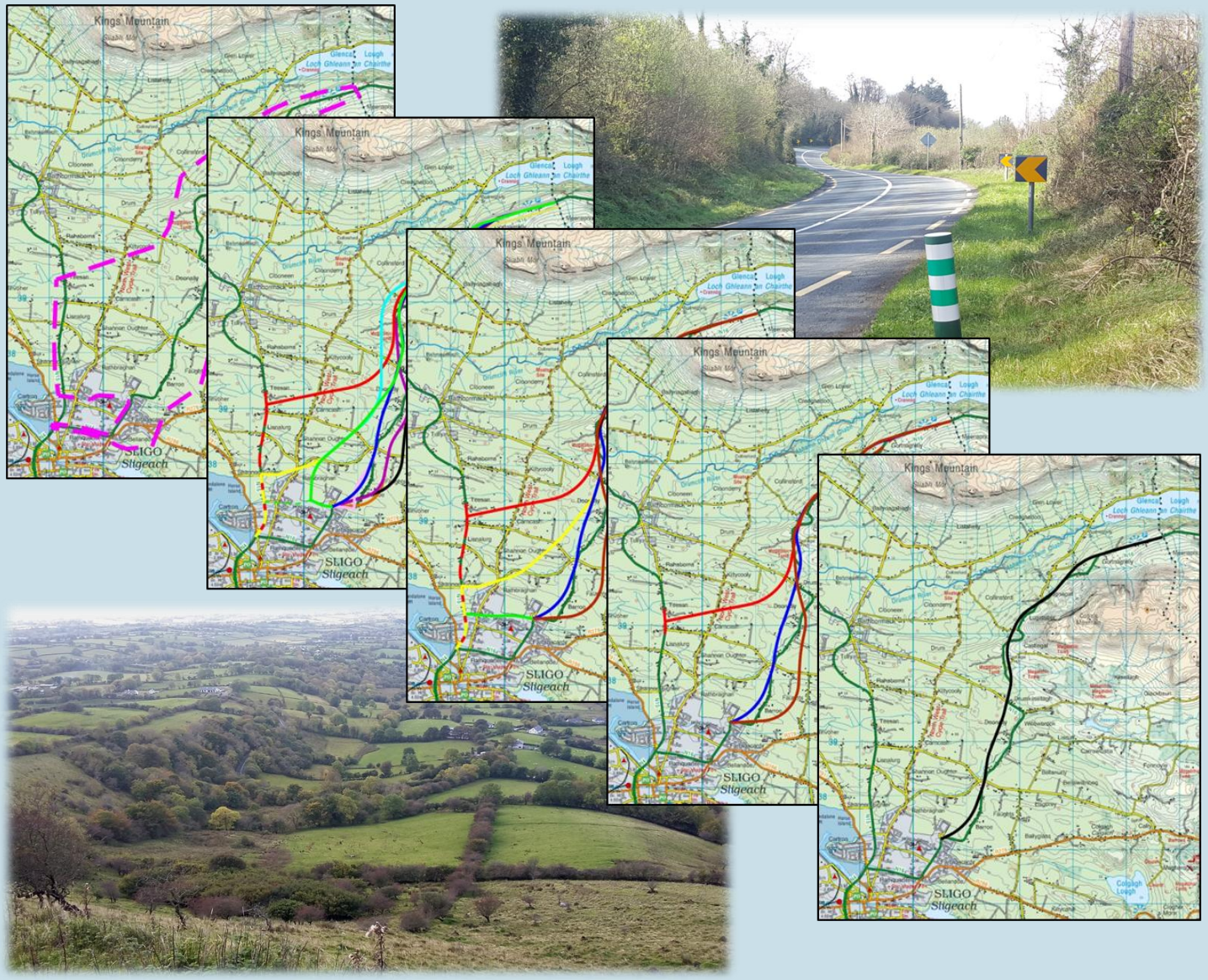
Route Selection Report

Volume 2: Engineering Appendices

PART B: Road Engineering, Road Safety Impact Assessment, Cost Estimate

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

N16 Sligo to County Boundary



Land of Hearts Desire

SLIGO COUNTY COUNCIL

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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, Cost 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

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FINAL	*Public Info*	*Fergus Meehan*	*July 2017*	*Emer Concannon*

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This Route Selection Report (RSR) has been prepared and coordinated by Sligo County Councils National Roads Project Office, under the auspices of Transport Infrastructure Ireland and with the assistance of specialist engineering, planning and environmental sub-consultants as outlined below.

Table 2-1: 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.

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2 Road Engineering

2.1 Introduction

This section of the 'Route Selection Report' outlines the Engineering Assessment carried out as part of the 'Preliminary Options Assessment'.

Engineering, Traffic and Economic's are closely intertwined. In particular, many of the impacts associated with Engineering are monetised through the project costs and benefits in the Cost-Benefit analysis that forms the basis of the economic assessment criterion of the Project Appraisal outlined in section 9 of the Main Report (Volume 1).

Engineering is also a significant component of the other appraisal criteria; in particular Environment and Safety.

2.2 Methodology

All of the Feasible Route Options (FRO) and subsequent Refined Route Options were developed to an initial outline design stage. A mainline alignment with associated indicative junction arrangements and link roads was designed for each of the Options. At 'Preliminary Options Assessment' stage, the design did not extend to the provision of direct accesses and parallel accommodation tracks, this it was considered would be similar for each FRO (and subsequent RRO) and would not unduly influence the initial refinement of Route Options.

The design criteria set out in DN-GEO-03031[3] (formerly, NRA TD 9/12, Road Link Design) is extensive. At a basic level the consideration of the geometric parameters outlined in 'Table 1/3: Design Speed Related Parameters' is appropriate for a comparison of the engineering characteristics of the various Route Options.

Specimen horizontal and vertical route alignments have been developed, that comply with current design standards as per the Design Manual for Roads and Bridges (DMRB). In certain cases where it is not possible to achieve 'Desirable Minimum' standards, relaxations to the standards have been applied. Departures from standards have not been targeted at the Route Selection Stage; however that is not to say that these will not be required in the final alignment design of the 'Preferred Route'.

These alignments form the basis on which the engineering assessments were carried out.

2.3 Assessment

2.3.1 **Road Geometry**

The Road Geometry assessment considered the following criteria in the 'Preliminary Options Assessment'.

- Length;
- Horizontal Alignment;
- Vertical Alignment;
- Stopping Sight Distance;

[3] TII, Design Manual for Roads and Bridges

- Full Overtaking Sight Distance; and
- Constructability.

The assessment of these criteria, are expanded upon in the following section of this Route Selection Report.

> *The TII DMRB specifies a hierarchy of thresholds for the design of roads. These standards represent the various criteria, whose incorporation in the road design would achieve a desirable level of performance in average driving conditions. This is most true in terms of traffic safety, operation, economic effects, environmental effects and sustainability.*
> *The first tier of the hierarchy specifies a desirable minimum value which would produce a high standard of road safety and which should be the initial choice. However, the level of service may remain generally satisfactory and a road may not become unsafe where these values are reduced. This second tier of the hierarchy is termed a Relaxation. The third tier of the hierarchy is known as a Departure from standard and is generally only applied in situations of exceptional difficulty.*[4]

The approach in relation to the design of the Feasible Route Options was if possible, to achieve a desirable minimum value, however, there are two instances were relaxations to standards were applied; these are outlined in Table 2-1.

Table 2-1: Relaxations to Design Standards (FRO)

Feasible Route Options	Relaxation to Mainline	Notes
Option 01A	☒	No Relaxation or Departure an initial Sketch Design Stage.
Option 01A/1B	☒	No Relaxation or Departure an initial Sketch Design Stage.
Option 02A	☒	No Relaxation or Departure an initial Sketch Design Stage.
Option 02A/02B	☒	No Relaxation or Departure an initial Sketch Design Stage.
Option 03	☒	No Relaxation or Departure an initial Sketch Design Stage.
Option 04	☒	No Relaxation or Departure an initial Sketch Design Stage.
Option 05	☒	No Relaxation or Departure an initial Sketch Design Stage.
Option 06	☒	No Relaxation or Departure an initial Sketch Design Stage.
Option 07	☑	A One Step relaxation below the Desirable Minimum Horizontal Curve, resulting in a similar steeped relaxation in terms of Stopping Sight Distance which can be improved in terms of verge widening. The relaxations are not in proximity to junctions, therefore are not considered a departure.
Option 08	☒	No Relaxation or Departure an initial Sketch Design Stage.
Option 09	☑	A One Step relaxation below the Desirable Minimum Horizontal Curve, resulting in a similar steeped relaxation in terms of Stopping Sight Distance which can be improved in terms of verge widening. The relaxations are not in proximity to junctions, therefore are not considered a departure.
Option 10	☒	No Relaxation or Departure an initial Sketch Design Stage.

[4] TII, NRA DMRB, DN-GEO-03031.

Feasible Route Options	Relaxation to Mainline	Notes
Option 11	☒	No Relaxation or Departure an initial Sketch Design Stage.

2.3.1.1 Length (Physical Works)

The Length of the Route Options has not been considered in the Engineering Assessment. It is however assessed in the Road Safety Impact Assessment (Section 4 of this Report) and in the traffic section of the Route Selection report, which for example measures the wider journey time benefits. However, for information purposes, Table 2-2 and Table 2-3 outline the lengths of the Feasible Route Options and the Refined Route Options respectively.

