550	9.9	550	11.7	550	9.8	550	11.9	550	9.9	550	9.9
	564	3.6	564	3.2	564	5.2	564	5.2	564	5.2	564	5.2	564	3.2	564	3.2
	569	22.6	569	14.8	569	14.9	569	14.8	569	15.1	569	14.9	569	14.8	569	14.7
	619	85.8	619	65.4	619	64.6	619	63.8	619	63.1	619	64.1	619	63.5	619	63.5
	623	33.6	623	24.4	623	24.6	623	21.9	623	24.4	623	22.3	623	26.1	623	26.0
	624	38.5	624	33.5	624	33.9	624	30.9	624	33.6	624	31.2	624	35.3	624	35.2
	626	9.2	626	12.2	626	12.4	626	12.4	626	12.3	626	12.3	626	13.3	626	13.3
	627	32.8	627	19.1	627	18.1	627	18.2	627	18.9	627	18.2	627	20.0	627	19.9
	628	11.3	628	8.5	628	8.3	628	8.3	628	8.4	628	8.4	628	7.4	628	7.4

102

N16 Key Performance Indicator Testing

Table 4.18: 2047 IP – City Centre Junctions Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
City Centre Junctions			304	10.5	304	9.3	304	9.3	304	10.0	304	9.8	304	12.5	304	12.5
			305	5.6	305	4.6	305	4.6	305	4.9	305	4.8	305	5.8	305	5.8
	501	14.7	501	16.9	501	16.9	501	14.7	501	16.1	501	14.1	501	16.6	501	16.6
	502	31.7	502	25.0	502	25.7	502	24.2	502	25.4	502	24.1	502	24.1	502	24.2
	503	28.2	503	25.2	503	23.7	503	26.2	503	23.5	503	25.8	503	24.1	503	24.1
	504	25.8	504	24.8	504	24.0	504	23.2	504	23.9	504	23.0	504	24.0	504	24.1
	505	25.4	505	23.6	505	22.2	505	21.9	505	22.1	505	21.8	505	23.6	505	23.6
	506	17.6	506	9.2	506	8.8	506	8.7	506	9.7	506	9.2	506	11.5	506	11.4
	507	11.1	507	8.2	507	7.6	507	7.5	507	7.9	507	7.8	507	9.5	507	9.5
	508	29.9	508	28.2	508	26.2	508	25.9	508	26.2	508	25.9	508	28.3	508	28.4
	509	8.1	509	9.2	509	8.9	509	8.9	509	8.9	509	8.9	509	9.1	509	9.2
	510	47.2	510	40.8	510	40.7	510	39.8	510	40.7	510	39.7	510	40.8	510	40.9
	515	27.1	515	24.0	515	22.5	515	22.7	515	22.8	515	22.7	515	24.0	515	24.0
	516	42.7	516	39.3	516	38.6	516	38.1	516	38.5	516	38.1	516	39.2	516	39.3

103

N16 Key Performance Indicator Testing

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	517	24.8	517	22.1	517	20.2	517	20.0	517	20.3	517	19.9	517	22.3	517	22.3
	531	38.9	531	28.3	531	32.3	531	32.3	531	32.7	531	32.2	531	28.3	531	28.2
	532	22.5	532	14.9	532	15.7	532	15.4	532	15.9	532	15.4	532	14.9	532	14.9
	533	40.2	533	34.2	533	30.9	533	30.4	533	31.2	533	30.5	533	34.5	533	34.6
	534	5.8	534	5.5	534	5.6	534	5.6	534	5.8	534	5.7	534	5.5	534	5.5
	538	28.2	538	23.3	538	21.2	538	20.9	538	21.6	538	20.9	538	23.6	538	23.6
	550	13.1	550	9.5	550	8.6	550	12.1	550	8.5	550	11.9	550	9.0	550	9.0
	564	3.7	564	3.5	564	4.7	564	4.9	564	4.9	564	4.9	564	3.4	564	3.4
	569	29.5	569	23.4	569	20.0	569	20.0	569	20.5	569	20.0	569	23.5	569	23.6
	619	62.0	619	50.5	619	51.4	619	50.1	619	51.5	619	49.9	619	50.5	619	50.6
	623	20.5	623	17.2	623	16.4	623	15.4	623	16.7	623	15.6	623	17.3	623	17.3
	624	25.3	624	23.2	624	23.1	624	22.1	624	23.3	624	22.1	624	23.8	624	23.9
	626	5.3	626	6.2	626	6.3	626	6.3	626	6.1	626	6.3	626	6.1	626	6.2
	627	16.9	627	13.4	627	12.2	627	12.1	627	12.8	627	12.6	627	15.3	627	15.2
	628	3.3	628	2.5	628	2.3	628	2.3	628	2.6	628	2.3	628	2.5	628	2.5

104

N16 Key Performance Indicator Testing

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Table 4.19: 2047 PM – City Centre Junctions Volume/Capacity Ratios

	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
City Centre Junctions			304	14.4	304	12.4	304	13.4	304	13.4	304	13.7	304	16.9	304	16.5
			305	7.4	305	5.6	305	8.0	305	5.6	305	8.0	305	8.0	305	7.9
	501	34.1	501	25.9	501	27.0	501	21.4	501	26.6	501	21.0	501	25.4	501	25.5
	502	48.2	502	36.4	502	35.1	502	35.0	502	35.4	502	35.0	502	35.9	502	36.0
	503	32.0	503	26.8	503	26.6	503	28.5	503	26.5	503	28.4	503	26.3	503	26.4
	504	28.8	504	28.0	504	25.5	504	24.7	504	25.3	504	24.6	504	27.9	504	27.9
	505	31.7	505	29.0	505	29.9	505	27.5	505	29.9	505	27.6	505	29.1	505	29.1
	506	28.8	506	14.4	506	13.2	506	13.0	506	14.5	506	13.3	506	16.2	506	15.9
	507	14.3	507	10.2	507	12.0	507	9.7	507	12.1	507	9.9	507	11.1	507	10.9
	508	34.4	508	33.8	508	34.4	508	32.4	508	34.4	508	32.4	508	33.9	508	33.9
	509	6.6	509	8.5	509	7.4	509	7.6	509	7.4	509	7.6	509	8.5	509	8.5
	510	50.6	510	45.8	510	40.5	510	41.3	510	39.9	510	41.1	510	45.6	510	45.6
	515	33.2	515	27.0	515	19.6	515	18.4	515	20.6	515	18.4	515	26.5	515	26.6
	516	54.9	516	47.9	516	39.1	516	37.5	516	38.7	516	37.3	516	47.1	516	47.0
	517	30.7	517	28.5	517	29.9	517	27.8	517	30.0	517	27.7	517	28.6	517	28.6

N16 Key Performance Indicator Testing

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	DN		DM		OP1A_S1A		OP1B_S1B		OP2A_S2A		OP2B_S2B		OP5		OP8	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	531	50.2	531	41.8	531	41.5	531	38.6	531	41.8	531	38.5	531	41.7	531	41.7
	532	25.5	532	22.1	532	23.8	532	22.4	532	24.3	532	22.4	532	22.2	532	22.2
	533	47.3	533	42.9	533	44.3	533	39.6	533	43.9	533	39.5	533	43.2	533	43.1
	534	10.9	534	11.9	534	12.2	534	10.8	534	11.7	534	10.9	534	12.5	534	12.4
	538	35.5	538	31.6	538	32.3	538	28.5	538	31.6	538	28.5	538	31.7	538	31.7
	550	12.5	550	8.6	550	9.8	550	12.9	550	9.4	550	12.7	550	7.8	550	8.0
	564	8.2	564	7.2	564	5.7	564	6.3	564	6.3	564	6.2	564	7.3	564	7.2
	569	42.3	569	37.0	569	36.8	569	30.0	569	35.3	569	30.0	569	37.5	569	37.5
	619	71.0	619	59.8	619	53.8	619	54.7	619	53.0	619	54.4	619	59.6	619	59.4
	623	31.0	623	21.8	623	19.5	623	19.7	623	19.6	623	19.9	623	22.7	623	22.6
	624	37.5	624	30.1	624	27.5	624	28.1	624	27.3	624	28.3	624	31.4	624	31.2
	626	3.6	626	3.4	626	4.6	626	4.6	626	3.5	626	4.6	626	3.5	626	3.5
	627	21.8	627	17.5	627	18.6	627	15.8	627	19.5	627	16.1	627	19.1	627	18.8
	628	3.5	628	3.8	628	2.5	628	2.6	628	3.7	628	2.6	628	3.7	628	3.7

4.9 Objective 15

Objective 15 was to assess the impact on future pedestrianisation of Sligo city centre. The KPI assessed as part of this objective was the traffic volume changes on links within Sligo city which are presented in Table 4.20 below. This table details the changes in 2047 AADT flow across all the assessed scenarios when compared with the 2047 Do Minimum scenario. For ease of reading, percentage difference changes of greater than +15% have been coloured dark red indicating a notable increase in vehicular traffic. Percentage difference changes of greater than -15% have been coloured dark green indicating a notable decrease in vehicular traffic. Smaller percentage changes of between 0% to +15%, and 0% to -15% have been coloured light red and light green respectively.

As can be seen in Table 4.20 the AADT on the R870 Markievicz Road experienced a reduction in flow of approximately 52% in the northbound direction in Option 1B_S1B and Option 2B_S2B. Similarly, the R870 Markievicz Road southbound also experienced a reduction in flow of between 25% - 28% in Option 1B_S1B and Option 2B_S2B.

However, the traffic model indicates that any benefit gained by Markievicz Road northbound in Option 1B_S1B and Option 2B_S2B has a negative impact on Holborn Street northbound as it experienced an increase in flow of between 48% - 50%. The reason for this shift in traffic patterns on Markievicz Road and Holborn Street in Option 1B_S1B and 2B_S2B is likely due to the fact that more traffic is using the Ballytivnan Road in these options. The proposed N15 upgrade in Option 1B_S1B and 2B_S2B appears to encourage some vehicles to use the alternative Ballytivnan Road and Elm Gardens to access the N15 northbound. This route avoids some of the congestion experienced on the N15 in these options, the signalised junction of Markievicz Road / N15 and the signalised junction of the existing N16 / N15. This may explain the Markievicz Road traffic flow reduction and Holborn Street traffic flow increase in Option 1B_S1B and 2B_S2B.

The R286 Connaughton Road westbound (at the junction with City View) experienced an increase in flow of 39% in both the Option 5 and Option 8 models. It is believed that this is due to the fact that all traffic on the proposed N15 alignment in both these options enters the city centre via Molloway Hill and uses the R286 loop road to access the city centre. However, it is deemed that this increase on the R286 is not likely to adversely impact on city centre pedestrians as the R286 is designed to take vehicular traffic and is an area of relatively low pedestrian numbers when compared to other parts of the city centre (O'Connell Street, John Street, Grattan Street, Market Street and High Street). As previously discussed in Section 3.3.3 and illustrated in Figure 3.2 the R286 Connaughton Road according to the SEDP is a vehicular access to and from the city centre and so an increase in vehicular traffic on this route would not contravene the objectives of the SEDP.

All other city centre links experienced smaller changes in flows of between +/-10%. Most of these smaller percentage changes were positive reductions in city centre traffic volumes.

Table 4.20: 2047 Sligo City Centre Traffic Volume Changes

Link Name	2047 DM	2047 DM_OP1A_S1A			2047 DM_OP1B_S1B			2047 DM_OP2A_S2A			2047 DM_OP2B_S2B			2047 DM_OP5			2047 DM_OP8		
	Flow	Flow	Diff	% Diff	Flow	Diff	% Diff	Flow	Diff	% Diff	Flow	Diff	% Diff	Flow	Diff	% Diff	Flow	Diff	% Diff
R292 Hyde Bridge (EB) (one way)	9141	8958	-183	-2.0%	8820	-321	-3.5%	8900	-241	-2.6%	8799	-342	-3.7%	9097	-44	-0.5%	9096	-45	-0.5%
R286 WB (at jct with City View)	1663	1602	-61	-3.7%	1505	-158	-9.5%	1684	21	1.3%	1570	-93	-5.6%	2323	660	39.7%	2314	651	39.2%
R286 EB (from Holburn St jct) (one way)	11925	11513	-413	-3.5%	12462	536	4.5%	11475	-450	-3.8%	12377	452	3.8%	11622	-303	-2.5%	11636	-290	-2.4%
R286 EB (towards Holburn St jct) (one way)	12002	11568	-434	-3.6%	11141	-861	-7.2%	11483	-519	-4.3%	11059	-943	-7.9%	11537	-465	-3.9%	11512	-490	-4.1%
R870 Markievicz Rd NB	3445	3234	-211	-6.1%	1643	-1803	-52.3%	3181	-265	-7.7%	1646	-1799	-52.2%	3370	-75	-2.2%	3383	-62	-1.8%
Holborn St NB	2682	2525	-157	-5.8%	4017	1336	49.8%	2499	-183	-6.8%	3979	1298	48.4%	2611	-71	-2.6%	2642	-40	-1.5%
R286 WB (at Ulster Bank) (one way)	3013	2889	-124	-4.1%	2894	-120	-4.0%	2881	-133	-4.4%	2896	-117	-3.9%	3003	-10	-0.3%	3013	0	0.0%
R286 WB (at jct with Stephen St) (one way)	3013	2888	-125	-4.1%	2894	-119	-4.0%	2880	-133	-4.4%	2896	-117	-3.9%	3003	-10	-0.3%	3013	0	0.0%
Bridge St (SB) (one way)	11496	10945	-551	-4.8%	10576	-919	-8.0%	10938	-557	-4.8%	10580	-916	-8.0%	11568	72	0.6%	11567	72	0.6%
R286 EB (at jct with City View)	1418	1501	83	5.8%	1410	-8	-0.6%	1560	142	10.0%	1423	5	0.4%	1478	60	4.3%	1447	30	2.1%
R286 SB (to Bridge St) (one way)	14509	13833	-676	-4.7%	13470	-1039	-7.2%	13818	-691	-4.8%	13476	-1033	-7.1%	14571	62	0.4%	14581	72	0.5%
R286 NB (to R870 Markievicz Rd) (one way)	12154	11847	-307	-2.5%	11713	-441	-3.6%	11780	-374	-3.1%	11696	-459	-3.8%	12100	-54	-0.4%	12110	-45	-0.4%
R870 Markievicz Rd SB	3217	2899	-317	-9.9%	2391	-825	-25.7%	2875	-341	-10.6%	2328	-889	-27.6%	2892	-325	-10.1%	2909	-308	-9.6%
Holborn St SB	2758	2581	-177	-6.4%	2696	-62	-2.3%	2507	-251	-9.1%	2661	-97	-3.5%	2526	-232	-8.4%	2518	-240	-8.7%

4.10 Specific Objectives and KPIs Summary

To summarise the specific objectives and identify the higher scoring options a summary table has been created. Table 4.21 below indicates that Options 2B_S2B, 5 and 8 perform the best at complying with the specific objectives. Each of the options generally performs well against the objectives but in the circumstances in which it was deemed that an option did not comply with an objective these are outlined below.

In Option 1A_S1A, 1B_S1B, 2A_S2A and 2B_S2B the AADTs on local roads were lower than in the Do Nothing and Do Minimum but not to the same level as Option 5 and 8 which scored the best.

The highest number of junctions with a V/C ratio between 50% - 85% was in Option 1B_S1B. The Option 2B_S2B, 5 and 8 recorded the least amount of junctions with a V/C ratio between 50% – 85%.

Option 1A_S1A and Option 2A_S2A recorded the highest over-capacity queuing in the 2047 PM peak period of 16.4 and 12.7 PCU Hrs / Hr. Although this level of over-capacity is not severe it is higher than the all the other options for the same period which ranged between 0 – 2.5 PCU Hrs / Hr.

There was minor variation in overall travel time in all of the proposed options, all of which were below that of the Do Nothing. Option 1A_S1A and 1B_S1B recorded slightly higher travel distance than the other options. Average network speed was quite consistent across all the proposed options.

In terms of vehicle emissions each of the proposed options recorded fewer emissions than the Do Nothing and Do Minimum with Option 1B_S1B and 2B_S2B preforming slightly better than the other options.

Option 1B_S1B has four consecutive junctions which have a Volume / Capacity ratio of between 52.8% and 67.0%.

In terms of city centre Volume / Capacity ratios the worst preforming junction was in the Do Nothing with a highest V/C ratio of 85.8% in the 2047 AM peak period. This was for the signalised junction of the R292 / O'Connell Street / Fish Quay in the centre of Sligo city. None of the proposed options recorded a V/C ratio greater than 85%.

It was only Options 1A_S1A and 2A_S2A that maintained traffic volume changes within +/- 10% of the Do Minimum scenario. In other options greater decreases in street flows were experienced but often to the equal detriment of other street flows. It is thought that the proposed N15 upgrade roundabouts in Option 1B_S1B and 2B_S2B would encourage some vehicles to use the Ballytivnan Road and Elm Gardens to access the N15. The effect this would have in the city centre appears to decrease the traffic flow on Markievicz Road and increase it on Holborn Street as vehicles re-route to the Ballytivnan Road. Option 5 and 8 are likely to increase traffic flows on the R286 Connaughton Road, however this is a main traffic route (as stated in the SEDP) into the city centre from the existing N16 and not a heavily pedestrianised area when compared to other parts of the city centre which have a much higher pedestrian footfall.

N16 Key Performance Indicator Testing

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Table 4.21: Specific Objectives and KPIs Summary

	Objective	KPI	Option 1A_S1A	Option 1B_S1B	Option 2A_S2A	Option 2B_S2B	Option 5	Option 8
8	Ensure local roads cater for local movement	AADTs on local and regional roads within study area to north of Sligo City appropriate to local levels	2	2	2	2	1	1
9	Road network to cater for future traffic	Number of V/C ratios broken into bands throughout entire Sligo modelled network. E.g. number of junctions >85%, 50% - 85% and <50%	2	3	2	1	1	1
		GIS map indicating these locations	N/A	N/A	N/A	N/A	N/A	N/A
10	Reduce congestion on network	Transient and over-capacity queuing	2	1	2	1	1	1
11	Overall network operations	Overall travel time	1	1	1	1	1	1
		Overall travel distance	2	2	1	1	1	1
		Average network speed	1	1	1	1	1	1
12	Environment	Vehicle emissions	2	1	2	1	2	2
13	Operational efficiency of N15	V/C ratios of junctions on N15	1	2	1	1	1	1
14	Operational efficiency of key centre centre junctions	V/C ratios of key junctions within Sligo City Centre	1	1	1	1	1	1
15	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City	1	2	1	2	2	2
		Overall Score	15	16	14	12	12	12

	Sample Scoring
Very High Preference	1
High Preference	2
Medium Preference	3
Not Applicable	N/A

110

5. Summary and Conclusions

This Key Performance Indicator Testing Technical Note has assessed a series KPIs against the list of predefined objectives. From the summary table below it can be seen that Option 1B_S1B has obtained the lowest rank with an overall score of 30 points. Option 1A_S1A scored better with 27 points, followed by Option 2A_S2A with a score of 26 points. Option 2B_S2B scored better again with 25 points. However, the best ranked options were Option 5 and 8 with a score of 21 points.

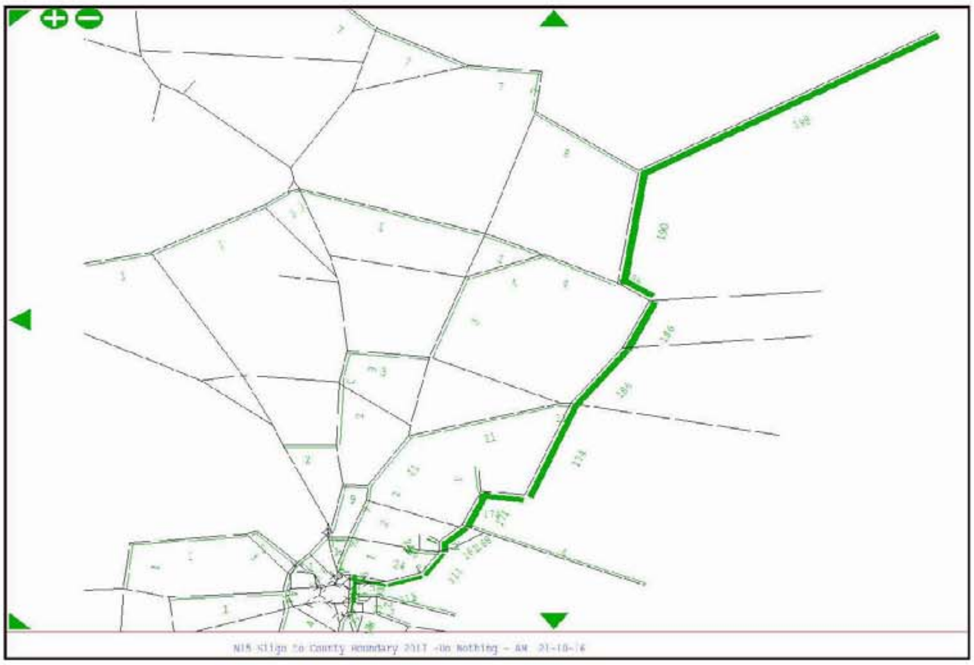
	Objective	KPI	Option 1A_S1A	Option 1B_S1B	Option 2A_S2A	Option 2B_S2B	Option 5	Option 8
3	Effectively cater for strategic traffic on N16	AADT on N16	3	3	3	3	1	1
		Select Link Analysis of traffic on N16 at Leitrim Boundary	3	3	3	3	1	1
4	Effectively cater for strategic traffic on N15 &	AADT on N15	1	2	1	2	1	1
		AADT on N4	1	1	1	1	1	1
5	Efficiently cater for strategic national traffic	Journey Times from N16 at Leitrim Boundary to N4/N16/N15 Junction	1	1	1	1	2	2
6	Efficiently cater for strategic traffic to sligo city gateway (NSS)	Journey Times from N16 at Leitrim Boundary to Sligo City Centre	1	1	1	1	1	1
7	Operational efficiency of N16	V/C ratios of junctions on N16	1	2	1	1	1	1
		Turn Delay at Junctions on N16	1	1	1	1	1	1
		Overall Score	12	14	12	13	9	9

	Objective	KPI	Option 1A_S1A	Option 1B_S1B	Option 2A_S2A	Option 2B_S2B	Option 5	Option 8
8	Ensure local roads cater for local movement	AADTs on local and regional roads within study area to north of Sligo City appropriate to local levels	2	2	2	2	1	1
9	Road network to cater for future traffic	Number of V/C ratios broken into bands throughout entire Sligo modelled network. E.g. number of junctions >85%, 50% - 85% and <50%	2	3	2	1	1	1
		GIS map indicating these locations	N/A	N/A	N/A	N/A	N/A	N/A
10	Reduce congestion on network	Transient and over-capacity queuing	2	1	2	1	1	1
11	Overall network operations	Overall travel time	1	1	1	1	1	1
		Overall travel distance	2	2	1	1	1	1
		Average network speed	1	1	1	1	1	1
12	Environment	Vehicle emissions	2	1	2	1	2	2
13	Operational efficiency of N15	V/C ratios of junctions on N15	1	2	1	1	1	1
14	Operational efficiency of key centre centre junctions	V/C ratios of key junctions within Sligo City Centre	1	1	1	1	1	1
15	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City	1	2	1	2	2	2
		Overall Score	15	16	14	12	12	12

	Option 1A_S1A	Option 1B_S1B	Option 2A_S2A	Option 2B_S2B	Option 5	Option 8
Overall Score	27	30	26	25	21	21

Appendix A – Select Link Analysis

2017 Do Nothing (AM)



N16 Key Performance Indicator Testing

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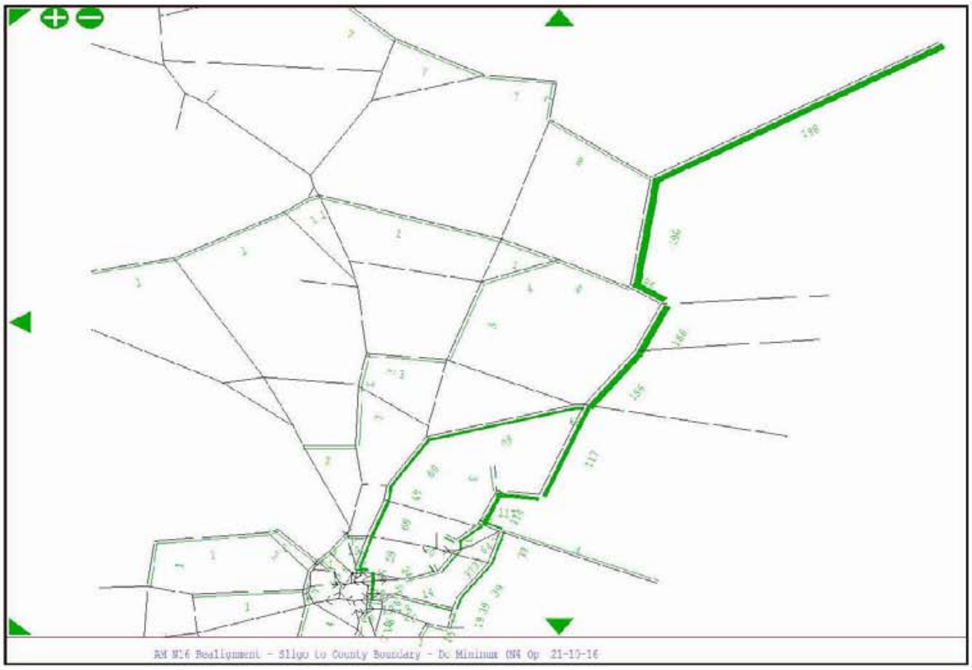
2017 Do Minimum (AM)



113

N16 Key Performance Indicator Testing

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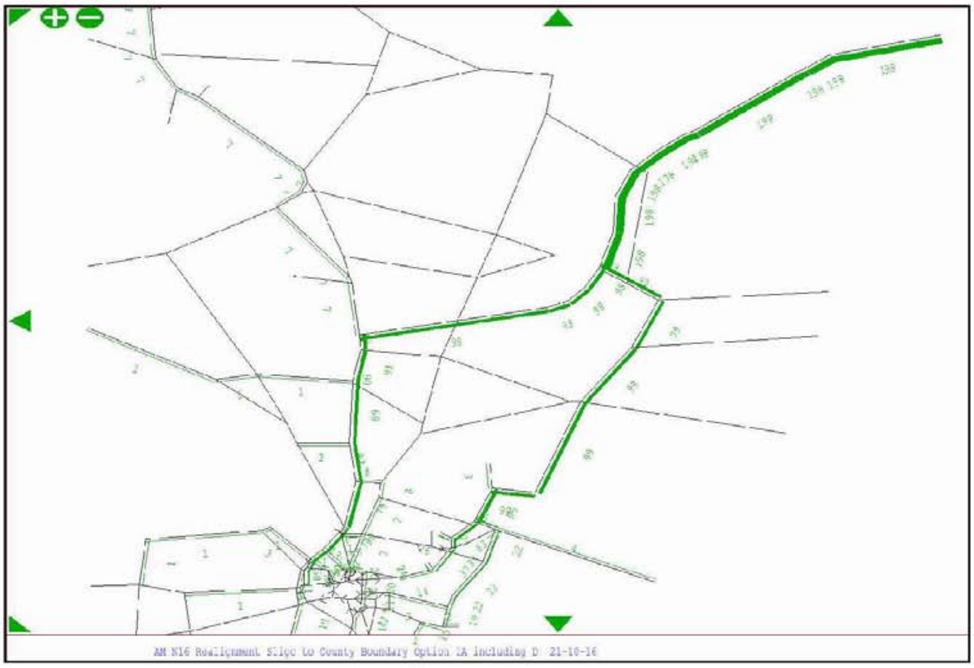
2017 Do Minimum Opt 1A_S1A (AM)



N16 Key Performance Indicator Testing

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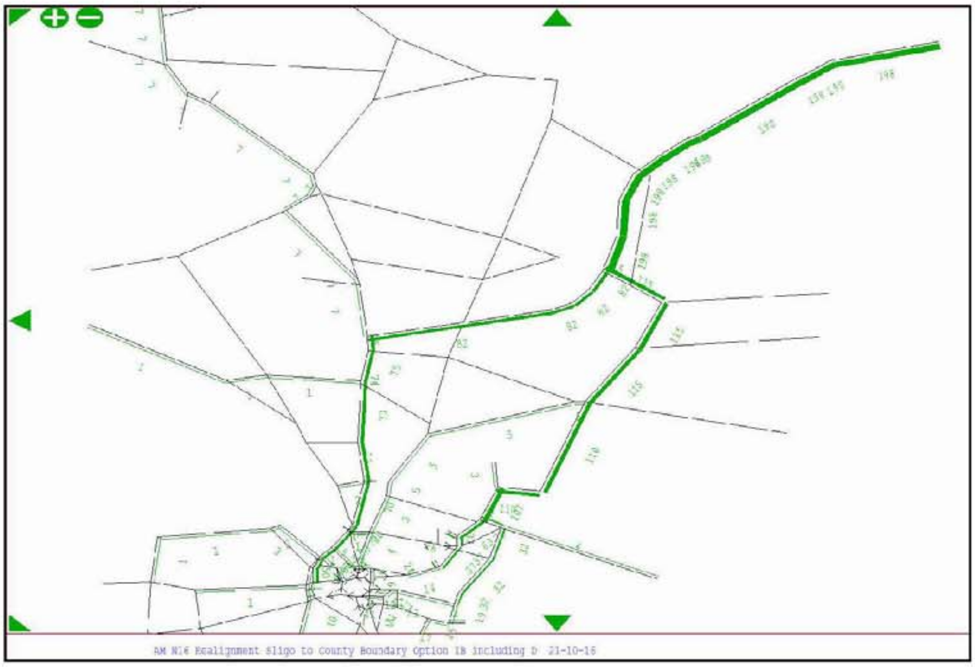
2017 Do Minimum Opt 1B_S1B (AM)



