Appendix A.8.1

NPF Traffic Sensitivity Test

A.8.1

NPF SENSITIVITY TEST ANALYSIS

NPF SENSITIVITY TEST ANALYSIS

IDENTIFICATION TABLE	
Client/Project owner	ARUP
Project	N6 GCRR
Title of Document	NPF Sensitivity Test Analysis
Type of Document	Information Note
Date	12/06/2019
Reference number	30023812
Number of pages	34

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Background

National Planning Framework

1.1.1 The National Planning Framework (NPF) 2040 has recently been published as a guide to the high level strategic planning and development of Ireland over the next 20+ years. The NPF, and accompanying National Development Plan (NDP), provide a single policy to guide strategic development and infrastructure investment at a national level. The NPF and NDP also set the context for each of Ireland's three regional assemblies to develop their regional and spatial strategies taking account of, and co-ordinating, local authority County and City Development Plans in a manner that will ensure National, Regional and Local plans align. The NPF is a statutory document which must be adhered to by all City and County Development Plans and Regional & Spatial Economic Strategies. The document sets out the long term context for our country's physical development and associated progress in economic, social and environmental terms and in an island, European and global context.

N6 GCRR Modelling

1.1.2 To date, all modelling and appraisal of the N6 Galway City Ring Road (GCRR) has been undertaken using a set of three different population and employment growth assumptions, namely:

- NTA Reference Case (Low Growth Scenario);
- TII Medium Growth Scenario; and
- TII High growth Scenario.

1.1.3 This modelling was carried out prior to the publication of the NPF and therefore population and employment assumptions used in the appraisal presented in the Environmental Impact Assessment Report (EIAR) for the N6 GCRR are not aligned with the latest planning policy for the Region and Country. SYSTRA have been tasked with undertaking a review of the N6 GCRR Modelling, using the recently published NPF forecasts, and determining the likely impacts resulting from the updated planning assumptions.

1.2 Purpose of Report

1.2.1 The purpose of this document is to provide a comparison of the planning assumptions used in the appraisal of the N6 GCRR in the EIAR with those contained within the NPF and to determine the likely impacts of the NPF assumptions on the forecast Transport Network.

1.3 Report Structure

1.3.1 The remainder of the document is structured as follows:

- **Chapter 2** provides an overview of the assumptions and methodology used to develop the NPF population and employment forecasts for input into the Western Regional Model.
- **Chapter 3** provides a comparison between the NPF assumptions and those used in the appraisal of the N6 GCRR in the EIAR.
- **Chapter 4** outlines the modelling assessment carried out using the latest NPF assumptions.

- **Chapter 5** provides a summary of the Average Annual Daily Traffic (AADT) forecasts, for key routes in Galway City, using the NPF assumptions.
- **Chapter 6** provides of comparison of the NPF sensitivity test results with the modelling results reported in the EIAR for the N6 GCRR.

2. DEVELOPMENT OF 2040 NATIONAL PLANNING FRAMEWORK SCENARIOS

2.1 Background

2.1.1 In 2018, the National Planning Framework was published, setting out the planning policy framework for the next 22 years. The publication of the NPF provided a major new policy emphasis on renewing and developing existing settlements, rather than continual expansion and sprawl of cities and towns into the countryside, at the expense of town centres and smaller villages.

2.1.2 Within the estimations of population and employment growth at the national level, the NPF recognised the role that Galway and the other regional cities of Limerick, Cork and Waterford have to play in providing a counter-weight to Dublin and assigned a population growth forecast of 50%-60% for each city.

2.1.3 For this reason, as part of this sensitivity test, the growth forecast for the N6 GCRR has been amended to align with the published NPF 2040.

2.2 NPF Land Use Planning Assumptions

2.2.1 To develop the NPF forecast year Western Regional Model (WRM) demand, it is first necessary to prepare a Land Use Planning file containing population, employment and education data at a census small area (CSA) level. This land use spreadsheet is input to the National Trip End Model (NTEM) to produce the forecast travel demand required to carry out an NPF WRM run.

2.2.2 In order to prepare the required land use planning assumptions at a level sufficient for input into the NTA's NTEM, assumptions have been made on the distribution of forecast population and employment growth in Galway City and County. These assumptions have largely come from two sources:

- The National Planning Authority Integrated Planning Department;
- Galway City Council Planning Department; and
- Galway County Council Planning Department.

2.2.3 This section of the report will document those assumptions and the sources of the data used.

National Transport Authority Planning Sheet

2.2.4 The NTA provided the project team with a copy of their "NPF Planning Sheet". This planning sheet took the NPF targets and disaggregated them to the CSA level.

2.2.5 To inform this disaggregation of population and employment growth, the NTA used all information available. The primary source of information was the Galway City Development Plan and the Galway County Development Plan. In addition, a GIS assessment was undertaken, which allowed Geo-directory Census information to be used to establish existing land uses and intensity.

Galway City and County Planning Departments

2.2.6 Following receipt of the NTA planning sheets, members of the Galway City and County planning department carried out a thorough review of the forecasts at a CSA level. Using local knowledge, the planning departments were able to provide a further level of disaggregation using the following information:

- Existing planning applications;
- Existing land use zoning and plot ratios; and
- Existing and emerging policy.

2.2.7 Using the information above, the planning teams refined the NTA assumptions and established the final set of NPF planning assumptions which are referred to as the NTA/GCC NPF Forecasts throughout. Further details on these assumptions are outlined in the following section.

2.3 Final NTA/GCC NPF Forecasts

2.3.1 Following the steps outlined above, a final set of NPF demographic forecasts were developed for each Census Small Area in Galway City and County. These forecasts are detailed in the table below at the city and county Level.

2.3.2 While the NPF targets are for the year 2040, in order to produce a conservative estimate, and because of the uncertainty which surrounds such forecasts, it has been assumed that all of the population and jobs growth assumed in the NPF has occurred by the design year of the Scheme (2039). This allows us to directly compare the NPF forecasts with the forecasts used in the EIAR (TII Central).

Table 2-1 Galway NTA/GCC NPF Population Forecasts

Scenario	2016 Census	NTA/GCC NPF Forecasts	
		Total	% Increase from 2016
2039 Galway City Population	78,668	121,741	55%
2039 Galway County Population	179,390	218,459	22%
Galway Total	**258,058**	**340,200**	**32%**

Table 2-2 Galway NTA/GCC NPF Job Forecasts

Scenario	2016 Census	NTA/GCC NPF Forecasts	
		Total	% Increase from 2016
2039 Galway City Jobs	41,775	63,647	52%
2039 Galway County Jobs	32,420	48,487	50%
Galway Total	**74,195**	**112,134**	**51%**

2.3.3 The Figures below illustrate the distribution of the proposed population and employment (job location) increases at a sector level of Galway City and its environs. These figures show that the largest concentrations of additional population growth are located in Ardaun, the city centre and in the west of the city.

2.3.4 The NTA/GCC NPF forecasts for Galway City include for approximately 22,000 additional jobs. As shown in Figure 2-2, these additional jobs will primarily be located in the city centre and Parkmore/ Ballybrit areas.

Figure 2-1 NTA/GCC NPF Population Growth

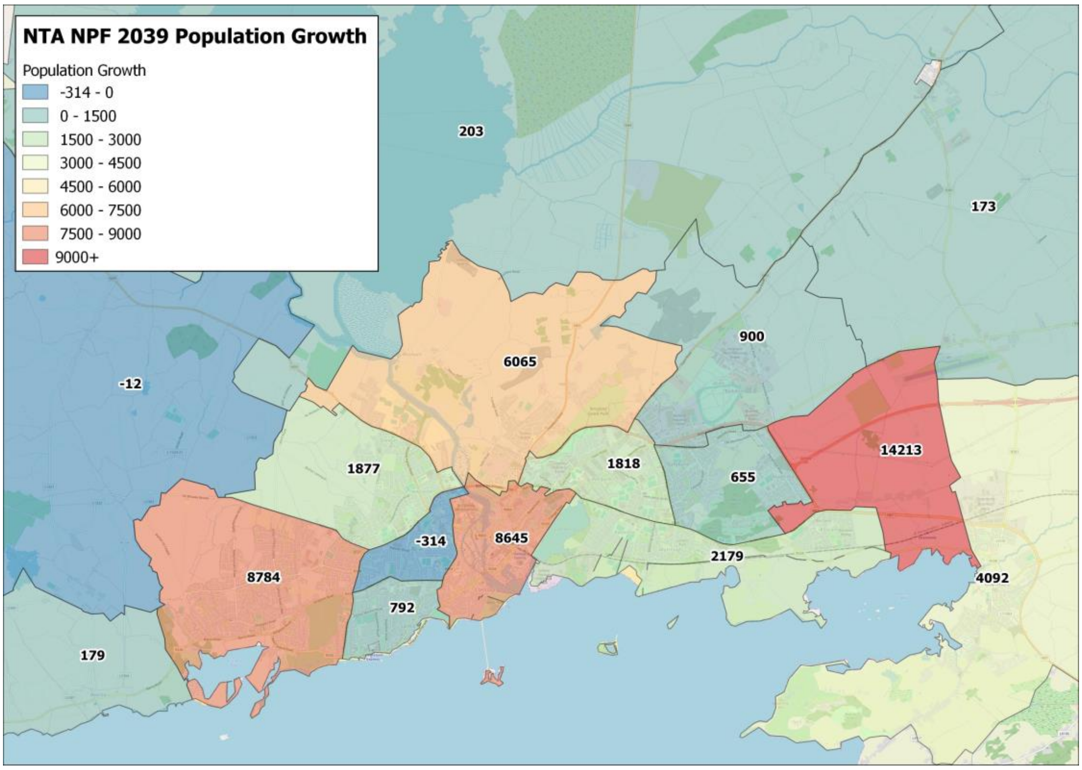
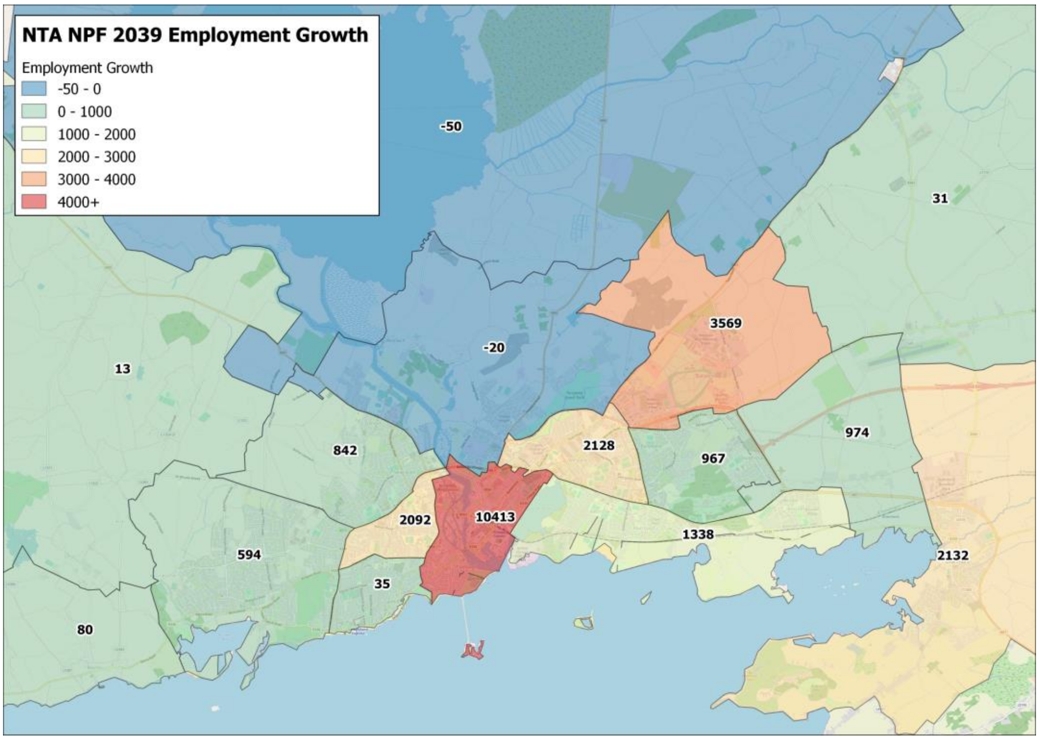


Figure 2-2 NTA/GCC NPF Employment Growth



2.4 Galway Transport Strategy

2.4.1 In 2016 the NTA, in association with Galway City Council and Galway County Council, prepared the Galway Transport Strategy (GTS). The GTS sets out a framework for how Galway's transport network can be redefined to address existing transport issues as well as catering for the future development of the city.

2.4.2 In line with the aims and objectives of previous studies, the principal aim for the GTS is to seek to:

"Examine potential options to improve Galway's transport network and identify a package of measures within an agreed programme of infrastructural development which will enable the transport network of Galway City to serve travel demand in the most efficient, effective and sustainable manner"

2.4.3 The GTS outlines a host of proposed measures for active travel, public transport and general traffic in Galway, to be implemented over a 20 year period. Some of the key proposals included in the Strategy are listed below:

- A public transport corridor through the city centre with public transport only allowed on the Salmon Weir Bridge, Eglington Street and College Road;
- Localised City Centre Traffic Management proposals;
- An outer orbital route (N6 GCRR) to enhance resilience of the GTS;
- Rationalise Bus Route network and increase service frequencies; and
- Provision for Park and Ride.