Table 2-2: Feasible Route Options – Length

	Travel Distance			
FRO	Physical Works Length (m)	Additional journey TO N15 Junction with N16 (m)	Additional journey TO N16 Junction with R286/Molloway Hill (m)	Total Journey Distance (m)
Option 01A	7,125	2,500	-	9,625
Option 01A/1B	9,625	-	-	9,625
Option 02A	8,180	1,180	-	9,360
Option 02A/02B	9,360	-	-	9,360
Option 03	8,220	680	-	8,900
Option 04	8,310	680	-	8,990
Option 05	7,680	-	840	8,520
Option 06	7,880	-	840	8,720
Option 07	8,110	-	840	8,950
Option 08	8,130	-	840	8,970
Option 09	8,020	-	840	8,860
Option 10	8,220	680	-	8,900
Option 11	8,220	680	-	8,900

Table 2-3: Refined Route Options – Length

	Travel Distance			
RRO	Physical Works Length (m)	Additional journey TO N15 Junction with N16 (m)	Additional journey TO N16 Junction with R286/Molloway Hill (m)	Total Journey Distance (m)
Option 01A – v2	7,125	2,500	-	9,625

RRO	Travel Distance			
	Physical Works Length (m)	Additional journey TO N15 Junction with N16 (m)	Additional journey TO N16 Junction with R286/Molloway Hill (m)	Total Journey Distance (m)
Option 01A/1B – v2	9,625	-	-	9,625
Option 02A – v2	8,180	1,180	-	9,360
Option 02A/02B – v2	9,360	-	-	9,360
Option 05	7,680	-	840	8,520
Option 08-v2	8,130	-	-	8,970
Option 12	8,270	-	840	9,110
Option 12 – v2	8,300	-	840	9,140

2.3.1.2 Horizontal Alignment

The Horizontal Alignment assessment examined the route options in terms of the aforementioned 'Design Speed Related Parameters' (Section 2.2) and also, in terms of Figure 7/6 (Horizontal Curve Design) of DN-GEO-03031 and the banding requirements described therein. In general the assessment was based on the occurrence of the following various horizontal geometries:

- Curves occurring in Band B, or, Band D, of the aforementioned Figure 7/6 and which are also of a Desirable Minimum standard;
- Curves requiring a Relaxation from standard;
- Curves requiring a departure from standard.

2.3.1.2.1 *Feasible Route Options*

In terms of the Feasible Route Options, each of the alignments exhibit similar characteristics, that is, with the exception of a 'One Step' relaxation to horizontal curvature in the Southern sections of Options 07 and 09. This results in both these options receiving 'Medium Preference' ranks as outlined in Table 2-4 below.

Table 2-4: Feasible Route Options - Horizontal Alignment Ranking

Section	Feasible Route Option												
	1A	1A/B	2A	2A/B	3	4	5	6	7	8	9	10	11
South	1	1	1	1	1	1	1	1	3	1	3	1	1
Central	1	1	1	1	1	1	1	1	1	1	1	1	1
North	1	1	1	1	1	1	1	1	1	1	1	1	1
Overall	1	1	1	1	1	1	1	1	2	1	2	1	1

2.3.1.2.2 *Refined Route Options*

In term of the Refined Routes, a similar range of results to the foregoing was evident. In these cases, a 'Medium' preference ranking as outlined in Table 2-5 was attributed to Route Option 12 – v2, due to the presence of horizontal curve with a one step relaxation in design standards.

Table 2-5: Refined Route Options – Horizontal Alignment Ranking

Section	Refined Route Option														
	1A (v2)	1A/B (v2)	2A (v2)	2A/B (v2)	3	4	5	6	7	8 (v2)	9	10	11	12	12 (v2)
South	1	1	1	1	n/a	n/a	1	n/a	n/a	ref 12	n/a	n/a	n/a	1	ref 12
Central	ref 8-v2	ref 8-v2	ref 5	ref 5	n/a	n/a	1	n/a	n/a	1	n/a	n/a	n/a	1	ref 12
North	ref 8-v2	ref 8-v2	ref 8-v2	ref 8-v2	n/a	n/a	ref 8-v2	n/a	n/a	1	n/a	n/a	n/a	1	3
Overall	1	1	1	1	n/a	n/a	1	n/a	n/a	1	n/a	n/a	n/a	n/a	2

2.3.1.3 Vertical Alignment

The Vertical Alignment assessment examined the FRO's in terms of the aforementioned 'Design Speed Related Parameters' and also, in terms of desirable maximum and minimum[5] gradients as required by Section 4 of DN-GEO-03031. In general, the assessment was based on the occurrence(s) of the following various vertical geometries:

- Curves to Des-Min, or curves which provide full FOSD, where they occur in Band B horizontal curves;
- Curves requiring a Relaxation from Standard;
- Curves requiring a Departure from Standard;
- Vertical Gradient less than 1% (for drainage);
- Vertical Gradient greater than 5%;
- Vertical Gradient greater than 6% (Relaxation);

2.3.1.3.1 *Feasible Route Options*

In general, all the routes in the 'Central' and 'Northern' areas exhibit similar characteristics with differences more noticeable in the 'South'. The routes which achieved a ranking of 'Very High' preference, were in full compliance with the design criteria, while relaxations will be required in the case of routes which were ranked 'High' and 'Medium' preference, however, in both these cases it is not expected that 'Departures' from standard will be required. The results of the assessment are outlined in Table 2-6.

Table 2-6: Feasible Route Options - Vertical Alignment ranking

Section	Feasible Route Option												
	1A	1A/B	2A	2A/B	3	4	5	6	7	8	9	10	11
South	2	2	3	3	1	1	3	3	2	2	2	1	1
Central	1	1	1	1	1	2	1	1	1	1	1	1	1
North	1	1	2	2	1	1	1	1	1	2	2	2	2
Overall	1	1	2	2	1	1	2	2	1	2	2	1	1

2.3.1.3.2 *Refined Route Options*

The vertical alignment assessment of the Refined Route Options generally provided similar results to the foregoing Feasible Route Options. Route options were consistently similar in the central and northern sections, while in the southern section, relaxations required in the case of options 02A, 02A/02B-v2 and 05 resulted in those options each receiving 'Medium' preference ranks.

[5] The minimum gradient as required by DN-GEO-03031 was increased from 0.5% to 1% to reflect the requirements of TII IAN 09 which requires a minimum 1% gradient on areas of super elevation.

Table 2-7: Refined Route Options – Vertical Alignment Ranking

Section	Refined Route Option														
	1A (v2)	1A/B (v2)	2A (v2)	2A/B (v2)	3	4	5	6	7	8 (v2)	9	10	11	12	12 (v2)
South	2	2	3	3	n/a	n/a	3	n/a	n/a	ref 12	n/a	n/a	n/a	2	ref 12
Central	ref 8-v2	ref 8-v2	ref 5	ref 5	n/a	n/a	1	n/a	n/a	1	n/a	n/a	n/a	1	ref 12
North	ref 8-v2	ref 8-v2	ref 8-v2	ref 8-v2	n/a	n/a	ref 8-v2	n/a	n/a	2	n/a	n/a	n/a	2	2
Overall	2	2	2	2	n/a	n/a	2	n/a	n/a	2	n/a	n/a	n/a	2	2

2.3.1.4 Stopping Sight Distance

The 'Stopping Sight Distance' assessment examined the FRO's in terms of the aforementioned 'Design Speed Related Parameters' and also in terms of the permitted application of 'Relaxations' to standards as described in Section 2 of DN-GEO-03031. In this regard, each Feasible Route Option was examined for the occurrence of 'Stopping Sight Distances' within the following thresholds:

- SSD > 215m;
- SSD > 200m;
- SSD > 180m;
- SSD > 120m;
- SSD < 215m in the vicinity of a junction.

2.3.1.4.1 *Feasible Route Options*

In the 'South' section; Options 01A, 01A/01B generally achieved best compliance ('Very High' preference) with the standards. Options 04, 06, 07, 10 and 11 are all ranked 'Medium' preference resulting from the fact, that they each require a 'One Step Relaxation' in design standards combined with each of them requiring sight line improvements in the vicinity of junction locations (in order to ensure compliance with the 'Desirable Minimum' standard). 'Low' preference rankings are attributed to Options 02A, 02A/02B, 03, 05, 08 and 09, primarily as a result of 2 and 3 step relaxations in combination with the requirement for sightlines improvements in the vicinity of junction locations.

In the 'Central' section; Options 07, 09, 01A, 01A/01B, 02A, 02A/02B, 03, 04, 08, 10 and 11 generally achieved best compliance ('Very High' preference and 'High' preference) with the standards. Options 05 and 06 were ranked 'Medium Preference' resulting from the fact, that they each require a 'One Step Relaxation' in design standards combined with each of them requiring sight line improvements in the vicinity of junction locations (in order to ensure compliance with the 'Desirable Minimum' standard).

In the 'Northern' section; Options 01A, 01A/01B, 05, 06, 07, 09, 10 and 11 generally achieved best compliance ('Very High' preference and 'High' preference) with the standards. Options 03 and 04 were ranked 'Medium' preference, resulting from the fact that they each require a 'One Step Relaxation' in design standards combined with each of them requiring sight line improvements in the vicinity of junction locations (in order to ensure compliance with the 'Desirable Minimum' standard).