115

N16 Key Performance Indicator Testing

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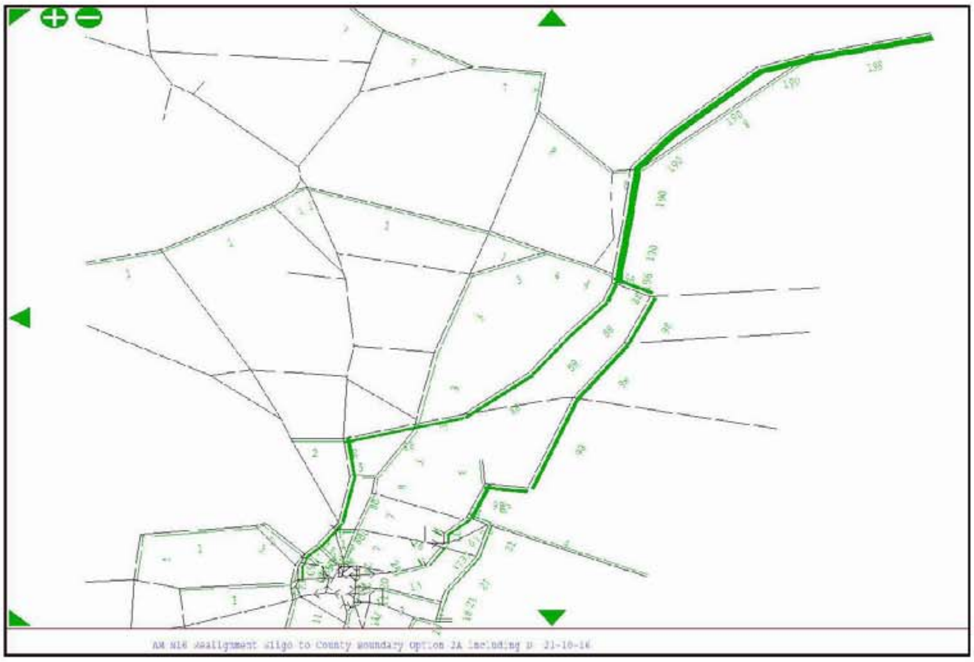
2017 Do Minimum Opt 2A_S2A (AM)



N16 Key Performance Indicator Testing

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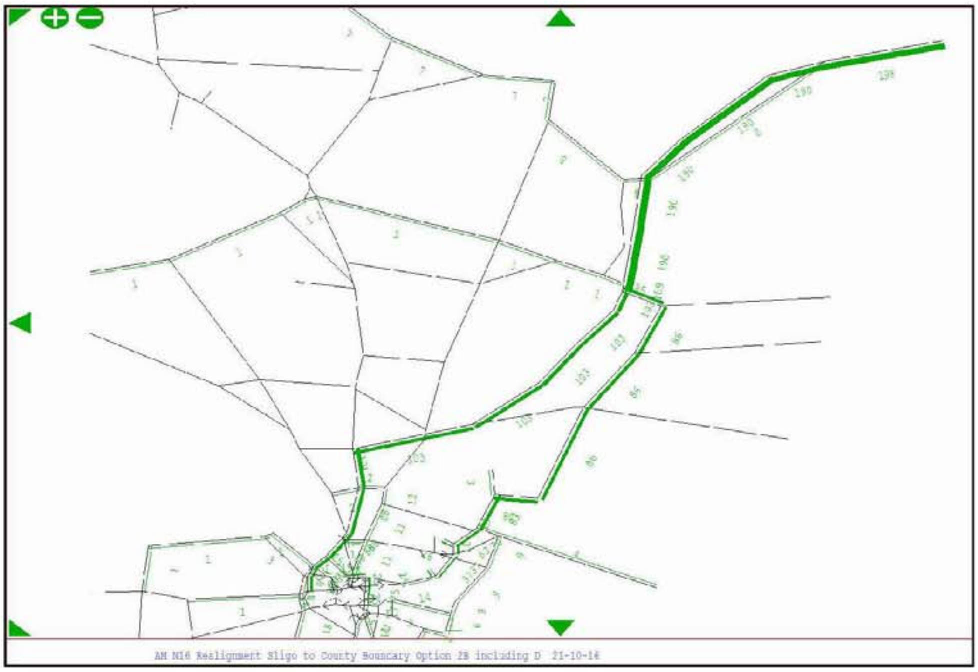
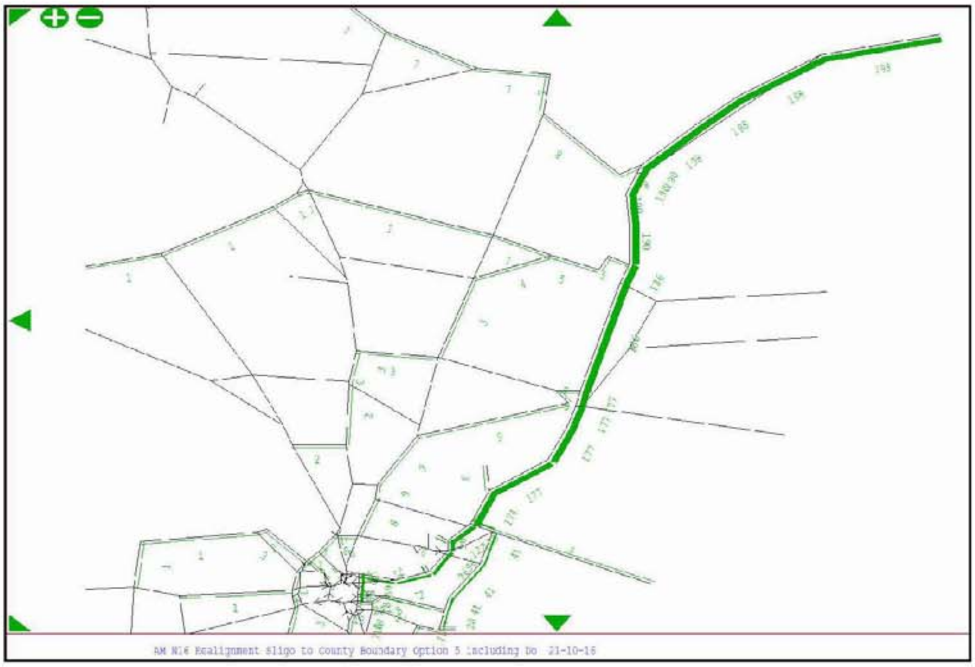
2017 Do Minimum Opt 2B_S2B (AM)



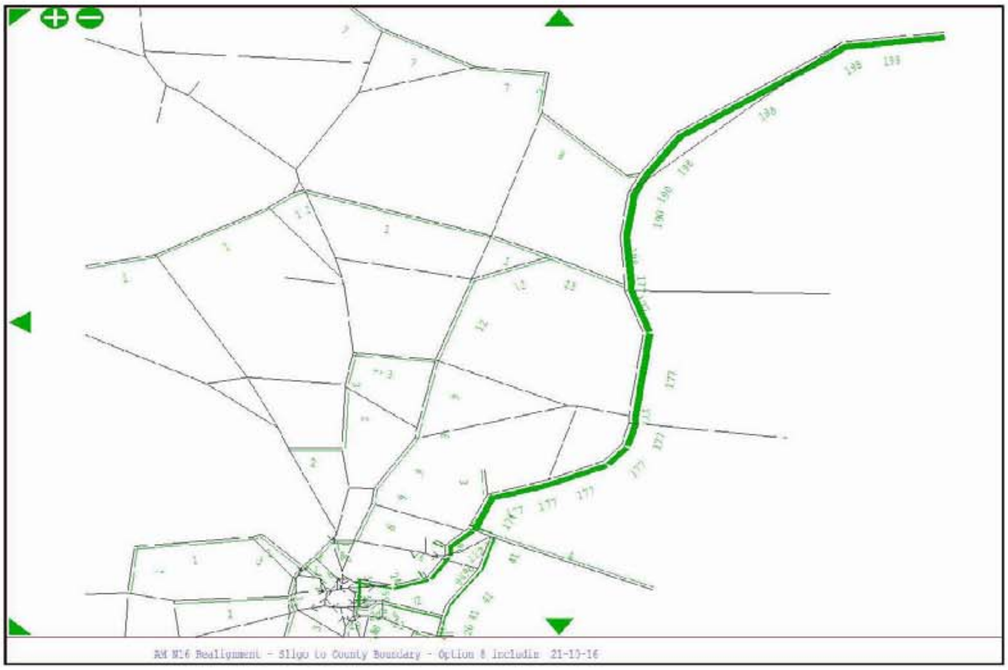
N16 Key Performance Indicator Testing

2017 Do Minimum Opt 5 (AM)

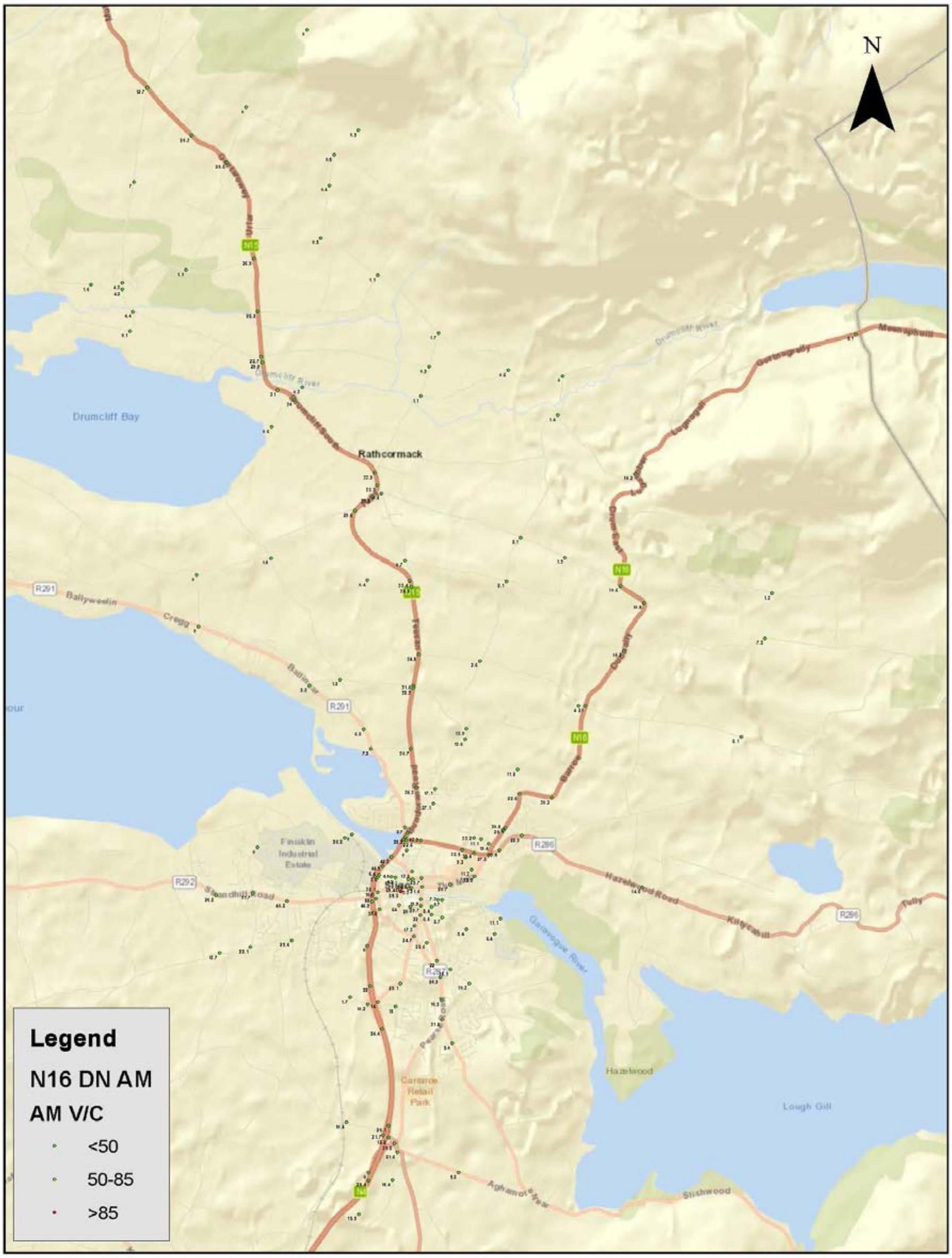


N16 Key Performance Indicator Testing

2017 Do Minimum Opt 8 (AM)



Appendix B – GIS Maps of Volume / Capacity Ratios (AM & PM)