2.4.4 In addition to the Core NPF Scenario tested, a further test has also been carried out to assess the performance of the proposed N6 GCRR and all of the active travel, public transport and road infrastructure proposals included in the Galway Transport Strategy in combination with the NPF growth assumptions.

2.5 NPF Modelled Scenarios

2.5.1 Based on the above, the following “NTA/GCC NPF” Scenarios have been modelled and assessed for the purposes of this study:

- 2039 Do-Minimum;
- 2039 Do-Something (Do-Min +N6 GCRR); and
- 2039 Do-Something (N6 GCRR + GTS).

3. NTA/GCC NPF VS EXISTING LAND USE ASSUMPTIONS

3.1 Introduction

3.1.1 The Phase 3 appraisal of the N6 GCRR utilised TII's Central Case Scenario growth forecasts to estimate population, employment and education figures for the opening and design year of the scheme. This section of the report compares the updated NTA/GCC NPF assumptions against these original forecasts. Comparison has also been made between the 2016 and the 2040levels to illustrate the level of growth between the various scenarios.

3.2 Population Growth

3.2.1 Table 3-1 below compares the 2039 TII Central Case forecasts with NTA/GCC NPF forecasts for Galway City and County population. This table clearly illustrates that the total growth assumed for Galway City + County is higher in the NTA/GCC NPF scenario. The Galway City population forecasts, in particular, are significantly higher in the NTA/GCC NPF scenario (+55%) than the TII Central Growth Scenario (+14%).

Table 3-1 Population Forecast Comparisons

Scenario	2016 Census	Tii Central Case Forecasts (2039)		NTA/GCC NPF Forecasts (2039)	
		Total	% Increase from 2016	Total	% Increase from 2016
2039 Galway City Population	78,668	90,000	14%	121,741	55%
2039 Galway County Population	179,390	205,362	14%	218,459	22%
Galway Total	**258,058**	**295,362**	**14%**	**340,200**	**32%**

3.3 Employment Growth

Table 3-2 below compares the 2039 TII Central Case forecasts with NTA/GCC NPF forecasts for Galway City and County employment. As with the population forecasts, the NTA/GCC NPF forecasts contain significantly more jobs in the city (+52%) than the TII forecasts (+15%). Similarly, the total jobs growth for Galway City and County assumed in the NTA/GCC NPF scenario (+51%) is more than double that assumed in the TII Central Case forecasts (+24%).

Table 3-2 Employment Forecast Comparisons

Scenario	2016 Census	Tii Central Case Forecasts (2039)		NTA/GCC NPF Forecasts (2039)	
		Total	% Increase from 2016	Total	% Increase from 2016
2039 Galway City Jobs	41,775	48,000	15%	63,647	52%
2039 Galway County Jobs	32,420	44,100	36%	48,487	50%
Galway Total	**74,195**	**92,100**	**24%**	**112,134**	**51%**

3.4 Summary and Implications

3.4.1 In line with latest policy, the NTA/GCC NPF assumptions have attributed a much greater level of growth (both jobs growth and population growth) to Galway City and its environs. This in turn will lead to an increased level of travel demand in the NTA/GCC NPF Scenario.

3.4.2 By locating a large proportion of the forecast population and jobs in Galway City, which is easier to serve by public transport and active modes, the NTA/GCC NPF Scenario will result in a greater integration of land uses which in turn increases the potential for travel by active modes and public transport.

4. MODELLING ANALYSIS

4.1 Introduction

4.1.1 This section provides a summary of the performance of the N6 GCRR, based on the following analysis:

- Network Performance Indicators;
- Journey Times;
- V/C at major junctions; and
- Mode Share.

4.1.2 The analysis presented in this section has been run through the demand model to take account of changes in transport costs, such as vehicle operating costs, values of time, congestion levels and the impact of Do-Minimum or Do-Something Scenarios.

4.2 Network Performance Indicators

4.2.1 Network performance indicators for the Design Year (2039) are outlined in the tables below, extracted from each of the model assignments.

GTS Scenario

4.2.2 The full implementation of the Galway Transport Strategy (GTS) results in decreased delay and higher average speeds when compared to the Do-Something N6 GCRR Scenario. These results suggest that the implementation of the GTS measures, combined with the integrated land use assumptions of the NTA/GCC NPF, have resulted in a shift towards sustainable modes in the city centre (where most delay occurs). This in turn leads to improved network performance.

Table 4-1 Network Performance Indicators AM Peak Comparison using NTA/GCC NPF

Scenario	Total Vehicle Distance (pcu. Kms)	Total Network Travel Time (pcu. Hrs)	Total Network Delay (pcu. Hrs)	Average Vehicle Speed (kph)
2039 Do-Minimum	277,745	10,879	4,256	25.5
2039 Do-Something N6 GCRR	339,630	9,300	2,440	36.5
2039 Do-Something N6 GCRR +GTS	325,157	8,707	2,082	37.3

Table 4-2 Network Performance Indicators PM Peak using NTA/GCC NPF

Scenario	Total Vehicle Distance (pcu. Kms)	Total Network Travel Time (pcu. Hrs)	Total Network Delay (pcu. Hrs)	Average Vehicle Speed (kph)
2039 Do-Minimum	263,284	9,255	3,132	28.4
2039 Do-Something N6 GCRR	308,985	8,323	2,121	37.1
2039 Do-Something N6 GCRR +GTS	303,467	8,168	2,034	37.2

4.3 Journey times

4.3.1 To develop an understanding of the potential impact of the proposed N6 GCRR on key routes serving Galway, the projected change in vehicular journey times were assessed. Journey times represent a good basis for strategic traffic impact assessment as they provide a mechanism to quantify the traffic impact along a full route. This KPI will be based on a comparison between the 'Do-Minimum' journey times (i.e. without the N6 GCRR) and the 'Do-Something' journey times (i.e. with the N6 GCRR). Both the percentage change and absolute change in journey times (seconds) is considered in order to determine the impact.

4.3.2 The routes used for the Journey Time impact assessment are shown in Figure 4.1.

Figure 4-1 Journey Time Assessment Routes

4.3.3 The tables below detail the results of the Journey Time comparison as extracted from the 2039 NTA/GCC NPF traffic models for the Do-Something N6 GCRR Scenario AM and PM peak periods.

Table 4-3 AM Peak Journey Time Comparison

Description	DM	DS N6 GCRR	Diff	% Diff
Route 1 - Inbound	1201	877	-324	-27%
Route 1 - Outbound	693	682	-11	-2%
Route 2 - Inbound	1465	1239	-226	-15%
Route 2 - Outbound	1324	1281	-43	-3%
Route 3 - Inbound	591	334	-257	-43%
Route 3 - Outbound	260	267	7	3%
Route 4a - Inbound	764	705	-59	-8%
Route 4a - Outbound	777	691	-86	-11%
Route 4b - Inbound	1353	795	-558	-41%
Route 4b - Outbound	1347	753	-594	-44%
Route 5 - Inbound	1310	1127	-183	-14%
Route 5 - Outbound	1389	1169	-220	-16%
Route 6 - Inbound	1136	1151	15	1%
Route 6 - Outbound	1002	992	-10	-1%
Route 7 - Inbound	1519	1378	-141	-9%
Route 7 - Outbound	1538	1249	-289	-19%
Route 8 - Inbound	978	934	-44	-4%
Route 8 - Outbound	625	613	-12	-2%
Route 9 - Inbound	360	359	-1	0%
Route 9 - Outbound	360	358	-2	-1%
Route 10 - Inbound	701	611	-90	-13%
Route 10 - Outbound	901	621	-280	-31%
Route 11 - Inbound	1574	997	-577	-37%
Route 11 - Outbound	1352	1071	-281	-21%

Table 4-4 PM Peak Journey Time Comparison

Description	DM	DS N6 GCRR	Diff	% Diff
Route 1 - Inbound	731	692	-39	-5%
Route 1 - Outbound	818	691	-127	-16%
Route 2 - Inbound	1217	1271	54	4%
Route 2 - Outbound	1212	1191	-21	-2%
Route 3 - Inbound	293	296	3	1%
Route 3 - Outbound	260	269	9	3%
Route 4a - Inbound	857	683	-174	-20%
Route 4a - Outbound	919	704	-215	-23%
Route 4b - Inbound	839	634	-205	-24%
Route 4b - Outbound	1571	790	-781	-50%
Route 5 - Inbound	1258	1065	-193	-15%
Route 5 - Outbound	1172	1080	-92	-8%
Route 6 - Inbound	1153	1026	-127	-11%
Route 6 - Outbound	1072	1147	75	7%
Route 7 - Inbound	1198	1093	-105	-9%
Route 7 - Outbound	1724	1587	-137	-8%
Route 8 - Inbound	627	641	14	2%
Route 8 - Outbound	934	949	15	2%
Route 9 - Inbound	359	359	0	0%
Route 9 - Outbound	362	360	-2	-1%
Route 10 - Inbound	661	545	-116	-18%
Route 10 - Outbound	852	573	-279	-33%
Route 11 - Inbound	929	758	-171	-18%
Route 11 - Outbound	1760	1340	-420	-24%

4.3.4 The 2039 results show that, in general, the opening of the N6 GCRR has a significantly positive impact on the majority of Journey Times on the routes analysed in all 2039 modelled periods.

4.3.5 A small number of routes show negligible or minor impacts, with combined increases in Journey Times of less than 180 seconds across all routes. These increases are caused by the addition of new signalised junctions, requiring traffic to slow down where previously it was not necessary

4.3.6 The Do-Something N6 GCRR Scenario+GTS results show a similar pattern whereby, the opening of the N6 GCRR, in conjunction with the other measures proposed in the GTS, has a positive impact on the majority of Journey Time routes analysed.

4.3.7 The results below show some negative impacts on Journey Times on some routes in the Do-Something N6 GCRR Scenario+GTS. The reason for this is that the GTS contains a number of proposals which provide increased active mode and public transport priority in the city centre, and therefore adds delay and increased journey lengths in certain sections of the network.

Table 4-5 AM Peak Journey Time Comparison

Description	DM	DS N6 GCRR +GTS	Diff	% Diff
Route 1 - Inbound	1201	896	-305	-25%
Route 1 - Outbound	693	688	-5	-1%
Route 2 - Inbound	1465	1254	-211	-14%
Route 2 - Outbound	1324	1347	23	2%
Route 3 - Inbound	591	414	-177	-30%
Route 3 - Outbound	260	426	166	64%
Route 4a - Inbound	764	697	-67	-9%
Route 4a - Outbound	777	729	-48	-6%
Route 4b - Inbound	1353	705	-648	-48%
Route 4b - Outbound	1347	730	-617	-46%
Route 5 - Inbound	1310	1053	-257	-20%
Route 5 - Outbound	1389	1261	-128	-9%
Route 6 - Inbound	1136	1102	-34	-3%
Route 6 - Outbound	1002	1024	22	2%
Route 7 - Inbound	1519	1210	-309	-20%
Route 7 - Outbound	1538	1250	-288	-19%
Route 8 - Inbound	978	829	-149	-15%
Route 8 - Outbound	625	684	59	9%
Route 9 - Inbound	360	359	-1	0%
Route 9 - Outbound	360	358	-2	-1%
Route 10 - Inbound	701	592	-109	-16%
Route 10 - Outbound	901	624	-277	-31%
Route 11 - Inbound	1574	963	-611	-39%
Route 11 - Outbound	1352	1063	-289	-21%

Table 4-6 PM Peak Journey Time Comparison

Description	DM	DS N6 GCRR +GTS	Diff	% Diff
Route 1 - Inbound	731	717	-14	-2%
Route 1 - Outbound	818	722	-96	-12%
Route 2 - Inbound	1217	1331	114	9%
Route 2 - Outbound	1212	1286	74	6%
Route 3 - Inbound	293	404	111	38%
Route 3 - Outbound	260	430	170	65%
Route 4a - Inbound	857	684	-173	-20%
Route 4a - Outbound	919	739	-180	-20%
Route 4b - Inbound	839	629	-210	-25%
Route 4b - Outbound	1571	733	-838	-53%
Route 5 - Inbound	1258	1055	-203	-16%
Route 5 - Outbound	1172	1116	-56	-5%
Route 6 - Inbound	1153	1031	-122	-11%
Route 6 - Outbound	1072	1121	49	5%
Route 7 - Inbound	1198	1072	-126	-11%
Route 7 - Outbound	1724	1553	-171	-10%
Route 8 - Inbound	627	666	39	6%
Route 8 - Outbound	934	1044	110	12%
Route 9 - Inbound	359	359	0	0%
Route 9 - Outbound	362	360	-2	-1%
Route 10 - Inbound	661	513	-148	-22%
Route 10 - Outbound	852	574	-278	-33%
Route 11 - Inbound	929	950	21	2%
Route 11 - Outbound	1760	1275	-485	-28%

4.4 Ratio of Flow to Capacity

4.4.1 To further understand the potential impact on junction operations of the proposed N6 GCRR, the ratio of flow (of traffic) over capacity (RFC) at key junctions along the existing N6 corridor have been analysed and compared across scenarios.