Table 2-8: Feasible Route Options – Stopping Sight Distance Ranking

Section	Feasible Route Option												
	1A	1A/B	2A	2A/B	3	4	5	6	7	8	9	10	11
South	1	1	4	4	4	3	4	3	3	4	4	3	3
Central	2	2	2	2	2	2	3	3	1	2	1	2	2
North	1	1	2	2	3	3	1	1	1	3	1	1	1
Overall	1	1	3	3	3	3	3	3	2	3	2	2	2

2.3.1.4.2 *Refined Route Options*

In the 'South' section; Options 01A-v2 and 01A/01B-v2 achieved best compliance (Very High Preference) with the standards. 'Low Preference' Rankings are attributed to Options 02A-v2, 02A/02B-v2, 05 and 12, primarily as a result of 2 and 3 step relaxations in combination with the requirement for sightlines improvements in the vicinity of junction locations.

In the 'Central' section; Options 08-v2 and 12 achieved best compliance ('High Preference') with the standards. Option 05 was ranked 'Medium Preference' resulting from the fact, that it requires a 'One Step Relaxation' in design standards combined with a requirement for sight line improvements in the vicinity of junction locations (in order to ensure compliance with the 'Desirable Minimum' standard).

In the 'Northern' section option 12 achieved best compliance ('Very High Preference') with the standards. Options 08-v2 and 12-v2 were ranked 'Medium Preference', resulting from the fact that they each require a 'One Step Relaxation' in design standards combined with each of them requiring sight line improvements in the vicinity of junction locations (in order to ensure compliance with the 'Desirable Minimum' standard).

Table 2-9: Refined Route Options – Stopping Sight Distance Ranking

Section	Refined Route Option														
	1A (v2)	1A/B (v2)	2A (v2)	2A/B (v2)	3	4	5	6	7	8 (v2)	9	10	11	12	12 (v2)
South	1	1	4	4	n/a	n/a	4	n/a	n/a	ref 12	n/a	n/a	n/a	4	ref 12
Central	ref 8-v2	ref 8-v2	ref 5	ref 5	n/a	n/a	3	n/a	n/a	2	n/a	n/a	n/a	2	ref 12
North	ref 8-v2	ref 8-v2	ref 8-v2	ref 8-v2	n/a	n/a	ref 8-v2	n/a	n/a	3	n/a	n/a	n/a	1	3
Overall	2	2	3	3	n/a	n/a	3	n/a	n/a	3	n/a	n/a	n/a	3	3

2.3.1.5 Full Overtaking Sight Distance

DN-GEO-03031 recommends the levels of overtaking value to be provided on differing Road Types. The values are outlined in Table 2-10.

Table 2-10: Rural Road Types – Overtaking Value

Rural Road Type	Overtaking Value
Type 2 and Type 3 Single	15%
Type 1 Single	30%

An MX Roads analysis carried out on each Feasible Route Option, established the various overtaking values attributable per option. Notwithstanding the thresholds in the aforementioned Table 2-10 and considering the fact that, greater FOSD generally provide greater journey time benefits, the assessment established 3 separate criteria for assessment, these include as follows:

(1) FOSD (580m) Greater than 30%;

(2) FOSD (580m) Between 15% and 30%;

(3) FOSD (580m) below 15%.

2.3.1.5.1 *Feasible Route Options*

The results of the assessment are outlined in Table 2-11. In the 'South' section; Options 01A and 01A/01B provide the best overtaking values and were attributed 'Very High' preference scores, all the remaining options provide values between 15% and 30% and are accordingly attributed 'High' preference rankings.

In the 'Central' section Options 01A, 01A/B, 02A and 02A/B, each had values over 30% and were assessed as being of 'Very High' Preference', all of the other options in this section had values between 15% and 30% and were thus attributed 'High' preference ranks.

In the 'North' section, all options, with the exception of Option 11 had overtaking values greater than 30% and were thus all given 'Very High' preference' ranks. Option 11 had a value between 15% and 30% and was thus given 'High' preference rank.

Table 2-11: Feasible Route Options – Full Overtaking Sight Distance Ranking

Section	Feasible Route Option												
	1A	1A/B	2A	2A/B	3	4	5	6	7	8	9	10	11
South	1	1	2	2	2	2	2	2	2	2	2	2	2
Central	1	1	1	1	2	2	2	2	2	2	2	2	2
North	1	1	1	1	1	1	1	1	1	1	1	1	2
Overall	1	1	1	1	2	2	2	2	2	2	2	2	2

2.3.1.5.2 *Refined Route Options*

The results of the assessment are outlined in Table 2-12. In the 'South' section; Options 01A-v2 and 01A/01B-v2 provide the best overtaking values and were attributed 'Very High' preference scores, all the remaining options provide values between 15% and 30% and are accordingly attributed 'High' preference rankings. In the 'Central' section, each option had a value between 15% and 30% corresponding to 'High' preference ranks. In the 'North' section, all options, had overtaking values greater than 30% and were thus all given 'Very High' preference ranks.

Table 2-12: Refined Route Options – Full Overtaking Sight Distance Ranking

Section	Refined Route Option														
	1A (v2)	1A/B (v2)	2A (v2)	2A/B (v2)	3	4	5	6	7	8 (v2)	9	10	11	12	12 (v2)
South	1	1	2	2	n/a	n/a	2	n/a	n/a	ref 12	n/a	n/a	n/a	2	ref 12
Central	ref 8-v2	ref 8-v2	ref 5	ref 5	n/a	n/a	2	n/a	n/a	2	n/a	n/a	n/a	2	ref 12
North	ref 8-v2	ref 8-v2	ref 8-v2	ref 8-v2	n/a	n/a	ref 8-v2	n/a	n/a	1	n/a	n/a	n/a	1	1
Overall	1	1	2	2	n/a	n/a	2	n/a	n/a	2	n/a	n/a	n/a	2	2

2.3.1.6 Constructability

Constructability of all the route options will be complicated due to the extent of existing residential housing, commercial businesses, farms, local roads and accesses dotted along the length of the route options. Disruption to residences and local traffic will need to be minimised throughout the construction period. Detailed assessment of these impacts will be carried at the next stage of the development process, i.e. Phase 3, Design and Phase 4, Statutory procedures.

It follows that the route option with the greatest length of on-line construction will be most difficult to construct. In addition, it is likely that in extreme cases diversions will be required at a wider geographical scale in order to construct these sections; this will have temporary impacts in terms of journey times and in terms of the amenity of the regional routes where diversions are directed – this impact is assessed separately, in monetary terms, as part of the 'Options Comparison Estimate' under the heading of Residual Network (See Section 5 of this Report).

The route options have been ranked based in general on the length of online construction expected, with the 'Very High' preference ranks being attributed to the options which will be the most straight forward to construct and the 'Very Low' preference ranks being attributed to those which are most difficult to construct. In order to quantify and compare the various different options in terms of

'Constructability', the following percentages of sections of route which were online were used to undertake the assessment:

- 0% to 5% of route online;
- 5% to 25% of route online;
- 25% to 50% of route online;
- 50% to 75% of route online;
- 75% to 100% of route online;
- Difficult local interactions with the existing N16

2.3.1.6.1 *Feasible Route Options*

The results of the assessment are outlined in Table 2-13. In the 'South' section; Options 01A, 02A, 03, 04, 07, 08, 09, 10, 11, 02A/02B and 05 are considered the most preferable ('Very High' and 'High' preference) from an ease of construction perspective. Options 01A/01B and 06 are considered more difficult to construct and are each attributed 'Medium' preference ranks.

Constructability in the 'Central' section is generally consistent across route options with each option considered to be either 'Very High' or 'High' preference.

Due to online realignment, constructability is more difficult in the north, with options 03 and 04 considered to be 'Low' preference, followed by options 01A, 01A/01B, 02A, 02A/02B, 05 and 06 which are each considered to be 'Medium' preference.

Table 2-13: Feasible Route Options – Constructability Ranking

Section	Feasible Route Option												
	1A	1A/B	2A	2A/B	3	4	5	6	7	8	9	10	11
South	1	3	1	2	1	1	2	3	1	1	1	1	1
Central	2	2	2	2	2	1	2	2	1	1	1	2	2
North	3	3	3	3	4	4	3	3	2	2	2	2	2
Overall	2	3	2	2	3	2	2	3	1	1	1	2	2

2.3.1.6.2 *Refined Route Options*

The results of the assessment are outlined in Table 2-14. In the 'South' section; Options 01A –v2, 02A-v2, 12, 02A/02B-v2 and 05 are considered the most preferable ('Very High' and 'High' preference) from an ease of construction perspective. Option 01A/01B is considered more difficult to construct and similar to the Feasible Route Option assessment is attributed a 'Medium' preference rank.

Constructability in the 'Central' section is generally consistent across route options with each option considered to be either 'Very High' or 'High' preference.

In the 'Northern' section, option 8-v2 is considered the best from an ease of construction perspective, while options 12 and 12-v2 are both considered more difficult ('Low Preference') due to their more online nature.