N
Drumcliff Bay
Rathcormack
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Cregg
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Kilycasill
Tully
Finisklin Industrial Estate
Sligo
Garavogue River
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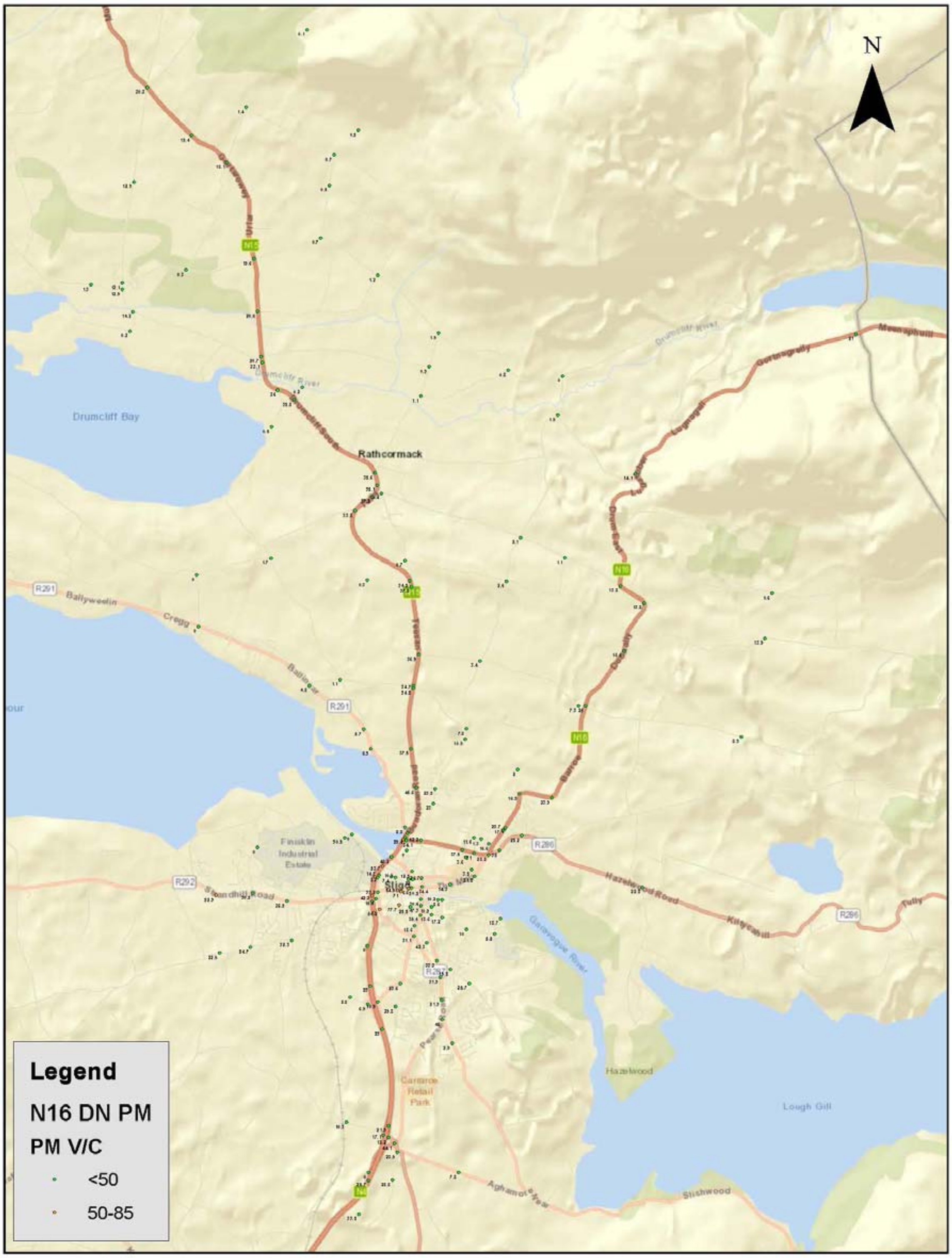
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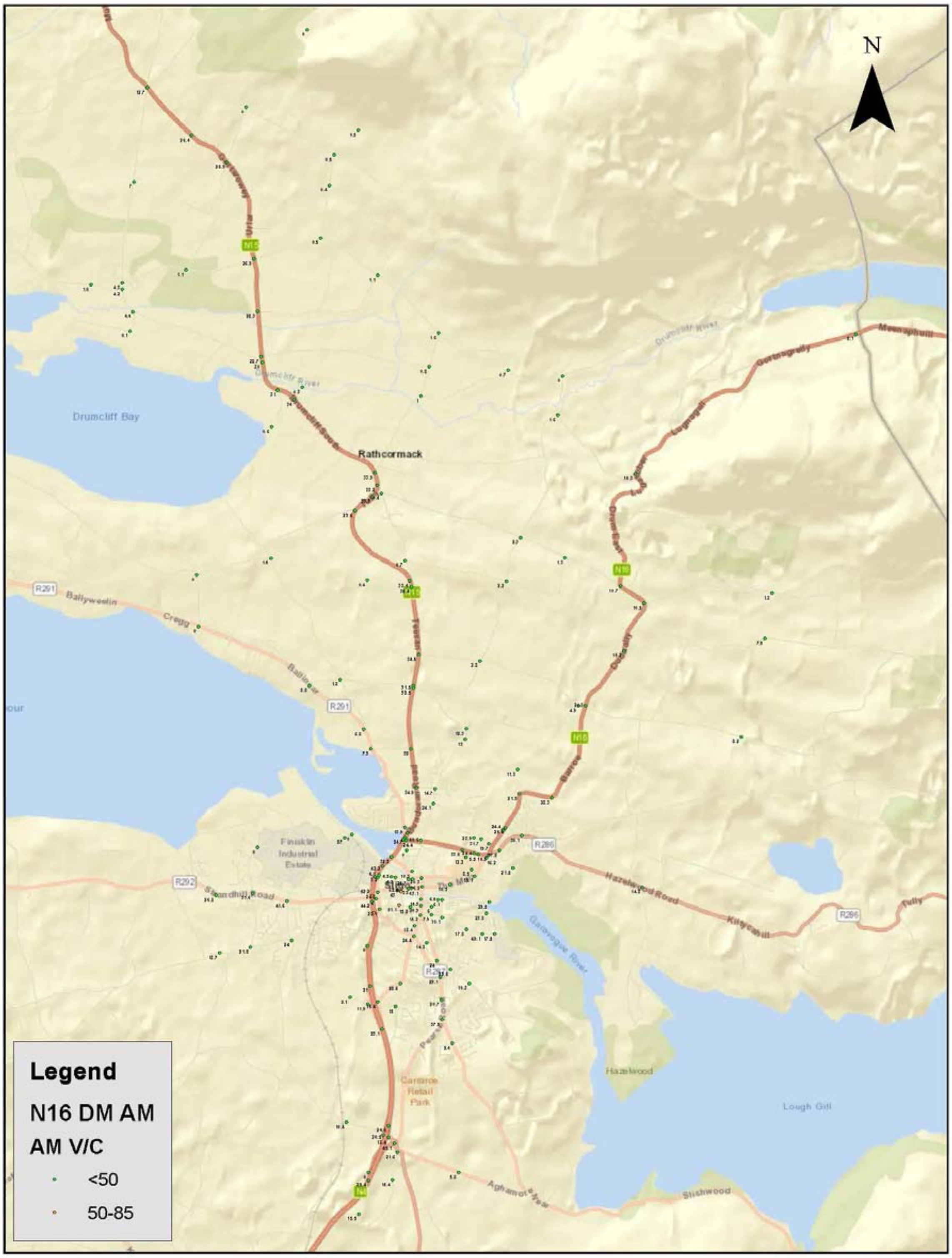
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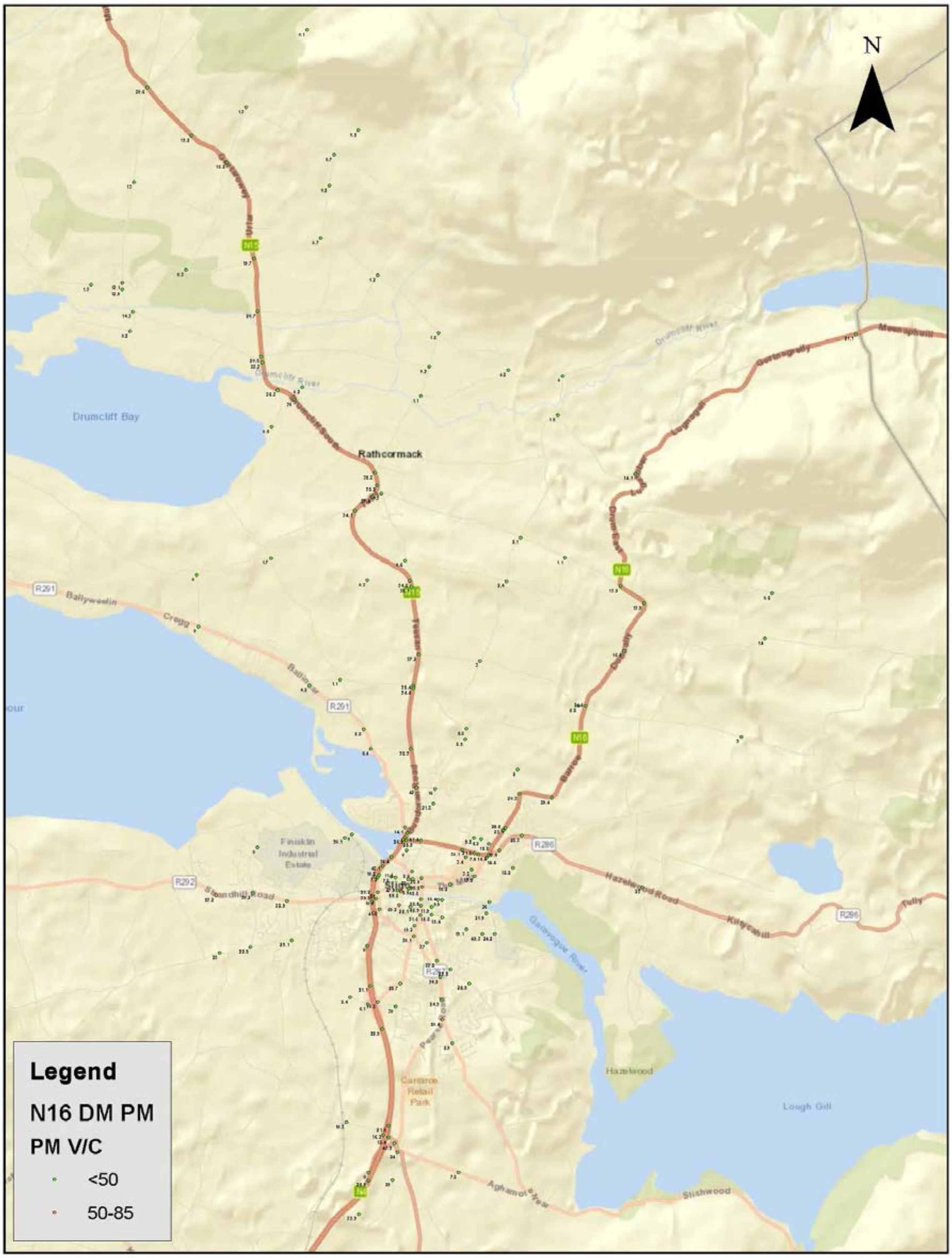
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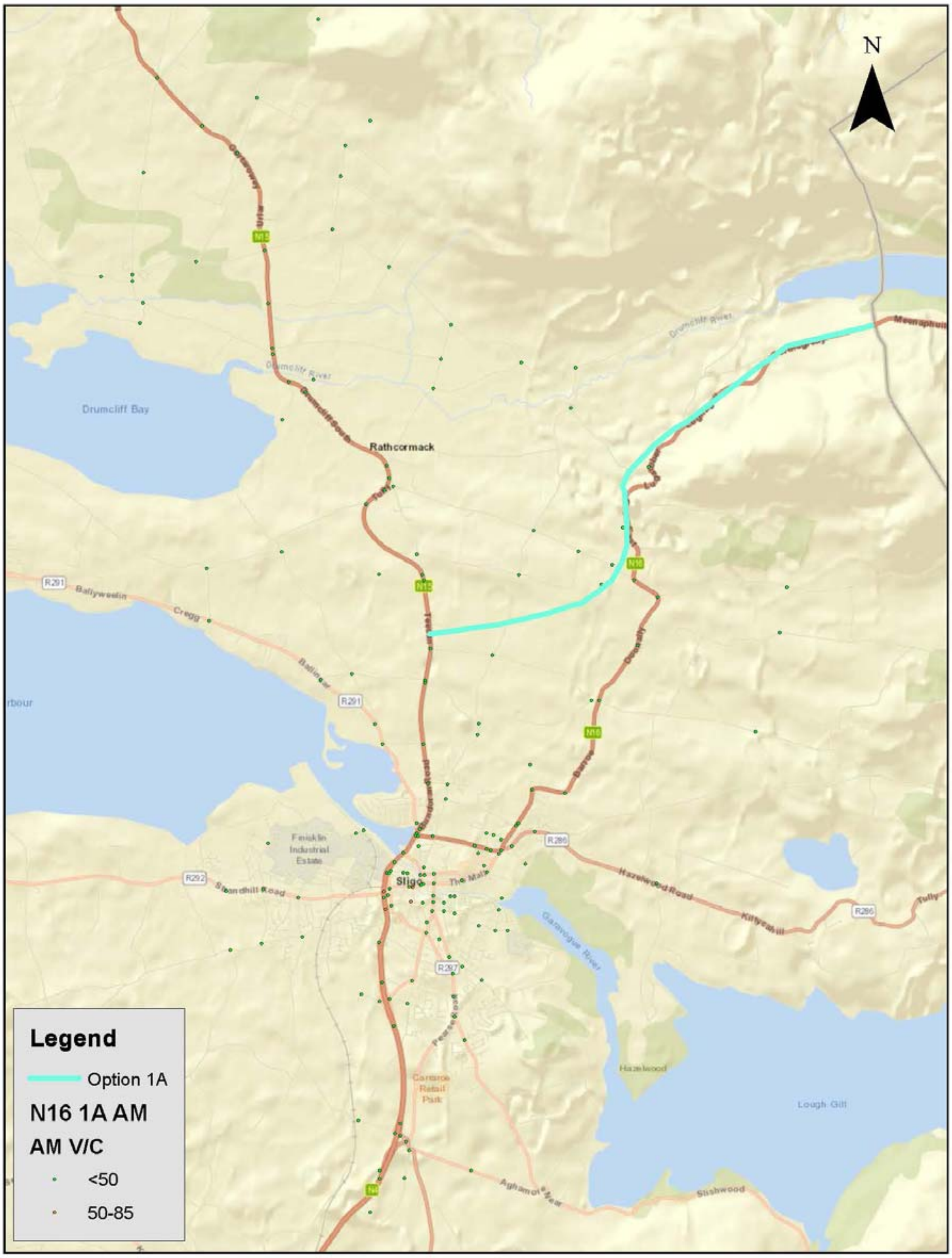
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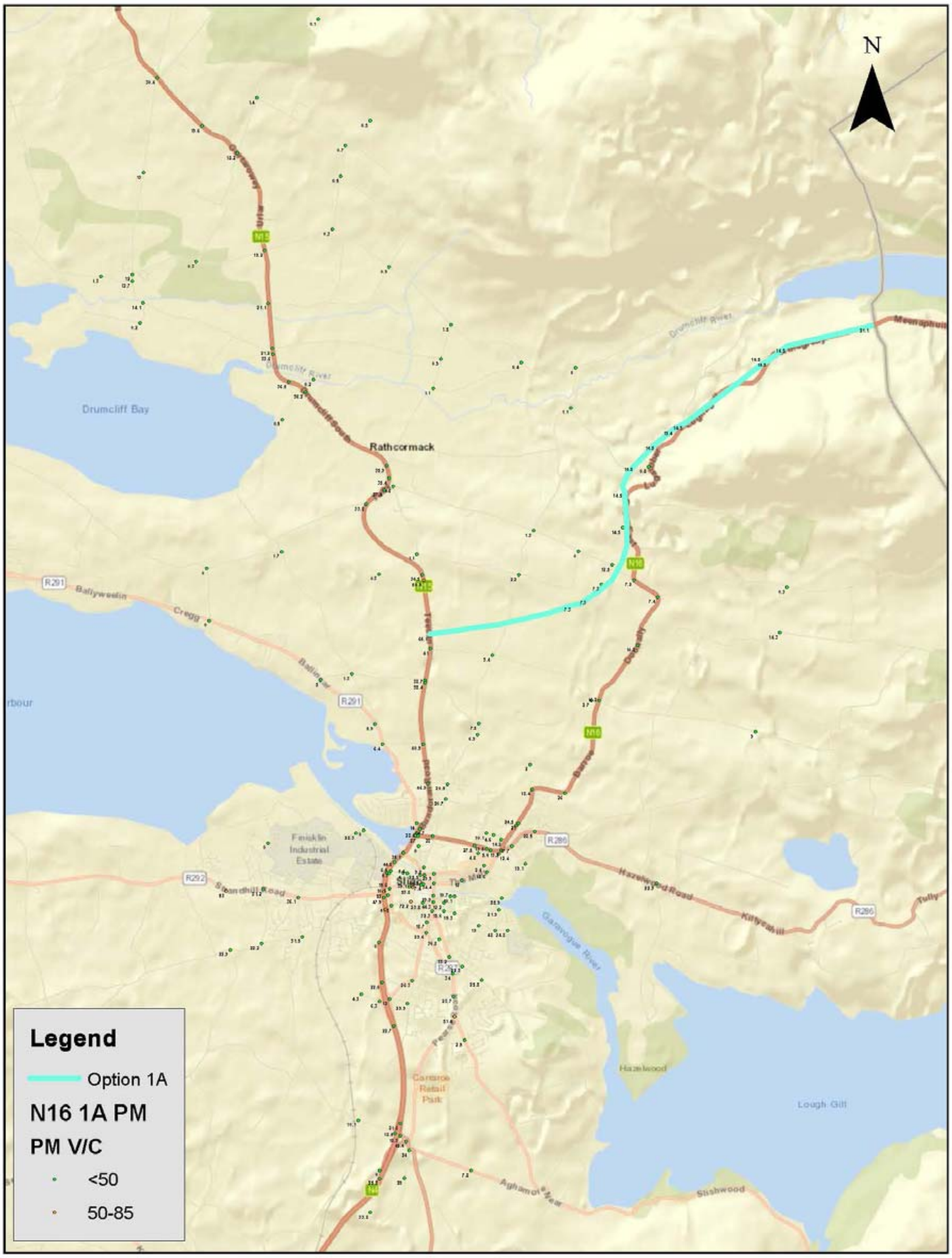
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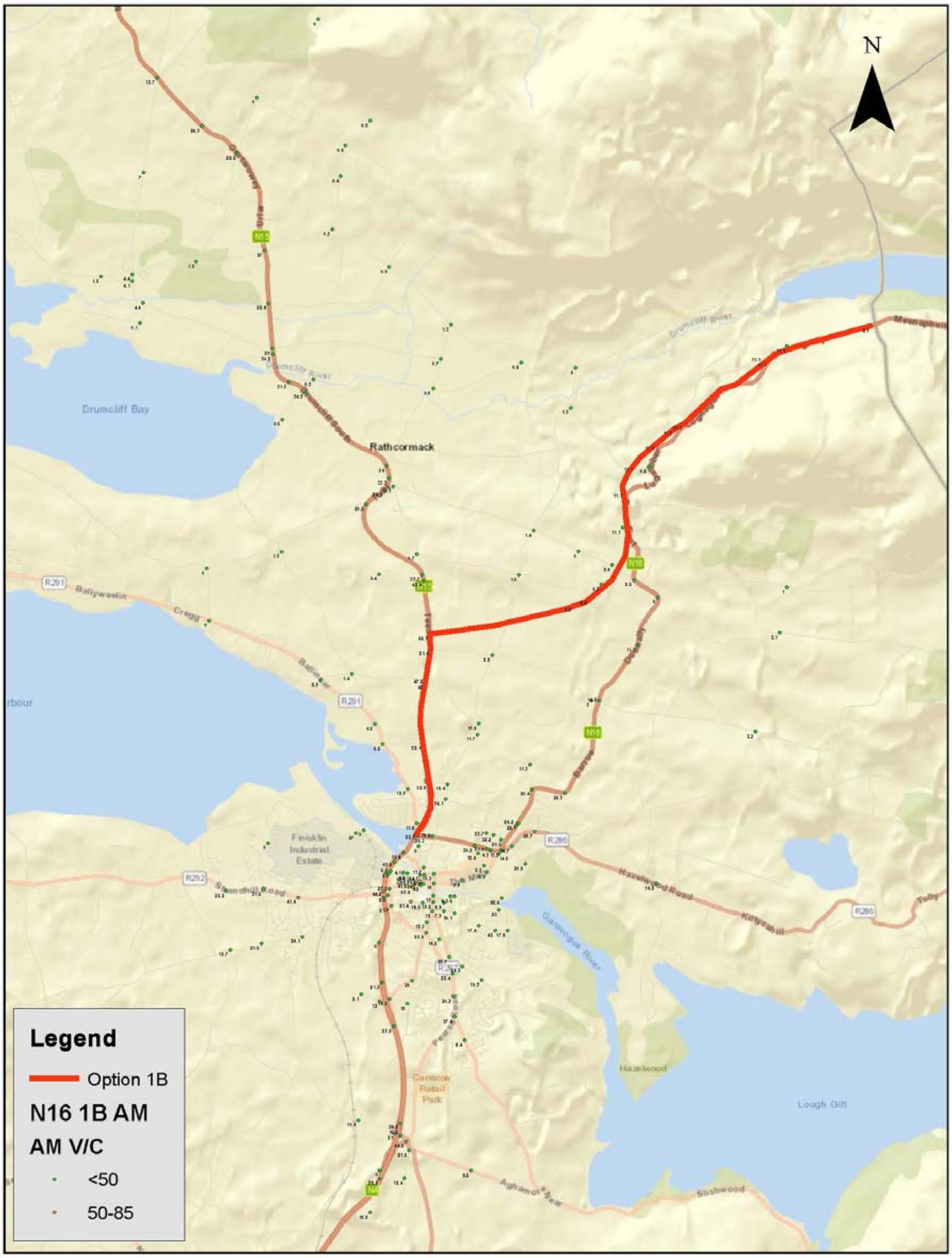
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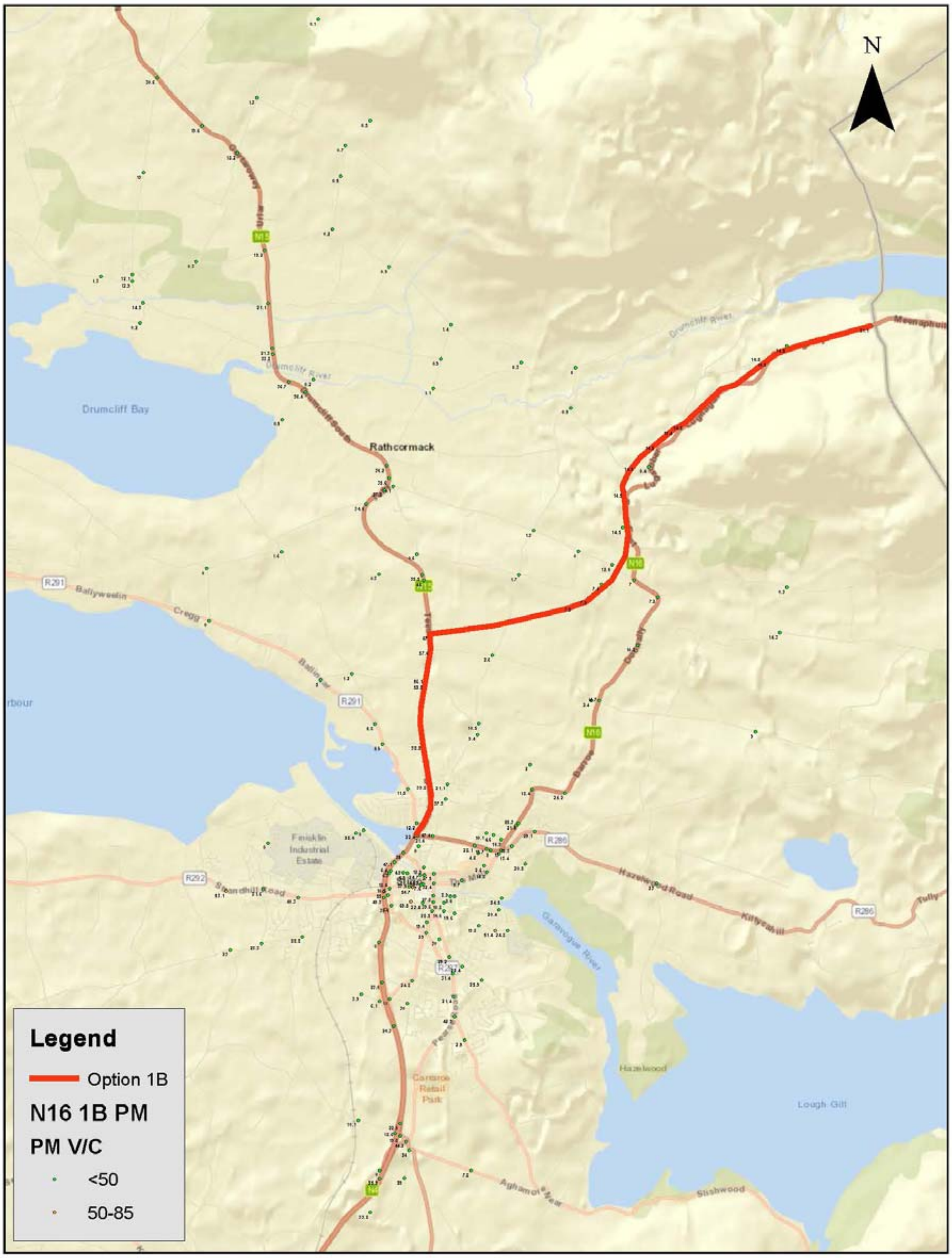
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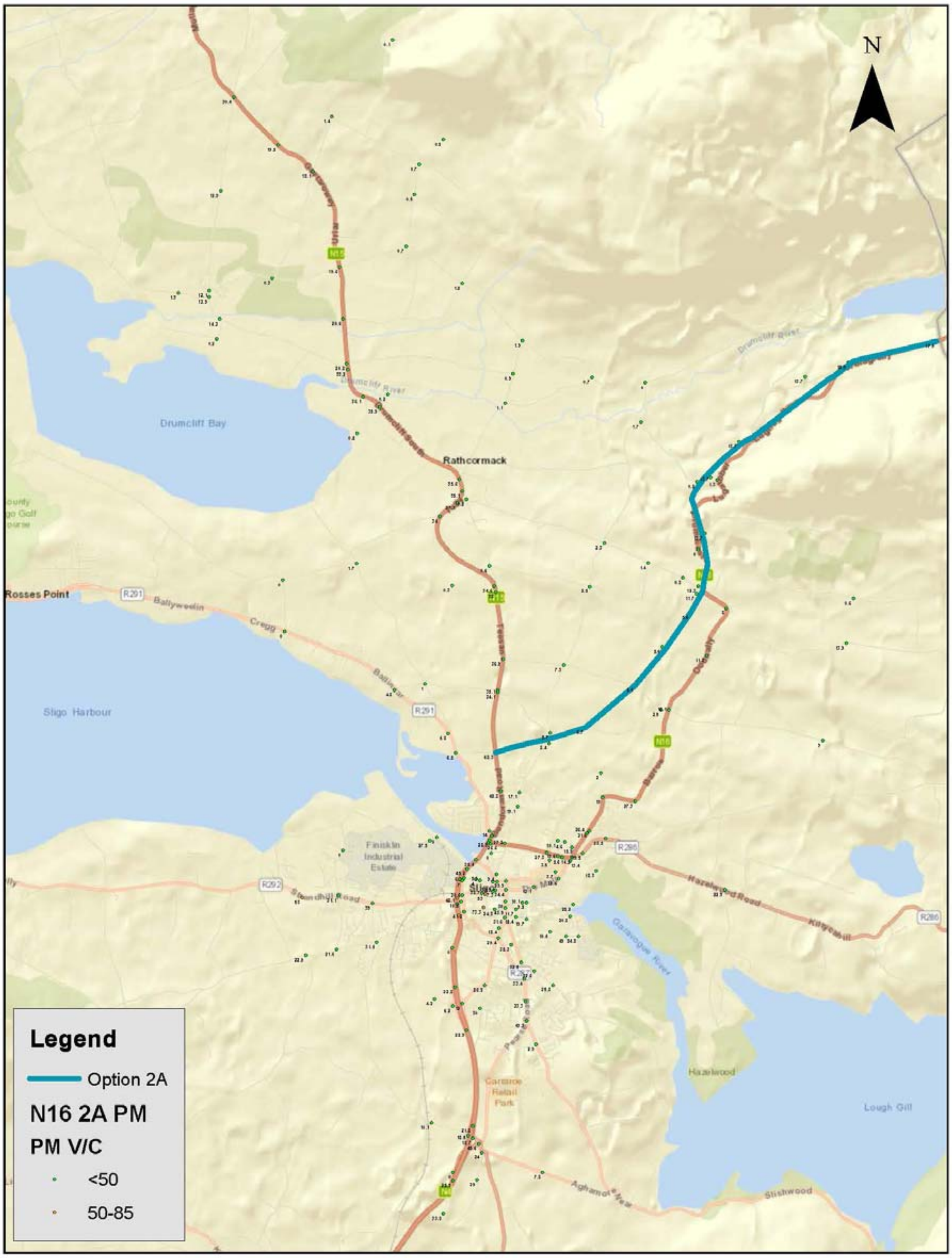
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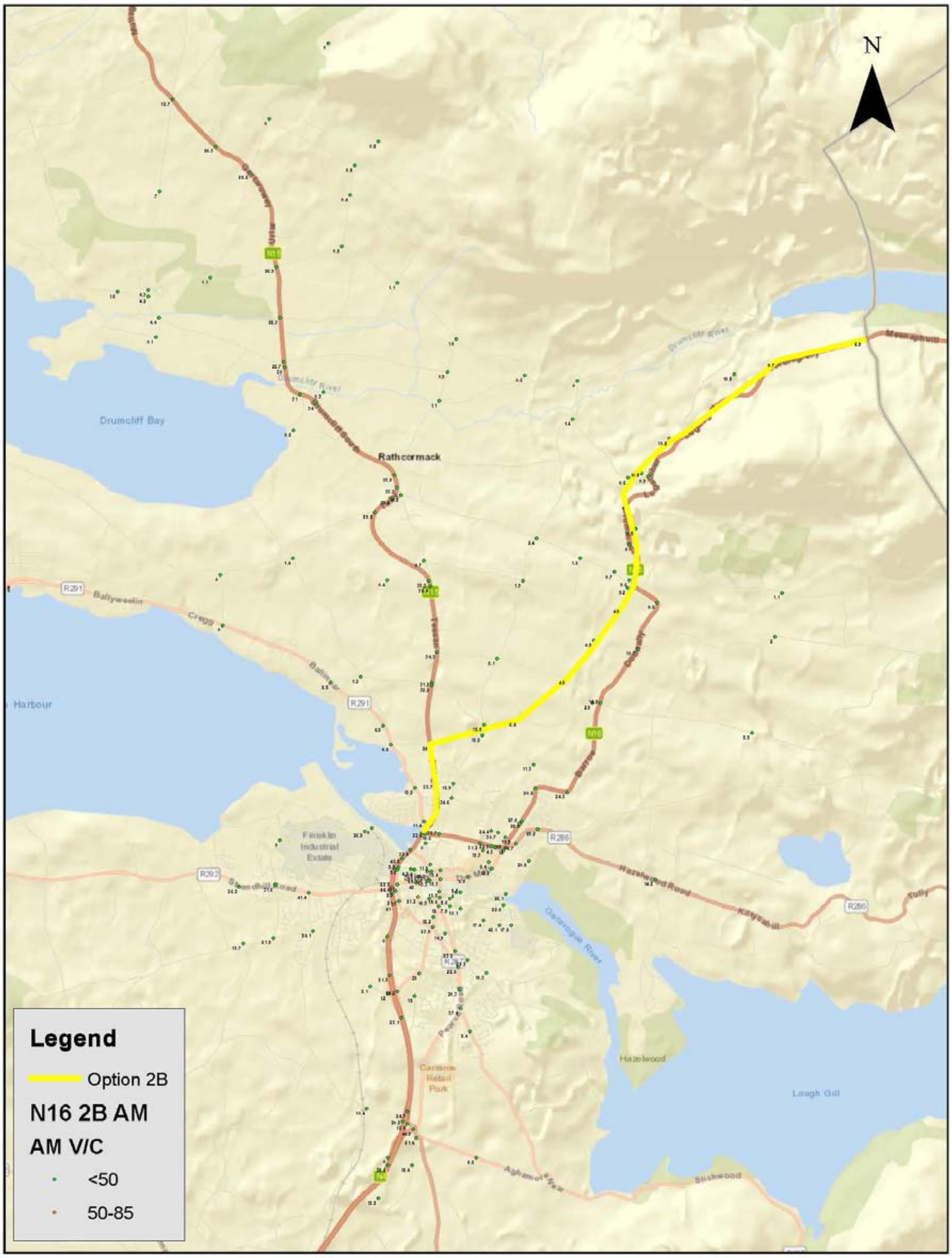
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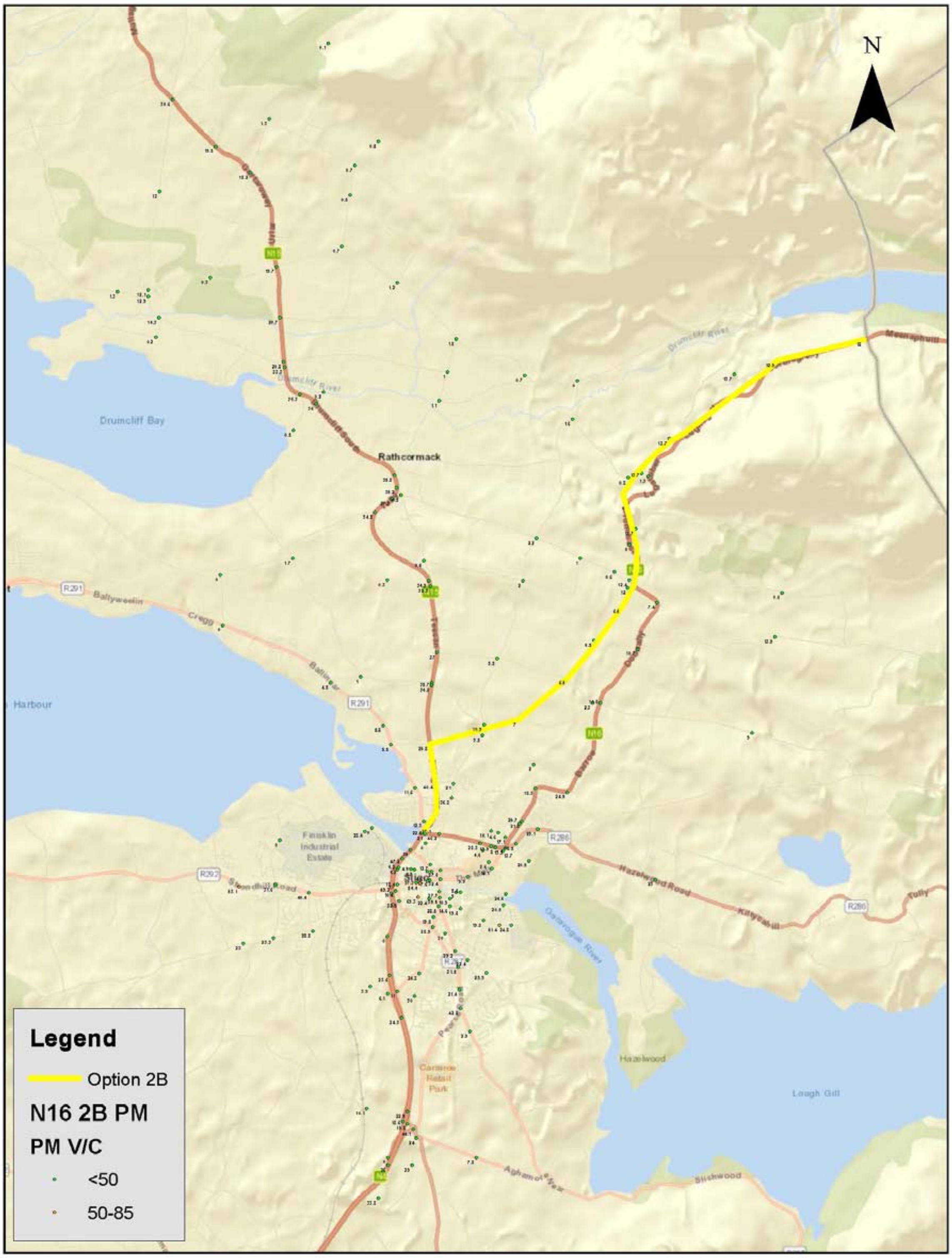
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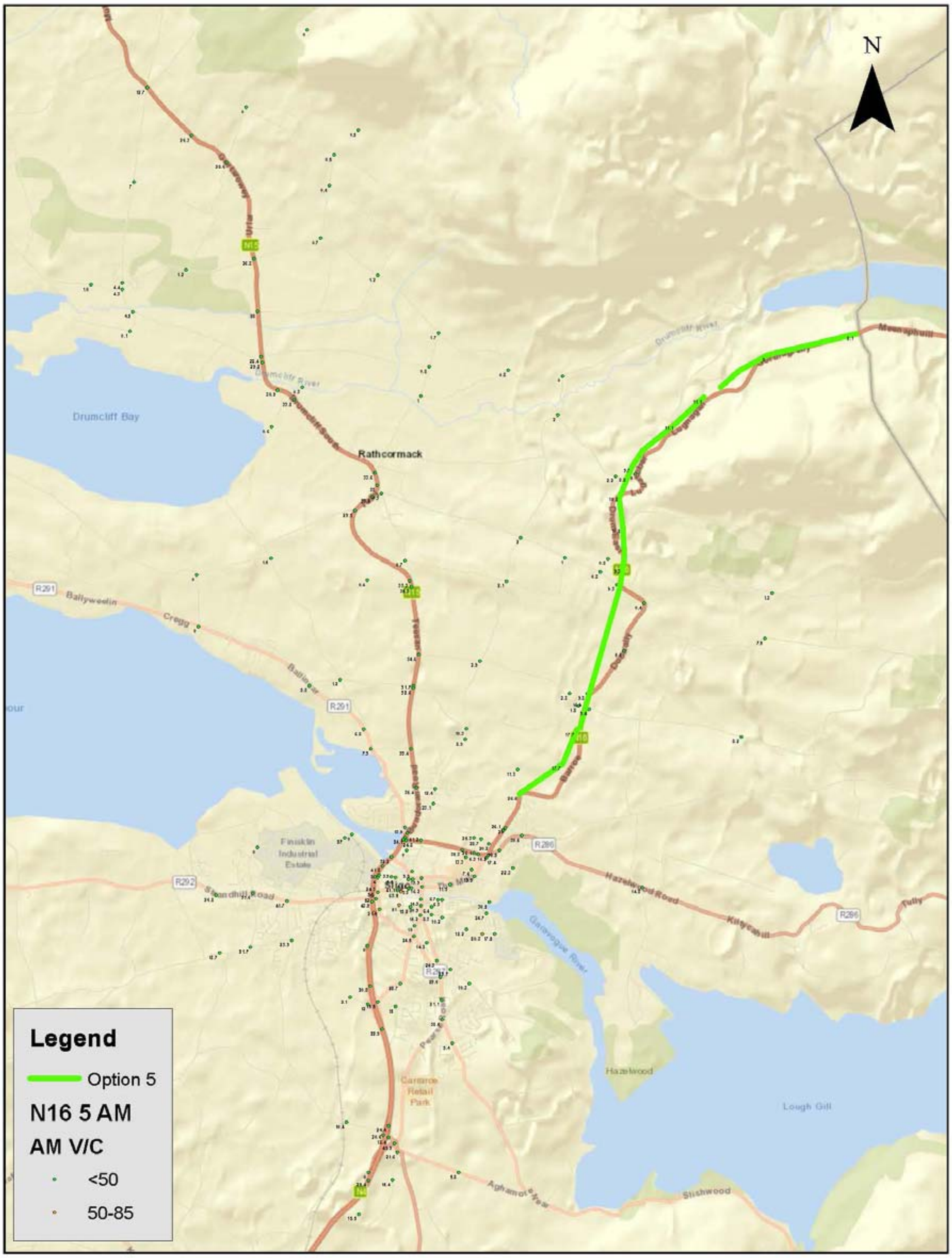
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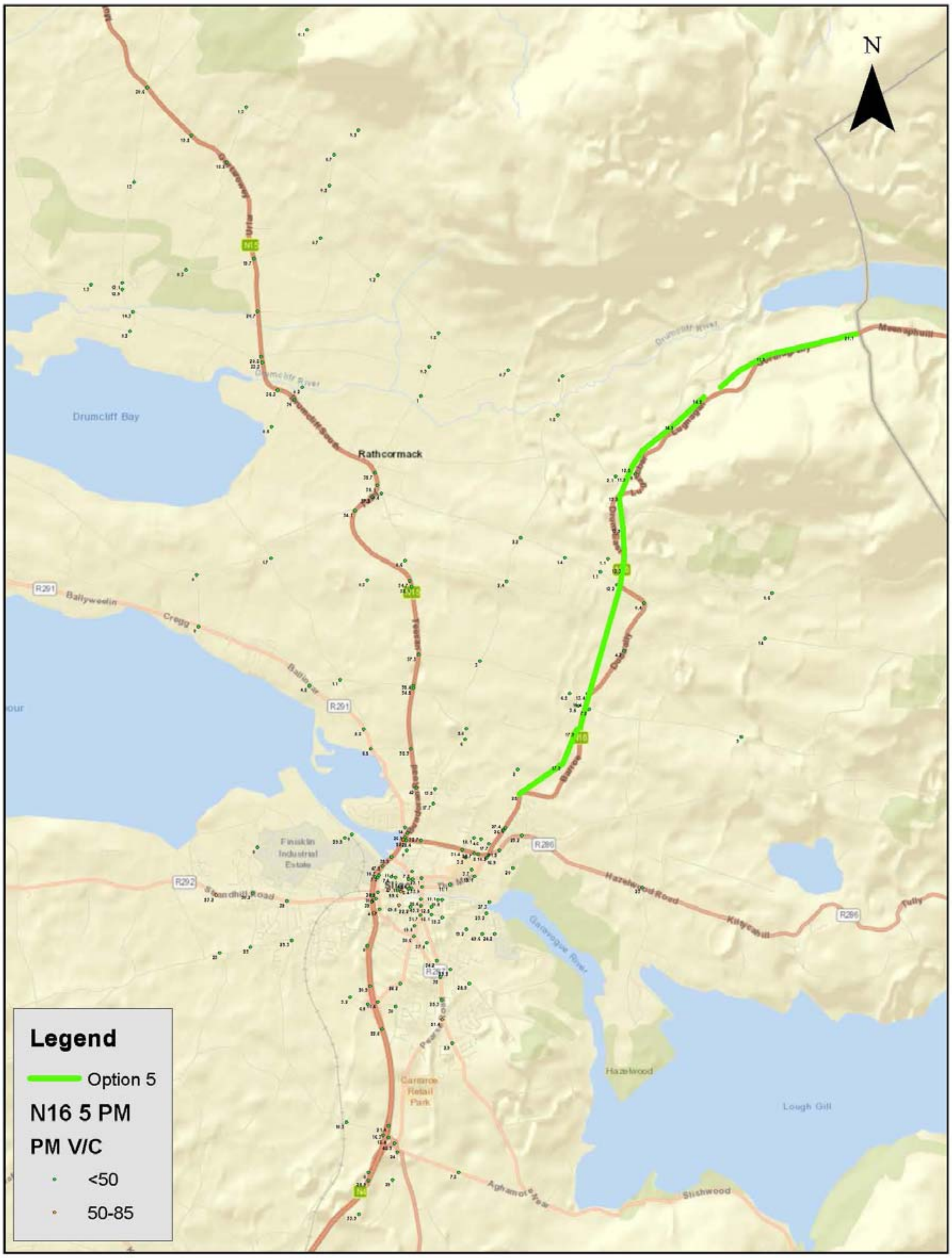
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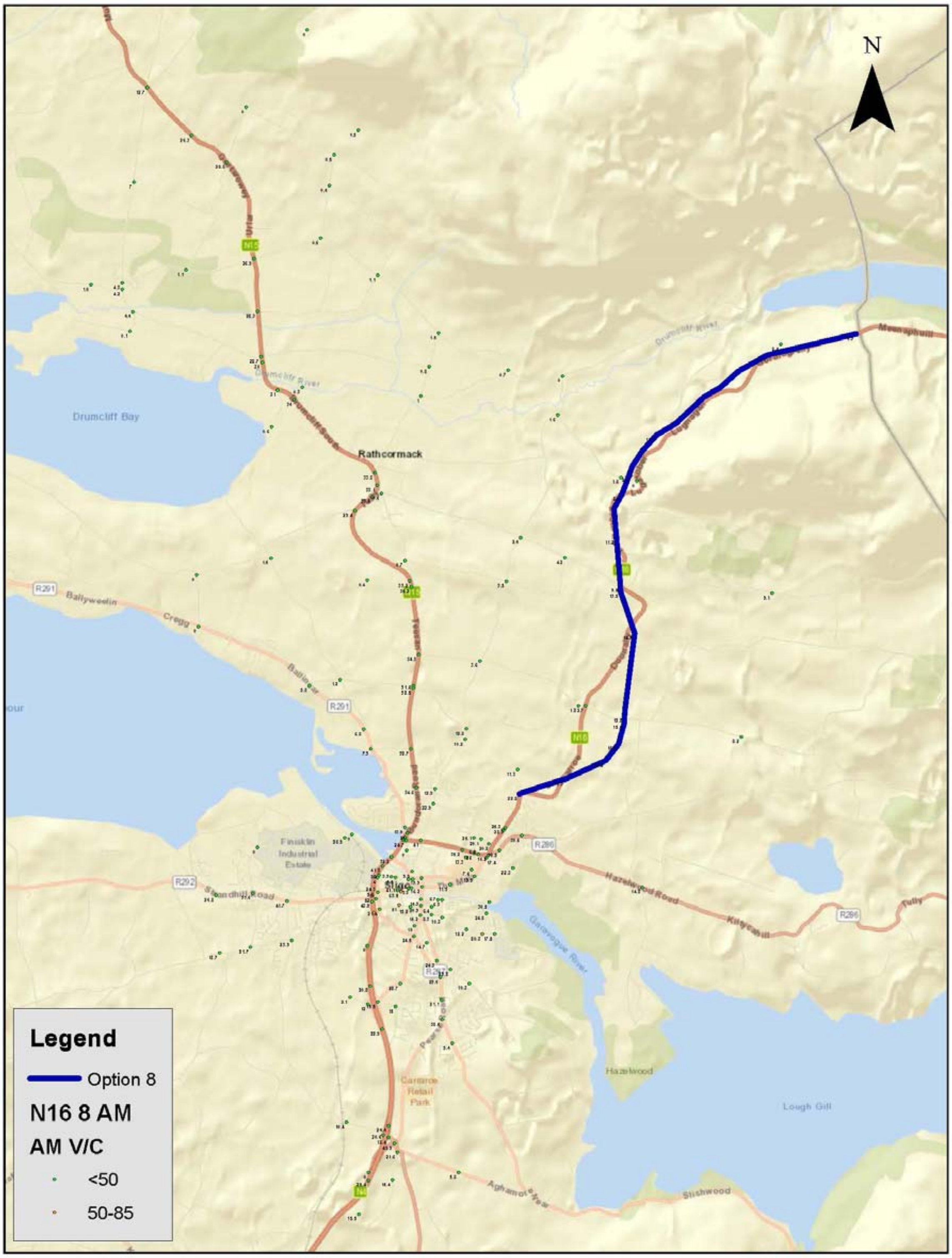
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Lough Gill
Hazelwood
Sligo

4 Key Performance Indicator Sensitivity Testing

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N16 Key Performance Indicator Sensitivity Testing

Sligo County Council

Technical Note

32106101 Report 30

January 2017

N16 Key Performance Indicator Sensitivity Testing

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N16 Key Performance Indicator Sensitivity Testing

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N16 Key Performance Indicator Sensitivity Testing

Contents

N16 Key Performance Indicator Sensitivity Testing

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1. Introduction

1.1 Background

Sligo County Council (SCC) is undertaking a study on route selection for the N16 between the Leitrim County boundary and the junction of N4/N15 in Sligo city. SCC has commissioned Jacobs Engineering Ireland Ltd. (Jacobs) to undertake the traffic and transport element of the route selection process. The N16 upgrade comprises an off-line single carriageway arrangement which will provide an improved alignment to the existing sub-standard N16 route.