4.4.2 RFC is a standard reference for measuring traffic congestion at a junction. It is standard practice to consider that a junction is congested when traffic flows are at 85% of the estimated capacity of a priority junction, or 90% of a signalised junction. At traffic flows above 90% of capacity the delays at a junction become erratic and are difficult to control. A value of 100% means that demand and capacity are equal and no further traffic is able to progress through the junction without experiencing significant delays.

4.4.3 A Ratio of Flow to Capacity analysis has been undertaken using information from the N6 GCRR traffic Model for each modelling scenario and is presented below. This analysis considered the number of links at Key Junctions along the existing N6 /R338 corridor with an RFC over 90% and also the number of links in the entire city area with an RFC over 90%. Figure 4.2, below, illustrates the location of the Key Junctions on the existing N6 / R338 Corridor.

Figure 4-2 Key Junctions

4.4.4 The tables below summarise these junction evaluations for the 2039 – NTA/GCC NPF – Scenarios.

Table 4-7 Number of Junctions at or over capacity in the AM Peak

	Criteria	DM	DS N6 GCRR	Impact	DS N6 GCRR+GTS	Impact
Key Junctions (N6 / R338)	RFC > 90%	22	14	Positive	8	Positive
Entire Network	RFC > 90%	281	185	Positive	129	Positive

Table 4-8 Number of Junctions at or over capacity in the PM Peak

	Criteria	DM	DS N6 GCRR	Impact	DS N6 GCRR+GTS	Impact
Key Junctions (N6 / R338)	RFC > 90%	21	8	Positive	6	Positive
Entire Network	RFC > 90%	228	164	Positive	150	Positive

4.4.5 The above tables show that, with the introduction of the N6 GCRR, there is a significant decrease compared to the Do-Minimum in the number of links in the network which have an RFC of over 90%. This is particularly evident in the PM peak period where the number of over-capacity links, at key junctions along the existing N6/ R338 Corridor, reduces by over 60%. Similarly, the number of over-capacity links on the entire city network is reduced by 28% as a result of the introduction of the N6 GCRR.

4.4.6 The above tables also show that, as with the Do-Something Scenario, the introduction of the GTS proposals results in a significant decrease in number of junctions operating above their capacity within the entire city area and also along the existing N6 / R338 corridor when compared with the Do-Minimum. As outlined in section 4.2, these results also suggest that the implementation of the GTS measures, combined with the integrated land use assumptions of the NPF, have resulted in a shift towards sustainable modes in the city centre. This in turn leads to improved network performance when compared to the Do-Something Scenario.

4.4.7 Further analysis of the Do-Something N6 GCRR and Do-Something N6 GCRR+GTS Scenarios highlighted that there are 2,000 fewer vehicle trips in the Do- Something N6 GCRR+GTS scenario, this has resulted in fewer junctions operating close to, or over, capacity.

Junction Modelling Results

4.4.8 In addition to the analysis carried out above, a further operational analysis of the busiest junctions along the alignment of the N6 GCRR was carried out. Linsig analysis software was used for analysing these signalised junctions in order to ensure that each of the junctions would operate within capacity in the design year. The results of this analysis (included in Appendix A) show that, with the inclusion of some mitigation measures, all junctions along the N6 GCRR will operate within capacity in the design year.

4.5 Mode Share

Full Network

4.5.1 The tables below present the mode share between private vehicle, public transport, walking and cycling for the 2012 Base Year and 2039 Design Year, for the entire model area for the 24 hour period.

4.5.2 The mode share analysis shows that there is a low public transport mode share of just 4% in the Base Year. As can be seen below, the impact of the Do-Something N6 GCRR option on mode share is minimal, with Car Mode share increasing by circa 1% in 2039 as a result of the opening of the N6 GCRR.

4.5.3 The GTS Sensitivity test i.e. Do-Something N6 GCRR+GTS increases public transport (PT) mode share to 4%, which is a 19% increase in PT trips relative to the Do-Minimum.

Table 4-9 Network Wide Mode Share Percentages

Option	% Car	% PT	% Walk	% Cycle
2039 Do-Min	80%	3%	14%	3%
2039 Do-Something N6 GCRR	81%	3%	14%	3%
2039 Do-Something N6 GCRR+GTS	80%	4%	14%	3%

City Centre

4.5.4 As the majority of sustainable travel initiatives are aimed at increasing sustainable travel within Galway City a mode share analysis has also been undertaken for the city centre area in isolation. The tables below present the mode share for the 2012 Base Year and 2039 Design Year, for the city centre over a full 24 hour period.

4.5.5 The mode share analysis shows that there is a low public transport mode share of just 4% in the Base Year. As can be seen below, the impact of the Do-Something N6 GCRR option on mode share is minimal, with Car Mode share increasing by circa 2% in 2039 as a result of the opening of the N6 GCRR.

4.5.6 The GTS sensitivity test i.e. Do-Something N6 GCRR+GTS increases PT mode share to 8%, which is a 22% increase in PT trips relative to the Do-Minimum.

4.5.7 The GTS measures also result in a double of the cycling mode share in the city centre from 3% to 6% and an increase in walking mode share from 30% to 32%.

Table 4-10 City Centre Mode Share Percentages

Option	% Car	% PT	% Walk	% Cycle
2039 Do-Min	59%	7%	31%	4%
2039 Do-Something N6 GCRR	61%	6%	30%	3%
2039 Do-Something N6 GCRR+GTS	54%	8%	32%	6%

5. AVERAGE ANNUAL DAILY TRAFFIC (AADT) ESTIMATES

5.1 Introduction

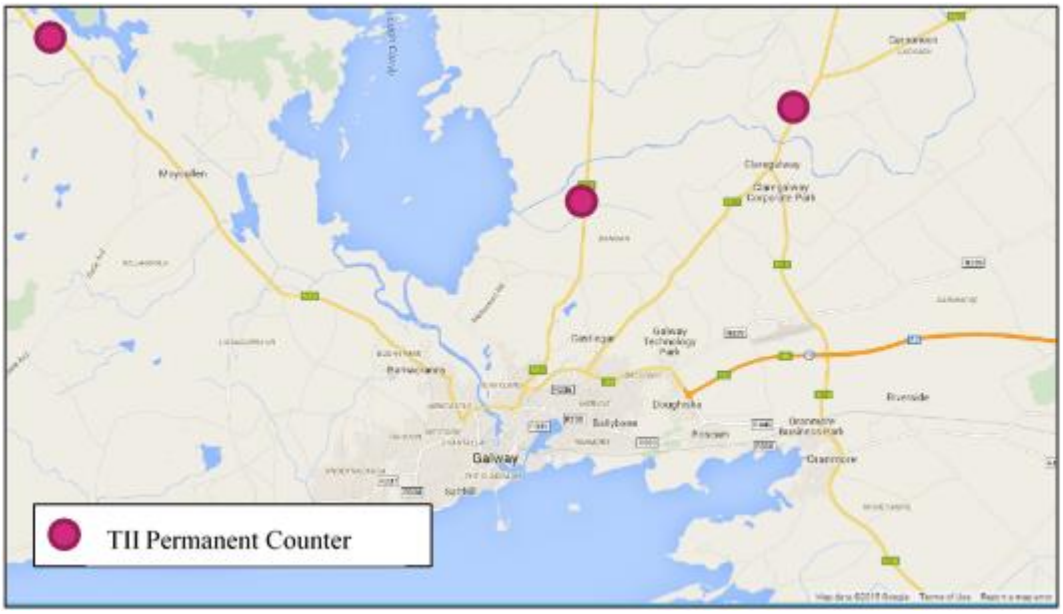
5.1.1 The information in this chapter presents the methodology adopted to estimate AADT values from the modelled flows and also illustrates the estimated AADT values on key sections of the Galway road network, with and without the proposed N6 GCRR in place. This methodology has been based on the TII Project Appraisal guidelines. Unit 16.1: Estimating AADT on National Roads.

5.2 Methodology

Permanent Counter Method

5.2.1 According to the PAG, the preferable method of estimating AADT is the permanent counter method. Currently there are only three TII Permanent Counters near Galway and they are located a considerable distance from the city, as illustrated in Figure 5-1 below. As the purpose of this exercise is to estimate AADTs across a broad geographical area in Galway City and surrounds it is felt that the permanent counter method is not appropriate in this instance.

Figure 5-1: TII Permanent Counter Locations



Localised Period Counter Method

5.2.2 The Localised Period Counter Method utilises local traffic counts to estimate Period Expansion Factors, so that short period model flows (i.e. AM, IP1, IP2 and PM) can be expanded to estimate all day (24 hours flows). These 24 hour flows can subsequently be extrapolated to AADT using a selection of permanent TII traffic counters in the region.

5.2.3 The Localised Period Counter method has been adopted in this instance in order to estimate AADT (Annual Average Daily Traffic) values for Galway. The steps involved in estimating the AADTs are outlined in the remaining sections of this chapter.

5.3 AADT Estimation Process

Step 1 - 12hour Mid-Week Flow Calculation

5.3.1 The first step in the AADT estimation process is to apply peak hour factors to each of the model time periods to estimate 12 hour (07:00 - 19:00) weekday flows. The peak hour factors were calculated during model development to determine the relationship between the modelled peak hour (e.g. 08:00-09:00) and the entire, three hour, peak period (e.g. 07:00-10:00).

5.3.2 These peak hour factors were calculated using local traffic data which was collected from different sites around Galway City during the month of November (precisely from 12th of November to 18th) in 2012. Based on the PAG unit 16.1 methodology for multiple counts, a linear regression has been performed based on the Automatic Traffic Counts in order to estimate these peak hour factors. These factors can then be used to calculate the peak period flows as follows:

- AM Peak assigned flows * peak hour factor = 07:00 - 10:00 flows;
- IP 1 assigned flows * peak hour factor = 10:00 - 13:00 flows;
- IP2 assigned flows * peak hour factor = 13:00 - 16:00 flows; and
- PM Peak assigned flows * peak hour factor = 16:00 - 19:00 flows.

5.3.3 Utilising the above factors therefore allows us to estimate 12 hour (07:00 - 19:00) weekday flows from the four, peak hour, model assignments.

Step 2 - WADT Calculation

5.3.4 The second step in the process requires expanding the 12 hour weekday counts, estimated above, to 24 hour Monday to Sunday flows (Weekly Average Daily Traffic, WADT). This is done by calculating an expansion factor based on the existing relationship between 12 hour Monday - Friday flows and 24 hour Monday - Sunday Flows. The formula for this factor is:

$$F1 = \frac{Average\ 24h\ Monday - Sunday}{Average\ 07{:}00 - 19{:}00\ Monday - Friday}$$

5.3.5 Based on the PAG unit 16.1 methodology for multiple counts, a linear regression has been performed based on all 72 ATCs in order to estimate this WADT factor. As different vehicle types display different mid-week and weekend travel patterns, separate factors were calculated for cars, light good vehicles (LGVs) and heavy goods vehicles (HGVs). These calculations resulted in the following WADT factors:

$$WADT_{Nov2012} = 1.21\ \times 12hr_{WD}\ for\ cars$$

$$WADT_{Nov2012} = 1.07\ \times 12hr_{WD}\ for\ LGVs$$

$$WADT_{Nov2012} = 1.08\ \times 12hr_{WD}\ for\ HGVs$$

Where:

$WADT_{Nov2012}$ is the weekly average daily traffic for the 3rd week of November 2012, $12hr_{WD}$ is the average 07:00-19:00 weekday (Monday-Friday) traffic for the 3rd week of November 2012.

Step 3 - AADT Calculation

5.3.6 The Final step in the process is to convert the WADT figures calculated above into Annual Average Daily Traffic (AADT) figures. This is done in order to take into account the seasonality of traffic flows. To do so, the period when the ATC counts have been performed has been compared with the rest of the year.

5.3.7 In this case, there is no available data for the three closest TII Permanent Counters for November 2012. Indeed between the summer 2012 and March 2013 a number of TII Permanent counters seem to have been relocated.

5.3.8 Therefore, in order to estimate how the 3rd week of November relates to the rest of the year in terms of traffic, available data of the three closest permanent counters from 2011 and 2013 has been considered. This is not ideal considering the fact that it would not capture any specific event that happened in November 2012 (e.g. weather , special event). Yet, apart from those special cases, one can assume that from year to year, the annual flow profile will not differ significantly.

5.3.9 A linear regression has been performed based on four annual counts to estimate the seasonal expansion factor (F2). The Permanent counters and the periods taken into account are:

Table 5-8 TII Permanent Counters Used

TII Permanent Counter Name	Location	Period Start	Period End
Claregalway	N17 – 16	01/01/2011	31/12/2011
PC 1841	N84	01/03/2013	28/02/2014
PC 20172	N17	15/03/2013	14/03/2014
PC 1591	N59	24/03/2013	23/03/2014

5.3.10 This extrapolation factor, F2, is calculated using the formula below:

$$F2 = \frac{WADT_{Nov}}{AADT}$$

Where:

$WADT_{Nov2012}$ is the weekly average daily traffic for the 3rd week of November of the considered year and $AADT$ is the annual average daily traffic for the considered year.