Table 2-14: Refined Route Options – Constructability Ranking

Section	Refined Route Option														
	1A (v2)	1A/B (v2)	2A (v2)	2A/B (v2)	3	4	5	6	7	8 (v2)	9	10	11	12	12 (v2)
South	1	3	1	2	n/a	n/a	2	n/a	n/a	ref 12	n/a	n/a	n/a	1	ref 12
Middle	ref 8-v2	ref 8-v2	ref 5	ref 5	n/a	n/a	2	n/a	n/a	1	n/a	n/a	n/a	1	ref 12
North	ref 8-v2	ref 8-v2	ref 8-v2	ref 8-v2	n/a	n/a	ref 8-v2	n/a	n/a	2	n/a	n/a	n/a	4	4
Overall	1	2	2	2	n/a	n/a	2	n/a	n/a	1	n/a	n/a	n/a	2	2

2.3.1.7 Junction Strategy

At this stage in the design process, the junction strategy has not been fully developed. For the purposes of comparison it has been assumed that there will be equal treatment for each option, this is in consideration of the fact that design year traffic figures dictate that no junction grade separation is required, in this regard all junctions will be at grade, with roundabout('s) generally provided at terminus points.

2.3.2 **Earthworks**

Earthworks extents and volumes are assessed under the Soils and Geology section of the Route Selection Report, therefore they are not considered under the Engineering heading.

2.3.3 **Drainage**

Each of the route options will require the provision of road surface water facilities. Based on initial assessments, the requirements for each of the corridors will be similar in scale and will discharge to the same receiving waters.

2.4 Engineering Summary

Based on the forgoing assessment, Table 2-15 (Feasible Route Options) and Table 2-16 (Refined Route Options), average the results of the various geometry sub-criteria and provides a preference ranking for each route option. In general, all routes are considered to be 'Very High' preference, or 'High' preference overall.

Table 2-15: Engineering Summary – Feasible Route Options

Section	Feasible Route Option												
	1A	1A/B	2A	2A/B	3	4	5	6	7	8	9	10	11
South	1	2	2	2	2	2	2	2	2	2	2	2	2
Central	1	1	1	1	2	2	2	2	1	1	1	2	2
North	1	1	2	2	2	2	1	1	1	2	1	1	2
Overall	1	1	2	2	2	2	2	2	1	2	1	2	2

Table 2-16: Engineering Summary – Refined Route Options

Section	Refined Route Option														
	1A (v2)	1A/B (v2)	2A (v2)	2A/B (v2)	3	4	5	6	7	8 (v2)	9	10	11	12	12 (v2)
South	1	2	2	2	n/a	n/a	2	n/a	n/a	ref 12	n/a	n/a	n/a	2	ref 12
Central	ref 8-v2	ref 8-v2	ref 5	ref 5	n/a	n/a	2	n/a	n/a	2	n/a	n/a	n/a	2	ref 12
North	ref 8-v2	ref 8-v2	ref 8-v2	ref 8-v2	n/a	n/a	ref 8-v2	n/a	n/a	2	n/a	n/a	n/a	2	3
Overall	1	2	2	2	n/a	n/a	2	n/a	n/a	2	n/a	n/a	n/a	2	2

3 Selection of Road Type – N16 Rural

3.1 Introduction

The N16 National Primary Route forms part of East/West corridor linking Northern Ireland with the Republic and more specifically linking Sligo on the west coast with Belfast and Dundalk on the east coast. Emanating from Belfast, the M1 motorway heads west passed Lisburn, Craigavon and Lurgan and terminates at Dungannon reducing to the trunk route (A4) to Enniskillen and the border. In the Republic it becomes the N16 from Blacklion in Co. Cavan via Manorhamilton in Co. Leitrim to Sligo Gateway City.

At 49 kilometres (30 miles), the N16 is one of the shorter national primary routes, as it forms only part of a major route from Sligo to Enniskillen and onwards to Belfast. Compared with many other national primary roads in Ireland, long sections of the N16 are narrow and twisty which can make travelling on it slow and difficult. In recent years improvements have been made to short sections in County Leitrim but no works have been carried out in County Sligo apart from maintenance and Low Cost Accident Schemes.

The Co. Sligo section is particularly scenic providing impressive views of the Dartry Mountains and Glencar Lake below and also Sligo Bay, Benbulben, the Atlantic Ocean and south Donegal. The existing N16 route within County Sligo extends from the Ash Lane/N4/N15 junction near Hughes Bridge to the County Leitrim boundary at *Meenaphuill* Townland and has an overall length of approximately 10.5 km.

In terms of the Trans European Road Network, the EU have designated[6] the Belfast/Sligo road as part of a:

> *...comprehensive network of routes, feeding into the core network at regional and national level. The aim is to ensure that progressively, throughout the entire EU, the TEN-T will contribute to enhancing internal market, strengthening territorial, economic and social cohesion and reducing greenhouse gas emissions.*

This emphasises the routes strategic importance in linking the peripheral north-west of Ireland with Belfast and the north-eastern ports.

The N16 also forms an essential component in cross-border co-operation.

As an Appendix to the N16 Route Selection Report, this Report, considers the Road Type to be selected within the **Rural** Area.

3.2 Traffic

The Traffic Model as developed by Jacobs Engineering provides an overview of the traffic volume's within the study area. Table 3-1 outlines 2015 traffic statistics at various points along the existing route.

[6] Trans-European Transport Network; Annex I Maps Of The Comprehensive And The Core Network

Table 3-1: Indicative N16 Base Traffic Figures

Location	AADT (2015)	% HGV 2015
N16 - City Centre at Ash Lane	10,500	6%
N16 - City Centre, between the Junction with the R286 and the AbbVie Roundabout	4,600	10%
N16 - Between the AbbVie Roundabout and the junction with the L3406-0 (Drum Road)	3,800	10%
N16 - Between the L3406-0 (Drum Road) and the County Boundary	3,400	11%

The traffic model predicts volumes of traffic expected to use each of the Feasible and Refined Route Options. For the purposes of Route Selection, the following traffic figures (for those Refined Route Options) are an appropriate assumption for a design year of 2047:

Table 3-2: Indicative N16 Refined Route Options – 2047 traffic figures

Route Options	Approx AADT		
	N15 to Drumkilsellagh	AbbVie Roundabout to Drumkilsellagh	Drumkilsellagh to N16 intersection with County Boundary
Option 1A/1B	2,500	-	3,700
Option 2A/2B	2,200	-	3,700
Option 5, 8-v2, 12	-	3,500 – 4,500	3,700

Considering the foregoing, it was deemed appropriate, for the purposes of Road Type selection, to consider that the route from a current day perspective would be required to carry a design volume of between 4,000 and 5,000 AADT.

3.3 Assessment Considerations

It would be typical in the selection of a Road Type to apply the principle of 'Incremental Analysis', however such a scenario is only appropriate where it is possible to compare the benefits and costs, of increasing the scale of the Road Type. In the current situation, it is obvious that the traffic figures under consideration are not in any way close to guidance set out in TII DN-GEO-03031 (formerly TD 09) (see Figure 3-1 of this Report) for the provision of a Dual Carriageway, therefore the only Road Type available for selection is a Single Carriageway. In this regard, the comparison of incremental benefits becomes ineffective for the reasons outlined below:

(1) Each cross section is undivided;

(2) Similar overtaking will be provided on each cross section;

(3) Similar junction arrangements are applicable to each Single Carriageway cross section;

Considering the foregoing, the Road Type to be assessed will be selected under the following criteria.

(1) The Guidance set out in the DMRB;

(2) Consistency of Network Layout;

(3) Reducing the Environmental Impacts; and

(4) Scale/Construction Costs;

Section 3.4 of this Report sets out the assessment under the above headings.

3.3.1 **Road Types to be Considered**

3.3.1.1 Cross Sections and Layout

In terms of Single Carriageway roads, the TII DMRB in DN-GEO-03036 (formerly TD 27/14) (as per Figure 1-1 of this Report) sets out 3 particular types. These include:

- Type 1 Single (See Figure 3-2);
    - This Road Type consists of 2no. 3.65m carriageways supported by 2.5m hard shoulders and 3m grass verges on each side. In this cross section, there is no further specific requirement for cyclist/pedestrian provisions;
- Type 2 Single (See Figure 3-3);
    - This Road Type consists of 2no. 3.5m carriageways supported by 0.5m hard strips and 4.5m grass verges (5m total) on each side. In this cross section, there is a requirement for the provision of cyclist/pedestrian facilities on both sides (one way). It is proposed for the purposes of establishing Road Type at Route Selection Stage to consider a two way facility which will cater for cyclists and pedestrians, this results in a 3m wide paved track offset 1.5m from the edge of the paved surface, resulting in an increase in the grassed verge area of 1m on one side – Depending on the route selected;
- Type 3 Single (See Figure 3-4);
    - This Road Type consists of 2no. 3.0m carriageways supported by 0.5m hard strips and 4.5m grass verges (5m total) on each side. In this cross section, there is a requirement for the provision of cyclist/pedestrian facilities on both sides (one way), or, on one side (two ways). It is proposed for the purposes of establishing Road Type at Route Selection Stage to consider a two way facility which will cater for cyclists and pedestrians, this results in a 3m wide paved track offset 1.5m from the edge of the paved surface, resulting in an increase in the grassed verge area of 1m on one side;

Notwithstanding the foregoing, consideration will be had during the design Phase (Phase 3 of the TII PMG), to examine alternative routes for the purposes of cyclist/pedestrian usage. This approach will provide an alternating Road Type (i.e. a cross section which accommodates the cycle way, to, one which does not). This approach, from an environmental perspective, may have the potential to reduce the 'likelihood of significant effects'.