This *N16 Key Performance Indicator Sensitivity Testing Technical Note* should be read in conjunction with the *N16 Key Performance Indicator Testing Technical Note* issued in December 2016. In that report, nine options were assessed but only the Do Minimum scenario and three emerging scheme options have been taken forward for sensitivity testing. The results of this sensitivity testing are detailed in this Technical Note. The three emerging options chosen for sensitivity testing are:

- Option 1A_S1A;
- Option 5; and
- Option 12.

Option 12 was formerly referred to as Option 8 in the previous KPI Testing Technical Note. Henceforth it is referred to as Option 12.

1.2 Sensitivity Tests

This Technical Note details the traffic assessment of the Do Minimum scenario and the three emerging options for three Sensitivity Tests in relation to the N16 scheme. The Sensitivity Tests undertaken were;

1. No Eastern Garavogue Bridge Sensitivity Test;
2. City Centre Pedestrian / Cycle Priority Sensitivity Test; and
3. N16 Abbvie Roundabout to Elm Gardens (East / West Link) Sensitivity Test.

1.2.1 Sensitivity Test 1 - No Eastern Garavogue Bridge

This sensitivity test considered the Do Minimum and three emerging scheme options without the proposed Eastern Garavogue Bridge in place. This sensitivity test was also undertaken for the N4-N15 Urban Improvement Scheme. The KPIs associated with this sensitivity test are listed below in Table 1.1. The KPIs have been undertaken for the Do Minimum and the emerging three options in the 2047 forecast year only.

Table 1.1: No Eastern Garavogue Bridge Sensitivity Test 1 KPIs

	Objective	KPI
1	Effectively cater for strategic traffic	AADTs on N16, N15 and N4
2	Efficiently cater for strategic National Road traffic	Journey times from N16 at Leitrim Boundary to N4/N16/N15 junction
3	Efficiently cater for strategic traffic to Sligo City Gateway (NSS)	Journey times from N16 at Leitrim Boundary to Sligo City Centre
4	Road network to cater for future traffic	Number of V/C ratios broken into bands throughout Sligo modelled network

	Objective	KPI
		E.g.: number of junctions >85%, 50%-85%, <50%
5	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City Centre

While the KPI assessment only considered the 2047 forecast year, the modelling was undertaken for 2017, 2032 and 2047 in order to undertake the TUBA analysis of this sensitivity test. The details of the TUBA assessment will be included as part of the N16 Final Report.

1.2.2 Sensitivity Test 2 - City Centre Pedestrian / Cycle Priority

This sensitivity test considered the Do Minimum and three emerging scheme options with pedestrian and cycle priority measures included in Sligo City Centre. The KPIs associated with this sensitivity test are listed below in Table 1.2. The KPIs have been undertaken for the Do Minimum and the emerging three options in the 2047 forecast year only.

The following taken from the Sligo and Environs Development Plan lists the pedestrian and cycle priority measures included in Sensitivity Test 2;

1. Pedestrianised O'Connell Street (PED-1);
2. Pedestrian prioritisation and environmental improvements to include Castle Street, Grattan Street, Market Street, High Street and John Street (PED-2); and
3. Reduce traffic lanes crossing Markievicz Bridge southbound in City Centre from 2 to 1, providing footpath and cycle lane (eliminating need for additional bridge outlined in PED-8).

Table 1.2: City Centre Pedestrian / Cycle Priority Sensitivity Test 2 KPIs

	Objective	KPI
1	Effectively cater for strategic traffic	AADTs on N16, N15 and N4
2	Efficiently cater for strategic traffic to Sligo City Gateway (NSS)	Journey times from N16 at Leitrim Boundary to Sligo City Centre
3	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City Centre
4	Operational efficiency of key City Centre junctions	V/C ratios of key junctions within Sligo City Centre

While the KPI assessment only considered the 2047 forecast year, the modelling was undertaken for 2017, 2032 and 2047 in order to undertake the TUBA analysis of this sensitivity test. The details of the TUBA assessment will be included as part of the N16 Final Report.

1.2.3 Sensitivity Test 3 - N16 Abbvie Roundabout to Elm Gardens East / West Link

This sensitivity test considered the Do Minimum and three emerging scheme options with the East / West Link between the N16 Abbvie Roundabout and Elm Gardens in place. The sensitivity test is focussed on determining the likely usage of the potential link. The KPIs associated with this sensitivity test are listed below in Table 1.3. The KPIs have been undertaken for the Do Minimum and the emerging three options in the 2047 forecast year only.

Table 1.3: N16 Abbvie Roundabout / Cycle Priority Sensitivity Test 3 KPIs

	Objective	KPI
1	Effectively cater for strategic traffic	AADTs on N16, N15 and East / West Link

While the KPI assessment only considered the 2047 forecast year, the modelling was undertaken for 2017, 2032 and 2047 in order to undertake the TUBA analysis of this sensitivity test. The details of the TUBA assessment will be included as part of the N16 Final Report.

2. Sensitivity Options Undertaken

2.1 Summary of Sensitivity Test Options

As well as the Do Minimum, the sensitivity testing assessed three distinct route option alignments across strategic route Options 1 and 4 as agreed with SCC and as outlined below;

- **Do Minimum**
- **Strategic Option 1**
    - Option 1A_S1A
- **Strategic Option 4**
    - Option 5
    - Option 12

2.2 Do Minimum

The Do Minimum scenario included the Eastern Garavogue Bridge (EGB) and the N4-N15 Sligo Urban Improvement Scheme (UIS). The N16 model development and assessment has considered the same Opening, Design and Forecast years as the N4-N15 UIS, namely 2017, 2032 and 2047 respectively.

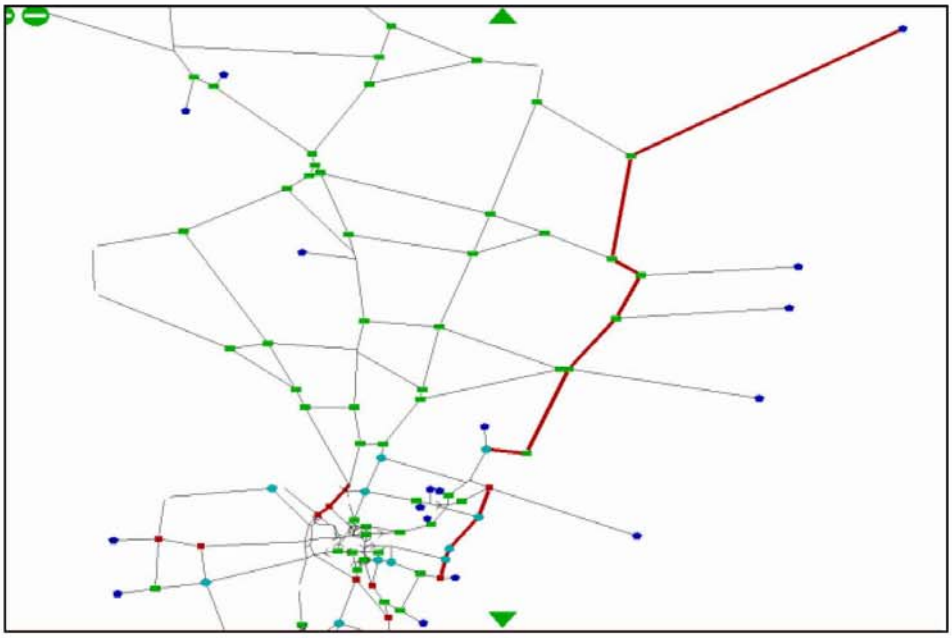

Figure 2.1: Do Minimum model with committed schemes, EGB and UIS

2.3 Strategic Options

There were a total of four strategic options comprising different alignment arrangements for the N16, varying in lengths, junction configurations and tie-in points to the existing road network. The N16 route corridor alignment ends at Leitrim county boundary near Glencar in the north. Each model had the Speed Flow Curve (SFC) upgraded on the new alignment to standard single carriageway one lane rural road with free flow speed of 90 kph.

The three emerging route options stem from two of the strategic options (Option 1A_S1A from strategic Option 1 and Options 5 and 12 from strategic Option 4). These are described below;

2.3.1 Strategic Option 1

2.3.1.1 Option 1A_S1A

The new alignment emerges from the existing N15 section between Lisnalurg and Teesan and co-aligns with the existing N16 at Drumkilsellagh. It routes further northeast to terminate at the Leitrim County border. The total length is 7.15 km and has 11 new or redesigned junctions. Five of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst three of them are related to the realignment of existing local road junctions to facilitate the new N16 alignment. Option 1A_S1A differs slightly from previous Option 1A scenarios as it has a bridge over the L-7421-0 in effect closing off access to the Ballytivnan Road into Sligo city centre from the proposed N16. The remaining three junctions are on the widened N15 section.

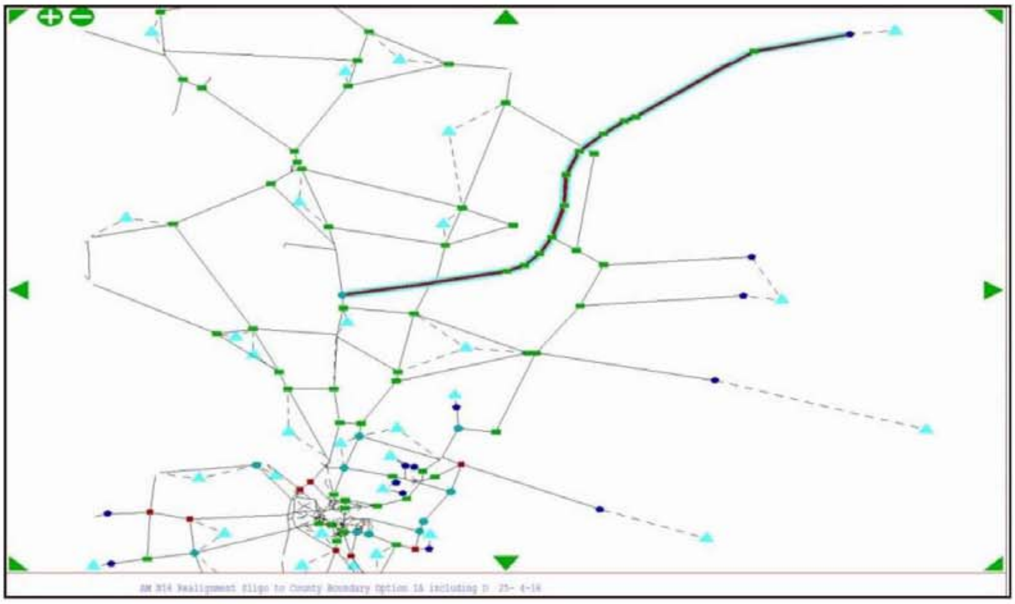

Figure 2.2: SATURN Model Option 1A_S1A

2.3.2 Strategic Option 4

2.3.2.1 Option 5

Option 5 has a new N16 alignment terminating at the AbbVie roundabout at the same point as the existing N16 meets the roundabout. The total length is 7.7 km with 16 new or redesigned junctions. Nine of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst the remaining seven are related to the realignment of existing local road junctions to facilitate the alignment.

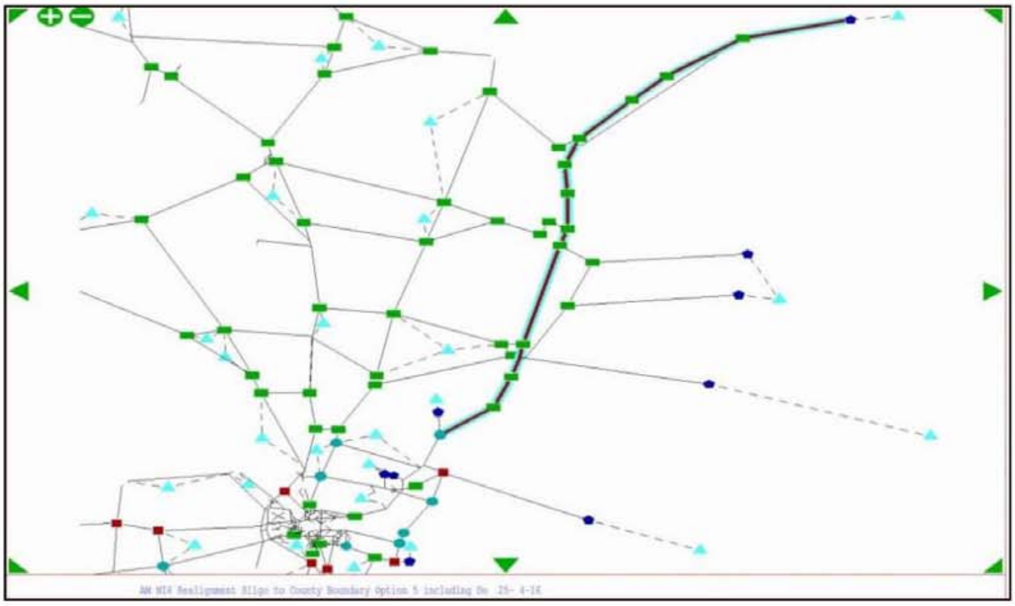

Figure 2.3: SATURN Model Option 5

2.3.2.2 Option 12

Option 12 is a variant of Option 5 with the new N16 alignment tapering off the existing N16 just after Willowbrook Bridge and meeting the existing N16 again before connecting into the AbbVie roundabout. The total length is 8.3 km including 12 new or redesigned junctions. Nine of these are along the N16 route connecting it to the local road network including the existing N16 alignment whilst the remaining three are related to the realignment of existing local road junctions to facilitate the alignment.

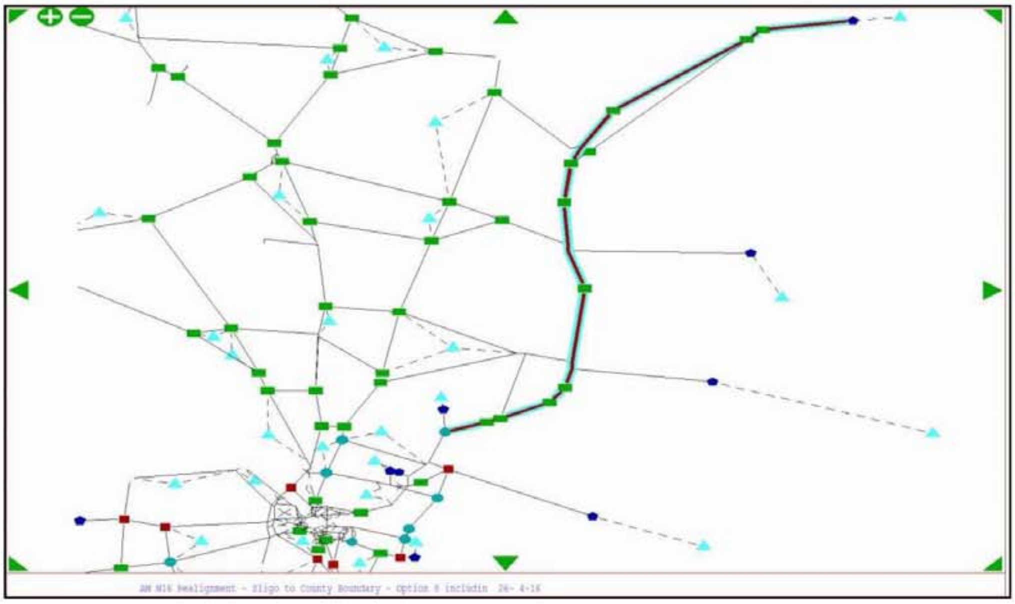

Figure 2.4: SATURN Model Option 12

3. Sensitivity Test 1 - No Eastern Garavogue Bridge

3.1 Introduction

This section details the Strategic Objectives and the results of the KPIs as described in Table 1.1. Sensitivity Test 1 was the testing of the emerging schemes without the Eastern Garavogue Bridge. The comparison of KPIs achieved in this sensitivity test will quantify how well each option achieves the Sensitivity 1 objectives.

3.2 Sensitivity Test 1 - Objective 1

Objective 1 was to effectively cater for strategic traffic. The KPIs assessed as part of this objective were the AADTs on the N16, N15 and N4. The results of these KPIs are detailed below.

3.2.1 Sensitivity Test 1 - AADT on the N16

The 2047 AADT at various critical locations on N16 alignment are presented in Table 3.1. The locations of the N16 AADT values are illustrated in Figure 3.1 to Figure 3.4 showing the different option arrangements and configurations for the Do Minimum and the three sensitivity options considered in Sensitivity Test 1.

It can be seen that in the Do Minimum traffic volumes increase on the approach to Sligo, but reduce slightly to the south of the N16 junction with the L-3407-22 due to traffic using the L-7422-0 as an alternative route to the N16. At reference point 5 the impact of the Sensitivity Test 1 on the Do Minimum indicates that northbound AADT will decrease by approximately 300 (to 2167) and southbound AADT will increase by approximately 250 (to 1722).

Option 1A_S1A shows similar patterns of traffic using the N16, with greater reductions in traffic on the N16 as it gets closer to the N15. This highlights that traffic demand on the N16 is focussed more within Sligo and results in this demand utilising the existing N16 route as an alternative to the proposed alignments. At reference point 4 the impact of the Sensitivity Test 1 on Option 1A_S1A indicates that northbound AADT will increase by approximately 90 (to 538) and southbound AADT will decrease by approximately 100 (to 1427).

Options 5 and 12 showed similar traffic patterns with traffic volumes on the proposed N16 alignments increasing closer to Sligo. This suggests that these routes generally cater for the demand to Sligo, with limited use of the alternative routes to the N16. In Option 5 at reference point 5 the impact of Sensitivity Test 1 on the northbound AADT is a decrease of approximately 400 (to 2511), while the southbound AADT also indicates a decrease by approximately 150 (to 2519). In Option 12 the biggest impact of Sensitivity Test 1 is at reference point 6 at which the northbound AADT is indicated to decrease by approximately 550 (to 2180), while the southbound AADT also indicates a decrease by approximately 300 (to 2217).

Option 5 caters for the highest demand levels of the three emerging options in Sensitivity Test 1.

Table 3.1: Sensitivity Test 1 - N16 2047 AADT Comparisons

Map Reference	Direction	N16 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
1	NB	1839	1839	1839	1839
1	SB	1813	1813	1813	1813
2	NB	1839	1839	1839	1839
2	SB	1813	1813	1813	1813
3	NB	1738	1839	1767	1761
3	SB	1730	1813	1741	1741

N16 Key Performance Indicator Sensitivity Testing

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Map Reference	Direction	N16 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
4	NB	2454	538	1706	2035
4	SB	2301	1427	1692	2057
5	NB	2167	-	2511	2058
5	SB	1722	-	2519	2145
6	NB	-	-	-	2180
6	SB	-	-	-	2217

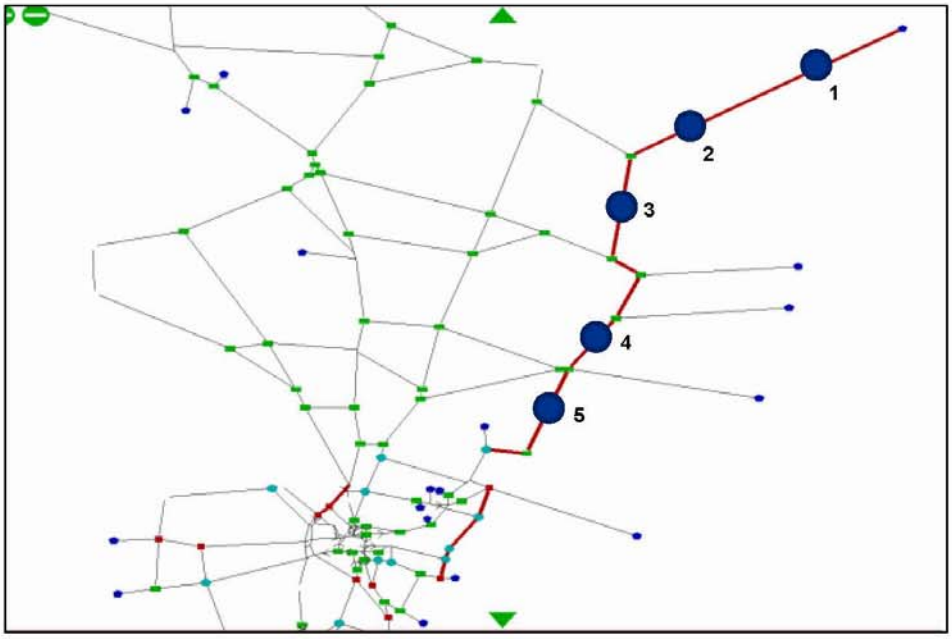

Figure 3.1: SATURN Model Do Minimum

N16 Key Performance Indicator Sensitivity Testing

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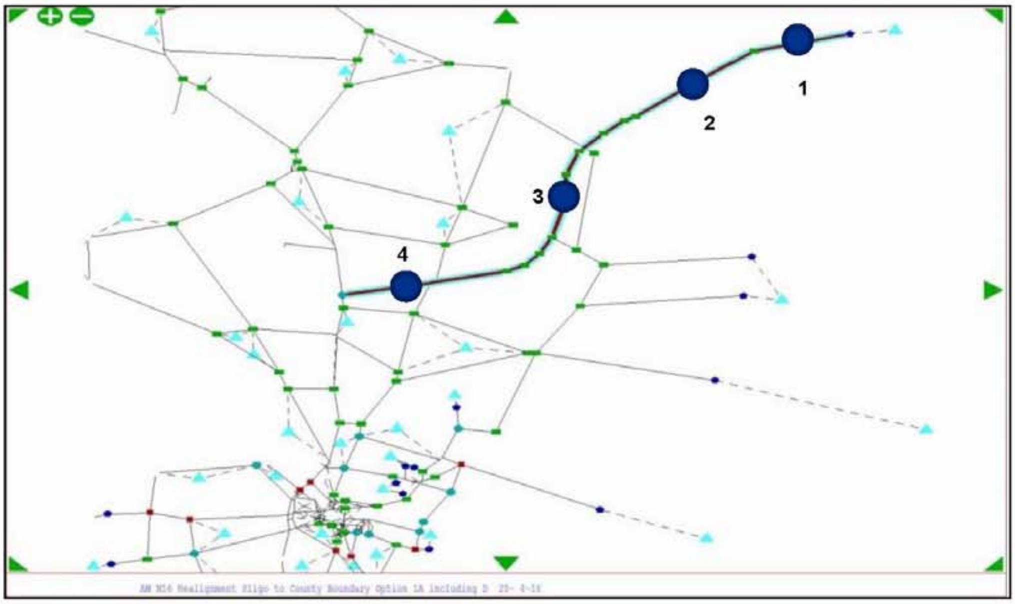

Figure 3.2: SATURN Model Option 1A_S1A

N16 Key Performance Indicator Sensitivity Testing

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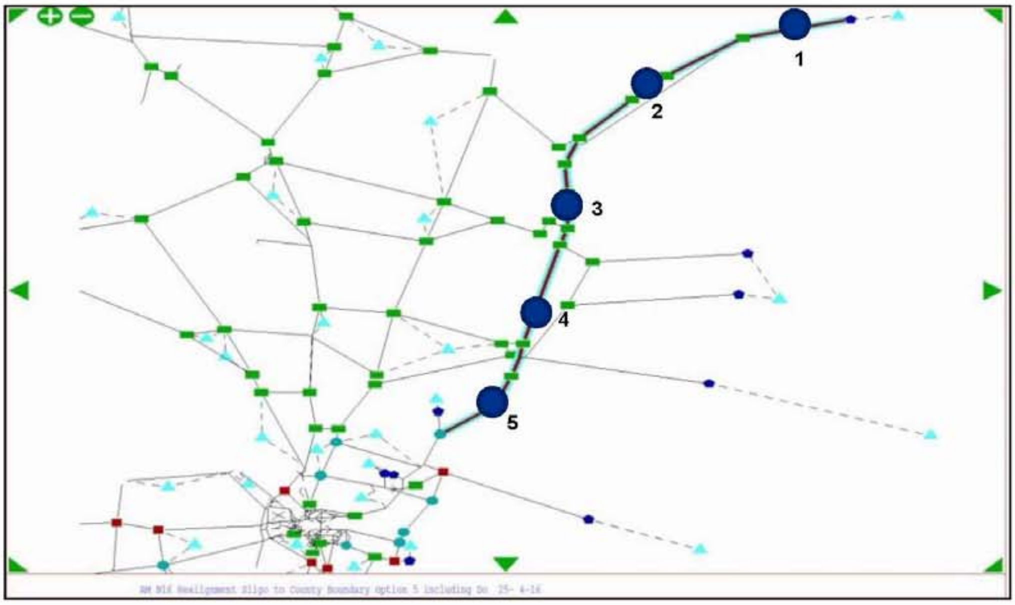

Figure 3.3: SATURN Model Option 5

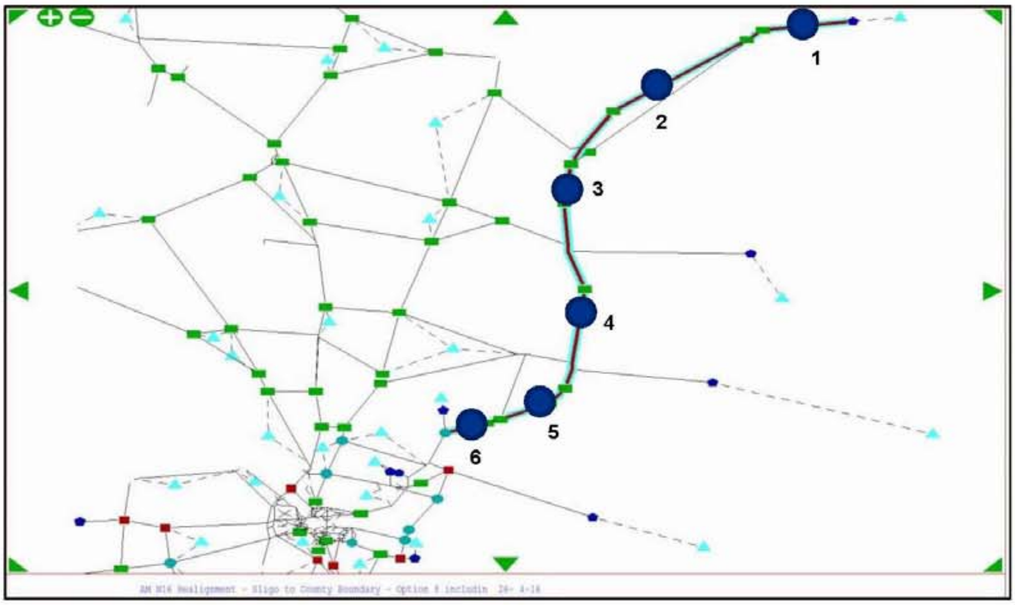

Figure 3.4: SATURN Model Option 12

3.2.2 Sensitivity Test 1 - AADT on the N15

The AADT values on the section of N15 adjacent to the N16 alignment are presented in Table 3.2 below. The locations of the N15 AADT values are illustrated in Figure 3.5 below. The section of the N15 in question spans just north of where the proposed N16 intercepts in Option 1 to the signalised junction of the R291 Rosses Point Road.

It can be seen that on the N15 north of where the proposed N16 intercepts it (AADT 1), the northbound and southbound flows are relatively constant across all the scenarios.

The northbound and southbound flows on the N15 immediately south of where the proposed Option 1 N16 intercepts it (AADT 2) have been included indicating that the southbound AADT is approximately 700 greater than the northbound in Option 1A_S1A. Throughout all the reference points on the N15, Option 1A_S1A has the highest AADT owing to the proposed N16 intercepting the N15 in this option, while Option 5 and 12 show similar AADT levels with the Do Minimum scenario.

In most cases, the impact of Sensitivity Test 1 on the N15 is an increase of up to 800 at each AADT reference point. This is when compared with the AADTs in the *N16 Key Performance Indicator Testing Technical Note* issued in December 2016.