5.3.11 The seasonality factors calculated for each vehicle type are:

$$AADT = 1.03 \times WADT_{Nov}\ for\ cars$$

$$AADT = 0.96 \times WADT_{Nov}\ for\ LGVs$$

$$AADT = 0.97 \times WADT_{Nov}\ for\ HGVs$$

5.4 2039 AADT Estimates

5.4.1 The forecast AADT flows on the road network extracted from the models for the NPF Do-Min, Do-Something N6 GCRR and Do-Something N6 GCRR+GTS Scenarios test, are presented in the tables below.

Figure 5-2: AADT Locations

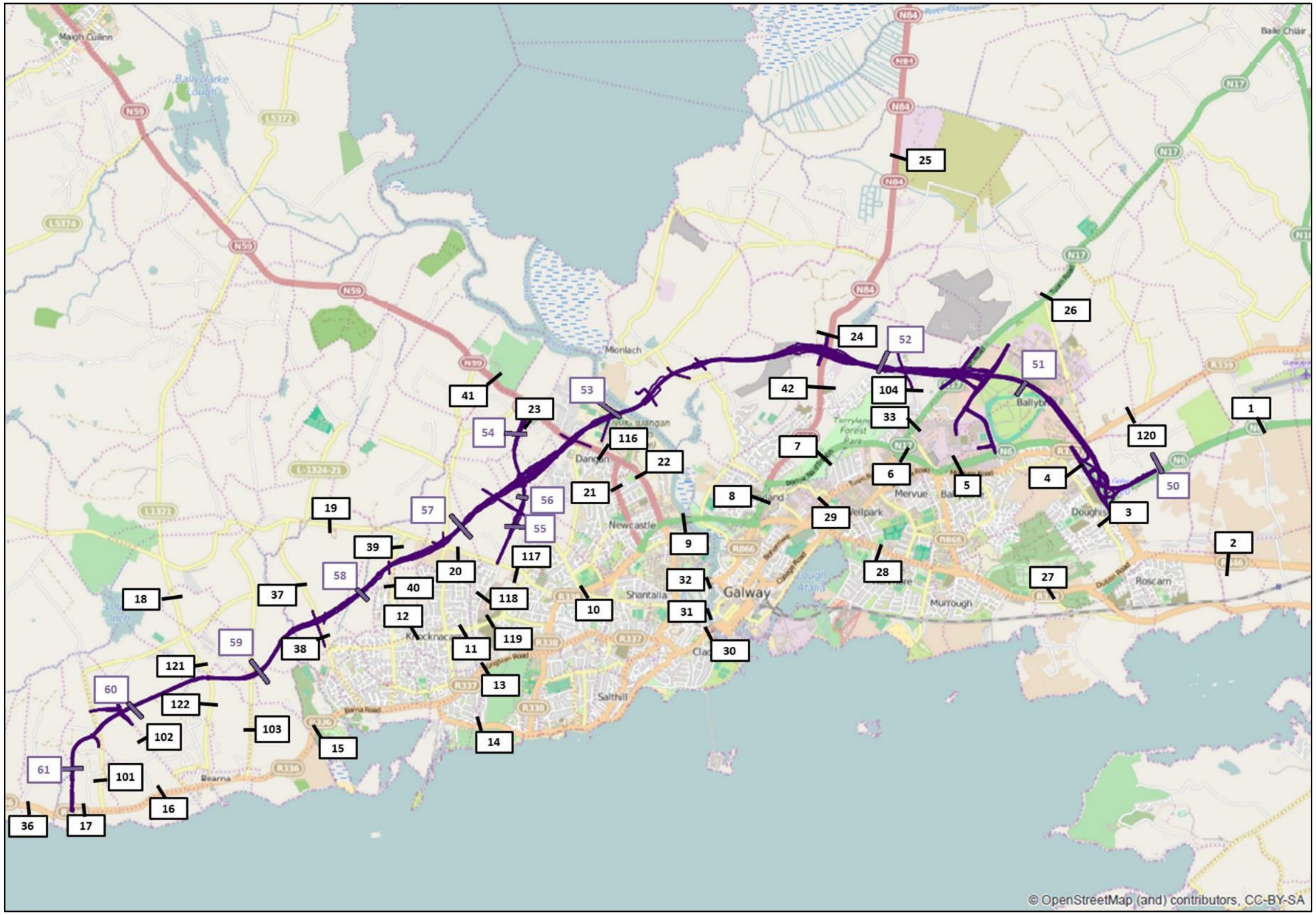


Table 5-1: NPF Do-Something N6 GCRR 2039 AADTs

			2039 DM		2039 N6 GCRR	
	AADT Point	Location	AADT	% HGV	AADT	% HGV
DM links	1	N6 South of Galway Airport	26,014	6%	46,591	5%
	2	R446 West of Oranmore Business Park	26,639	7%	27,504	6%
	3	R446 South of N6 Roundabout	28,978	4%	37,927	4%
	4	N6 South of Briarhill	36,302	5%	26,716	4%
	5	N6 Near Ballybrit Business park	31,688	5%	22,918	3%
	6	N6 between N17 and R865	29,928	4%	22,927	2%
	7	N6 Between N84 and N17	20,124	4%	12,604	3%
	8	N6 East of Quincentenary Bridge	25,234	6%	24,122	3%
	9	N6 - On Quincentenary Bridge	36,487	6%	26,989	4%
	10	R338 at Westside Playing fields	15,525	4%	8,987	1%
	11	Western Distributor Rd between Clybaun Rd and R338	13,336	2%	9,349	1%
	12	Western Distributor Rd between Clybaun Rd and Ballymoneen Rd	9,814	1%	7,303	1%
	13	R337 Kingston Road. Kingston	12,161	4%	6,864	1%
	14	R336. Salthill Road Upper. Galway Golf Course.	11,977	2%	9,848	2%
	15	R336. Barna Road. Barna Woods	17,635	3%	4,731	0%
	16	R336. Barna Road. Barna. Creagan bus stop	13,222	3%	3,102	0%
	17	R336. Barna Road. West of Barna. Garrynagry	11,311	3%	13,447	3%
	18	L1321. At Loughinch. South East of Bearna Golf Club	849	0%	2,159	0%
	19	Boleybeg Road. Between Cappagh Road and Ballymoneen Road	1,865	1%	666	1%
	20	Rahoon Road. Between Clybaun Rd and Bothar Stiofain	4,446	0%	5,115	0%
	21	N59. Thomas Hynes road. Between Hazel Park and Cherry Park	6,629	2%	5,834	0%
	22	N59. Upper Newcastle Road. Between R338 and Corrib Village	14,086	2%	12,790	0%
	23	N59. Barnacranny. Between chesnut Ln and Circular Rd	19,028	2%	17,104	0%
	24	N84. South of Ballindooly. Ballindooly Lough	13,842	6%	18,464	4%
	25	N84. North of Ballindooly	14,458	4%	17,964	3%
	26	N17. Tuam Road. NorthEast of Parkmore Road	17,836	4%	19,444	6%
	27	R338. Dublin Road. West of Junction with Coast Road.	22,097	6%	21,803	5%
	28	R338. Dublin road. Between Renmore Rd and M. Collins road	18,282	6%	18,356	4%
	29	R336. Tuam Road. Mervue Business Park	20,240	6%	15,988	5%
	30	Wolfe Tone Bridge	20,580	3%	16,939	3%
	31	O'Briens Bridge	10,332	4%	9,517	3%
	32	Salmon Weir Bridge	20,645	1%	16,469	1%
	33	N17. Tuam Road. NorthEast of School Road	19,137	4%	20,541	4%
	34	Eglington Street	7,437	2%	6,143	1%
	35	R336 South of Eyre Square	16,821	5%	17,230	5%
	36	R336 West of N6	11,311	3%	13,448	3%
	37	Cappagh Road - North of GCRR	539	0%	213	0%
	38	Cappagh Road - South of GCRR	539	0%	6,857	2%
	39	Ballymoneen Rd - North of GCRR	1,114	0%	5,890	1%
	40	Ballymoneen Rd - South of GCRR	1,114	0%	5,551	2%
	41	N59 - North of GCRR Link Road	18,771	3%	19,372	3%
	42	N84 South of GCRR	13,842	6%	20,405	4%
	112	N17 South of Link to Parkmore	19,137	4%	20,541	4%
	113	N17 Between GCRR on and off Ramps	19,137	4%	22,913	5%
	114	Ballybrit Industrial Estate Link to N6	1,379	0%	3,004	0%
	115	N6 East of Ballybrit	33,059	4%	25,921	2%
	116	N59 South of Link to Interchange	19,028	2%	17,104	0%
	117	Rahoon Rd east of GCRR Link Rd	9,801	1%	9,818	1%
	118	Gort Na Bro South of Rahoon Rd	3,953	0%	2,556	0%
	119	Western Distributor Rd - East of Gort Na Bro	13,736	2%	9,468	1%
	120	R339 East of Parkmore	19,263	0%	17,650	0%
DS links	50	GCRR - Briarhill Junction	-		46,591	5%
	51	GCRR - Parkmore	-		50,216	4%
	52	GCRR - Between N17 and N84	-		60,117	4%
	53	GCRR - New Corrib Crossing	-		43,307	4%
	54	GCRR - N59 Link Road	-		14,505	4%
	55	GCRR - Rahoon Link Road	-		7,432	2%
	56	GCRR - Letteragh Link Road	-		14,997	2%
	57	GCRR - Between Ballymoneen and N59 Interchange	-		24,706	3%
	58	GCRR - Between Ballymoneen and Cappagh Road	-		18,821	3%
	59	GCRR - Between Moycullen Rd and Cappagh Road	-		19,411	2%
	60	GCRR - at Turskey West	-		11,364	3%
	61	GCRR - North of R336 Junction	-		11,364	3%

M17 / M18 Links					
80	M18 South of M6 Motorway	23,693	4%	28,900	4%
81	M17 North of M6 Motorway	27,386	5%	27,355	5%
82	M6 East of M17 / M18 Junciton	50,715	4%	54,582	4%
83	M6 West of M17 / M18 Junction	38,065	5%	52,832	5%

Table 5-2: NPF - Do-Something N6 GCRR+GTS - 2039 AADTs

			2039 DM		2039 N6 GCRR + GTS	
	AADT Point	Location	AADT	% HGV	AADT	% HGV
DM links	1	N6 South of Galway Airport	26,014	6%	45,683	5%
	2	R446 West of Oranmore Business Park	26,639	7%	26,690	6%
	3	R446 South of N6 Roundabout	28,978	4%	38,323	4%
	4	N6 South of Briarhill	36,302	5%	25,133	4%
	5	N6 Near Ballybrit Business park	31,688	5%	20,795	3%
	6	N6 between N17 and R865	29,928	4%	22,711	2%
	7	N6 Between N84 and N17	20,124	4%	10,485	5%
	8	N6 East of Quincentenary Bridge	25,234	6%	24,395	4%
	9	N6 - On Quincentenary Bridge	36,487	6%	33,902	4%
	10	R338 at Westside Playing fields	15,525	4%	8,300	1%
	11	Western Distributor Rd between Clybaun Rd and R338	13,336	2%	4,669	0%
	12	Western Distributor Rd between Clybaun Rd and Ballymoneen Rd	9,814	1%	2,741	0%
	13	R337 Kingston Road. Kingston	12,161	4%	9,459	1%
	14	R336. Salthill Road Upper. Galway Golf Course.	11,977	2%	9,643	2%
	15	R336. Barna Road. Barna Woods	17,635	3%	4,869	0%
	16	R336. Barna Road. Barna. Creagan bus stop	13,222	3%	3,346	0%
	17	R336. Barna Road. West of Barna. Garrynagry	11,311	3%	13,227	3%
	18	L1321. At Loughinch. South East of Bearna Golf Club	849	0%	2,191	0%
	19	Boleybeg Road. Between Cappagh Road and Ballymoneen Road	1,865	1%	633	1%
	20	Rahoon Road. Between Clybaun Rd and Bothar Stiofain	4,446	0%	6,991	0%
	21	N59. Thomas Hynes road. Between Hazel Park and Cherry Park	6,629	2%	5,762	0%
	22	N59. Upper Newcastle Road. Between R338 and Corrib Village	14,086	2%	12,200	0%
	23	N59. Barnacranny. Between chesnut Ln and Circular Rd	19,028	2%	16,711	0%
	24	N84. South of Ballindooly. Ballindooly Lough	13,842	6%	18,144	4%
	25	N84. North of Ballindooly	14,458	4%	17,687	3%
	26	N17. Tuam Road. NorthEast of Parkmore Road	17,836	4%	19,491	6%
	27	R338. Dublin Road. West of Junction with Coast Road.	22,097	6%	21,182	5%
	28	R338. Dublin road. Between Renmore Rd and M. Collins road	18,282	6%	19,066	4%
	29	R336. Tuam Road. Mervue Business Park	20,240	6%	15,474	3%
	30	Wolfe Tone Bridge	20,580	3%	14,831	4%
	31	O'Briens Bridge	10,332	4%	8,128	1%
	32	Salmon Weir Bridge	20,645	1%	-	
	33	N17. Tuam Road. NorthEast of School Road	19,137	4%	20,252	3%
	34	Eglington Street	7,437	2%	-	
	35	R336 South of Eyre Square	16,821	5%	-	
	36	R336 West of N6	11,311	3%	13,228	3%
	37	Cappagh Road - North of GCRR	539	0%	215	0%
	38	Cappagh Road - South of GCRR	539	0%	6,990	3%
	39	Ballymoneen Rd - North of GCRR	1,114	0%	6,767	1%
	40	Ballymoneen Rd - South of GCRR	1,114	0%	4,960	1%
	41	N59 - North of GCRR Link Road	18,771	3%	18,616	3%
	42	N84 South of GCRR	13,842	6%	21,009	4%
	112	N17 South of Link to Parkmore	19,137	4%	20,252	3%
	113	N17 Between GCRR on and off Ramps	19,137	4%	22,423	5%
	114	Ballybrit Industrial Estate Link to N6	1,379	0%	2,804	0%
	115	N6 East of Ballybrit	33,059	4%	23,598	3%
	116	N59 South of Link to Interchange	19,028	2%	16,711	0%
	117	Rahoon Rd east of GCRR Link Rd	9,801	1%	9,039	1%
	118	Gort Na Bro South of Rahoon Rd	3,953	0%	3,279	0%
	119	Western Distributor Rd - East of Gort Na Bro	13,736	2%	5,026	0%
	120	R339 East of Parkmore	19,263	0%	16,376	0%
DS links	50	GCRR - Briarhill Junction	-		45,683	5%
	51	GCRR - Parkmore	-		49,257	4%
	52	GCRR - Between N17 and N84	-		57,786	4%
	53	GCRR - New Corrib Crossing	-		42,551	4%
	54	GCRR - N59 Link Road	-		14,503	4%
	55	GCRR - Rahoon Link Road	-		7,101	1%
	56	GCRR - Letteragh Link Road	-		15,472	3%
	57	GCRR - Between Ballymoneen and N59 Interchange	-		24,326	3%
	58	GCRR - Between Ballymoneen and Cappagh Road	-		20,424	3%
	59	GCRR - Between Moycullen Rd and Cappagh Road	-		18,789	2%
	60	GCRR - at Turskey West	-		10,930	4%
	61	GCRR - North of R336 Junction	-		10,930	4%