Figure 3-1: TII DN-GEO-03036 Cross Sections and Headroom

National Roads Authority
Design Manual for Roads and Bridges

Volume 6 Section 1
Part 2 NRA TD 27/14
(including Amendment No. 2)

Table 3: Rural All-Purpose Roads - Dimensions of Cross-Section Elements Including: Slip Roads, Interchange Links and Loops

	Nearside				Offside		
	Verge [1,4,11]	Hard Strip [2]	Hard Shoulder [2]	Carriageway [2]	Hard Strip [2]	Verge [1,4]	Central Reserve [1,4]
MAINLINES							
Type 3 Single (S2)	5.00	0.50	-	6.00	-	-	-
Type 2 Single (S2)	5.00	0.50	-	7.00	-	-	-
Type 1 Single (S2)	3.00	-	2.50	7.30	-	-	-
Type 3 Dual Carriageway	5.00	0.50 min	-	7.00 (2 Lane) 3.50 (1 Lane)	0.50	-[3]	1.50
Type 2 Dual Carriageway	5.00	0.50	-	7.00	0.50	-[3]	1.50
Type 1 Dual Carriageway	2.00	-	2.50	7.00	1.00	-[3]	2.60[5]
SLIP ROADS, INTERCHANGE LINKS AND LOOPS: MERGES AND DIVERGES							
1 Lane	4.50	1.50	-	4.00		3.50	-
2 Lane	4.00	1.00 (Type 2/3)[6] 1.50 (Type 1)[6]		7.30	0.50 0.50	3.50	
SLIP ROADS. DIVERGE ONLY							
2 Lane	4.00	1.00 (Type 2/3)[6] 1.50 (Type 1)[6]	-	6.00	0.50	3.50	-

Figure 3-2: Type 1 Single Carriageway

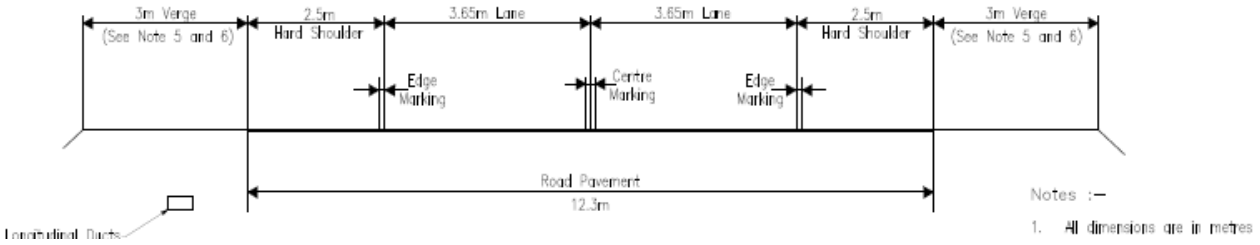


Figure 3-3: Type 2 Single Carriageway

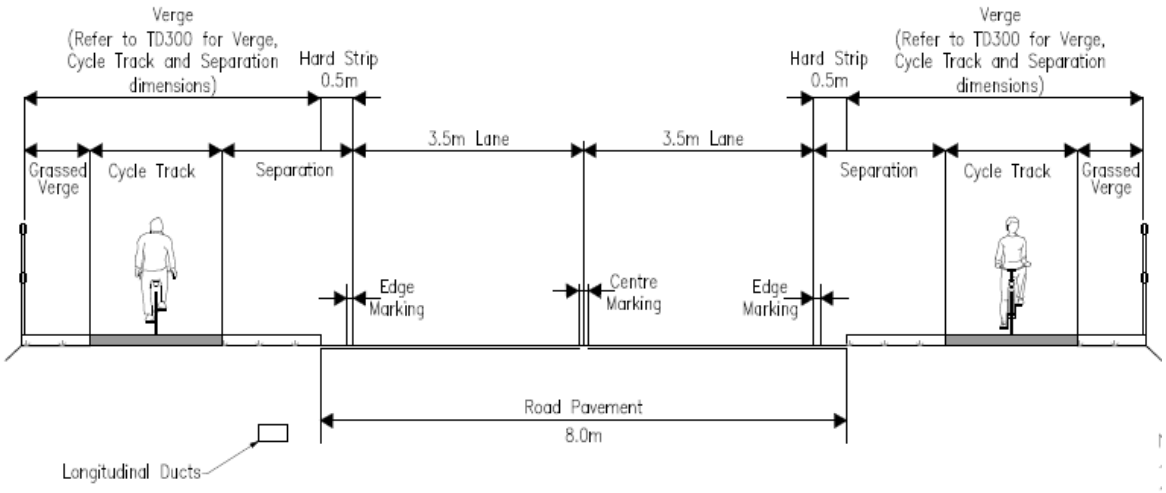
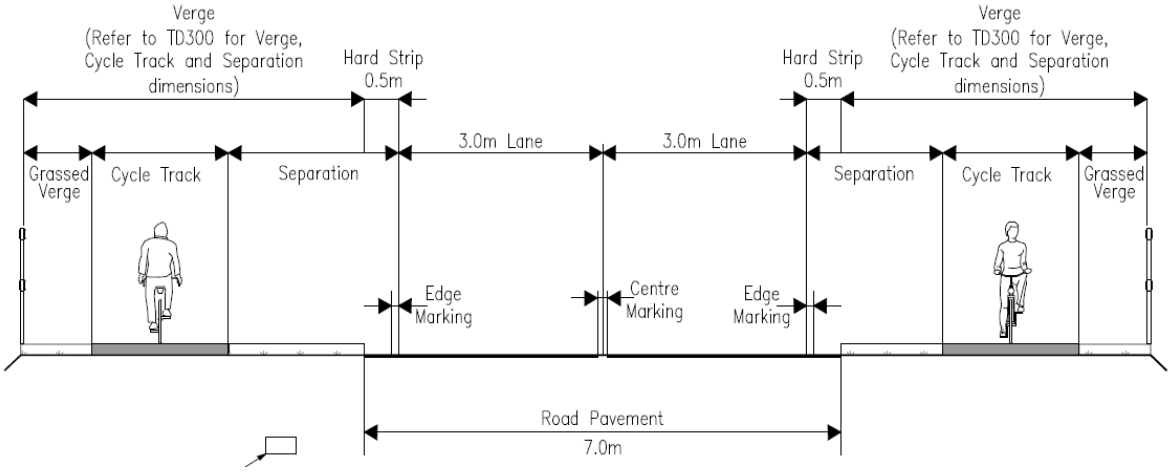


Figure 3-4: Type 3 Single Carriageway



3.3.1.2 Junction Strategy

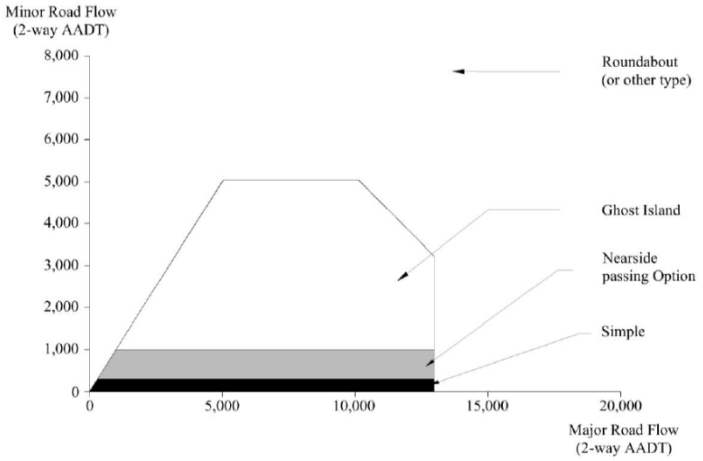
The junction strategy will be influenced by projected traffic volumes, however for the purposes of Initial Sketch Arrangement (at Route Selection Stage) and in accordance with the DMRB DN-GEO-03043 (formerly TD 41-42/11), the junction types are currently proposed to be:

- Simple T Junctions, or, staggered Right – Left junctions, for side road traffic with less than 300 AADT. This arrangement may be supplemented with Ghost Islands, where the AADT on the side road is in excess of 300;
- Roundabouts for:
  - Change in cross section;
  - Tie in points to the urban area;
  - Cross road situations in the Urban Area; or
  - Very highly trafficked local roads;
- Traffic Signals may also be appropriate for cross road situations in the urban area.

Figure 3-5: DN-GEO-03043 (formerly TD 41-42/11) – Possible Junction Types for Different Major Road Carriageway Types

Carriageway Type		Junction/Direct Access Type								
		Simple (Fig. 1/1)			Ghost Island (Fig.1/2)			Single Lane Dualling (Fig. 1/3)		
Standard	Location									
S2	Urban	Yes	Yes	Maybe	Yes	Yes	No	No	No	No
	Rural	Yes	Yes	No	Yes	Yes	No	No	No	No

Figure 3-6: DN-GEO-03043 (formerly TD 41-42/11) – Approximate Level of Provision of T-junctions on New Single Carriageway Roads for Various Major and Minor Road Design Year Traffic Flows



3.3.1.3 Treatment of Direct Accesses (lightly trafficked and minor junctions)

TII DMRB DN-GEO-03043 (formerly TD 41-42/11) provides further guidance in relation to the treatment of direct accesses and minor junctions:

> *There is a potential saving in collisions where there is a reduction in the number of lightly trafficked direct accesses and minor junctions made directly on to each national road. Such accesses can be joined together with a link or service road before they join the main carriageway of the national road. Options for such indirect connections should always be explored, as should providing the access from the local road network.*

The design process for the N16 will adopt this approach, insofar as is reasonably practicable. The incorporation of these accesses into side roads, via the potential provision of parallel tracks, will concentrate turning movements onto and off the proposed N16, thereby improving safety aspects and Full Overtaking Sight Distance on the mainline.