Table 3.2: Sensitivity Test 1 - N15 2047 AADT Comparisons

Map Reference	Direction	N15 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
1	NB	8270	8341	8274	8245
1	SB	8125	8171	8121	8082
2	NB	-	8702	-	-
2	SB	-	9420	-	-
3	NB	8257	8646	8341	8316
3	SB	8144	9382	8157	8143
4	NB	8100	8499	8198	8115
4	SB	7993	9181	8109	7641
5	NB	8599	8978	8716	8831
5	SB	8799	10014	8892	8429
6	NB	8585	8752	8330	8573
6	SB	7870	8734	7586	7502

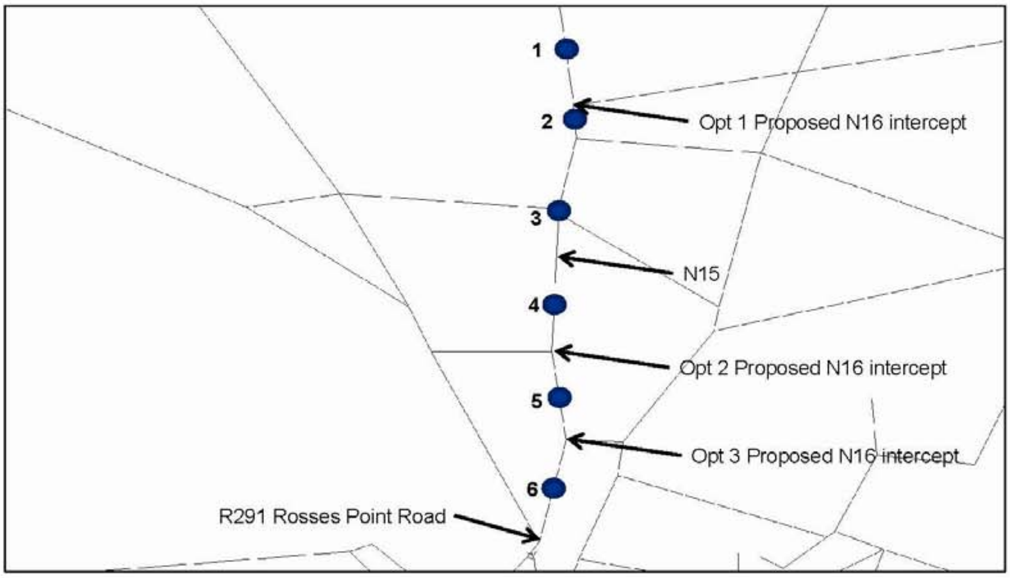

Figure 3.5: Sensitivity Test 1 - N15 AADT Locations

3.2.3 Sensitivity Test 1 - AADT on the N4

The AADT values at locations on the N4 are presented in Table 3.3 below. The locations of the N4 AADT values are illustrated in Figure 3.6 below.

The locations of the AADTs are on the section of the N4 spanning above the signalised junction of Upper John Street to the south, and just below where the existing N16 intercepts to the north.

Throughout all the reference points on the N4, Option 1A_S1A, 5 and 12 all show similar AADT levels with the Do Minimum scenario.

In most cases, the impact of Sensitivity Test 1 on the N4 is an increase of 2,000 – 3,000 at each reference point apart from AADT 3 southbound which has indicated a smaller increase of 200 – 700. This is when compared with the AADTs in the *N16 Key Performance Indicator Testing Technical Note* issued in December 2016.

Table 3.3: Sensitivity Test 1 - N4 2047 AADT Comparisons

Map Reference	Direction	N4 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
1	NB	15368	15428	15373	15598
1	SB	11365	11372	11322	11200
2	NB	12522	12544	12464	12522
2	SB	12390	12353	12388	12271
3	NB	14820	15012	14771	14968

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Map Reference	Direction	N4 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
3	SB	16080	16717	15803	15798

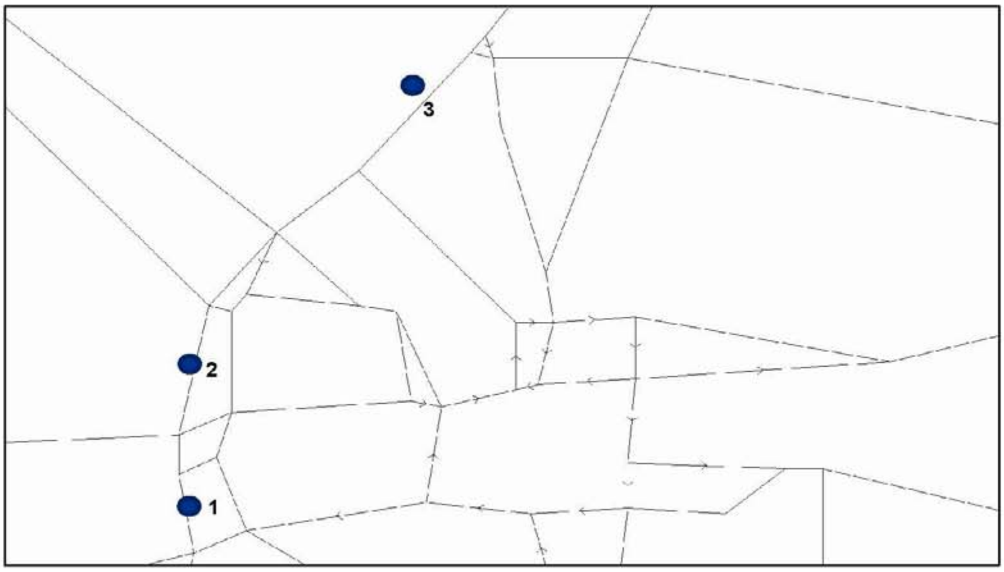

Figure 3.6: N4 AADT Locations

3.2.4 Sensitivity Test 1 - Wider Sligo Network AADT

Figure 3.7 and Figure 3.8 outline the locations considered on the wider Sligo network in the context of the introduction of the different N16 option alignments. The findings are presented in Table 3.4.

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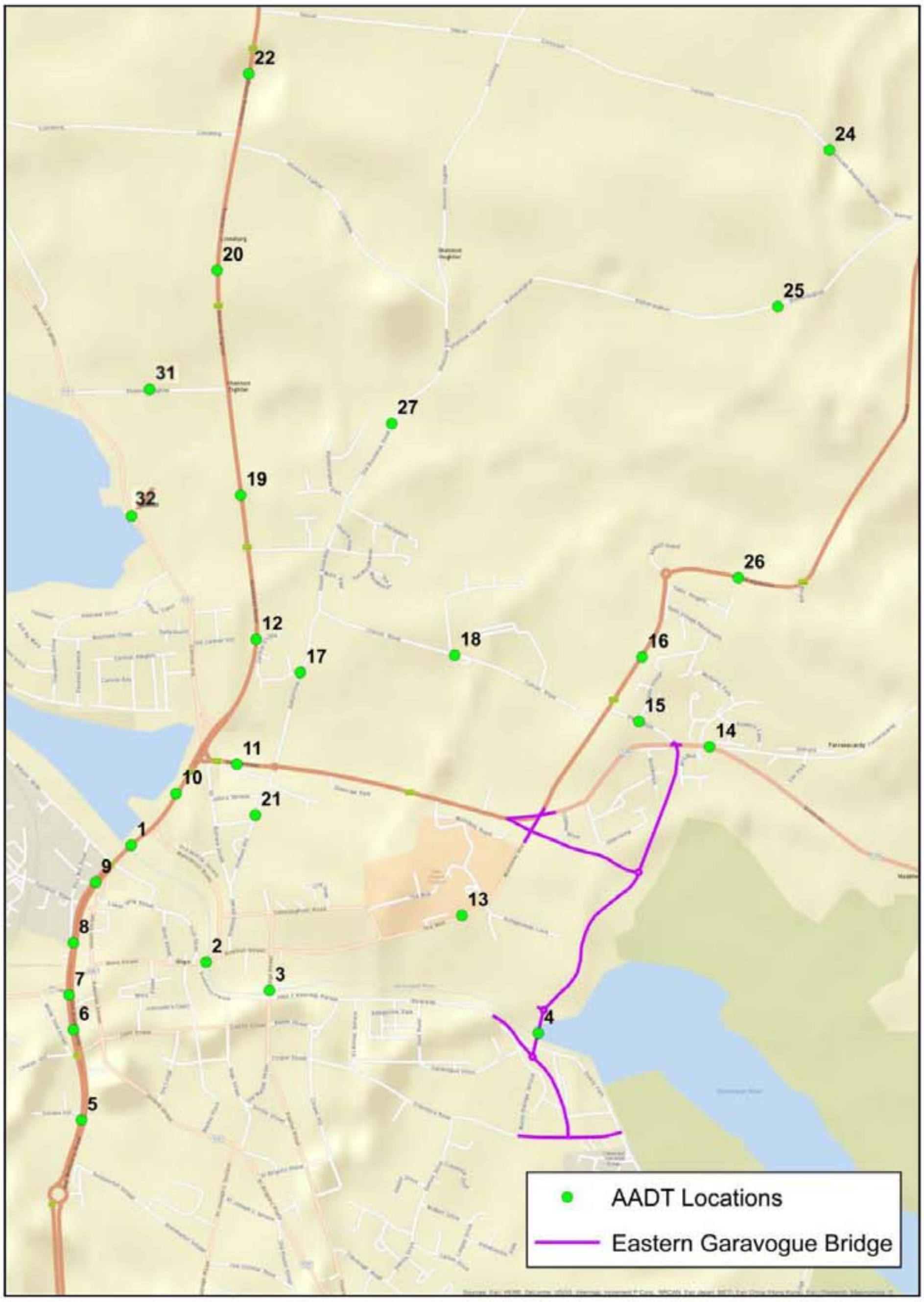

Figure 3.7: AADT Location Map – Sligo Town

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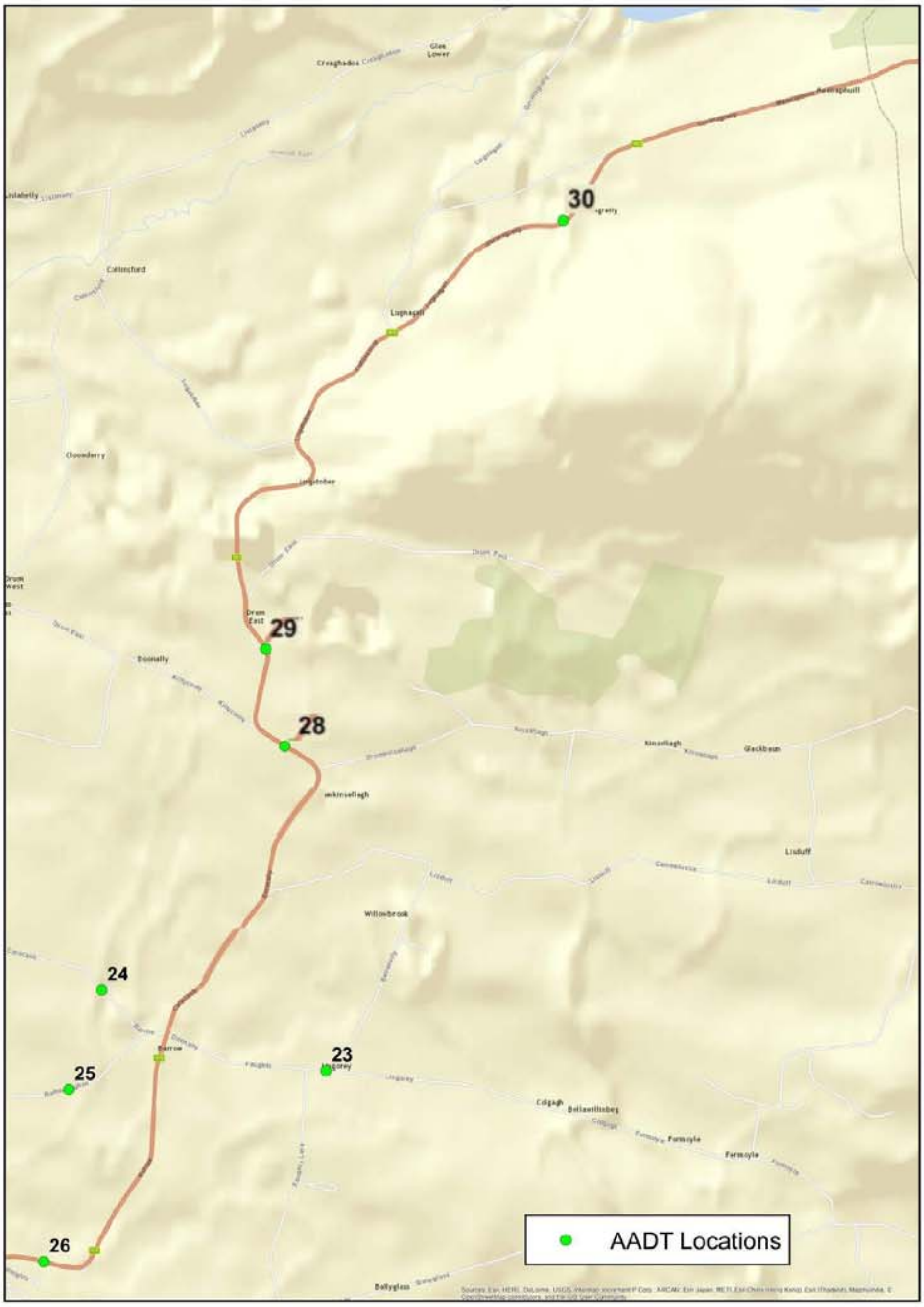

Figure 3.8: AADT Location Map – N16 Corridor

18

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Table 3.4: Sensitivity Test 1 - 2047 AADT Comparisons N16, N15 and N4

AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)			
Link Name			DM	OP1A_S1A	OP5	OP12
Hughes Bridge	1	NB	13743	13878	13724	13887
Hughes Bridge	1	SB	15254	15979	15222	15327
Hyde Bridge	2	NB	11139	11054	11188	11021
Bridge Street	3	SB	12362	11687	12424	12314
Garavogue Bridge	4	NB	-	-	-	-
Garavogue Bridge	4	SB	-	-	-	-
N4 North of Summerhill R'about	5	NB	11786	11802	11802	12355
N4 North of Summerhill R'about	5	SB	11905	11961	11899	12038
N4 Church Hill/John Street to Sráid an Fhiona (S5-S6)	6	NB	15368	15428	15373	15598
N4 Sráid an Fhiona to Church Hill/John Street (S6-S5)	6	SB	11365	11372	11322	11200
N4 Sráid an Fhiona to Wine Street (S6-S7)	7	NB	15341	15391	15300	15377
N4 Wine Street to Sráid an Fhiona (S7-S6)	7	SB	11113	11053	11075	10961
N4 Wine Street to Finiskin Road	8	NB	12522	12544	12464	12522
N4 Finiskin Road to Wine Street	8	SB	12390	12353	12388	12271
N4 Finiskin Road to Ballast Quay	9	NB	10016	10059	9971	10032
N4 Ballast Quay to Finiskin Road	9	SB	9918	9887	9906	9755
N4 Markievicz Road to Duck Street	10	NB	14820	15012	14771	14968
N4 Duck Street to Markievicz Road	10	SB	16080	16717	15803	15798
N16 Duck Street (N4 to R'about)	11	EB	5926	5961	6087	6021
N16 Duck Street (R'about to N4)	11	WB	7036	6837	6976	6850
N15 Rosses Point to Elm Gardens	12	NB	8585	8752	8330	8573
N15 Elm Gardens to Rosses Point	12	SB	7870	8734	7586	7502
R 286 - The Mall	13	NB	4085	4106	4231	3417
R 286 - The Mall	13	SB	3481	2968	3935	3660
R286 - Hazelwood Road	14	EB	3561	3561	3561	3561
R286 - Hazelwood Road	14	WB	3750	3750	3750	3750

N16 Key Performance Indicator Sensitivity Testing

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AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)			
Link Name			DM	OP1A_S1A	OP5	OP12
Short walk	15	EB	522	517	518	522
Short walk	15	WB	657	655	651	660
N16 South of Abbvie R'about	16	NB	2784	2784	3128	2797
N16 South of Abbvie R'about	16	SB	2072	1473	2869	2566
Ballytivnan Road	17	NB	1769	1619	1667	2249
Ballytivnan Road	17	SB	2859	2602	2351	2905
Clarion Road	18	EB	486	495	521	1024
Clarion Road	18	WB	621	607	717	1091
N15 Shannon Eighter to Elm Gardens	19	NB	8599	8978	8716	8831
N15 Shannon Eighter to Elm Gardens	19	SB	8799	10014	8892	8429
N15 Lisnalurg to Shannon Eighter	20	NB	8100	8499	8198	8115
N15 Lisnalurg to Shannon Eighter	20	SB	7993	9181	8109	7641
Holborn Hill	21	NB	2045	1830	1947	2565
Holborn Hill	21	SB	1990	1859	1791	2064
N15 Lisnalurg to Teesan	22	NB	8201	8645	8286	8260
N15 Lisnalurg to Teesan	22	SB	8058	9355	8071	8057
L - 3407 - 22 (Lisgorey)	23	EB	657	657	657	657
L - 3407 - 22 (Lisgorey)	23	WB	644	644	644	644
L - 3407 - 0 (Carncash)	24	EB	122	163	192	113
L - 3407 - 0 (Carncash)	24	WB	133	180	153	108
L - 7422 - 0 (Rathbraughan Lane)	25	EB	825	422	418	340
L - 7422 - 0 (Rathbraughan Lane)	25	WB	1070	391	258	288
N16 East of Abbvie R'about	26	EB	2167	2167	2511	2180
N16 East of Abbvie R'about	26	WB	1722	1123	2519	2217
Old Bundoran Road	27	NB	1973	1575	1530	1949
Old Bundoran Road	27	SB	1911	1290	998	1771
N16 (L - 3406 - 0 to L - 7416 - 0)	28	NB	1780	1330	-	-

AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)			
Link Name			DM	OP1A_S1A	OP5	OP12
N16 (L - 3406 - 0 to L - 7416 - 0)	28	SB	1839	521	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	29	NB	1738	17	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	29	SB	1730	122	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	30	NB	1839	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	30	SB	1813	-	-	-
L - 90102 - (Scotsman Walk)	31	EB	274	269	336	345
L - 90102 - (Scotsman Walk)	31	WB	268	217	373	575
R291 Rosses Point Road	32	NB	1221	1241	1136	935
R291 Rosses Point Road	32	SB	1652	1657	1656	1648

3.3 Sensitivity Test 1 - Objective 2

Objective 2 was to efficiently cater for strategic national road traffic. This KPI was assessed using journey times from the N16 at the Leitrim boundary to the N4 / N16 / N15 junction for the Do Minimum and the three sensitivity options considered in Sensitivity Test 1.

The 2047 AM, IP and PM peak journey time comparisons for the Do Minimum and three emerging route options between the Leitrim county boundary and the N4 / N16 / N15 junction are presented in Table 3.5. For information purposes, Option 1A_S1A includes two journey times. The two journey times are when using the proposed N16 and using the existing N16. These indicate that the journey times when using the proposed N16 are approximately 90 seconds quicker than when using the existing N16 in Option 1A_S1A. Overall, Option 1A_S1A recorded the shortest journey time (when using the proposed N16) followed by Option 5 and 12.

Although Option 5 and 12 have slightly longer journey times it is important to stress that the Select Link Analysis has indicated that there is a low level of strategic traffic on the N16 travelling to the N4/N16/N15 junction.

For illustration purposes the Opt 1A_S1A routes using the proposed N16 (green) and existing N16 (red) are shown in Figure 3.9 below. In this example the length of the green route using the proposed N16 to the N4/N16/N15 junction is 9.51 km, while the length of the red route using the existing N16 is 10.62 km.

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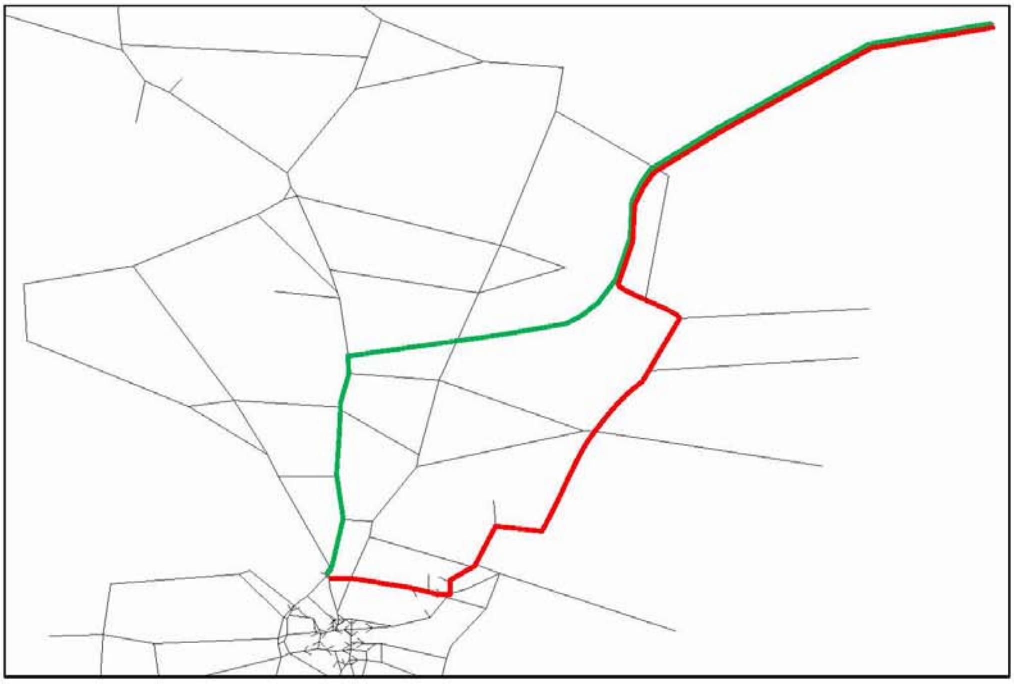

Figure 3.9: Journey Time routes illustration (Opt 1A_S1A) for the proposed N16 (green) and the existing N16 (red)

Table 3.5: Sensitivity Test 1 - Journey Time Comparison for 2047 AM, IP and PM peak inbound

Scenario	Modelled Journey Time (mins)		
	Leitrim county boundary to the N4 / N16 / N15 junction		
	2047 AM	2047 IP	2047 PM
Do Minimum	9:23	8:59	9:14
Do Minimum Opt 1A_S1A (Proposed N16)	7:32	7:07	7:16
Do Minimum Opt 1A_S1A (Existing N16)	8:59	8:42	8:56
Do Minimum Opt 5	8:04	7:48	7:53
Do Minimum Opt 12	8:25	8:12	8:25

3.4 Sensitivity Test 1 - Objective 3

Objective 3 was to efficiently cater for strategic traffic to Sligo City Gateway (NSS). This KPI was assessed using journey times from the N16 at the Leitrim boundary to Sligo city centre for the Do Minimum and the three sensitivity options considered in Sensitivity Test 1.

The 2047 AM, IP and PM peak journey time comparisons for the Do Minimum and three emerging route options between the Leitrim county boundary and Sligo city centre are presented in Table 3.6. For information purposes, Option 1A_S1A includes two journey times. The two journey times are when using the proposed N16 and using the existing N16. These indicate that there is not much difference in journey time to the city centre when using the proposed N16 or the existing N16 in Option 1A_S1A. Overall, Option 5 recorded the shortest journey time followed by Option 12 and Option 1A_S1A.

For illustration purposes the Opt 1A_S1A routes using the proposed N16 (green) and existing N16 (red) are shown in Figure 3.10 below. In this example the length of the green route using the proposed N16 to the city centre is 10.54 km, while the length of the red route using the existing N16 is 10.70 km.

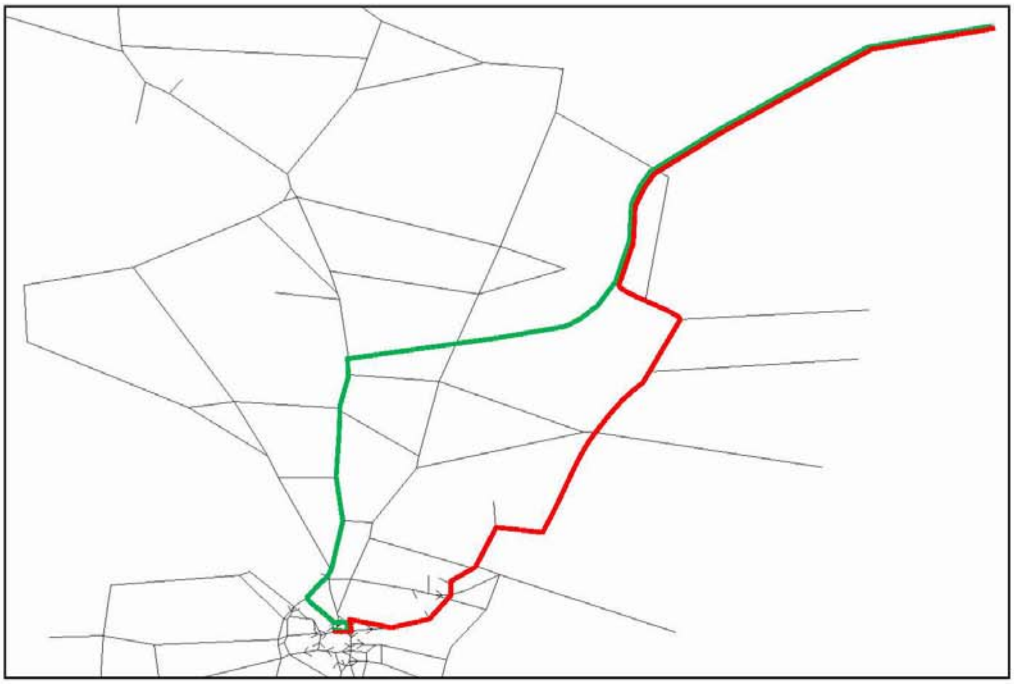

Figure 3.10: Journey Time routes illustration (Opt 1A_S1A) for the proposed N16 (green) and the existing N16 (red)

Table 3.6: Sensitivity Test 1 - Journey Time Comparison for 2047 AM, IP and PM peak inbound

Scenario	Modelled Journey Time (mins)		
	Leitrim county boundary to Sligo City Centre		
	2047 AM	2047 IP	2047 PM
Do Minimum	10:11	9:50	11:03
Do Minimum Opt 1A_S1A (Proposed N16)	10:18	9:17	10:02
Do Minimum Opt 1A_S1A (Existing N16)	9:44	9:30	10:40
Do Minimum Opt 5	8:47	8:36	9:08
Do Minimum Opt 12	9:08	8:59	9:52

3.5 Sensitivty Test 1 - Objective 4

Objective 4 was to determine if the road network could cater for future traffic. The KPI assessed as part of this objective was the Volume/Capacity ratios throughout the entire Sligo modelled network. The result of this KPI has been broken into three bands (number of junctions with V/C >85%, 50% - 85% and <50%) and is presented in Table 3.7 to Table 3.9 below. The three bands have been colour coded red, amber and green. The results indicated that a high number of the junctions recorded a V/C ratio of less than 50% and the remaining junctions were between 50% - 85% inclusive. There were no recorded instances of a V/C ratio of over 85%.

In each of the peak periods the number of V/C ratios between 50% - 85% is fairly constant in each option with 7-8, 3 and 8-12 junctions in the AM, IP and PM peaks respectively.

It should be noted that the SATURN model considers the peak hour and does not consider the profile of traffic within that peak hour. As such, capacity issues that can occur within the peak hour may not be represented in the model due to "flattening out" of the peak hour in the SATURN model, resulting in very few junctions having a V/C ratio of greater than 85%.

N16 Key Performance Indicator Sensitivity Testing

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Table 3.7: Sensitivity Test 1 - 2047 AM Volume / Capacity Ratios

	2047 AM Volume / Capacity Ratios			
	DM	OP1A_S1A	OP5	OP12
No. of Junctions	160	174	175	171
V / C Ratio >85%	0	0	0	0
V / C Ratio 50% - 85%	7	8	7	8
V / C Ratio <50%	153	166	168	163

Table 3.8: Sensitivity Test 1 - 2047 IP Volume / Capacity Ratios

	2047 IP Volume / Capacity Ratios			
	DM	OP1A_S1A	OP5	OP12
No. of Junctions	160	174	175	171
V / C Ratio >85%	0	0	0	0
V / C Ratio 50% - 85%	3	3	3	3
V / C Ratio <50%	157	171	172	168

Table 3.9: Sensitivity Test 1 - 2047 PM Volume / Capacity Ratios

	2047 PM Volume / Capacity Ratios			
	DM	OP1A_S1A	OP5	OP12
No. of Junctions	160	174	175	171
V / C Ratio >85%	0	0	0	0
V / C Ratio 50% - 85%	10	12	8	9
V / C Ratio <50%	150	162	167	162

3.6 Sensitivty Test 1 - Objective 5

Objective 5 was to assess the impact on future pedestrianisation of Sligo city centre. The KPI assessed as part of this objective was the traffic volume changes on links within Sligo city which are presented in Table 3.10 below. This table details the changes in 2047 AADT flow across the three assessed sensitivity scenarios when compared with the 2047 Do Minimum scenario. For ease of reading, percentage difference changes of greater than +15% have been coloured dark red indicating a notable increase in vehicular traffic. Percentage difference changes of greater than -15% have been coloured dark green indicating a notable decrease in vehicular traffic. Smaller percentage changes of between 0% to +15%, and 0% to -15% have been coloured light red and light green respectively.

As can be seen in Table 3.10 there were only two instances in Sensitivity Test 1 in which a city centre link indicated a percentage change of more than +/- 15% of the Do Minimum scenario. These were the R286 westbound in Option 1A_S1A (-15.8%) and the R286 eastbound in Option 12 (-28.8%).

All other city centre links experienced smaller changes in flows of between +/-15%. Most of these smaller percentage changes were positive reductions in city centre traffic volumes.