M17 / M18 Links					
80	M18 South of M6 Motorway	23,693	4%	28,354	4%
81	M17 North of M6 Motorway	27,386	5%	27,006	5%
82	M6 East of M17 / M18 Junciton	50,715	4%	53,767	4%
83	M6 West of M17 / M18 Junction	38,065	5%	50,968	5%

6. EIAR VS NPF MODELLING COMPARISON

6.1 Introduction

6.1.1 This chapter aims to provide a comparison of the 2039 Do-Something N6 GCRR NTA/GCC NPF scenario which is detailed in this report against the 2039 "TII Central Case" Do-Something N6 GCRR scenario which is presented in the EIAR for the N6 GCRR.

6.1.2 Both scenarios have the same infrastructure assumed (N6 GCRR only) but differ in their planning and land use assumptions. The 2039 DS N6 GCRR NTA/GCC NPF Scenario presented in this report uses assumptions from a combination of sources (detailed in Chapter 2) and for the purposes of this comparison will be known as the 'NTA/GCC NPF' Scenario while the 2039 Do-Something Scenario presented in the Chapter 6 Traffic Assessment and Route Cross Section of the EIAR uses assumptions from the TII National Model Medium Growth Scenario and will be known as the 'EIAR (TII Central Case)' Scenario.

6.2 Network Performance Indicators

6.2.1 A Network Performance comparison is shown in Table 6-1 below. The results show that the new NTA/GCC NPF assumptions lead to an increase in Total Vehicle Distance Travelled and Total Travel Time in both time periods, with average vehicle speed on the network decreasing. This is as a result of extra vehicles on the network in the Do-Something N6 GCRR NTA/GCC NPF Scenario, which in turn leads to additional total vehicle kilometres and results in more congestion than the EIAR Do-Something N6 GCRR (TII Central Case) Scenario.

6.2.2 These impacts are considered relatively small in the context of the large differences in assumed population and employment between the two scenarios. For example, the NTA/GCC NPF assumptions include 41% more population in Galway City (90,000 in the EIAR Scenario versus 121,741 in the NTA/GCC NPF Scenario) and 37% more employment growth in Galway City (48,000 in the EIAR Scenario versus 63,647 in the NTA/GCC NPF Scenario).

Table 6-1 Network Performance Indicators AM Peak

Scenario	Total Vehicle Distance (pcu. Kms)	Total Network Travel Time (pcu. Hrs)	Average Vehicle Speed (kph)
DS N6 GCRR EIAR (TII Central Case)	294,178	7,611	38.7
DS N6 GCRR NTA/GCC NPF	339,630	9,300	36.5
Difference (%)	15%	22%	-6%

Table 6-2 Network Performance Indicators PM Peak

Scenario	Total Vehicle Distance (pcu. Kms)	Total Network Travel Time (pcu. Hrs)	Average Vehicle Speed (kph)
DS N6 GCRR EIAR (TII Central Case)	264,746	6,919	38.3
DS N6 GCRR NTA/GCC NPF	308,985	8,323	37.1
Difference (%)	17%	20%	-3%

6.3 Journey Times

6.3.1 The routes used for the Journey Time assessment are the same as per Figure 4.1. The tables below detail the results of the Journey Time comparison for both the AM and PM peak periods.

Table 6-3 AM Peak Journey Time Comparison

Description	DS N6 GCRR EIAR (TII Central Case)	DS N6 GCRR NTA/GCC NPF	Diff	% Diff
Route 1 - Inbound	841	877	36	4%
Route 1 - Outbound	680	682	2	0%
Route 2 - Inbound	1209	1239	30	2%
Route 2 - Outbound	1255	1281	26	2%
Route 3 - Inbound	315	334	19	6%
Route 3 - Outbound	267	267	0	0%
Route 4a - Inbound	680	705	25	4%
Route 4a - Outbound	683	691	8	1%
Route 4b - Inbound	770	795	25	3%
Route 4b - Outbound	707	753	46	7%
Route 5 - Inbound	1016	1127	111	11%
Route 5 - Outbound	1029	1169	140	14%
Route 6 - Inbound	1110	1151	41	4%
Route 6 - Outbound	978	992	14	1%
Route 7 - Inbound	1270	1378	108	9%
Route 7 - Outbound	1257	1249	-8	-1%
Route 8 - Inbound	846	934	88	10%
Route 8 - Outbound	611	613	2	0%
Route 9 - Inbound	359	359	0	0%
Route 9 - Outbound	358	358	0	0%
Route 10 - Inbound	487	611	124	25%
Route 10 - Outbound	511	621	110	22%
Route 11 - Inbound	1061	997	-64	-6%
Route 11 - Outbound	895	1071	176	20%
Average	**800**	**844**	**44**	**6%**

Table 6-4 PM Peak Journey Time Comparison

Description	DS N6 GCRR EIAR (TII Central Case)	DS N6 GCRR NTA/GCC NPF	Diff	% Diff
Route 1 - Inbound	691	692	1	0%
Route 1 - Outbound	677	691	14	2%
Route 2 - Inbound	1308	1271	-37	-3%
Route 2 - Outbound	1183	1191	8	1%
Route 3 - Inbound	295	296	1	0%
Route 3 - Outbound	268	269	1	0%
Route 4a - Inbound	685	683	-2	0%
Route 4a - Outbound	689	704	15	2%
Route 4b - Inbound	633	634	1	0%
Route 4b - Outbound	688	790	102	15%
Route 5 - Inbound	1020	1065	45	4%
Route 5 - Outbound	1070	1080	10	1%
Route 6 - Inbound	1040	1026	-14	-1%
Route 6 - Outbound	1080	1147	67	6%
Route 7 - Inbound	1063	1093	30	3%
Route 7 - Outbound	1440	1587	147	10%
Route 8 - Inbound	638	641	3	0%
Route 8 - Outbound	918	949	31	3%
Route 9 - Inbound	359	359	0	0%
Route 9 - Outbound	360	360	0	0%
Route 10 - Inbound	424	545	121	29%
Route 10 - Outbound	489	573	84	17%
Route 11 - Inbound	761	758	-3	0%
Route 11 - Outbound	1124	1340	216	19%
Average	**788**	**823**	**35**	**4%**

6.3.2 The results show that, in general, the new NTA/GCC NPF assumptions have a negative impact on journey times across the city. In the AM, the routes which show the greatest increases in Journey Time are Routes 5and 10 which are a continuation of each other (Lough Atalia Road through Wellpark onto Monivea Road across the Briarhill Junction with the existing N6 in both directions) and Route 11 in the outbound direction (Old Dublin Road onto the N67 towards Oranmore).

6.3.3 In the PM, the routes which show the greatest increases in Journey Time are again Route 10 in both directions (Monivea Road from Ballybane Road across Briarhill Junction with the existing N6 in both directions), Route 11 in the outbound direction (Old Dublin Road onto the N67 towards Oranmore) and Route 4b in the outbound direction (entirety of the N6).

6.3.4 Across all routes, the results indicate that the new NTA/GCC NPF assumptions lead to an average increase in Journey Time of 5.8% in the AM Peak and 4.5% in the PM Peak, This is considered relatively minor in the context of the considerable amount of additional population assumed to be living in Galway City in the NTA/GCC NPF Scenario (an increase of 41% on the EIAR assumptions).

6.4 Ratio of Flow to Capacity

6.4.1 The key junctions used for this capacity assessment are the same as those outlined in Chapter 4 (Figure 4.2). The tables below detail the results of the RFC comparison for both the AM and PM peak periods.

Table 6-5 AM Peak Comparison

	Criteria	DS N6 GCRR EIAR (TII Central Case)	DS N6 GCRR NTA/GCC NPF	Do-Minimum NTA/GCC NPF
Key Junctions (N6 / R338)	RFC > 90%	12	14	22
Entire Network	RFC > 90%	115	185	281

Table 6-6 PM Peak Comparison

	Criteria	DS N6 GCRR EIAR (TII Central Case)	DS N6 GCRR NTA/GCC NPF	Do Minimum NTA/GCC NPF
Key Junctions (N6 / R338)	RFC > 90%	6	8	21
Entire Network	RFC > 90%	100	164	228

6.4.2 The above tables show that the new NTA/GCC NPF assumptions lead to an increase in the number of links in the network which have a RFC of over 90%. Both the AM and PM peaks experience an increase of over 60% compared to the EIAR (TII Central Case) Scenario.

6.4.3 This is because the NTA/GCC NPF land use assumptions have resulted in a much higher level of trip generation during the peak periods, arising from the increased population assumptions. This in turn leads to increased traffic flow through the key junctions in the Study Area. Analysis of the NTA/GCC Do-Minimum results show that, without the N6 GCRR in place, the forecast population and employment growth in this scenario will lead to a significant deterioration in the performance of the traffic network in Galway with 50% more links experiencing an RFC of greater than 90% than when the N6 GCRR is in place.

6.5 Mode Share

City Centre

6.5.1 The table below presents the mode share comparison, for the city centre, over a full 24 hour period.

6.5.2 The mode share analysis shows the significant benefits of locating the forecast population and jobs within the city centre and settlements easily served by public transport. This demonstrates that the NTA/GCC NPF Scenario will result in a greater integration of land uses which in turn increases the mode share of sustainable modes and reduces the mode share of private vehicles. This aligns with Smarter Travel policy and offers the most opportunity for further improvement on mode share with the full implementation of all measures within the Galway Transport Strategy.

Table 6-7 City Centre Mode Share Percentages

Option	% Car	% PT	% Walk	% Cycle
DS N6 GCRR EIAR (TII Central Case)	69%	4%	25%	3%
DS N6 GCRR NTA/GCC NPF	61%	6%	30%	3%
Difference (%)	-8%	2%	5%	0%

7. GALWAY TRANSPORT STRATEGY FORECASTS

7.1 Introduction

7.1.1 As outlined in section 2.4, The Galway Transport Strategy (GTS) was developed by Galway City and County Councils in partnership with the National Transport Authority (NTA) to help resolve existing transportation issues in Galway City and its environs. The GTS outlines a host of proposed measures for active travel, public transport and general traffic in Galway, to be implemented over a 20 year period.

7.1.2 A sensitivity test using the NTA/GCC NPF forecasts with the GTS recommendations in place has also been carried out. The sections below compare the results of this sensitivity test against the 'TII Central Case' Do-Something plus GTS recommendations which were presented in the EIAR.

7.2 Network Performance Indicators

7.2.1 The tables below compare the Total Vehicle Distance Travelled, Total Network Travel Time and Average Vehicle Speed in the model network for the EIAR (developed using TII Central Case forecasts) and NTA/GCC NPF scenarios.

7.2.2 The results below show that the GTS measures have a greater impact when combined with the NTA/GCC NPF growth assumptions compared to the TII Central Case forecasts. In the AM and PM peaks, both Vehicle Distance and Total Network Travel Time show a reduction (around 4% and 6% respectively in the AM while in the PM both show a 2% reduction), and Average Vehicle Speed improve as a result of the introduction of the GTS measures in the NTA/GCC NPF growth scenarios.