Notwithstanding the foregoing, it should be noted, that each direct access arrangement will be considered on a case-by-case basis. There may be instances where it is impracticable, or where significant engineering (via the provision of parallel tracks) makes the collection (to the local network) of some of these accesses unviable.

The case-by-case basis will focus on *inter-alia*:

- Journey Time and Community Severance; and
- Value Engineering;

3.4 Selection of Road Type

3.4.1 **Assessment**

The following outlines the various assessments which guide the 'Road Type' selection for the N16 Sligo to County Boundary Route Selection.

3.4.1.1 The Guidance set out in the DMRB DN-GEO-03031 (formerly TD 09)

DN-GEO-03031 (formerly TD 09) provides guidance on the Road Types considered suitable for the appropriate provision of a 'Level of Service D'. The general guidance is reproduced in this report as Table 3-3. In terms of capacity, the Type 3 Single Carriageway, in the base year of 2015 would have a reserve capacity of circa 30%, this reserve capacity will decrease as traffic growth increases.

Table 3-3: TII DN-GEO-03031 (formerly TD 09); Table 6/1 – Recommended Rural Road Layouts

Type of Road [1]	Capacity[2] (AADT) for Level of Service D	Edge Treatment	Access Treatment	Junction Treatment at Minor Road	Junction Treatment at Major Road
Type 3 Single (6.0m) Carriageway (S2)	5,000	0.5m hard strip. Footways/Cycle Tracks where required,	Minimise number of accesses to avoid standing vehicles and concentrate turning movements.	Simple Priority Junctions	Priority junctions, with ghost islands where necessary.
Type 2 Single (7.0m) Carriageway (S2)	8,600	0.5m hard strips. Footways/Cycle Tracks where required	Minimise number of accesses to avoid standing vehicles and concentrate turning movements.	Priority junctions, with ghost islands where necessary.	Ghost islands
Type 1 Single (7.3m) Carriageway (S2)	11,600	2.5m hard shoulders Footways/Cycle Tracks where required	Minimise number of accesses to avoid standing vehicles and concentrate turning movements.	Priority junctions, with ghost islands where necessary.	Ghost islands or roundabouts [3]
Type 3 Dual [4] (7.0m + 3.5m) Divided 2+1 lanes Primarily for retro fit projects	14,000	0.5m hard strips.	Minimise the number of accesses to avoid standing vehicles and concentrate turning movements.	Restricted number of left in/left out or ghost priority junctions.	Priority junctions or at-grade roundabouts.
Type 2 Dual [4] Divided 2 +2 Lanes (2x7.0m) Carriageways. ()	20,000	0.5m hard strips	No gaps in the central reserve. Left in / Left out	No gaps in the central reserve. Left in / Left out	At-grade roundabouts and compact grade separation
Type 1 Dual Divided 2+2 Lanes (2x7.0m) Carriageways ()	42,000	2.5m hard shoulders	No gaps in the central reserve. Left in / Left out	No gaps in the central reserve. Left in / Left out	At-grade roundabouts and full-or compact grade separation.
Standard Motorway Divided 2 +2 Lane (2X7.0m) (D2M)	52,000	2.5m hard shoulders	Motorway Regulations	No gaps in the central reserve.	Motorway standards Full-grade separation.
Wide Motorway Divided 2+2 Lane (2X7.5m) (D2M)	55,500	3m hard shoulders	Motorway Regulations	No gaps in the central reserve	Motorway standards Full-grade separation.

3.4.1.2 Consistency of Network Layout

3.4.1.2.1 *N16 – Current Layout (Nationally)*

As already outlined (in section 3.1 of this report), the N16 as it occurs within the Republic of Ireland measures approximately 49 Kilometres in length. The length of the N16 which is considered to be rural measures approximately 45 kilometres

There have been a number of minor localised improvements which have been carried out over the last number of years, particularly in County Leitrim. Considering these, Table 3-4 provides an

indicative overview of how the cross section of the N16 (in County Sligo) could be influenced in terms of consistency of layout, by improvements already carried out. In developing this table, consideration has not been had to previous stages of Major Roads Schemes (in planning) which have been suspended.

Table 3-4: Improved Section of the N16

Scheme Location (by approximate reference to townlands)	County	Road Type	Approx Length (m)	Constituting % of overall Rural Route Length
Shanvas to Tomrud Td. (North of Manorhamilton)	Leitrim	Standard Single (Direct Accesses generally permitted)	3.5km	circa 16%
Moneenshinnagh (North of Manorhamilton)	Leitrim	Standard Single/Reduced Single – Hybrid (Direct Accesses generally permitted)	0.5km	
Conacloy to Sradine (North of Manorhamilton)	Leitrim	Standard Single (Direct Accesses generally permitted)	3.1km	
North of Drumahan (South of Manorhamilton)	Leitrim	Reduced Single (Direct Accesses generally permitted)	2km	circa 4%
Percentage of Rural Route which is improved to date				circa 20%
Percentage of Rural Route which is legacy				circa 80%

In summary, improvements already carried out (or currently being carried out), have resulted in approximately 16% of the overall route being broadly commensurate with a Type 1 Single Carriageway while 4% of the route is broadly commensurate with a Type 2 Single Carriageway – the remaining balance is considered to be legacy network. The following points are relevant in making these observations:

- The TII standard cross sections have been modified since the above improvements were carried out, which has generally resulted in a wider overall cross section (particularly for the Type 2 Single Carriageway), owing to a wider verge space being required and the provision of, off road pedestrian/cyclist facilities;
- On the improvements carried out, direct accesses (domestic and agricultural) remain on the various improved sections;

Additionally, it is notable at the time of writing this report that Leitrim County Council are currently progressing through the Planning and Design process, a realignment of the N16 at Drummahan which will be circa 1.55km in length and which is proposed to be a Type 1 Single Carriageway.

3.4.1.3 Reducing the Environmental Impacts

Different scales of improvements are generally expected to result in proportional differing levels of environmental impact. In the case of the N16, considering the selection criteria is either a Type 1, Type 2 or Type 3 Single Carriageway, it is considered that impacts from a Socio-Economic, Noise & Vibration, Air Quality and Climate Change perspective are less of an issue in the selection of the Road Type – As each Road Type will have a similar level of community severance and a similar level of traffic emissions related impacts. In this regard, the relative levels of impacts are expected to be more related to the proportional scale of Cross Section.

Table 3-6 indicates that there is only a 2% difference[7] in overall cross sectional width between a Type 1 and Type 2 Single Carriageway, the gap extends to 7% when the Type 3 Single Carriageway is compared against the Type 1, or, 5% when the Type 3 is compared against a Type 2. These differences in scale would generally result in greater impacts on various receptors including *inter-alia* Property, Ecology, Landscape & Visual, Archaeology & Cultural Heritage and Architectural Heritage, however, the increasing scale of impact would not be expected to be proportional to those percentages outlined above, as each particular receptor is likely to be already impacted in each particular scenario.

Increasing the pavement width, in terms of comparing environmental impacts, is considered more relevant in terms of assessing the 3 separate, single carriageway cross sections. Of relevance in this regard, is impacts relating to water quality and visual effects. Table 3-6, outlines the likely increase to attenuation facilities which would be required as the pavement width cumulatively increases. It is less easy to cumulatively compare pavement width increases in terms of visual impacts, this is considered an important consideration given the setting of the project (See Figure 3-7 and Figure 3-8) where:

> *...Copes Mountain to the east is characterised as a Sensitive Rural Landscape with an intrinsic scenic quality and a low capacity to absorb new development[8]...*
> *...Similarly to the north, the Dartry Mountain Range is also characterised as a Sensitive Rural Landscape encompassing a Visually Vulnerable Area....*
> *...To the west of the study area the N15 Sligo to Donegal route also comprises a Scenic Route while Sensitive Rural Landscape and Visually Vulnerable areas occur west of the N15 and comprise in the main elements of Sligo Bay...[9]*

Considering the foregoing, the opinion of the Landscape & Visual specialist, was sought in relation to the Landscape and Visual Impacts. This is as outlined in Table 3-5.

Table 3-5: Landscape & Visual Assessment of Road Type Cross Sections

The main differences between the road type options that are relevant to potential landscape and visual impacts are; the overall width or footprint of the road types; and inclusion (or not) of cycle/pedestrian tracks. *From a landscape and visual perspective as there is no great variance in the cross section requirements for the different road types there is therefore little difference in potential degree of impacts from cuttings or embankments across the road type options. Where cuttings or embankments are required, their impacts will remain broadly the same for each road type. There will be negligible difference in potential impacts on sensitive landscapes or scenic views. Furthermore, the potential for landscape planting for mitigation purposes remains similar for all road types.* *The Type 1 carriageway has the largest overall width and potential footprint but doesn't require a dedicated cycle/pedestrian facility. The Type 1 also has a wider road pavement width in cross section than Type 2, or Type 3 carriageways. This wider pavement width includes a 2.5m hard shoulder on both sides. Without the provision of cycle/pedestrian facilities the Type 1 does not offer any potential beneficial amenity impacts.* *Inclusion of the cycle/pedestrian facility while increasing the extent of hard surface towards the edges of the cross section in Types 2 and 3 will not increase the potential for landscape and visual impacts. In addition it must be acknowledged that there would be potential for significant beneficial impact on*

[7] Considering Full Compliance with the TII DMRB.