Table 3.10: Sensitivity Test 1 - 2047 Sligo City Centre Traffic Volume Changes

Link Name	2047 DM	2047 DM_OP1A_S1A			2047 DM_OP5			2047 DM_OP12		
	Flow	Flow	Diff	% Diff	Flow	Diff	% Diff	Flow	Diff	% Diff
R292 Hyde Bridge (EB) (one way)	11139	11054	-84	-0.8%	11188	49	0.4%	11021	-118	-1.1%
R286 WB (at jct with City View)	3241	2728	-513	-15.8%	3695	454	14.0%	3420	179	5.5%
R286 EB (from Holburn St jct) (one way)	13707	13497	-210	-1.5%	13541	-165	-1.2%	13213	-494	-3.6%
R286 EB (towards Holburn St jct) (one way)	12735	12613	-122	-1.0%	12489	-246	-1.9%	11822	-913	-7.2%
R870 Markievicz Rd NB	2767	2854	88	3.2%	2766	-1	0.0%	2803	36	1.3%
Holborn St NB	3546	3334	-212	-6.0%	3450	-97	-2.7%	4067	521	14.7%
R286 WB (at Ulster Bank) (one way)	2818	2837	19	0.7%	2819	1	0.0%	2802	-16	-0.6%
R286 WB (at jct with Stephen St) (one way)	2817	2835	18	0.6%	2818	1	0.0%	2800	-17	-0.6%
Bridge St (SB) (one way)	12362	11687	-675	-5.5%	12424	62	0.5%	12314	-48	-0.4%
R286 EB (at jct with City View)	2474	2499	25	1.0%	2620	146	5.9%	1762	-713	-28.8%
R286 SB (to Bridge St) (one way)	15179	14522	-657	-4.3%	15241	62	0.4%	15114	-65	-0.4%
R286 NB (to R870 Markievicz Rd) (one way)	13957	13892	-66	-0.5%	14007	50	0.4%	13823	-134	-1.0%
R870 Markievicz Rd SB	2517	2459	-57	-2.3%	2300	-216	-8.6%	2193	-324	-12.9%
Holborn St SB	2576	2452	-124	-4.8%	2399	-177	-6.9%	2679	103	4.0%

3.7 Sensitivity Test 1 - Objectives and KPIs Summary

To summarise the Sensitivity Test 1 objectives and identify the higher scoring options a summary table has been created. Table 3.11 below indicates that Option 5 performs the best at complying with the Sensitivity 1 strategic objectives. Each of the options generally performs well against the objectives but in the circumstances in which it was deemed that an option did not score so well against an objective these are outlined below.

The AADT for the proposed N16 close to the junction with the N15 in Option 1A_S1A is quite low particularly in the northbound direction. This indicates that the proposed N16 is not well utilised in this option and that vehicles are using alternative routes. Options 5 and 12 both showed similar traffic patterns with traffic volumes on the proposed N16 alignments increasing closer to Sligo indicating that these routes generally cater for the demand to Sligo. However it was Option 5 that catered for the higher demand levels. AADT on the N15 was highest in Option 1A_S1A due to the proposed N16 intercepting the N15 to the north in this scenario.

The AM, IP and PM journey times for route one to the N4/N16/N15 junction (Objective 2) were approximately 9 minutes in the Do Minimum Sensitivity Test 1. The three emerging options all performed better with journey times of between 7-9 minutes. Although Option 5 and 12 have been scored below Option 1A_S1A in Objective 2 it is important to stress that the Select Link Analysis indicated there was a low level of strategic traffic on the N16 travelling to the N4/N16/N15 junction.

In Objective 3 the AM, IP and PM journey times for route two to Sligo city centre were approximately 10-11 minutes for the Do Minimum Sensitivity Test 1. The three emerging options all performed better with journey times of between 8-10 minutes, but it was Option 5 which recorded the quickest journey times to the city centre closely followed by Option 12.

In Objective 4 each of the emerging options recorded a low number of junctions with a V/C ratio between 50% - 85%. None of the options recorded a V/C ratio of greater than 85%. However, over the 3 peak periods it was Option 5 which recorded the least amount of junctions with a V/C ratio between 50% – 85%, closely followed by Options 12 and 1A_S1A.

None of the emerging options recorded city centre traffic volume changes greater than +15% of the Do Minimum Sensitivity Test 1. Option 1A_S1A and 12 each had one link with a traffic volume change greater than -15% (both of which were on the R286 Connaughton Road). Overall, Sensitivity Test 1 traffic volumes for the 3 emerging options are relatively close to the Do Minimum traffic volumes.

N16 Key Performance Indicator Sensitivity Testing

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Table 3.11: Sensitivity Test 1 - Objectives and KPIs Summary

	Objective	KPI	Option 1A_S1A	Option 5	Option 12
1	Effectively cater for strategic traffic	AADT on N16	3	1	2
		AADT on N15	1	2	2
		AADT on N4	1	1	1
2	Efficiently cater for strategic national traffic	Journey Times from N16 at Leitrim Boundary to N4/N16/N15 Junction	1	2	2
3	Efficiently cater for strategic traffic to Sligo City Gateway (NSS)	Journey Times from N16 at Leitrim Boundary to Sligo City Centre	2	1	1
4	Road network to cater for future traffic	Number of V/C ratios broken into bands throughout entire Sligo modelled network. E.g. number of junctions >85%, 50% - 85% and <50%	1	1	1
5	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City Centre	1	1	1
		Overall Score	10	9	10

	Sample Scoring
Very High Preference	1
High Preference	2
Medium Preference	3
Not Applicable	N/A

4. Sensitivity Test 2 – City Centre Pedestrian / Cycle Priority

4.1 Introduction

This section details the Strategic Objectives and the results of the KPIs as described in Table 1.2. Sensitivity Test 2 was the testing of the emerging schemes with city centre pedestrian and cycle priority measures. The comparison of KPIs achieved in this sensitivity test will quantify how well each option achieves the Sensitivity 2 objectives.

4.2 Sensitivity Test 2 - Objective 1

Objective 1 was to effectively cater for strategic traffic. The KPIs assessed as part of this objective were the AADTs on the N16, N15 and N4. The results of these KPIs are detailed below.

4.2.1 Sensitivity Test 2 - AADT on the N16

The 2047 AADT at various critical locations on N16 alignment are presented in Table 4.1. The locations of the N16 AADT values are illustrated in Figure 4.1 to Figure 4.4 showing the different option arrangements and configurations for the Do Minimum and the three sensitivity options considered.

It can be seen that in the Do Minimum traffic volumes increase on the approach to Sligo, but reduce to the south of the N16 junction with the L-3407-22 due to traffic using the L-7422-0 as an alternative route to the N16. At reference point 5 the impact of the Sensitivity Test 2 on the Do Minimum indicates that northbound AADT will decrease by approximately 30 (to 2419) and southbound AADT will decrease by approximately 150 (to 1322).

Option 1A_S1A shows similar patterns of traffic using the N16, with greater reductions in traffic on the N16 as it gets closer to the N15. This highlights that traffic demand on the N16 is focussed more within Sligo and results in this demand utilising the existing N16 route as an alternative to the proposed alignments. At reference point 4 the impact of the Sensitivity Test 2 on Option 1A_S1A indicates that northbound AADT will remained relatively unchanged (at 453) and the southbound AADT will decrease by approximately 200 (to 1346).

Options 5 and 12 showed similar traffic patterns with traffic volumes on the proposed N16 alignments increasing closer to Sligo. This suggests that these routes generally cater for the demand to Sligo, with limited use of the alternative routes to the N16. In Option 5 at reference point 5 the impact of Sensitivity Test 2 on the northbound AADT is a decrease of approximately 150 (to 2750), while the southbound AADT also indicates a decrease by approximately 150 (to 2553). In Option 12 the biggest impact of Sensitivity Test 2 is at reference point 6 at which the northbound AADT is indicated to decrease by approximately 50 (to 2672), while the southbound AADT also indicates a decrease by approximately 250 (to 2291).

Option 5 caters for the highest demand levels of the three emerging options in Sensitivity Test 2.

Table 4.1: Sensitivity Test 2 - N16 2047 AADT Comparisons

Map Reference	Direction	N16 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
1	NB	1839	1839	1839	1839
1	SB	1813	1813	1813	1813
2	NB	1839	1839	1839	1839
2	SB	1813	1813	1813	1813
3	NB	1738	1839	1794	1773
3	SB	1732	1813	1742	1741

N16 Key Performance Indicator Sensitivity Testing

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Map Reference	Direction	N16 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
4	NB	2454	453	1733	2180
4	SB	2304	1346	1702	2102
5	NB	2419	-	2750	2465
5	SB	1322	-	2553	2214
6	NB	-	-	-	2672
6	SB	-	-	-	2291
7	EB	-	-	-	-
7	WB	-	-	-	-

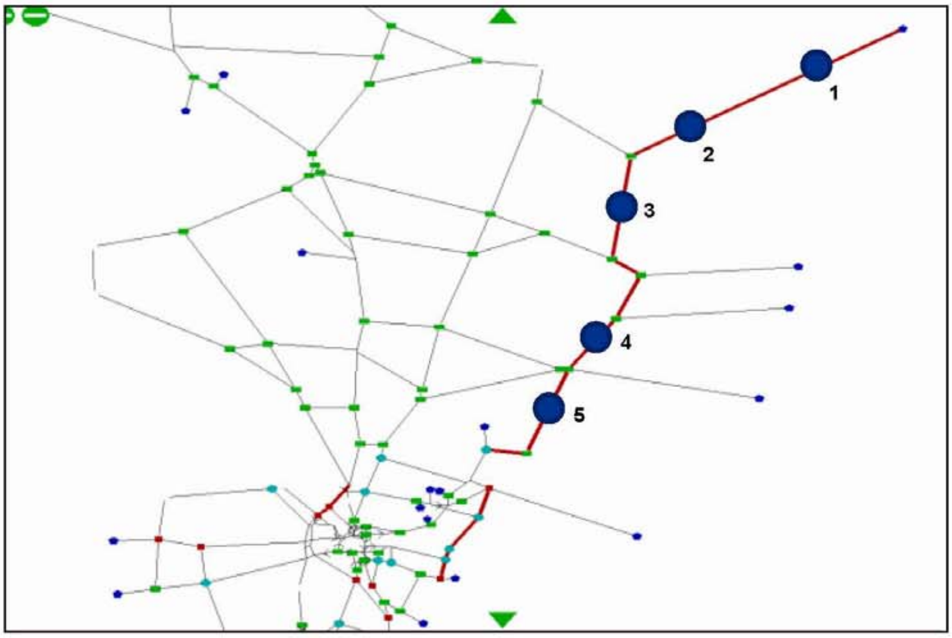

Figure 4.1: SATURN Model Do Minimum

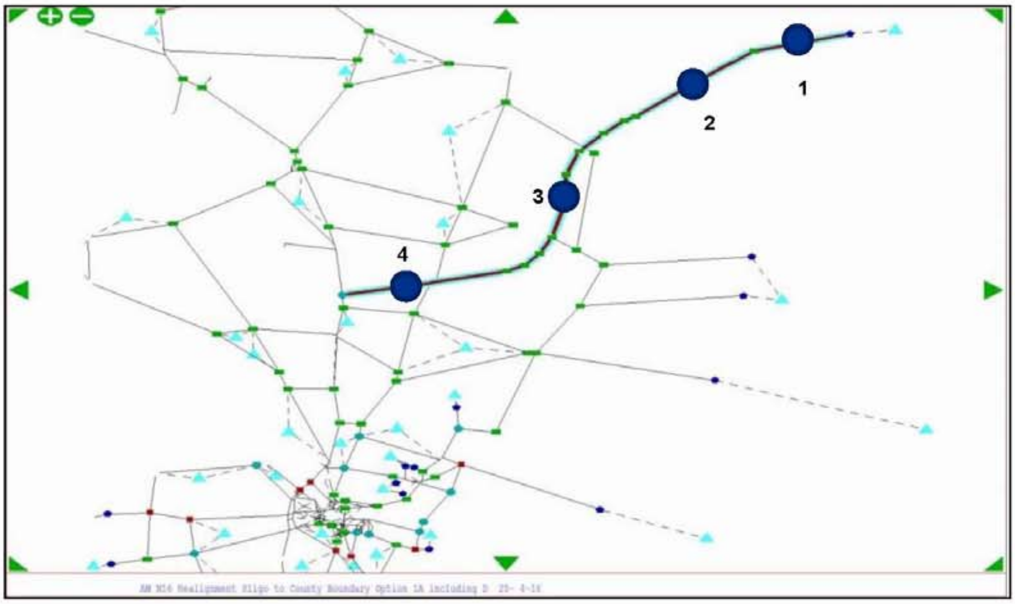

Figure 4.2: SATURN Model Option 1A_S1A

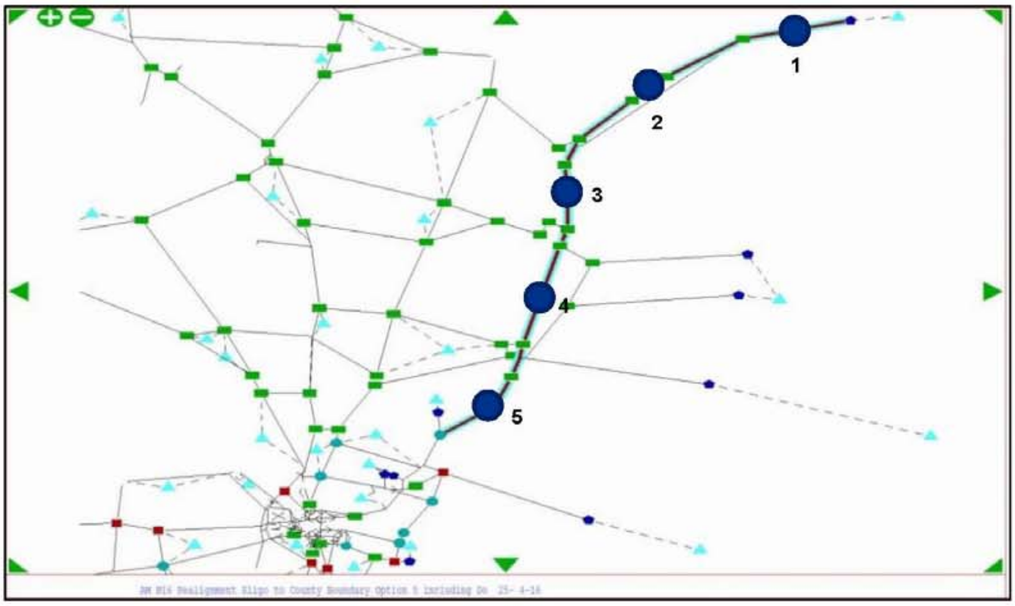

Figure 4.3: SATURN Model Option 5

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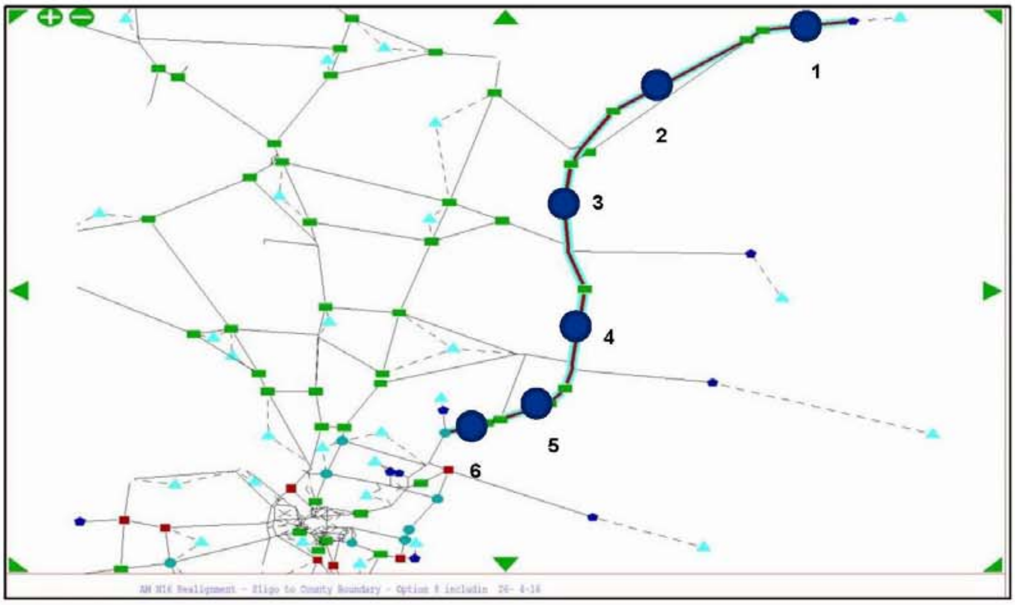

Figure 4.4: SATURN Model Option 12

4.2.2 Sensitivity Test 2 - AADT on the N15

The AADT values on the section of N15 adjacent to the N16 alignment are presented in Table 4.2 below. The locations of the N15 AADT values are illustrated in Figure 4.5 below. The section of the N15 in question spans just north of where the proposed N16 intercepts in Option 1 to the signalised junction of the R291 Rosses Point Road.

It can be seen that on the N15 north of where the proposed N16 intercepts it (AADT 1), the northbound and southbound flows are relatively constant across all the scenarios.

The northbound and southbound flows on the N15 immediately south of where the proposed Option 1 N16 intercepts it (AADT 2) have been included indicating that the southbound AADT is approximately 700 greater than the northbound in Option 1A_S1A. Throughout all the reference points on the N15, Option 1A_S1A has the highest AADT owing to the proposed N16 intercepting the N15 in this option, while Option 5 and 12 show similar AADT levels with the Do Minimum scenario.

In most cases, the impact of Sensitivity Test 2 on the N15 is an increase of up to 600 at each AADT reference point. This is when compared with the AADTs in the *N16 Key Performance Indicator Testing Technical Note* issued in December 2016.

Table 4.2: Sensitivity Test 2 - N15 2047 AADT Comparisons

Map Reference	Direction	N15 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
1	NB	8277	8304	8266	8252
1	SB	8122	8171	8119	8083

32

N16 Key Performance Indicator Sensitivity Testing

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Map Reference	Direction	N15 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
2	NB	-	8580	-	-
2	SB	-	9339	-	-
3	NB	8248	8512	8313	8275
3	SB	8132	9300	8142	8136
4	NB	7892	8141	8125	8049
4	SB	7917	9038	8106	8068
5	NB	8364	8609	8519	8485
5	SB	8716	9875	8890	8858
6	NB	7720	7825	7475	7574
6	SB	8373	9104	7915	7951

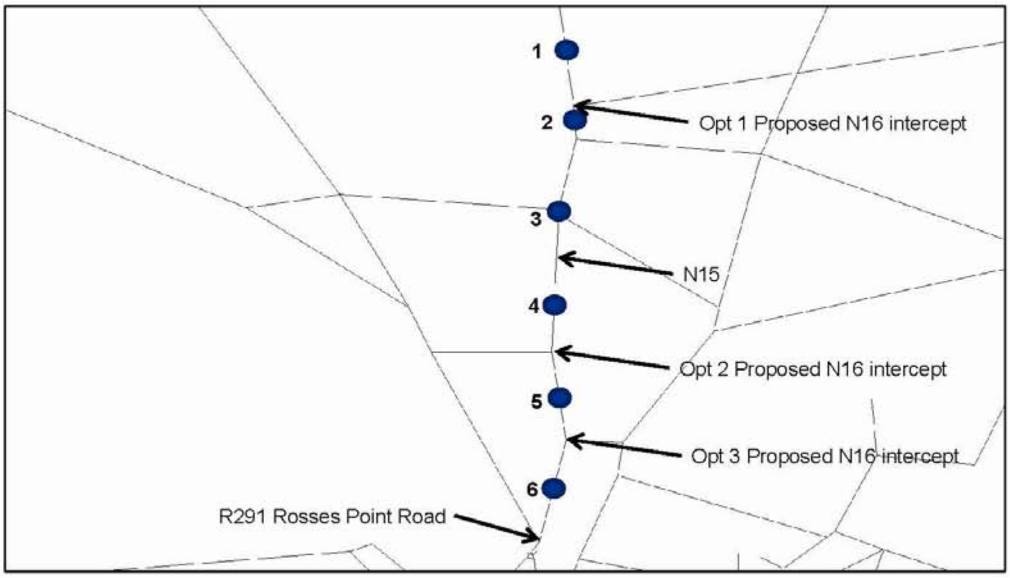

Figure 4.5: Sensitivity Test 2 - N15 AADT Locations

4.2.3 Sensitivity Test 2 - AADT on the N4

The AADT values at locations on the N4 are presented in Table 4.3 below. The locations of the N4 AADT values are illustrated in Figure 4.6 below.

The locations of the AADTs are on the section of the N4 spanning above the signalised junction of Upper John Street to the south, and just below where the existing N16 intercepts to the north.

Throughout all the reference points on the N4, Option 1A_S1A, 5 and 12 all show similar AADT levels with the Do Minimum scenario.

In most cases, the impact of Sensitivity Test 2 on the N4 is an increase of up to 2,000 at each reference point apart from AADT 3 which has indicated a smaller increase of up to 500. This is when compared with the AADTs in the *N16 Key Performance Indicator Testing Technical Note* issued in December 2016.

Table 4.3: Sensitivity Test 2 - N4 2047 AADT Comparisons

Map Reference	Direction	N4 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
1	NB	13592	13623	13489	13498
1	SB	10680	10549	10530	10555
2	NB	10930	10949	10786	10794
2	SB	11512	11331	11413	11443
3	NB	12735	12848	12593	12616
3	SB	15409	15897	14953	15028

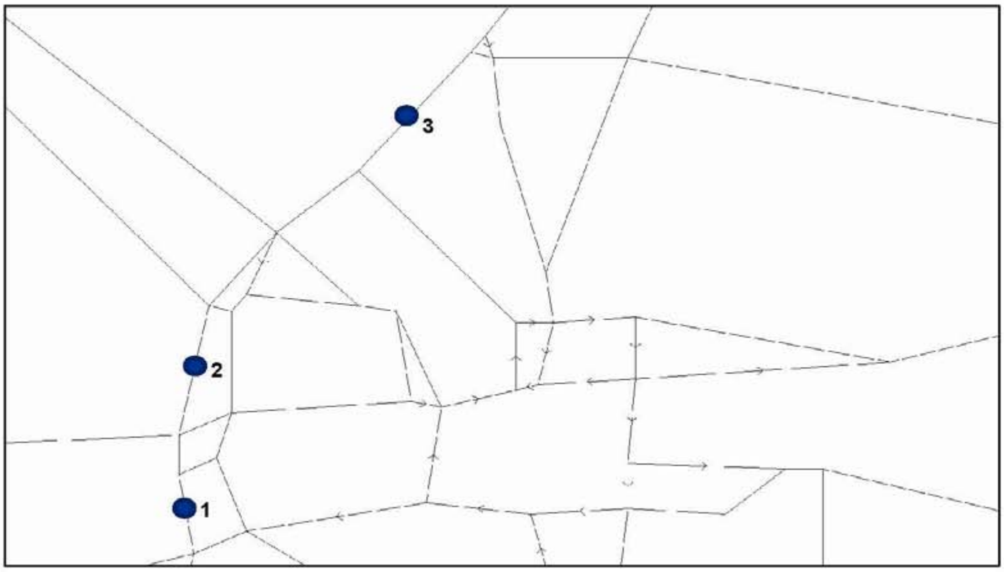

Figure 4.6: N4 AADT Locations

4.2.4 Sensitivity Test 2 - Wider Sligo Network AADT

Figure 4.7 and Figure 4.8 outline the locations considered on the wider Sligo network in the context of the introduction of the different N16 option alignments. The findings are presented in Table 4.4 .

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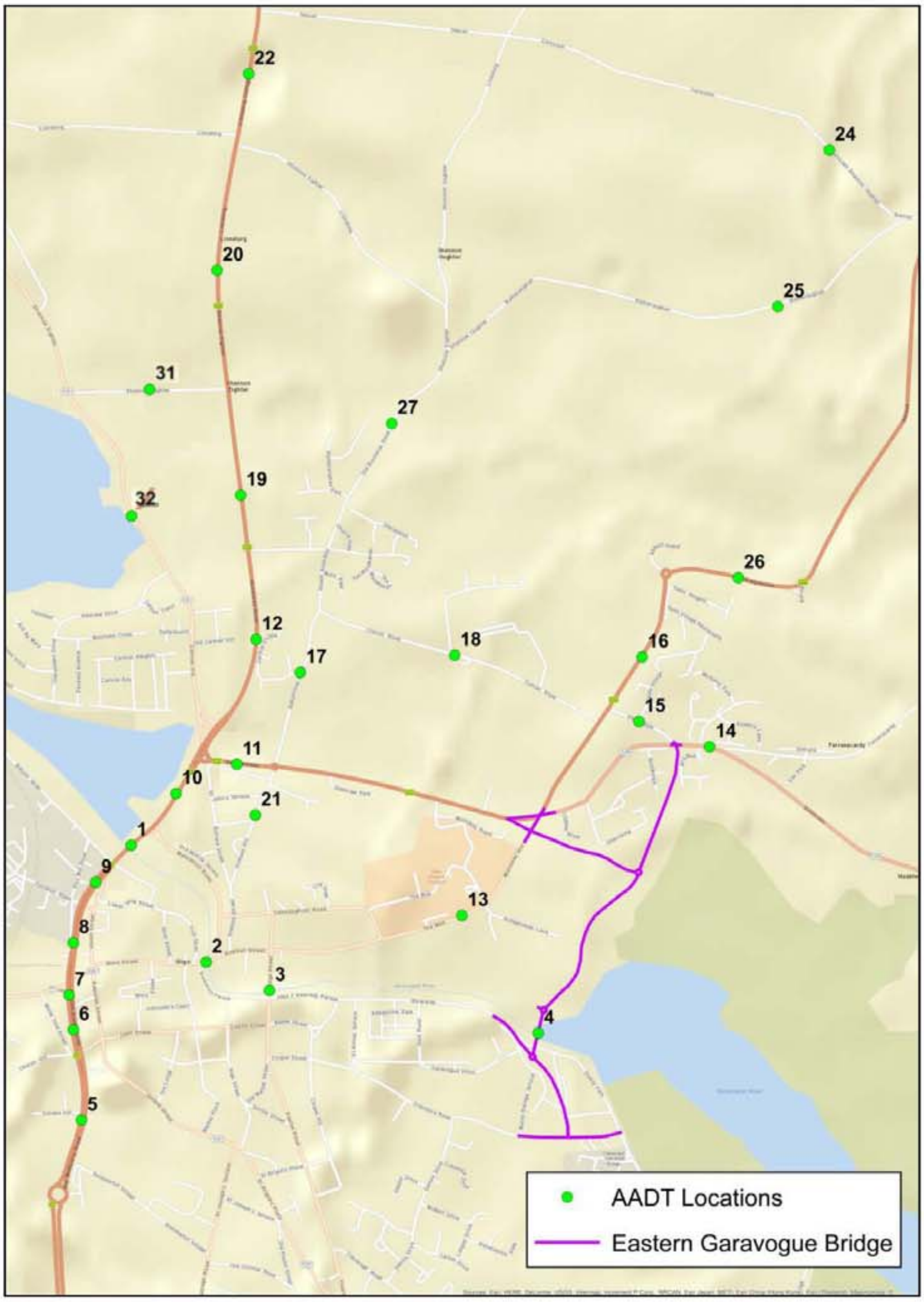

Figure 4.7: AADT Location Map – Sligo Town

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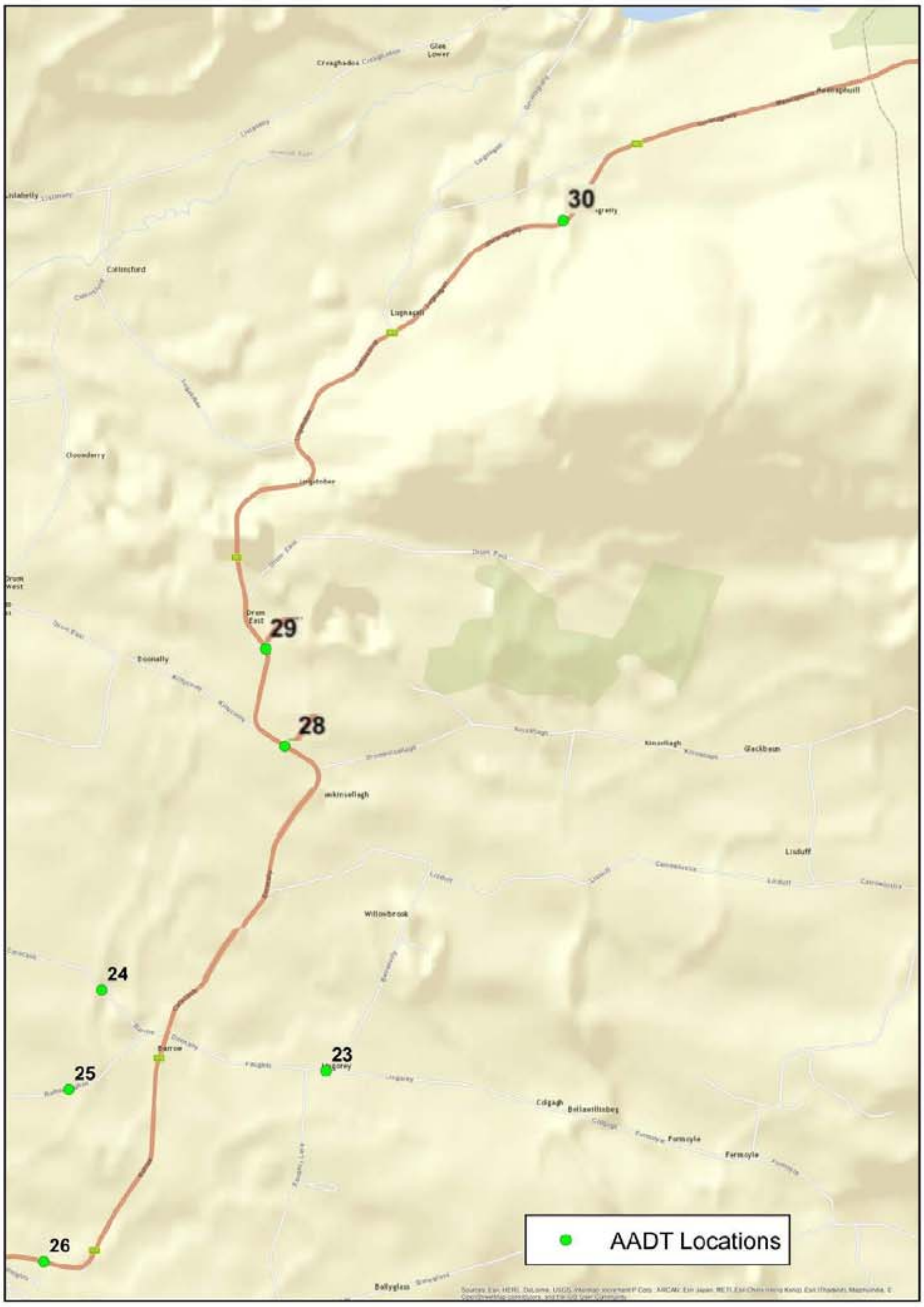