Table 7-1 Network Performance Indicators AM Peak

Scenario	Total Vehicle Distance (pcu. Kms)	Total Network Travel Time (pcu. Hrs)	Average Vehicle Speed (kph)
DS N6 GCRR EIAR (TII Central Case)	294,178	7,611	38.7
DS N6 GCRR EIAR (TII Central Case) + GTS	294,497	7,756	38.0
Difference (%)	+0%	+2%	-2%
DS N6 GCRR NTA/GCC NPF	339,630	9,300	36.5
DS N6 GCRR NTA/GCC NPF +GTS	325,157	8,707	37.3
Difference (%)	-4%	-6%	+2%

Table 7-2 Network Performance Indicators PM Peak

Scenario	Total Vehicle Distance (pcu. Kms)	Total Network Travel Time (pcu. Hrs)	Average Vehicle Speed (kph)
DS N6 GCRR EIAR (TII Central Case)	264,746	6,919	38.3
DS N6 GCRR EIAR (TII Central Case) + GTS	266,632	7,128	37.4
Difference (%)	1%	3%	-2%
DS N6 GCRR NTA/GCC NPF	308,985	8,323	37.1
DS N6 GCRR NTA/GCC NPF +GTS	303,467	8,168	37.2
Difference (%)	-2%	-2%	0%

7.3 Journey Times

7.3.1 The routes used for the Journey Time assessment are the same as per Figure 4.1. The tables below detail the results of the Journey Time comparison for both the AM and PM peak periods.

Table 7-3 AM Peak Journey Time Comparison

Description	EIAR (TII Central) DS	EIAR (TII Central) DS + GTS	Diff	% Diff	NTA/GCC NPF DS	NTA/GCC NPF DS + GTS	Diff	% Diff
Route 1 - IB	841	900	59	7%	877	896	19	2%
Route 1 – OB	680	685	5	1%	682	688	6	1%
Route 2 – IB	1209	1245	36	3%	1239	1254	15	1%
Route 2 – OB	1255	1421	166	13%	1281	1347	66	5%
Route 3 – IB	315	411	96	30%	334	414	80	24%
Route 3 – OB	267	427	160	60%	267	426	159	60%
Route 4a – IB	680	682	2	0%	705	697	-8	-1%
Route 4a – OB	683	724	41	6%	691	729	38	5%
Route 4b – IB	770	767	-3	0%	795	705	-90	-11%
Route 4b - OB	707	662	-45	-6%	753	730	-23	-3%
Route 5 – IB	1016	1063	47	5%	1127	1053	-74	-7%
Route 5 – OB	1029	1176	147	14%	1169	1261	92	8%
Route 6 – IB	1110	1066	-44	-4%	1151	1102	-49	-4%
Route 6 - OB	978	1009	31	3%	992	1024	32	3%
Route 7 – IB	1270	1237	-33	-3%	1378	1210	-168	-12%
Route 7 – OB	1257	1270	13	1%	1249	1250	1	0%
Route 8 – IB	846	935	89	11%	934	829	-105	-11%
Route 8 – OB	611	635	24	4%	613	684	71	12%
Route 9 – IB	359	359	0	0%	359	359	0	0%
Route 9 – OB	358	358	0	0%	358	358	0	0%
Route 10 – IB	487	481	-6	-1%	611	592	-19	-3%
Route 10 – OB	511	715	204	40%	621	624	3	0%
Route 11 – IB	1061	1008	-53	-5%	997	963	-34	-3%
Route 11 - OB	895	903	8	1%	1071	1063	-8	-1%
Average	**800**	**839**	**39**	**5%**	**844**	**844**	**0**	**0%**

Table 7-4 PM Peak Journey Time Comparison

Description	EIAR (TII Central) DS	EIAR (TII Central) DS + GTS	Diff	% Diff	NTA+GCC NPF DS	NTA+GCC NPF DS + GTS	Diff	% Diff
Route 1 - IB	691	711	20	3%	692	717	25	4%
Route 1 – OB	677	707	30	4%	691	722	31	4%
Route 2 – IB	1308	1388	80	6%	1271	1331	60	5%
Route 2 – OB	1183	1354	171	14%	1191	1286	95	8%
Route 3 – IB	295	407	112	38%	296	404	108	36%
Route 3 – OB	268	429	161	60%	269	430	161	60%
Route 4a – IB	685	713	28	4%	683	684	1	0%
Route 4a – OB	689	728	39	6%	704	739	35	5%
Route 4b – IB	633	607	-26	-4%	634	629	-5	-1%
Route 4b - OB	688	699	11	2%	790	733	-57	-7%
Route 5 – IB	1020	1063	43	4%	1065	1055	-10	-1%
Route 5 – OB	1070	1325	255	24%	1080	1116	36	3%
Route 6 – IB	1040	1015	-25	-2%	1026	1031	5	0%
Route 6 - OB	1080	1168	88	8%	1147	1121	-26	-2%
Route 7 – IB	1063	1050	-13	-1%	1093	1072	-21	-2%
Route 7 – OB	1440	1629	189	13%	1587	1553	-34	-2%
Route 8 – IB	638	669	31	5%	641	666	25	4%
Route 8 – OB	918	873	-45	-5%	949	1044	95	10%
Route 9 – IB	359	359	0	0%	359	359	0	0%
Route 9 – OB	360	359	-1	0%	360	360	0	0%
Route 10 – IB	424	509	85	20%	545	513	-32	-6%
Route 10 – OB	489	557	68	14%	573	574	1	0%
Route 11 – IB	761	859	98	13%	758	950	192	25%
Route 11 - OB	1124	1070	-54	-5%	1340	1275	-65	-5%
Average	**788**	**884**	**56**	**7%**	**823**	**849**	26	3%

7.3.2 The comparison of Journey Time for the EIAR Do-Something+GTS (developed using TII Central Case forecasts) and the NTA/GCC NPF Do-Something+GTS scenario indicates that the introduction of the GTS measures has a minimal impact on journey times under the NTA/GCC NPF scenario growth assumptions whereas they result in further delays using the TII Central Case development assumptions.

7.3.3 During the AM peak period, the average journey time increases by 5% with the GTS in place for the EIAR TII Central Case forecasts whereas there is no increase under the NTA/GCC NPF forecasts. In the PM period, while the average journey time for the NTA/GCC NPF forecasts do increase slightly by 3%, it has less of an impact compared to the EIAR TII Central Case forecasts which show a 7% increase.

7.3.4 The GTS includes several measures which reduce vehicular capacity in the city in favour of increased service provision for sustainable modes (e.g. closing Salmon Weir Bridge to vehicular traffic). This reduction in capacity leads to a decrease in Journey Time under the EIAR TII Central Case land use assumptions but has minimal impact under the NTA/GCC NPF assumptions. This is a reflection of the mode shift to sustainable modes facilitated by the NTA/GCC NPF policy and indicates that the GTS measures will be more beneficial when the forecast population and jobs growth is concentrated within the city centre and settlements which are easily served by public transport as is the case with the NTA/GCC NPF land use assumptions.

7.4 Ratio of Flow to Capacity

7.4.1 The key junctions used for this capacity assessment are the same as those outlined in Chapter 4 (Figure 4.2). The tables below detail the results of the RFC comparison for both the AM and PM peak periods.

Table 7-5 AM Peak Comparison

	Criteria	DS N6 GCRR EIAR (TII Central Case)	EIAR (TII Central Case) + GTS	DS N6 GCRR NTA/GCC NPF	DS N6 GCRR NTA/GCC NPF + GTS
Key Junctions (N6 / R338)	RFC > 90%	12	8	14	6
Entire Network	RFC > 90%	115	131	185	150

Table 7-6PM Peak Comparison

	Criteria	DS N6 GCRR EIAR (TIICentral Case)	DS N6 GCRR EIAR (TII Central Case) + GTS	DS N6 GCRR NTA/GCC NPF	DS N6 GCRR NTA/GCC NPF + GTS
Key Junctions (N6 / R338)	RFC > 90%	6	6	8	6
Entire Network	RFC > 90%	100	123	164	150

7.4.2 Examination of the impact of introducing the GTS measures shows that, in the EIAR TII Central Case Scenario, there are minor benefits along key junctions. However, on a network wide basis the GTS measures lead to an increase in links experiencing a RFC of over 90%.

7.4.3 Under NTA/GCC NPF assumptions, however, network performance improves at both key junctions and on a network-wide basis because of the introduction of the GTS measures. Notably, the number of key junctions experiencing an RFC of greater than 90% in the AM peak (6) is less than under the comparable EIAR TII Central Case Scenario (8) while in the PM peak the number of key junctions above 90% remain the same in both scenarios. Considering the NTA/GCC NPF Scenario will cater for significantly more person trips on the network than the EIAR TII Central Case Scenario, the fact that there are less or the same number of key links experiencing operational issues in the NTA/GCC NPF Scenario shows the considerable benefits to be gained from good integration of land use and transport.

7.5 Mode Share

City Centre

7.5.1 The table below presents the mode share comparison, for the city centre, over a full 24 hour period.

Table 7-7 City Centre Mode Share Percentages

Option	% Car	% PT	% Walk	% Cycle
EIAR (TII Central Case)	69%	4%	25%	3%
EIAR (TII Central Case) + GTS	67%	5%	25%	3%
Difference %	-2%	+1%	0%	0%
NTA/GCC NPF	61%	6%	30%	3%
NTA/GCC NPF+GTS	54%	8%	32%	6%
Difference (%)	-7%	+2%	+2%	+3%

7.5.2 This mode share analysis shows the significant benefits of locating the forecast population and jobs within the city centre and settlements easily served by public transport, as per NPF policy.

7.5.3 The introduction of the GTS measures under NTA/GCC NPF growth assumptions leads to a 7% decrease in car mode share in Galway City versus only a 2% reduction under the TII Central Case assumptions used in the analysis undertaken for the EIAR. This demonstrates that greater integration of land uses, and concentration of population growth, contained with the NTA/GCC NPF Scenario will result in greater increases in the mode share of sustainable modes when combined with the GTS proposals.

APPROVAL					
Version	**Name**		**Position**	**Date**	**Modifications**
1	Author	Peter Gannon	Senior Consultant	05/06/2019	
	Checked by	David Conlon	Associate Transport Planner	05/06/2019	
	Approved by	David Conlon	Associate Transport Planner	15/06/2019	
2	Author			DD/MM/YY	
	Checked by			DD/MM/YY	
	Approved by			DD/MM/YY	

Appendix A – Linsig Analysis

N6 GCRR

NPF SENSITIVITY TEST ANALYSIS

IDENTIFICATION TABLE	
Client/Project owner	ARUP
Project	Galway City Ring Road
Title of Document	NPF Scenario LINSIG Analysis
Type of Document	Info Note
Date	31/05/2019
Reference number	30023812
Number of pages	10

TABLE OF CONTENTS

8. N6 GCRR LINSIG ANALYSIS

8.1 Introduction

8.1.1 LINSIG micro-simulation models have been developed for nine of the N6 GCRR junctions which demonstrated high volume to capacity ratios in the strategic model outputs. These nine junctions are illustrated in the Figure 1.1 below.

8.1.2 The junctions were tested using 2039 forecast flows from the following strategic model scenarios –

- N6 Galway City Ring Road in place (N6 GCRR Scenario)
- N6 Galway City Ring Road and Galway Transport Strategy in place (N6 GCRR+GTS Scenario)

8.1.3 Both scenarios used National Planning Framework (NPF) Land Use assumptions developed by the National Transport Authority (NTA), with some revisions made in population distribution following recommendations from Galway City Council planners i.e. NTA/GCC NPF Scenario.

8.1.4 The remainder of this note will give a brief overview of the tests carried out on each of these junctions, the results of these tests and recommendations. The staging and phasing are not discussed in detail in the following paragraphs, therefore, please refer to preliminary LINSIG outputs for further details of signal timings. Flare lane lengths should be examined from the LINSIG model, as this will have a bearing on road design and may need to be altered based on design constraints, which include land ownership, proposed structures (i.e. number lanes available / bridge width) etc.