[8] Italics in this paragraph outline quotes from the Sligo County Development Plan.

[9] Quote extracted from the N16 Sligo to County Boundary Route Selection Report.

amenity from the provision of the cycle/pedestrian tracks along the N16 corridor that will benefit the visitor's appreciation of the area in particular Copes Mountain and Glencar Lake.
Notwithstanding the negligible impact on landscape and visual resources from the inclusion of the cycle/pedestrian facility the use of the existing N16 for the cyclist/pedestrian facility in Type 2 and 3 is to be recommended where possible particularly in the northern section depending on the preferred route.
Overall the slight variations in road cross section for each option will have negligible difference on the potential landscape and visual impacts such as for example in relation to residential visual impacts or loss of visually significant vegetation where broadly the same landscape and visual impacts will occur for each road type.

Figure 3-7: Sligo County Development Plan – Landscape Characterisation Map

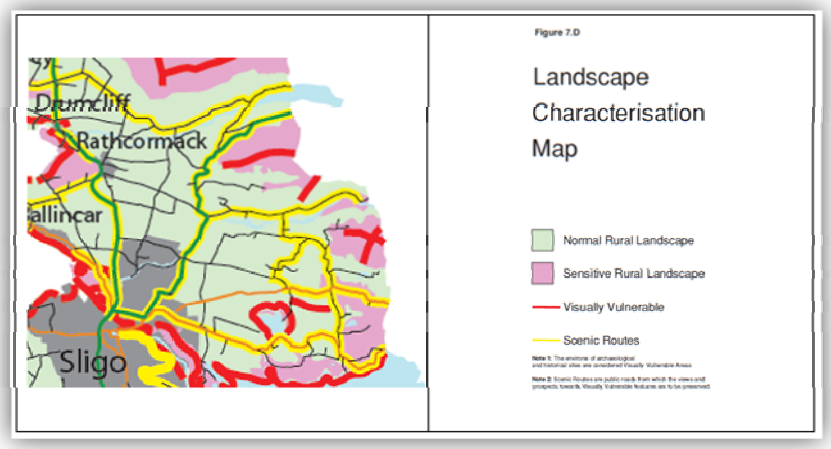


Figure 3-8: Designated Visually Vulnerable Areas – Copes Mountain and Glencar Lake

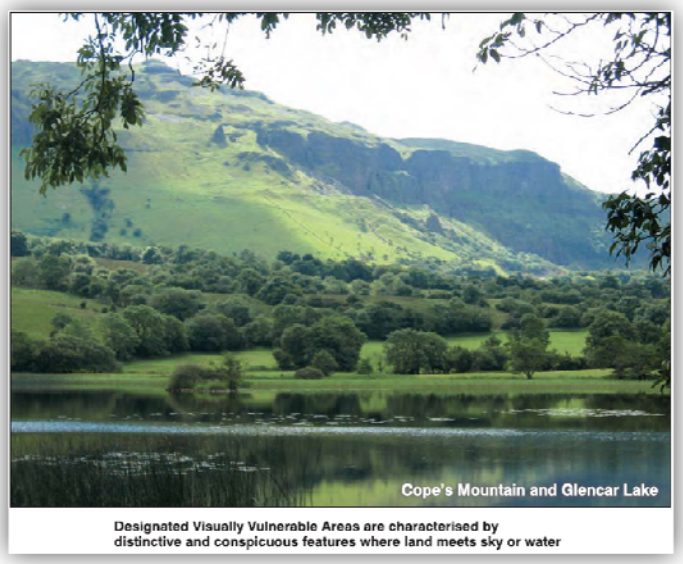


Figure 3-9: Leitrim County Development Plan – Areas of Outstanding Natural Beauty, High Amenity & Protected Views and Prospects

3.4.1.4 Scale/Construction Costs

The change in dimensions of each cross section in the 2014 edition of TII DN-GEO-03036 (formerly, TD 27, Cross Sections and Headroom) as outlined in Table 3-6, has resulted in a closer alignment of dimensions between cross sections, owing mainly to the increased verge width now provided for the Type 2 and 3 Single Carriageway, in comparison to the Type 1 Single Carriageway. There now, is no discernible difference (-2%) in overall cross sectional width, between the Type 1 and the Type 2 Single Carriageways and only a 5.5% difference between the Type 2 and Type 3. These separating scales are also reflected in terms of cost (albeit to a lesser degree due to the requirement for the cyclist/pedestrian facilities in the Type 2 and 3 Single Carriageway) – it is estimated for the purposes of this assessment that there is a c. €140k/Km[10] overall difference in costs between a Type 2 and a Type 1, with a c. €280k/Km difference between a Type 2 and Type 3.

Table 3-6: Comparison of Scale/Construction Costs

						Construction difference in comparison with a 'Type 1' Single Carriageway			Construction Costs			
Single Carriageway Road Type	Total Cross Section width (m)	Pavement width (m)	Verge width (excl. Pave) (m)		Cycle/ Pedestrian Facilities	Total Paved Width	Total Cross Section width (%)	Pavement width (%) - including where appropriate cycle facilities	Attenuation	Comparative Cost per Km to Type 1 based on Total Cross section.	Reduction in Pavement Costs per Km	Allowance per Km for Cycle Track	Total
Type 1	18.3	12.3	3	3	0	12.3	100%	100%	100%	€ 1,800,000			€ 1,800,000
Type 2	18	8	4.5	5.5	3	11	98%	89%	89%	€ 1,770,492	€ 175,000	€ 68,500	€ 1,663,992
Type 3	17	7	4.5	5.5	3	10	93%	81%	81%	€ 1,672,131	€ 215,000	€ 68,500	€ 1,525,631
Nb.:		Base comparable cost											
		Denotes combinded cycle/pedestrian (2 way) track incorporated											

[10] Costs provided for the purposes of the assessment are not detailed and are broadly based on the costs associated with the recently constructed N5 Ballaghaderreen Bypass in County Roscommon (Type 1 Single Carriageway).

3.4.2 Assessment and Scorecard

Similar to the approach adopted throughout the N16 Route Selection Report, a scorecard was prepared to document the assessment process. The assessment focussed on the four criteria which have already been set out in section 3.3 of this report. The following outlines the assessment considerations including the resulting scorecard which is provided in Figure 3-10.

3.4.2.1 Guidance Set out in the DMRB

The range required to be catered for on the mainline of the N16, as already outlined is considered to be between 4,000 and 5,000 ADDT. The following are the recommended AADT ranges within which, various road types provide a Level of Service D:

- Type 1 Single - 8,600 – 11,600
- Type 2 Single - 5,000 – 8,600
- Type 3 Single - <5,000

In this regard, it is apparent that a 'Type 3' Single Carriageway based on the assumptions made will be very close to, but most likely still operating within capacity, in a design year of 2047. In this regard, this cross section was considered most preferred and was given a 'High Preference' rank. The 'Type 2', had a slightly higher capacity range and was considered to be of 'Medium Preference'. The Type 1 was given a 'Very Low Preference' rank owing to the fact that the capacity level for a Type 2 will in all likelihood not be exceeded in the design year;

3.4.2.2 Consistency of Layout

In terms of 'Consistency of Network Layout', the majority of improvement schemes (circa 16% of 20%) carried out on the N16 would generally correspond to a Type 1 Single Carriageway, with the exception of a short 2km section, north of Drummahan in County Leitrim, in this regard, The Type 1 Single carriageway was considered to be a 'High Preference' rank. The Type 2 was given a 'Medium Preference' rank as some schemes have been developed along the route (circa 4%) generally corresponding to this cross section. No schemes have been developed along the route which corresponds to a Type 3 Single Carriageway, therefore this cross section was given a 'Very Low' preference rank.

3.4.2.3 Reducing the Environmental Impacts

Section 3.4.1.3 of this report, outlines the consideration of increased environmental impacts arising from increased road widths. In general, it is acknowledged that resulting increases in terms of Landscape & Visual effects are negligible across road types, owing mainly to the overall similar cross section. Similarly increases in terms of attenuation facilities required for water quality and quantity control are modest. Considering this, all road types were considered to be 'Medium Preference' ranks, however to recognise the discrete differences, separate indexes of 3 (Type 1), 2.75 (Type 2) and 2.5 (Type 3) were applied.

3.4.2.4 Scale/Construction Costs

It has been established in section 3.4.1.4 of this report that the differences of scale/construction costs between the various road types is marginal, ranging from approximately €1.8m/km for a Type 1 Single Carriageway to €1.525m/km for a Type 3 Single Carriageway. It was considered appropriate to apply the Type 3 Single Carriageway within the 'High Preference' Rank, albeit with a high index reading close to the 'Medium Preference' rank; the Type 2 and 1 Single Carriageways were then factored up in terms of indexes, based on their proportionate difference with the Type 1 Single Carriageway – This results in scores of 2.6 and 2.8 respectively for these options.