Figure 4.8: AADT Location Map – N16 Corridor

37

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Table 4.4: Sensitivity Test 2 - 2047 AADT Comparisons N16, N15 and N4

AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)			
Link Name			DM	OP1A_S1A	OP5	OP12
Hughes Bridge	1	NB	12280	12390	12181	12194
Hughes Bridge	1	SB	14373	14934	14203	14235
Hyde Bridge	2	NB	8107	8097	8060	8061
Bridge Street	3	SB	11472	11107	11593	11587
Garavogue Bridge	4	NB	4711	4686	4858	4845
Garavogue Bridge	4	SB	1987	1865	2037	2012
N4 North of Summerhill R'about	5	NB	10901	10931	10783	10784
N4 North of Summerhill R'about	5	SB	11268	11121	11110	11143
N4 Church Hill/John Street to Sráid an Fhiona (S5-S6)	6	NB	13592	13623	13489	13498
N4 Sráid an Fhiona to Church Hill/John Street (S6-S5)	6	SB	10680	10549	10530	10555
N4 Sráid an Fhiona to Wine Street (S6-S7)	7	NB	13730	13792	13565	13573
N4 Wine Street to Sráid an Fhiona (S7-S6)	7	SB	10305	10141	10149	10177
N4 Wine Street to Finiskin Road	8	NB	10930	10949	10786	10794
N4 Finiskin Road to Wine Street	8	SB	11512	11331	11413	11443
N4 Finiskin Road to Ballast Quay	9	NB	8354	8377	8218	8237
N4 Ballast Quay to Finiskin Road	9	SB	9032	8849	8934	8966
N4 Markievicz Road to Duck Street	10	NB	12735	12848	12593	12616
N4 Duck Street to Markievicz Road	10	SB	15409	15897	14953	15028
N16 Duck Street (N4 to R'about)	11	EB	4935	4925	4936	4896
N16 Duck Street (R'about to N4)	11	WB	6384	6132	6359	6403
N15 Rosses Point to Elm Gardens	12	NB	7720	7825	7475	7574
N15 Elm Gardens to Rosses Point	12	SB	8373	9104	7915	7951
R 286 - The Mall	13	NB	3314	3348	3349	3321
R 286 - The Mall	13	SB	2721	2585	3400	3397
R286 - Hazelwood Road	14	EB	3561	3561	3561	3561
R286 - Hazelwood Road	14	WB	3750	3750	3750	3750

N16 Key Performance Indicator Sensitivity Testing

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AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)			
Link Name			DM	OP1A_S1A	OP5	OP12
Short walk	15	EB	1271	1128	1354	1337
Short walk	15	WB	2336	2302	2484	2464
N16 South of Abbvie R'about	16	NB	3037	3015	3367	3290
N16 South of Abbvie R'about	16	SB	1672	1519	2903	2642
Ballytivnan Road	17	NB	1443	1364	1353	1369
Ballytivnan Road	17	SB	2966	2381	2468	2443
Clarion Road	18	EB	581	581	582	574
Clarion Road	18	WB	1799	1777	2014	1755
N15 Shannon Eighter to Elm Gardens	19	NB	8364	8609	8519	8485
N15 Shannon Eighter to Elm Gardens	19	SB	8716	9875	8890	8858
N15 Lisnalurg to Shannon Eighter	20	NB	7892	8141	8125	8049
N15 Lisnalurg to Shannon Eighter	20	SB	7917	9038	8106	8068
Holborn Hill	21	NB	1214	1090	1173	1190
Holborn Hill	21	SB	2177	1946	1889	1837
N15 Lisnalurg to Teesan	22	NB	8192	8511	8258	8220
N15 Lisnalurg to Teesan	22	SB	8045	9273	8056	8050
L - 3407 - 22 (Lisgorey)	23	EB	657	657	657	657
L - 3407 - 22 (Lisgorey)	23	WB	644	644	644	644
L - 3407 - 0 (Carncash)	24	EB	122	163	192	78
L - 3407 - 0 (Carncash)	24	WB	140	180	152	107
L - 7422 - 0 (Rathbraughan Lane)	25	EB	642	346	274	113
L - 7422 - 0 (Rathbraughan Lane)	25	WB	1473	433	240	265
N16 East of Abbvie R'about	26	EB	2419	2397	2750	2672
N16 East of Abbvie R'about	26	WB	1322	1168	2553	2291
Old Bundoran Road	27	NB	1936	1709	1373	1526
Old Bundoran Road	27	SB	2387	1388	966	1267
N16 (L - 3406 - 0 to L - 7416 - 0)	28	NB	1780	1415	-	-

AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)			
Link Name			DM	OP1A_S1A	OP5	OP12
N16 (L - 3406 - 0 to L - 7416 - 0)	28	SB	1842	602	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	29	NB	1738	17	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	29	SB	1732	122	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	30	NB	1839	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	30	SB	1813	-	-	-
L - 90102 - (Scotsman Walk)	31	EB	267	267	337	296
L - 90102 - (Scotsman Walk)	31	WB	249	207	258	252
R291 Rosses Point Road	32	NB	1248	1252	1252	1251
R291 Rosses Point Road	32	SB	1652	1652	1656	1656

4.3 Sensitivity Test 2 - Objective 2

Objective 2 was to efficiently cater for strategic traffic to Sligo City Gateway (NSS). This KPI was assessed using journey times from the N16 at the Leitrim boundary to Sligo city centre for the Do Minimum and the three sensitivity options considered in Sensitivity Test 2.

The 2047 AM, IP and PM peak journey time comparisons for the Do Minimum and three emerging route options between the Leitrim county boundary and Sligo city centre are presented in Table 4.5. For information purposes, Option 1A_S1A includes two journey times. The two journey times are when using the proposed N16 and using the existing N16. These indicate that there is not much difference in the AM and IP journey times to the city centre when using the proposed N16 or the existing N16 in Option 1A_S1A. Overall, Option 5 recorded the shortest journey time followed by Option 12 and Option 1A_S1A.

For illustration purposes the Opt 1A_S1A routes using the proposed N16 (green) and existing N16 (red) are shown in Figure 4.9 below. In this example the length of the green route using the proposed N16 to the city centre is 10.54 km, while the length of the red route using the existing N16 is 10.70 km.

N16 Key Performance Indicator Sensitivity Testing

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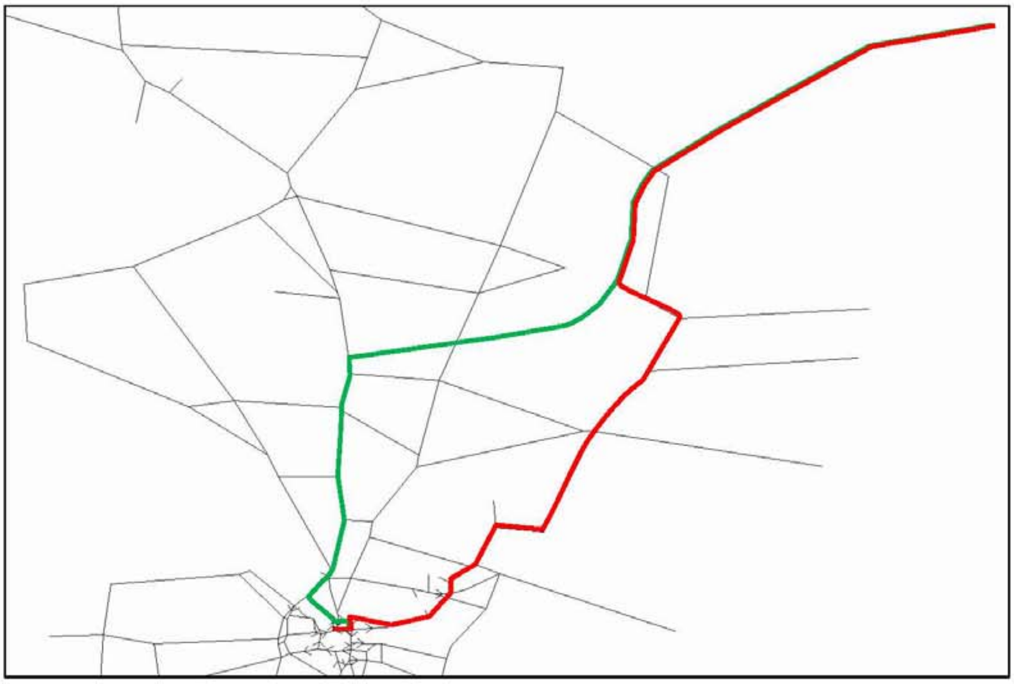

Figure 4.9: Journey Time routes illustration (Opt 1A_S1A) for the proposed N16 (green) and the existing N16 (red)

Table 4.5: Sensitivity Test 2 - Journey Time Comparison for 2047 AM, IP and PM peak inbound

Scenario	Modelled Journey Time (mins)		
	Leitrim county boundary to Sligo City Centre		
	2047 AM	2047 IP	2047 PM
Do Minimum	10:11	10:03	10:53
Do Minimum Opt 1A_S1A (Proposed N16)	9:55	9:13	9:30
Do Minimum Opt 1A_S1A (Existing N16)	9:53	9:46	10:44
Do Minimum Opt 5	8:56	8:50	9:48
Do Minimum Opt 12	9:13	9:09	10:01

4.4 Sensitivity Test 2 - Objective 3

Objective 3 was to assess the impact on future pedestrianisation of Sligo city centre. The KPI assessed as part of this objective was the traffic volume changes on links within Sligo city which are presented in Table 4.6 below. This table details the changes in 2047 AADT flow across the three assessed sensitivity scenarios when compared with the 2047 Do Minimum scenario. For ease of reading, percentage difference changes of greater than +15% have been coloured dark red indicating a notable increase in vehicular traffic. Percentage difference changes of greater than -15% have been coloured dark green indicating a notable decrease in vehicular traffic. Smaller percentage changes of between 0% to +15%, and 0% to -15% have been coloured light red and light green respectively.

As can be seen in Table 4.6 there were only two instances in Sensitivity Test 2 in which a city centre link indicated a percentage change of more than +/- 15% of the Do Minimum scenario. These were the R286 westbound in Option 5 (37.2%) and Option 12 (37.0%). Option 5 and 12 are likely to increase traffic flows on the R286 Connaughton Road, however this is a main traffic route (as stated in the SEDP) into the city centre from the existing N16 and not a heavily pedestrianised area when compared to other parts of the city centre which have a much higher pedestrian footfall.

All other city centre links experienced smaller changes in flows of between +/-15%. Most of these smaller percentage changes were positive reductions in city centre traffic volumes.

Table 4.6: Sensitivity Test 2 - 2047 Sligo City Centre Traffic Volume Changes

Link Name	2047 DM	2047 DM_OP1A_S1A			2047 DM_OP5			2047 DM_OP12		
	Flow	Flow	Diff	% Diff	Flow	Diff	% Diff	Flow	Diff	% Diff
R292 Hyde Bridge (EB) (one way)	8107	8097	-10	-0.1%	8060	-47	-0.6%	8061	-46	-0.6%
R286 WB (at jct with City View)	1830	1694	-136	-7.4%	2510	680	37.2%	2507	677	37.0%
R286 EB (from Holburn St jct) (one way)	11570	11494	-76	-0.7%	11275	-295	-2.6%	11317	-253	-2.2%
R286 EB (towards Holburn St jct) (one way)	11899	11714	-185	-1.6%	11370	-529	-4.4%	11348	-551	-4.6%
R870 Markievicz Rd NB	2520	2528	8	0.3%	2521	1	0.0%	2520	0	0.0%
Holborn St NB	2369	2246	-122	-5.2%	2327	-41	-1.7%	2345	-24	-1.0%
R286 WB (at Ulster Bank) (one way)	2883	2892	9	0.3%	2877	-5	-0.2%	2886	3	0.1%
R286 WB (at jct with Stephen St) (one way)	2882	2892	9	0.3%	2877	-5	-0.2%	2886	3	0.1%
Bridge St (SB) (one way)	11472	11107	-365	-3.2%	11593	121	1.1%	11587	115	1.0%
R286 EB (at jct with City View)	1712	1747	35	2.1%	1738	27	1.6%	1722	10	0.6%
R286 SB (to Bridge St) (one way)	14354	13999	-355	-2.5%	14470	116	0.8%	14473	119	0.8%
R286 NB (to R870 Markievicz Rd) (one way)	10990	10989	-1	0.0%	10937	-52	-0.5%	10946	-43	-0.4%
R870 Markievicz Rd SB	3100	3033	-67	-2.2%	2858	-242	-7.8%	2891	-210	-6.8%
Holborn St SB	2698	2466	-231	-8.6%	2422	-275	-10.2%	2375	-323	-12.0%

4.5 Sensitivity Test 2 - Objective 4

Objective 4 was to assess the operational efficiency of key city centre junctions. The KPI assessed as part of this objective was the Volume / Capacity ratios of the key city centre junctions which are presented in Table 4.7 to Table 4.9 below. These tables detail the AM, IP and PM peak periods for 2047. For ease of reading, Volume / Capacity ratios of less than 50% were coloured green, between 50% – 85% inclusive were coloured amber and over 85% were coloured red.

Across all scenarios most of the Volume / Capacity ratios of the key city centre junctions were under 50% with a small number of junctions between 50% - 85% inclusive. No junctions had a Volume / Capacity ratio of over 85%.

Overall, the worst preforming junctions were node 619 and node 516 which across the three emerging options recorded a varying Volume / Capacity ratio of between 50% - 85% in the 2047 AM, IP and PM peaks. Node 619 is the signalised junction of the R292 / O'Connell Street / Fish Quay. Node 516 is the priority junction of the R292 Wine Street and Quay Street. Both of these junctions are adjacent to each other in the centre of Sligo city.

Figure 4.10 below illustrates the location of the nodes in Sligo city centre.

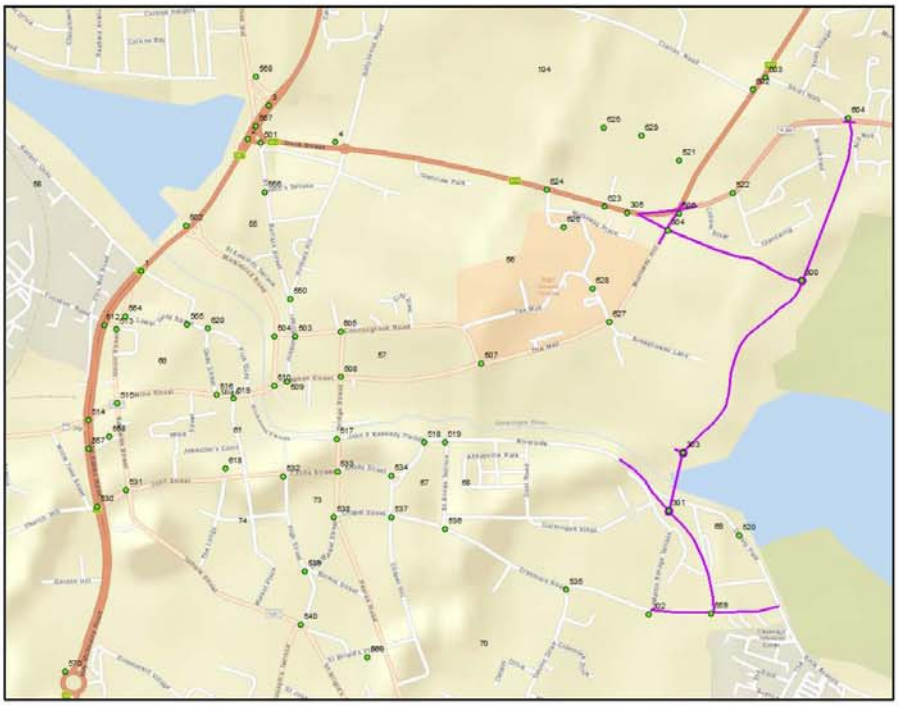

Figure 4.10: Sligo City Centre junction node numbers

N16 Key Performance Indicator Sensitivity Testing

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Table 4.7: Sensitivity Test 2 - 2047 AM – City Centre Junctions Volume/Capacity Ratios

	DM		OP1A_S1A		OP5		OP12	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
City Centre Junctions	304	17.0	304	16.9	304	18.9	304	18.9
	305	5.8	305	5.8	305	6.1	305	6.2
	501	25.2	501	24.8	501	25.3	501	25.2
	502	32.3	502	32.7	502	31.7	502	31.7
	503	27.8	503	27.1	503	26.8	503	26.8
	504	23.7	504	23.3	504	23.1	504	23.2
	505	19.8	505	19.3	505	19.9	505	19.8
	506	14.7	506	14.7	506	16.7	506	16.8
	507	10.8	507	10.7	507	12.3	507	12.2
	508	16.0	508	15.5	508	16.4	508	16.4
	509	3.3	509	3.3	509	3.3	509	3.3
	510	40.1	510	39.2	510	39.1	510	39.1
	515	40.5	515	42.0	515	39.5	515	39.5
	516	71.2	516	69.8	516	69.7	516	69.7
	517	17.4	517	16.9	517	17.8	517	17.8
	531	37.9	531	36.9	531	36.5	531	36.5
	532	14.8	532	14.8	532	14.1	532	14.1
	533	20.8	533	20.2	533	21.2	533	21.2
	534	6.6	534	6.3	534	7.1	534	7.0
	538	14.5	538	15.1	538	15.1	538	15.2
	550	9.5	550	9.0	550	9.0	550	9.0
	564	6.0	564	7.0	564	4.9	564	5.0
	569	14.9	569	15.1	569	15.7	569	15.7
	619	77.5	619	75.8	619	75.6	619	75.6
	623	24.7	623	24.6	623	25.7	623	25.6
	624	33.9	624	33.9	624	35.0	624	35.0

N16 Key Performance Indicator Sensitivity Testing

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	DM		OP1A_S1A		OP5		OP12	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	626	12.4	626	12.4	626	12.3	626	12.4
	627	19.6	627	19.6	627	21.9	627	21.7
	628	8.3	628	8.3	628	8.4	628	8.3

Table 4.8: Sensitivity Test 2 - 2047 IP – City Centre Junctions Volume/Capacity Ratios

	DM		OP1A_S1A		OP5		OP12	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
City Centre Junctions	304	10.8	304	10.5	304	12.4	304	12.4
	305	6.0	305	5.5	305	5.7	305	5.5
	501	16.8	501	16.6	501	16.9	501	16.8
	502	24.7	502	25.3	502	24.1	502	24.2
	503	24.4	503	23.7	503	23.1	503	23.1
	504	23.2	504	23.1	504	22.6	504	22.7
	505	23.2	505	22.6	505	23.1	505	23.1
	506	9.8	506	9.9	506	11.9	506	11.7
	507	8.7	507	8.4	507	10.2	507	10.2
	508	27.5	508	26.6	508	27.7	508	27.7
	509	8.9	509	8.9	509	8.9	509	8.9
	510	38.6	510	38.8	510	38.5	510	38.5
	515	17.1	515	19.0	515	17.0	515	17.0
	516	51.2	516	51.9	516	51.1	516	51.1
	517	25.5	517	24.7	517	25.8	517	25.8
	531	39.2	531	39.0	531	39.2	531	39.2
	532	22.8	532	22.9	532	22.9	532	22.9
	533	31.9	533	30.8	533	32.2	533	32.2
	534	5.6	534	5.4	534	5.7	534	5.7
	538	20.5	538	20.6	538	20.7	538	20.7

N16 Key Performance Indicator Sensitivity Testing

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	DM		OP1A_S1A		OP5		OP12	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
	550	8.7	550	8.0	550	8.0	550	8.0
	564	2.5	564	4.9	564	2.5	564	2.5
	569	19.8	569	20.2	569	20.1	569	20.1
	619	61.6	619	61.9	619	61.5	619	61.5
	623	17.6	623	17.5	623	17.7	623	17.5
	624	23.1	624	23.4	624	23.7	624	23.5
	626	5.1	626	5.0	626	5.2	626	5.2
	627	14.4	627	14.0	627	16.6	627	16.5
	628	3.5	628	3.7	628	3.5	628	3.5

Table 4.9: Sensitivity Test 2 - 2047 PM – City Centre Junctions Volume/Capacity Ratios

	DM		OP1A_S1A		OP5		OP12	
	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
City Centre Junctions	304	14.1	304	14.1	304	15.0	304	15.0
	305	6.6	305	6.8	305	6.1	305	6.2
	501	27.1	501	26.2	501	26.5	501	26.9
	502	34.3	502	34.6	502	34.0	502	34.2
	503	26.6	503	26.5	503	26.4	503	26.3
	504	23.8	504	23.8	504	23.8	504	23.8
	505	30.1	505	30.3	505	30.2	505	30.2
	506	14.7	506	14.6	506	15.9	506	15.9
	507	12.9	507	13.0	507	13.4	507	13.3
	508	34.5	508	34.4	508	34.5	508	34.5
	509	7.4	509	7.5	509	7.4	509	7.4
	510	38.0	510	37.9	510	37.8	510	37.9
	515	26.3	515	28.4	515	26.1	515	26.1
	516	58.1	516	58.1	516	57.7	516	57.8

N16 Key Performance Indicator Sensitivity Testing

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DM		OP1A_S1A		OP5		OP12	
Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)	Node no.	V/C ratio (%)
517	35.2	517	35.0	517	35.2	517	35.3
531	54.0	531	54.3	531	53.3	531	53.3
532	33.1	532	33.3	532	32.7	532	32.8
533	44.6	533	44.9	533	45.1	533	44.9
534	12.6	534	12.9	534	13.1	534	12.9
538	31.7	538	32.8	538	32.2	538	31.9
550	9.7	550	9.3	550	9.4	550	9.4
564	4.9	564	6.8	564	4.8	564	4.8
569	36.3	569	38.4	569	37.5	569	36.9
619	64.1	619	63.6	619	63.7	619	63.8
623	20.0	623	20.0	623	20.0	623	20.1
624	26.4	624	25.7	624	27.4	624	27.5
626	2.3	626	1.9	626	2.6	626	2.5
627	21.0	627	21.1	627	21.7	627	21.6
628	4.9	628	5.3	628	4.6	628	4.7

4.6 Sensitivity Test 2 - Objectives and KPIs Summary

To summarise the Sensitivity Test 2 objectives and identify the higher scoring options a summary table has been created. Table 4.10 below indicates that Option 1A_S1A and 5 perform the best at complying with the Sensitivity 2 strategic objectives. Each of the options generally performs well against the objectives but in the circumstances in which it was deemed that an option did not score so well against an objective these are outlined below.

The proposed N16 AADT close to the junction with the N15 in Option 1A_S1A is quite low particularly in the northbound direction. This indicates that the proposed N16 is not well utilised in this option and that vehicles are using alternative routes. Option 5 and 12 both showed similar traffic patterns with traffic volumes on the proposed N16 alignments increasing closer to Sligo indicating that these routes generally cater for the demand to Sligo. However it was Option 5 that catered for the higher demand levels. AADT on the N15 was highest in Option 1A_S1A due to the proposed N16 intercepting the N15 to the north in this scenario.

In Objective 2 the journey times for route two to Sligo city centre were approximately 10-11 minutes for the Do Minimum Sensitivity Test 2. The three emerging options all performed better with journey times of between 8-10 minutes, but it was Option 5 which recorded the quickest journey times to the city centre closely followed by Option 12.

In Objective 3 two of the emerging options recorded city centre traffic volume changes greater than +15% of the Do Minimum Sensitivity Test 2. Option 5 and 12 each had one link with a traffic volume change greater than +15% (both of which were on the R286 Connaughton Road).

For each of the emerging options Objective 4 identified two junctions as the worst performing in terms of city centre Volume / Capacity ratios. These junctions were the signalised junction of the R292 / O'Connell Street / Fish Quay and the priority junction of the R292 Wine Street and Quay Street, both adjacent to each other in Sligo city centre. However, the Volume / Capacity ratio of both junctions was within the 50% - 85% category in each emerging option, and so not deemed severe. None of the emerging options recorded a V/C ratio greater than 85% in Sensitivity Test 2.

N16 Key Performance Indicator Sensitivity Testing

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Table 4.10: Sensitivity Test 2 - Objectives and KPIs Summary

	Objective	KPI	Option 1A_S1A	Option 5	Option 12
1	Effectively cater for strategic traffic	AADT on N16	3	1	2
		AADT on N15	1	2	2
		AADT on N4	1	1	1
2	Efficiently cater for strategic traffic to Sligo City Gateway (NSS)	Journey Times from N16 at Leitrim Boundary to Sligo City Centre	1	1	1
3	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City Centre	1	2	2
4	Operational efficiency of key City Centre junctions	V/C ratios of key junctions within Sligo City Centre	1	1	1
		Overall Score	8	8	9

	Sample Scoring
Very High Preference	1
High Preference	2
Medium Preference	3
Not Applicable	N/A

5. Sensitivity Test 3 – N16 Abbvie Roundabout to Elm Gardens (East / West Link)

5.1 Introduction

This section details the one Strategic Objective and the results of the KPI as described in Table 1.3. Sensitivity Test 3 was the testing of the emerging schemes with the inclusion of a N16 Abbvie Roundabout to Elm Gardens East / West Link. The sensitivity test was focussed on determining the likely usage of the potential link. The comparison of KPIs achieved in this sensitivity test will quantify how well each option achieves the Sensitivity 3 objective.

5.2 Sensitivity Test 3 - Objective 1

Objective 1 was to effectively cater for strategic traffic. The KPIs assessed as part of this objective were the AADTs on the N16, N15 and the East / West link between the N16 Abbvie roundabout and Elm Gardens in place. The results of these KPIs are detailed below.

5.2.1 Sensitivity Test 3 - AADT on the N16

The 2047 AADT at various critical locations on N16 alignment are presented in Table 5.1. The locations of the N16 AADT values are illustrated in Figure 5.1 to Figure 5.4 showing the different option arrangements and configurations for the Do Minimum and the three sensitivity options considered in Sensitivity Test 3.

It can be seen that in the Do Minimum traffic volumes increase on the approach to Sligo, but reduce slightly to the south of the N16 junction with the L-3407-22 due to traffic using the L-7422-0 as an alternative route to the N16. At reference point 5 the impact of the Sensitivity Test 3 on the Do Minimum indicates that northbound AADT will decrease by approximately 100 (to 2331) and southbound AADT will decrease by approximately 100 (to 1382).

Option 1A_S1A shows similar patterns of traffic using the N16, with greater reductions in traffic on the N16 as it gets closer to the N15. This highlights that traffic demand on the N16 is focussed more within Sligo and results in this demand utilising the existing N16 route as an alternative to the proposed alignments. At reference point 4 the impact of the Sensitivity Test 3 on Option 1A_S1A indicates that the northbound AADT will remain relatively unchanged (at 440) and the southbound AADT will decrease by approximately 200 (to 1343).

Options 5 and 12 showed similar traffic patterns with traffic volumes on the proposed N16 alignments increasing closer to Sligo. This suggests that these routes generally cater for the demand to Sligo, with limited use of the alternative routes to the N16. In Option 5 at reference point 5 the impact of Sensitivity Test 3 on the northbound AADT is an increase of approximately 100 (to 3013), while the southbound AADT also indicates an increase by approximately 70 (to 2749). In Option 12 the biggest impact of Sensitivity Test 3 is at reference point 6 at which the northbound AADT is indicated to increase by approximately 250 (to 2974), while the southbound AADT also indicates an increase by approximately 200 (to 2745).

Option 5 caters for the highest demand levels (albeit by a small amount) of the three emerging options in Sensitivity Test 3.