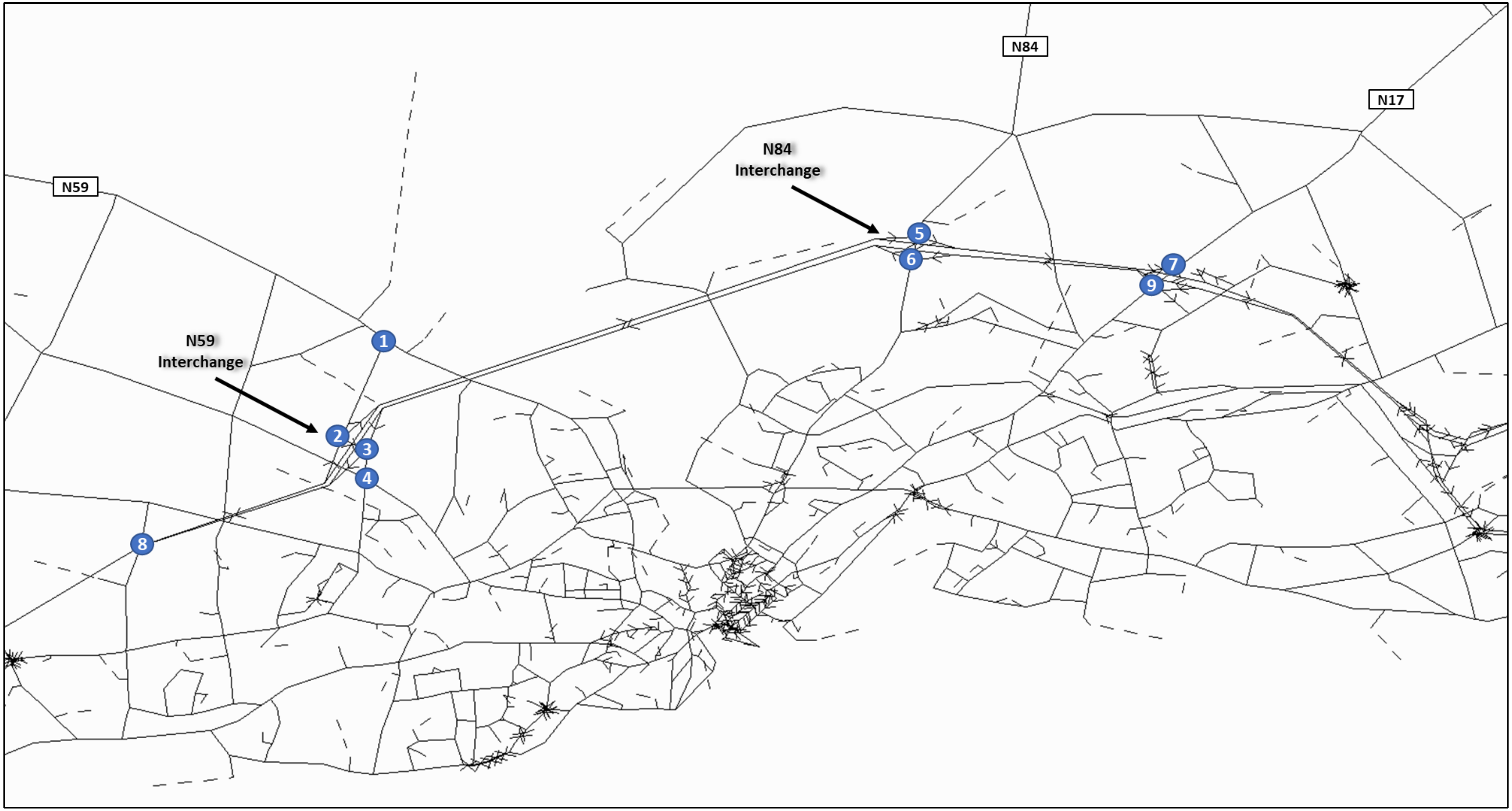


Figure 8-1: Junctions assessed in LinSig

8.2 Junction 1 (N59 Moycullen Road/ N59 Link Road North)

8.2.1 The latest design (shown below) was tested in LinSig and due to high demand on the eastern approach arm, the predicted volume of traffic was too excessive for a single lane approach and mitigation measures were required for both scenarios (listed below).

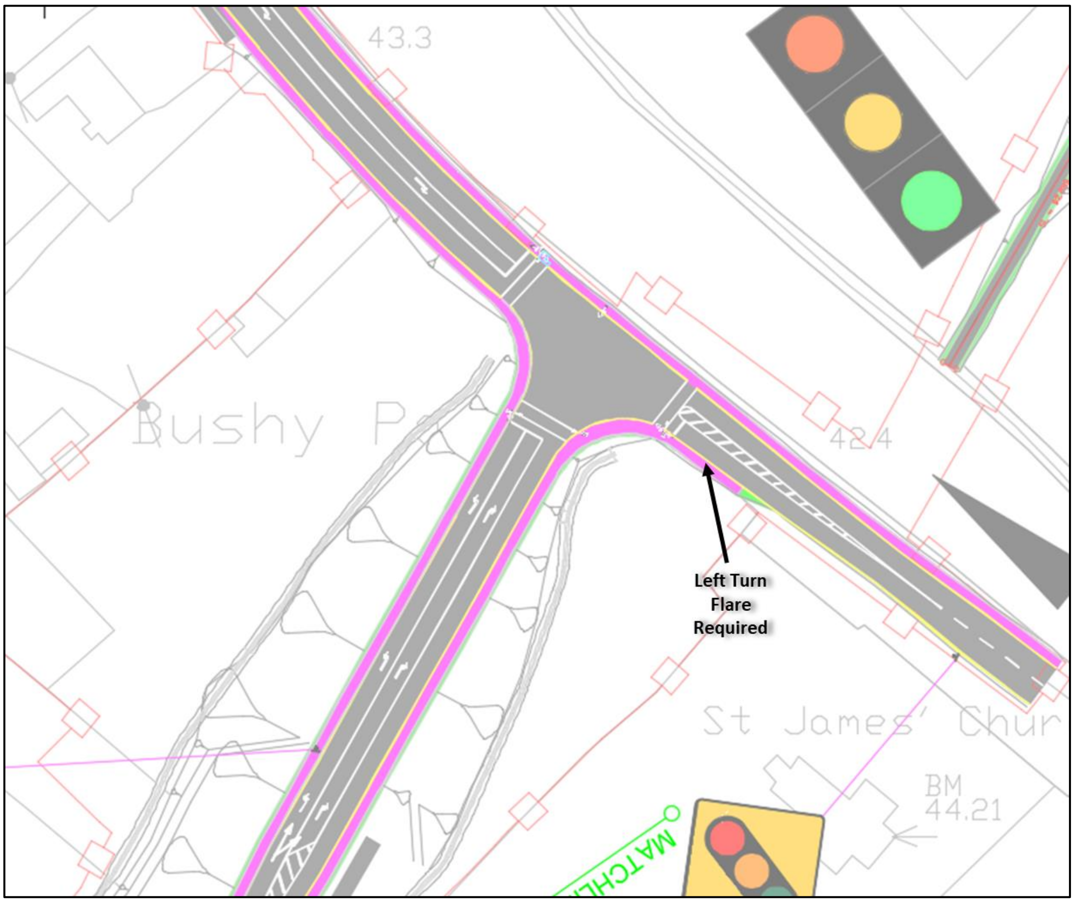


Figure 1-2: N59 Moycullen Road/ N59 Link Road North Junction

8.2.2 The following enhancements are proposed:

- Adding a left turn flare on the eastern approach arm (approximately 8 PCUs long); and
- including the pedestrian stage once every second cycle.

8.2.3 The inclusion of this flare lane combined with the pedestrian stage assumptions resulted in the junction operating within its capacity in all scenarios.

8.2.4 It is felt that by making these junction enhancements and incorporating an adaptive control (MOVA) system to increase the operational efficiency of the junction (and capacity) will enable the junction to operate within its capacity in the design year.

8.3 Junction 2 & 3 (N59 Letteragh Junction – junction with the N59 Link Road North and South)

8.3.1 The latest design (shown below) was tested in LinSig and was found to operate within capacity in the forecast scenarios. Although from an investigation of the flows on the eastbound diverge lane, it was deemed suitable to change the nearside left turning flare to a combined nearside left turning flare and far side right turning flare.

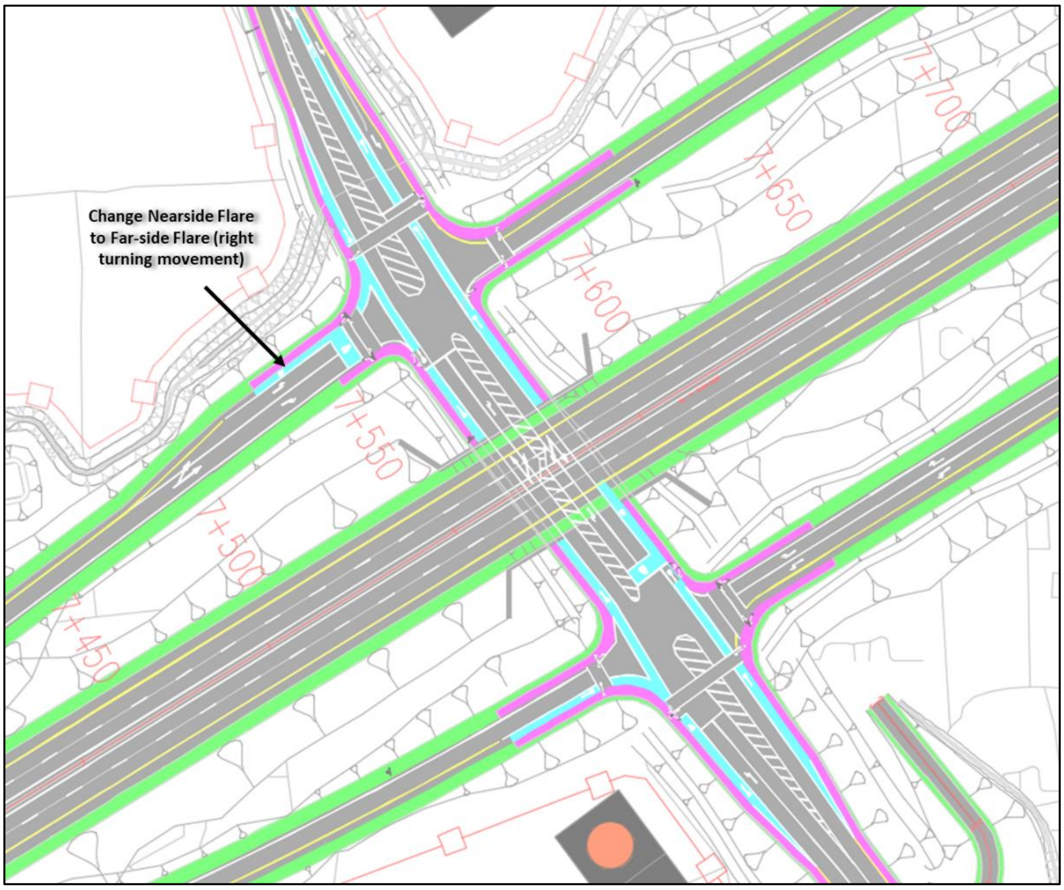


Figure 1-3: N59 Letteragh Junctions

8.4 Junction 4 (N59 Link Road South and Letteragh Road)

8.4.1 The latest design (shown below) was tested in LinSig and due to high demand on the northern approach arm, the predicted volume of traffic was too excessive to accommodate both the left and straight ahead traffic in the same lane. Therefore, the following mitigation measures are proposed for both scenarios (listed below).

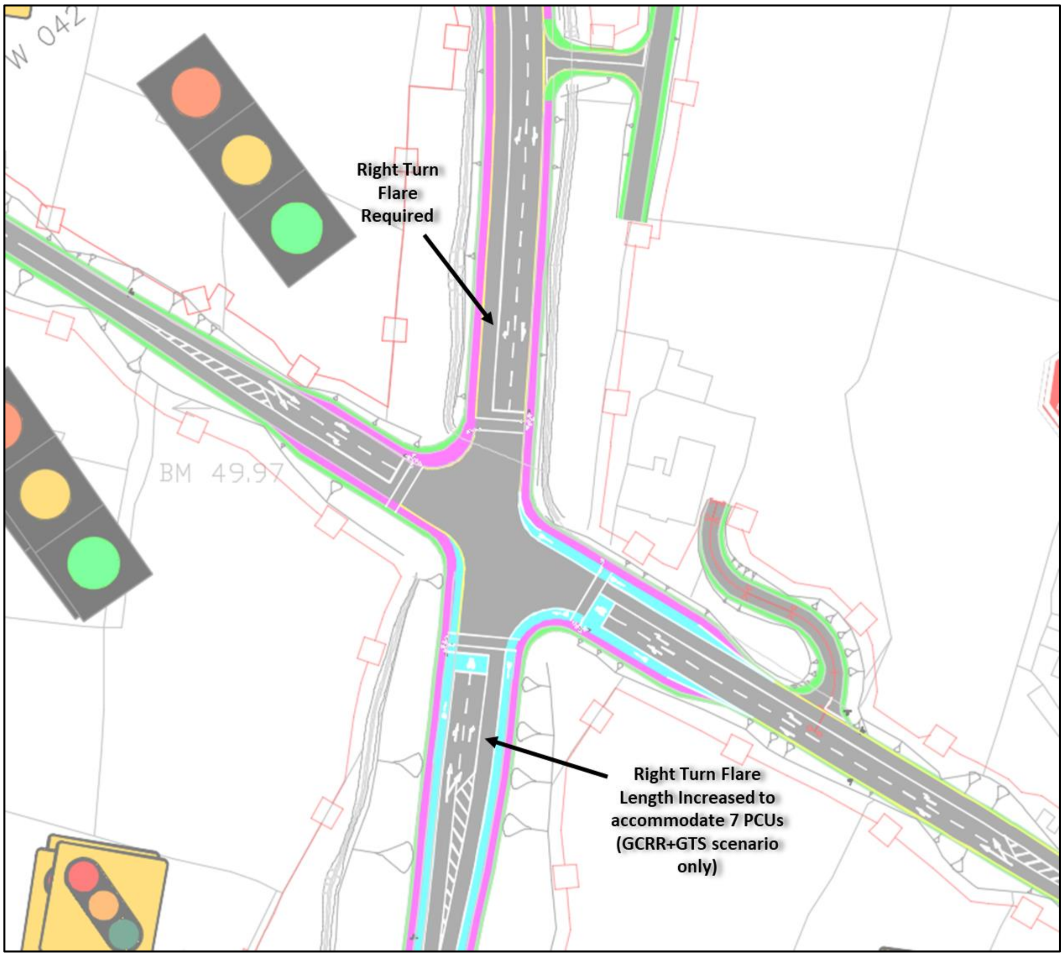


Figure 1-4: N59 Link Road South and Letteragh Road Junction

8.4.2 The following enhancements are proposed:

- Adding a right turn flare on the northern approach arm (approximately 5 PCUs long);
- including the pedestrian stage once every second cycle; and
- Increasing the length of the right turn flare on the southern approach arm to approximately 7 PCUs long (Only Required in the GCRR+GTS scenario).