Table 5.1: Sensitivity Test 3 - N16 2047 AADT Comparisons

Map Reference	Direction	N16 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
1	NB	1839	1839	1839	1839
1	SB	1813	1813	1813	1813
2	NB	1839	1839	1839	1839

N16 Key Performance Indicator Sensitivity Testing

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Map Reference	Direction	N16 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
2	SB	1813	1813	1813	1813
3	NB	1738	1839	1776	1766
3	SB	1732	1813	1743	1741
4	NB	2454	440	1726	2460
4	SB	2304	1343	1693	2338
5	NB	2331	-	3013	2858
5	SB	1382	-	2749	2719
6	NB	-	-	-	2974
6	SB	-	-	-	2745

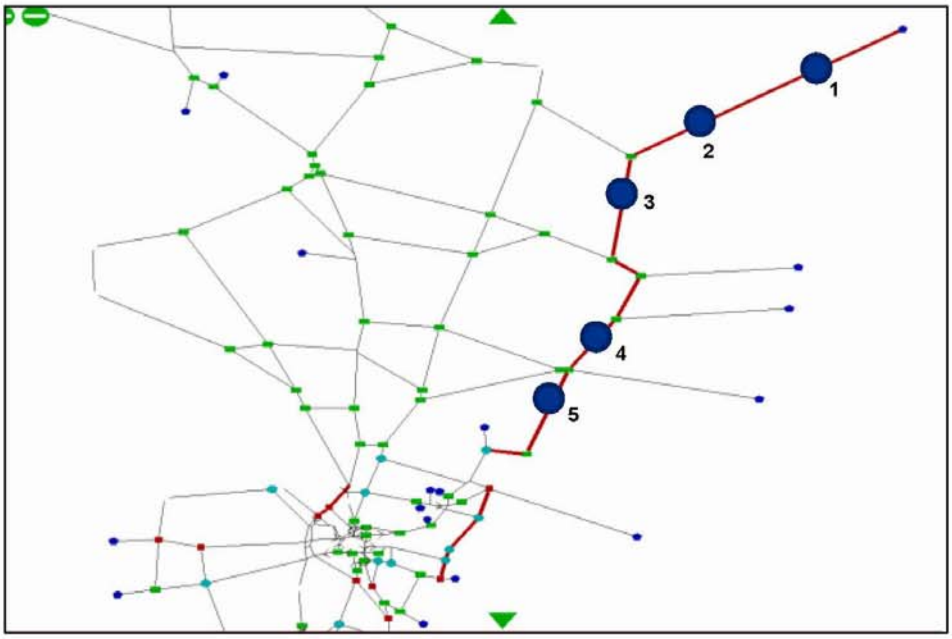

Figure 5.1: SATURN Model Do Minimum

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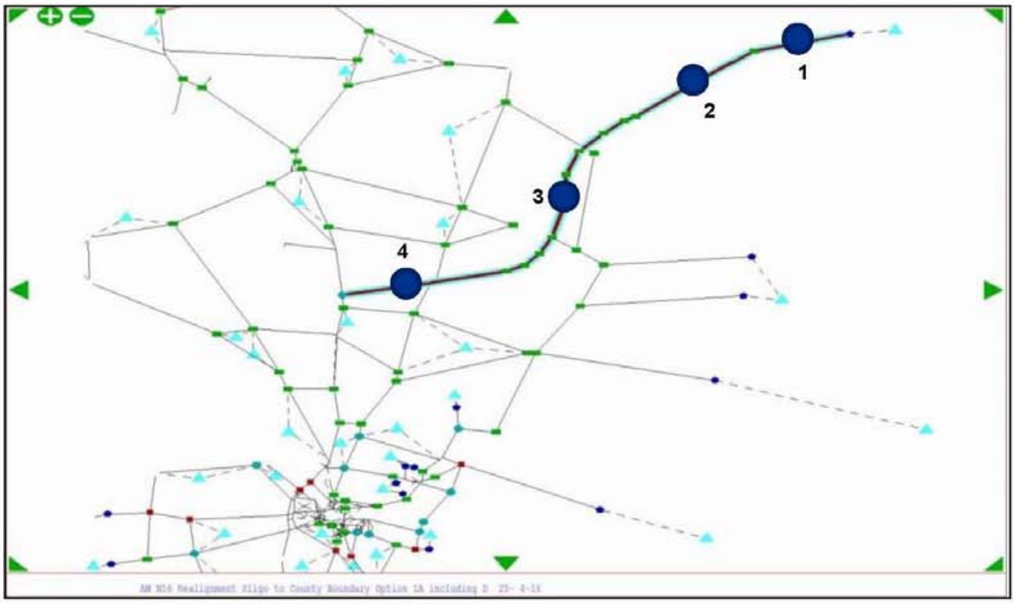

Figure 5.2: SATURN Model Option 1A_S1A

52

N16 Key Performance Indicator Sensitivity Testing

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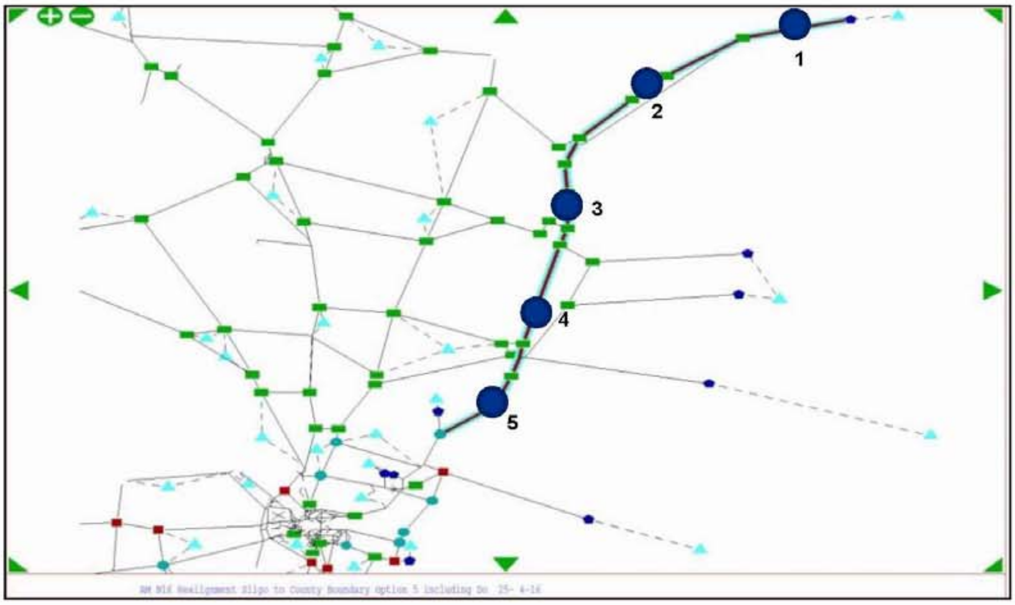

Figure 5.3: SATURN Model Option 5

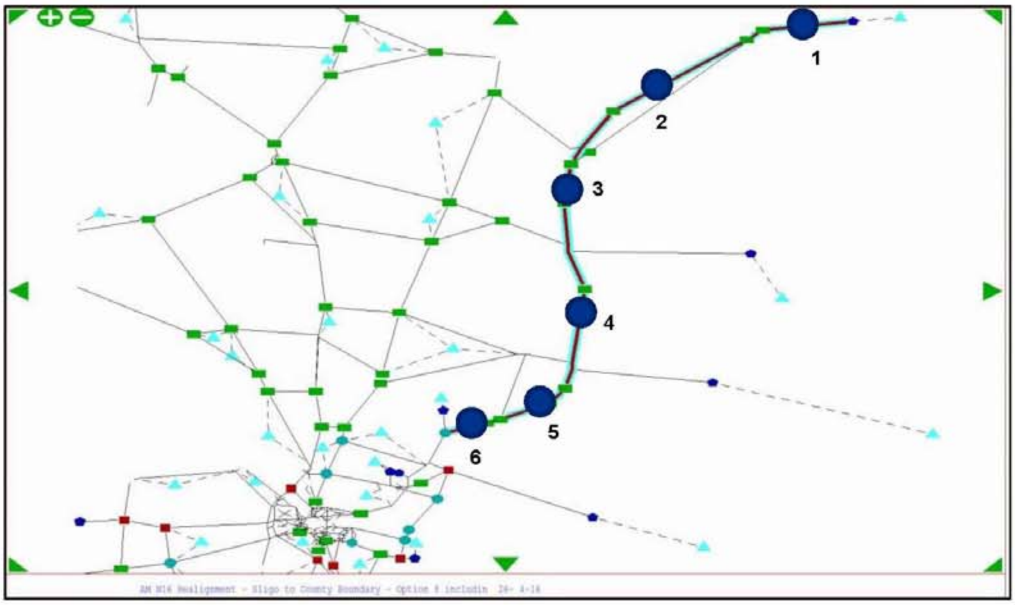

Figure 5.4: SATURN Model Option 12

5.2.2 Sensitivity Test 3 - AADT on the N15

The AADT values on the section of N15 adjacent to the N16 alignment are presented in Table 5.2 below. The locations of the N15 AADT values are illustrated in Figure 5.5 below. The section of the N15 in question spans just north of where the proposed N16 intercepts in Option 1 to the signalised junction of the R291 Rosses Point Road.

It can be seen that on the N15 north of where the proposed N16 intercepts it (AADT 1), the northbound and southbound flows are relatively constant across all the scenarios.

The northbound and southbound flows on the N15 immediately south of where the proposed Option 1 N16 intercepts it (AADT 2) have been included indicating that the southbound AADT is approximately 700 greater than the northbound in Option 1A_S1A. Throughout all the reference points on the N15, Option 1A_S1A has the highest AADT owing to the proposed N16 intercepting the N15 in this option, while Option 5 and 12 show similar AADT levels with the Do Minimum scenario.

Table 5.2: Sensitivity Test 3 - N15 2047 AADT Comparisons

Map Reference	Direction	N15 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
1	NB	8298	8345	8291	8273
1	SB	8123	8145	8117	8080
2	NB	-	8607	-	-
2	SB	-	9310	-	-
3	NB	8363	8628	8345	8393
3	SB	8188	9327	8181	8191
4	NB	8329	8589	8312	8360
4	SB	7714	8757	7713	7719
5	NB	9578	9703	9610	9609
5	SB	8519	9613	8518	8521
6	NB	6377	6725	6260	6229
6	SB	6809	7392	6212	6214

N16 Key Performance Indicator Sensitivity Testing

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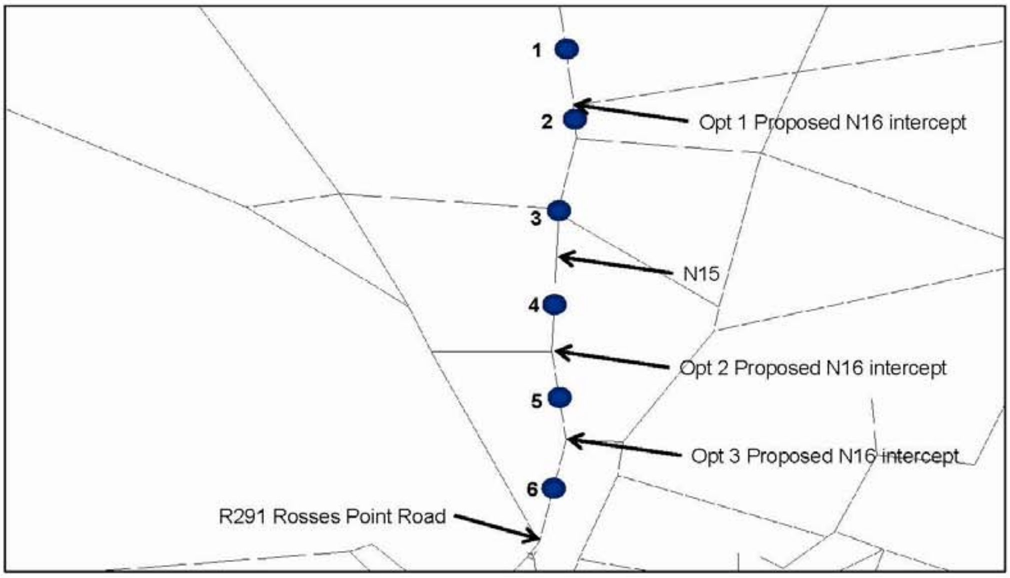

Figure 5.5: Sensitivity Test 3 - N15 AADT Locations

5.2.3 Sensitivity Test 3 - AADT on the N16 Abbvie Roundabout to Elm Gardens East / West Link

The AADT values at locations on the N16 Abbvie Roundabout to Elm Gardens East / West Link are presented in Table 5.3 below. The locations of the East / West Link AADT values are illustrated in Figure 5.6 below.

The locations of the AADTs are on the section of the East / West Link between the N15 in the west and the N16 Abbvie roundabout to the east.

Option 5 caters for the highest demand levels (albeit by a small amount) of the three emerging options in Sensitivity Test 3.

Table 5.3: Sensitivity Test 3 – East / West Link 2047 AADT Comparisons

Map Reference	Direction	East / West Link 2047 AADT (Per Direction)			
		DM	OP1A_S1A	OP5	OP12
1	EB	2695	3139	3279	3243
1	WB	4186	3895	4323	4315
2	EB	659	658	1318	1275
2	WB	464	467	997	985
3	EB	71	68	723	685
3	WB	143	144	668	662

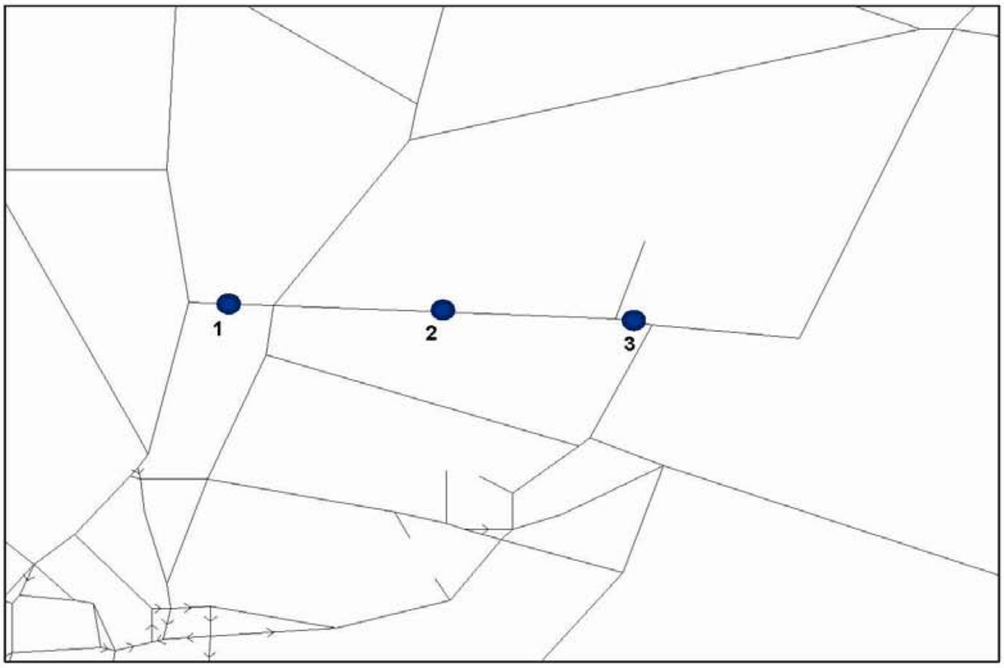

Figure 5.6: Sensitivity Test 3 - East / West Link AADT Locations

5.2.4 Sensitivity Test 3 - Wider Sligo Network AADT

Figure 5.7 and Figure 5.8 outline the locations considered on the wider Sligo network in the context of the introduction of the different N16 option alignments. The findings are presented in Table 5.4.

N16 Key Performance Indicator Sensitivity Testing

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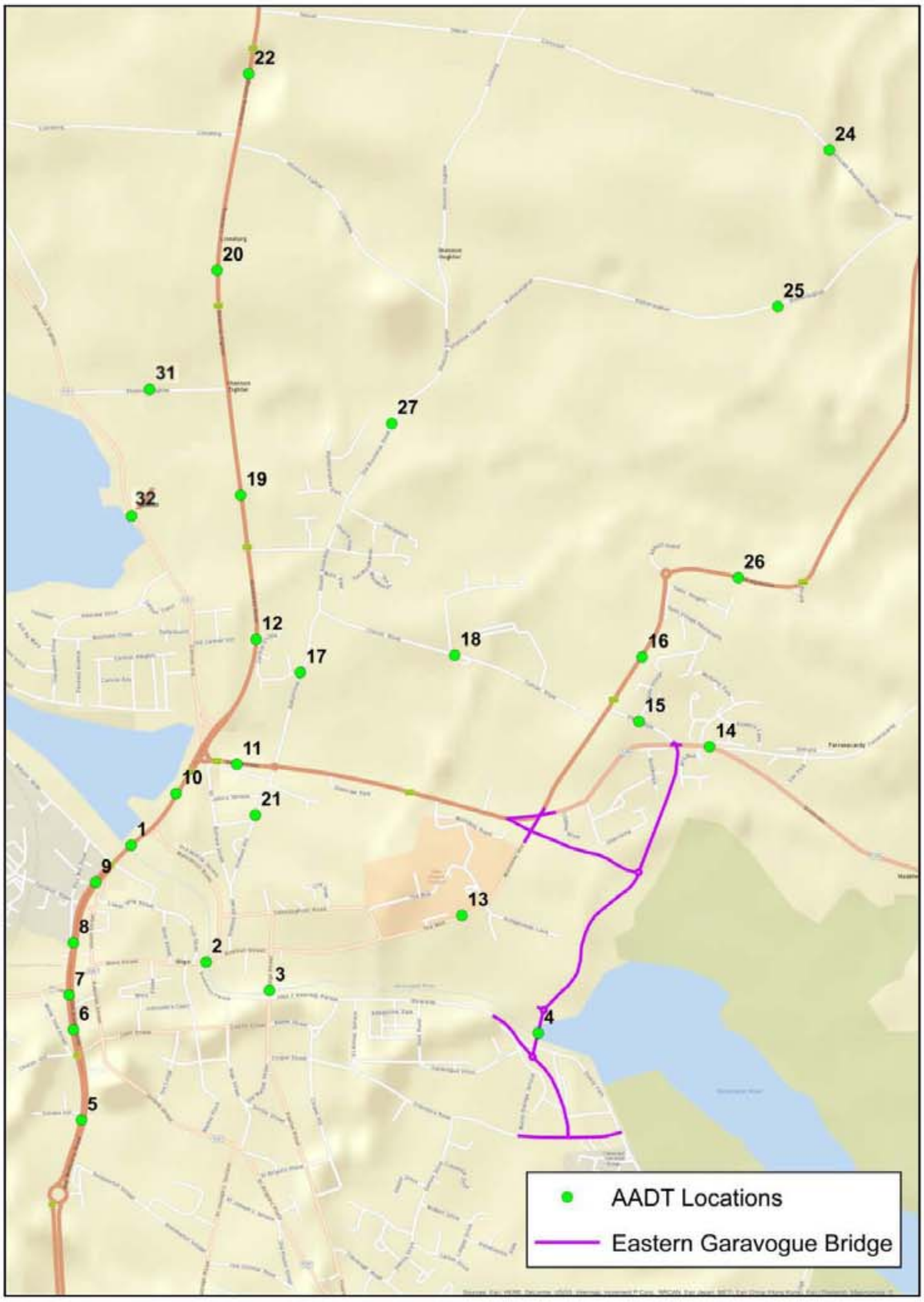

Figure 5.7: AADT Location Map – Sligo Town

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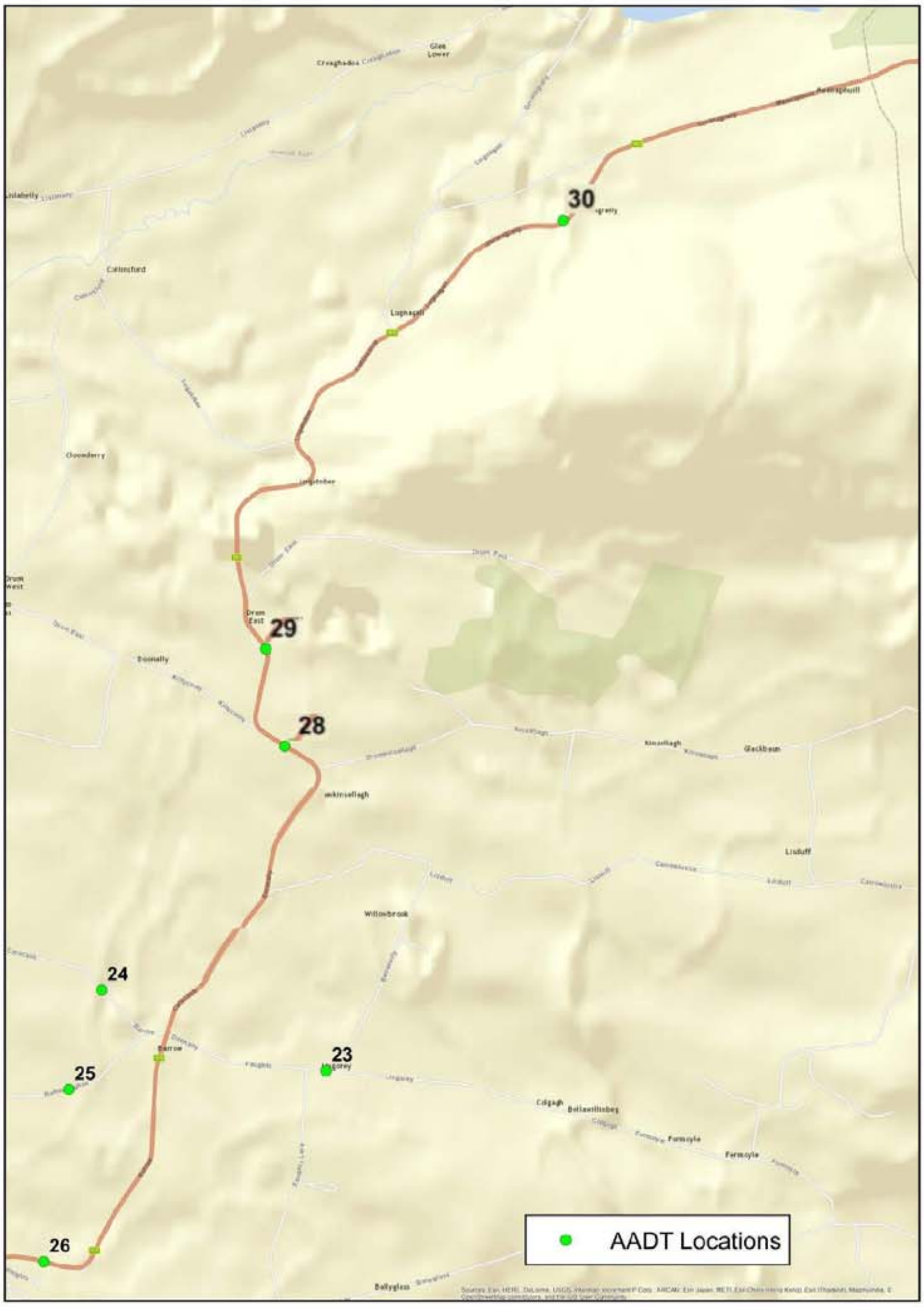

Figure 5.8: AADT Location Map – N16 Corridor

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Table 5.4: Sensitivity Test 3 - 2047 AADT Comparisons N16, N15 and N4

AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)			
Link Name			DM	OP1A_S1A	OP5	OP12
Hughes Bridge	1	NB	12032	12192	12037	12038
Hughes Bridge	1	SB	14838	15524	14719	14723
Hyde Bridge	2	NB	9237	9121	9235	9233
Bridge Street	3	SB	11250	10753	11403	11399
Garavogue Bridge	4	NB	3878	3859	3878	3878
Garavogue Bridge	4	SB	1793	1629	1763	1762
N4 North of Summerhill R'about	5	NB	10784	10805	10818	10812
N4 North of Summerhill R'about	5	SB	11571	11512	11471	11474
N4 Church Hill/John Street to Sráid an Fhiona (S5-S6)	6	NB	13710	13781	13698	13696
N4 Sráid an Fhiona to Church Hill/John Street (S6-S5)	6	SB	10922	10854	10831	10832
N4 Sráid an Fhiona to Wine Street (S6-S7)	7	NB	13266	13343	13224	13224
N4 Wine Street to Sráid an Fhiona (S7-S6)	7	SB	10645	10583	10546	10550
N4 Wine Street to Finiskin Road	8	NB	10586	10681	10556	10558
N4 Finiskin Road to Wine Street	8	SB	11928	11878	11826	11830
N4 Finiskin Road to Ballast Quay	9	NB	7997	8091	7965	7968
N4 Ballast Quay to Finiskin Road	9	SB	9626	9586	9530	9534
N4 Markievicz Road to Duck Street	10	NB	11666	11888	11578	11582
N4 Duck Street to Markievicz Road	10	SB	15213	15607	14636	14637
N16 Duck Street (N4 to R'about)	11	EB	4993	4863	4991	4982
N16 Duck Street (R'about to N4)	11	WB	6563	6535	6527	6526
N15 Rosses Point to Elm Gardens	12	NB	6377	6725	6260	6229
N15 Elm Gardens to Rosses Point	12	SB	6809	7392	6212	6214
R 286 - The Mall	13	NB	2987	3016	3007	3004
R 286 - The Mall	13	SB	2464	2407	3177	3177
R286 - Hazelwood Road	14	EB	3561	3561	3561	3561
R286 - Hazelwood Road	14	WB	3750	3750	3750	3750

N16 Key Performance Indicator Sensitivity Testing

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AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)			
Link Name			DM	OP1A_S1A	OP5	OP12
Short walk	15	EB	1218	1081	1214	1218
Short walk	15	WB	2012	2030	2010	2011
N16 South of Abbvie R'about	16	NB	2420	2401	2445	2444
N16 South of Abbvie R'about	16	SB	1398	1194	2236	2239
Ballytivnan Road	17	NB	3329	3008	3438	3431
Ballytivnan Road	17	SB	4202	3941	3963	3962
Clarion Road	18	EB	498	499	491	495
Clarion Road	18	WB	1929	1868	1954	1954
N15 Shannon Eighter to Elm Gardens	19	NB	9578	9703	9610	9609
N15 Shannon Eighter to Elm Gardens	19	SB	8519	9613	8518	8521
N15 Lisnalurg to Shannon Eighter	20	NB	8329	8589	8312	8360
N15 Lisnalurg to Shannon Eighter	20	SB	7714	8757	7713	7719
Holborn Hill	21	NB	2982	2746	3072	3068
Holborn Hill	21	SB	2597	2425	2488	2488
N15 Lisnalurg to Teesan	22	NB	8305	8625	8288	8336
N15 Lisnalurg to Teesan	22	SB	8101	9299	8095	8104
L - 3407 - 22 (Lisgorey)	23	EB	657	657	657	657
L - 3407 - 22 (Lisgorey)	23	WB	644	644	644	644
L - 3407 - 0 (Carncash)	24	EB	69	110	67	25
L - 3407 - 0 (Carncash)	24	WB	59	108	59	29
L - 7422 - 0 (Rathbraughan Lane)	25	EB	660	375	0	0
L - 7422 - 0 (Rathbraughan Lane)	25	WB	1363	365	0	0
N16 East of Abbvie R'about	26	EB	2331	2312	3013	2974
N16 East of Abbvie R'about	26	WB	1382	1181	2749	2745
Old Bundoran Road	27	NB	1554	1275	890	881
Old Bundoran Road	27	SB	2530	1633	1164	1161
N16 (L - 3406 - 0 to L - 7416 - 0)	28	NB	1780	1426	-	-

N16 Key Performance Indicator Sensitivity Testing

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AADT Comparison (2047)	Map Reference	Direction	2047 AADT (Per Direction)			
Link Name			DM	OP1A_S1A	OP5	OP12
N16 (L - 3406 - 0 to L - 7416 - 0)	28	SB	1842	603	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	29	NB	1738	17	-	-
N16 (L - 7415 - 0 to L - 7416 - 0)	29	SB	1732	122	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	30	NB	1839	-	-	-
N16 (L - 3404 - 0 to L - 7411 - 0)	30	SB	1813	-	-	-
L - 90102 - (Scotsman Walk)	31	EB	261	213	250	296
L - 90102 - (Scotsman Walk)	31	WB	983	748	1020	1022
R291 Rosses Point Road	32	NB	748	846	699	699
R291 Rosses Point Road	32	SB	1656	1660	1657	1652

5.3 Sensitivity Test 3 - Objective and KPIs Summary

To summarise the Sensitivity Test 3 objective and identify the higher scoring options a summary table has been created. Table 5.5 below indicates that Option 5 and 12 perform the best at complying with the Sensitivity 3 strategic objectives. Each of the options generally performs well against the objectives but in the circumstances in which it was deemed that an option did not score so well against an objective these are outlined below.

The proposed N16 AADT close to the junction with the N15 in Option 1A_S1A is quite low particularly in the northbound direction. This indicates that the proposed N16 is not well utilised in this option and that vehicles are using alternative routes. Options 5 and 12 both showed similar traffic patterns with traffic volumes on the proposed N16 alignments increasing closer to Sligo indicating that these routes generally cater for the demand to Sligo. However it was Option 5 (by a small margin) that catered for the higher demand levels on the N16.

AADT on the N15 was highest in Option 1A_S1A due to the proposed N16 intercepting the N15 to the north in this scenario.

The East / West Link AADTs indicated that Option 5 and 12 would have the higher usage with little difference in flows between the two options. Option 1A_S1A indicated that the East / West Link would not be as well utilised when compared with Options 5 and 12.

Table 5.5: Sensitivity Test 3 - Objectives and KPIs Summary

	Objective	KPI	Option 1A_S1A	Option 5	Option 12
1	Effectively cater for strategic traffic	AADT on N16	3	1	1
		AADT on N15	1	2	2
		AADT on East / West Link	3	1	1
		Overall Score	7	4	4

	Sample Scoring
Very High Preference	1
High Preference	2
Medium Preference	3
Not Applicable	N/A

6. Summary and Conclusions

This Key Performance Indicator Sensitivity Testing Technical Note has assessed a series of KPIs against the list of predefined objectives across three Sensitivity Tests. From the summary tables below it can be seen that Option 5 has obtained the best rank with an overall score of 21 points. Option 12 obtained second rank with 23 points, followed by Option 1A_S1A in third rank with a score of 25 points. Based on the findings of this Technical Note, Option 5 is the recommended option.

Table 6.1: Sensitivity Test 1 – No Eastern Garavogue Bridge

	Objective	KPI	Option 1A_S1A	Option 5	Option 12
1	Effectively cater for strategic traffic	AADT on N16	3	1	2
		AADT on N15	1	2	2
		AADT on N4	1	1	1
2	Efficiently cater for strategic national traffic	Journey Times from N16 at Leitrim Boundary to N4/N16/N15 Junction	1	2	2
3	Efficiently cater for strategic traffic to Sligo City Gateway (NSS)	Journey Times from N16 at Leitrim Boundary to Sligo City Centre	2	1	1
4	Road network to cater for future traffic	Number of V/C ratios broken into bands throughout entire Sligo modelled network. E.g. number of junctions >85%, 50% - 85% and <50%	1	1	1
5	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City Centre	1	1	1
		Overall Score	10	9	10

Table 6.2: Sensitivity Test 2 – City Centre Pedestrian / Cycle Priority

	Objective	KPI	Option 1A_S1A	Option 5	Option 12
1	Effectively cater for strategic traffic	AADT on N16	3	1	2
		AADT on N15	1	2	2
		AADT on N4	1	1	1
2	Efficiently cater for strategic traffic to Sligo City Gateway (NSS)	Journey Times from N16 at Leitrim Boundary to Sligo City Centre	1	1	1
3	Impact on future pedestrianisation of Sligo City Centre	Traffic volume changes on links within Sligo City Centre	1	2	2
4	Operational efficiency of key City Centre junctions	V/C ratios of key junctions within Sligo City Centre	1	1	1
		Overall Score	8	8	9

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Table 6.3: Sensitivity Test 3 – N16 Abbvie Roundabout to Elm Gardens (East / West Link)

	Objective	KPI	Option 1A_S1A	Option 5	Option 12
1	Effectively cater for strategic traffic	AADT on N16	3	1	1
		AADT on N15	1	2	2
		AADT on East / West Link	3	1	1
		Overall Score	7	4	4

Table 6.4: Combined Summary

	Option 1A_S1A	Option 5	Option 12
Overall Score	25	21	23

64