8.4.3 The combined inclusion of the above measures and assumptions resulted in the junction operating under capacity in all scenarios.

8.4.4 It is felt that by making these junction enhancements and incorporating an adaptive control (MOVA) system to increase the operational efficiency of the junction (and capacity) it will enable the junction to operate within capacity in the design year.

8.5 Junction 5 & 6 (N84 Headford Road North and South)

8.5.1 A number of configurations were tested for these junctions and it was found that the most efficient configuration was to signalise all lanes on both junctions (due to the high demand on all approach arms) while also adding another northbound approach arm onto the southern arm of Junction 6 and changing the northbound right turn flare on the bridge to a full lane by removing the hatching to the south. With this configuration in place both junctions are expected to work within the capacity threshold.

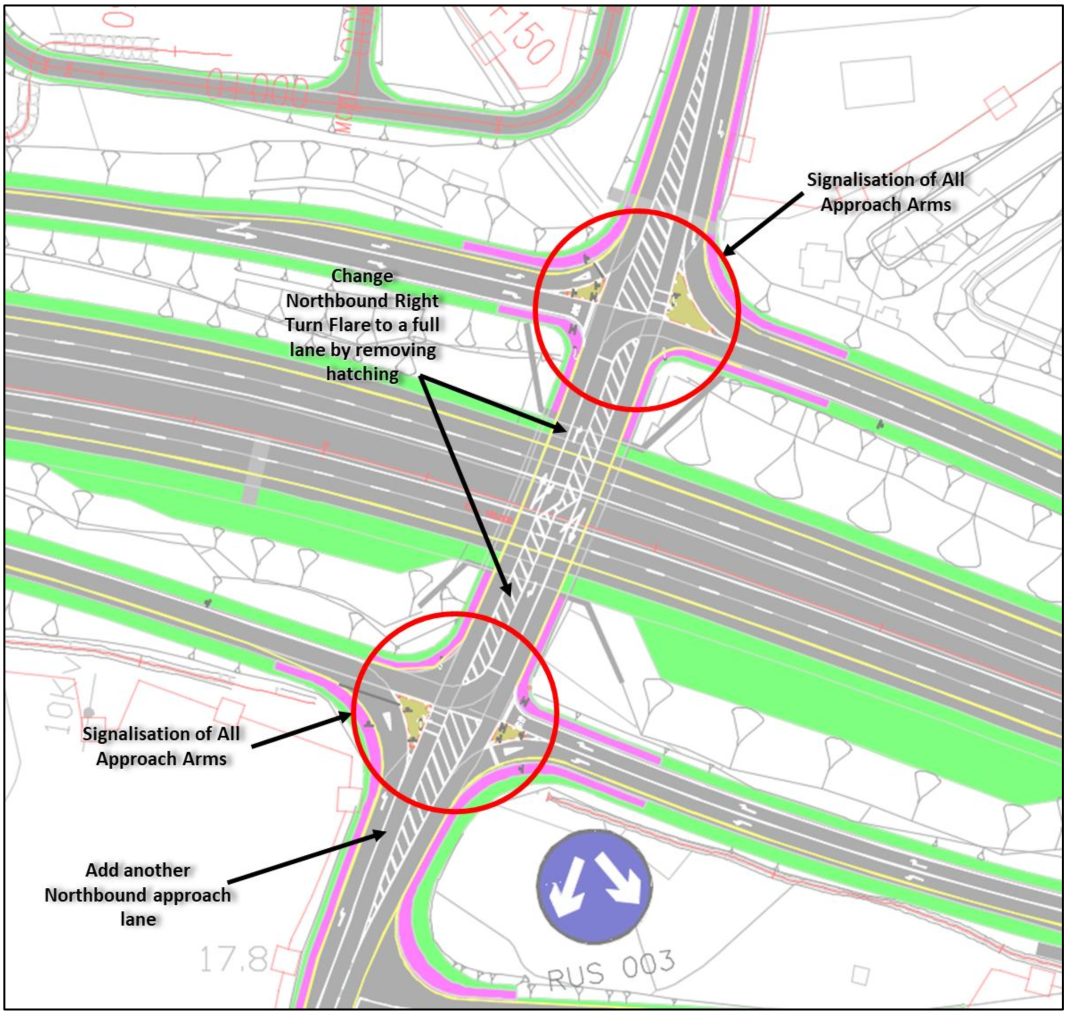


Figure 1-5: N84 Headford Road North and South Junction

8.6 Junction 8 (Ballymoneen Road Junction)

8.6.1 The latest design (shown below) was tested in LinSig and due to the high right turning demand on the eastern approach arm, the predicted volume of traffic was too excessive to be accommodated on the right turn flare provided. Therefore, the length was increased to approximately 90 – 95m. This combined with the assumption that the all pedestrian stage would be called every two cycles was enough to enable the junction to operate within capacity in the design year.

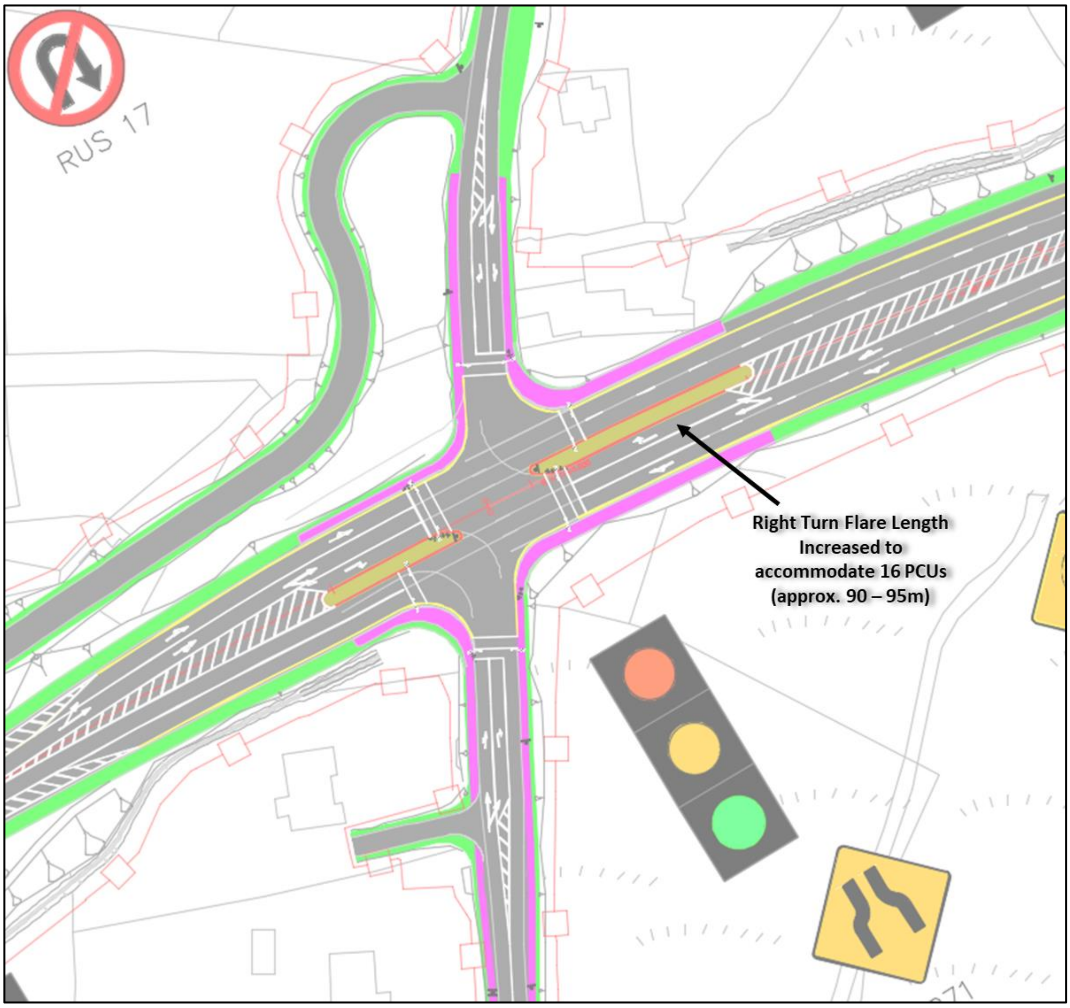


Figure 1-6: Ballymoneen Road Junction

8.7 Junction 7 & 9 (N83 Tuam Road / N6 GCRR Merge)

8.7.1 The latest design (shown below) was tested in LinSig and due to the high right turning demand on Junction 9 from the northern approach arm, the predicted volume of traffic could not be accommodated efficiently with a give way operation. Therefore, the junction was signalised and the right turn flare length was increased to approximately 90 – 95m. These measures were enough to enable the junction to operate within capacity.

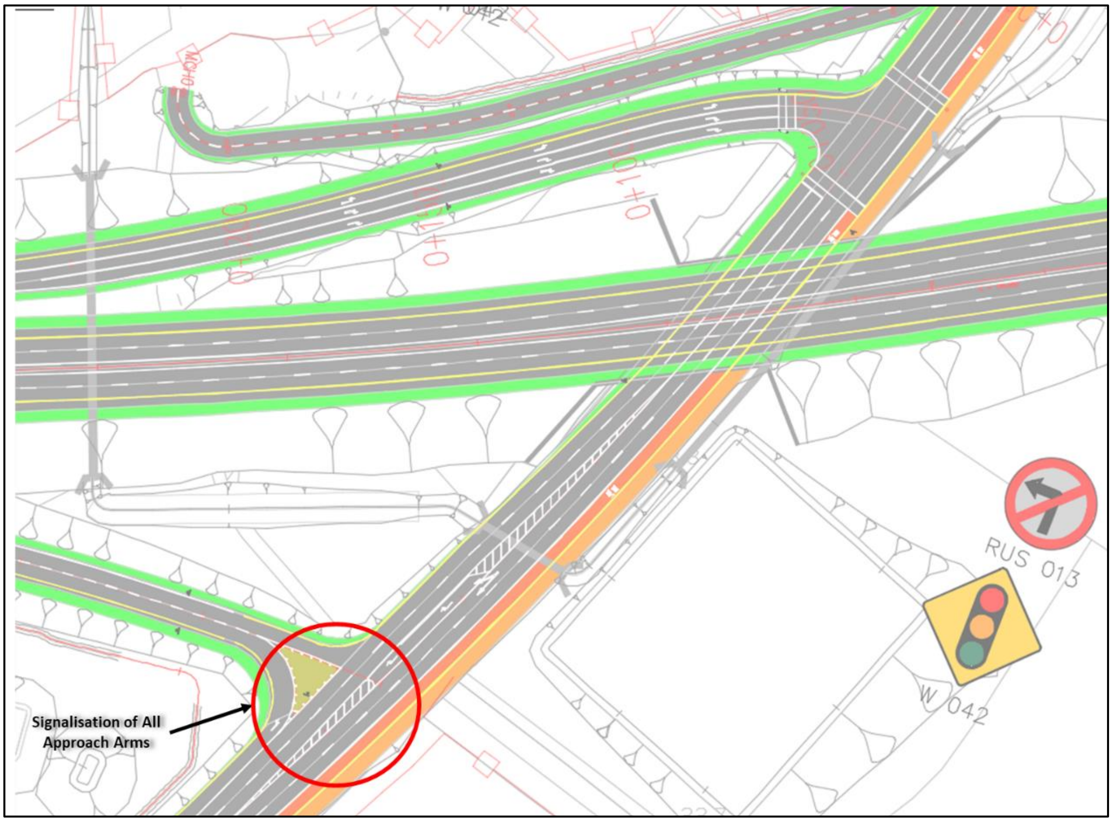


Figure 1-7: N83 Tuam Road / N6 GCRR Merge Junctions

APPROVAL

Version	Name		Position	Date	Modifications
1	Author	Peter Gannon	Senior Consultant	31/05/2019	
	Checked by	David Conlon	Associate	04/06/2019	
	Approved by	David Conlon	Associate	15/06/2019	
2	Author			DD/MM/YY	
	Checked by			DD/MM/YY	
	Approved by			DD/MM/YY	