Figure 3-10: Road Type Selection – Score Card

Disipine	Engineering		
Sub-Disipine	Road Type Selection		
Section	Road Type		
	Type 1	Type 2 (DMRB)	Type 3 (DMRB)
Guidance set out in DMRB	5	3	2
Consistency of Network Layout	2	3	5
Reducing the Environmental Impacts	3	2.75	2.5
Scale/Construction Costs	2.8	2.6	2.4
Overall Preference	3.2	2.8375	2.975

Legend	
Pref. Rank	Decription
1	Very High preference
2	High preference
3	Medium preference
4	Low preference
5	Very Low preference

3.5 Recommendation

The 'Selection of Road Type' assessment report has been carried out under the headings of:

- Guidance set out in the DMRB;
- Consistency of Layout;
- Reducing the Environmental Impacts;
- Scale/Construction Costs

In general, there is only a marginal difference between the various road types when they are assessed under the latter headings of 'Reducing the Environmental Impacts' and 'Scale/Construction Costs'. In terms of 'Consistency of Layout', it is apparent when examining the entire N16 Network, that most improvements, have been carried to a standard which generally corresponds to a 'Type 1' Single Carriageway, however, the difficulty with this road type, is the fact that traffic projections when compared with the 'Guidance set out in the DMRB' (recommended AADT ranges for various road types) would almost require a doubling before they would come into the bracket recommended, for a 'Type 1' Single Carriageway (LoS D). While acknowledging the fact that these are guidelines, it is considered, that this difference is too great, to make it the optimum solution in terms of road type.

The comparison then becomes one between the 'Type 2', and the 'Type 3' Single Carriageways. In terms of 'Consistency of Layout', the 'Type 3' has not generally been utilised to date, while the 'Type 2' has been utilised in some sections. Strict application in terms of DMRB guidance traffic figures, would suggest the 'Type 3' to be more appropriate, however the 'Type 2' with a marginal increase in pavement width (1m) provides a notable improvement in terms of capacity. This factor, in combination with the fact the route is a National Primary and part of the TEN-T Comprehensive Network, is the basis for the recommendation that the proposed road type for the purposes of Route Selection shall be a 'Type 2' Single Carriageway.

This recommendation shall be reviewed during the design phase (Phase 3 of the TII PMG) – in addition, it is recommended that the overall cross section proposed, shall be developed in a manner that it may be widened to a 'Type 1' Single Carriageway, if that becomes required in the longer term.

4 Road Safety Impact Assessment

4.1 Context

The Road Safety Impact Assessment is a standalone document, prepared as part of the Route Selection Process. The report, prepared by the design team, is provided in its standalone format within this section of the Route Selection Report.

Road Safety Impact Assessment

Document Control				
Status	**Issued For**	**Author**	**Date**	**Approved**
DRAFT	*Route Selection*	*Fergus Meehan*	*November 2015*	*Emer Concannon*
DRAFT	*Route Selection*	*Fergus Meehan*	*October 2016*	*Emer Concannon*
DRAFT	*Route Selection*	*Fergus Meehan*	*March 2017*	*Emer Concannon*

Inventory of Road Safety Impact Assessment			
TII PMG Project Phase	**Signed**	**Impact Assessment Team**	**Approved**
Phase 2 – Route Selection – Feasible Route Options	*Fergus Meehan*	*Project and Road Design Engineer*	*Emer Concannon*
	Kevin Crawley	*Road Safety Auditor*	
	Barry Ruane	*Road Design Observer.*	

Date	Comments
20th November 2015	*Existing N16 and N15 Routes (affected sections) driven;* *Tie in Points examined;* *Assessment of 'Feasible Route Options' commenced;*
25th November 2015	*Assessment of 'Feasible Route Options' cont.;*
16th September 2016	*Assessment of 'Refined Route Options';*

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Tables

1 Introduction

1.1 General

The Road Safety Impact Assessment Report (RSIA), as required by EU Directive 2008/96/EC, Road Safety Infrastructure Management, was prepared by the Sligo, TII National Roads Project Office. The RSIA was prepared with reference to the NRA (now TII) 2010 Project Management Guidelines (PMG) which states an RSIA to be:

> *... a strategic comparative analysis of the impact of a Scheme on the safety performance of the road network. An RSIA must be carried out on all Schemes at the initial Planning stage, i.e. during Phases 1 and 2. EU Directive 2008/96/EC defines RSIA and requires it to be carried out for all infrastructure projects on the Trans-European Road Network...*

Additionally, the structure and contents are based upon the requirements set out in PE-PMG-02001 (formerly NRA HD 18/12) Road Safety Impact Assessment standard. The scope of the impact assessment as defined in the aforementioned standard is as follows:

> *2.2 The primary purpose of a Road Safety Impact Assessment is to demonstrate, on a strategic level, the implications on road safety of different planning alternatives of an infrastructure project.*
>
> *2.3 The Road Safety Impact Assessment shall indicate the road safety considerations which contribute to the choice of the proposed solution. It shall further provide all relevant information necessary for the selection of the solution, including a comparative analysis of the road safety implications of each alternative considered and an evaluation of the road safety benefits and disbenefits arising from each alternative.*

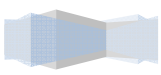
The aforementioned directive requires Road Safety Impact Assessment's for infrastructure projects to consider the following aspects:

(a) problem definition;
(b) current situation and "do nothing" scenario;
(c) road safety objectives;
(d) analysis of impacts on road safety of the proposed alternatives;
(e) comparison of the alternatives, including cost-benefit analysis;
(f) presentation of the range of possible solutions.

The RSIA for the Route Selection process was undertaken over two separate stages as follows:

(1) Following the development of the 'Feasible Route Options';

(2) Following the 'Preliminary Options Assessment' and on those emerging 'Refined Route Options'.



2 Proposal Definition

2.1 Overview of the proposed scheme and problems encountered

2.1.1 Existing Route

The N16 National Primary Route forms part of East/West corridor linking Northern Ireland with the Republic and more specifically linking Sligo on the west coast with Belfast and Dundalk on the east coast. Emanating from Belfast, the M1 motorway heads west passed Lisburn, Craigavon and Lurgan and terminates at Dungannon reducing to the trunk route (A4) to Enniskillen and the border (see Figure 2-1). In the Republic, it becomes the N16 from Blacklion in Co. Cavan and travels via Manorhamilton in Co. Leitrim to Sligo (See Figure 2-2).

At 49 kilometres (30 miles), the N16 is one of the shorter national primary routes, as it forms only part of a major route from Sligo to Enniskillen and onwards to Belfast. Compared with many other national primary roads in Ireland, long sections of the N16 are narrow and twisty which can make travelling on it slow and difficult. In recent years, improvements have been made to short sections in County Leitrim but no works have been carried out in County Sligo, apart from maintenance and Low Cost Accident Schemes.

The Co. Sligo section is particularly scenic providing impressive views of the Dartry Mountains and Glencar Lake below and also Sligo Bay, Benbulben, the Atlantic Ocean and south Donegal. The existing N16 route within County Sligo extends from the Ash Lane/N4/N15 junction near Hughes Bridge to the County Leitrim boundary at *Meenaphuill* townland and has an overall length of approximately 10.4km.

In terms of the Trans European Road Network, the EU have designated[1] the Belfast/Sligo road as part of a:

> *...comprehensive network of routes, feeding into the core network at regional and national level. The aim is to ensure that progressively, throughout the entire EU, the TEN-T will contribute to enhancing internal market, strengthening territorial, economic and social cohesion and reducing greenhouse gas emissions.*

This emphasises the routes strategic importance in linking the peripheral north-west of Ireland with Belfast and the north-eastern ports.

The N16 also forms an essential component in cross-border co-operation.

[1] Trans-European Transport Network; Annex I Maps Of The Comprehensive And The Core Network

Figure 2-1: N16/A4 Sligo to Belfast[2]

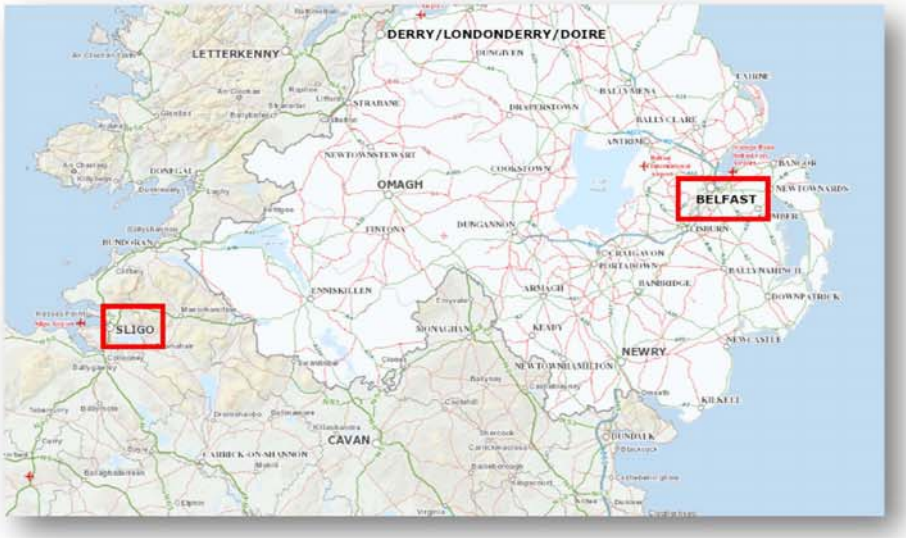
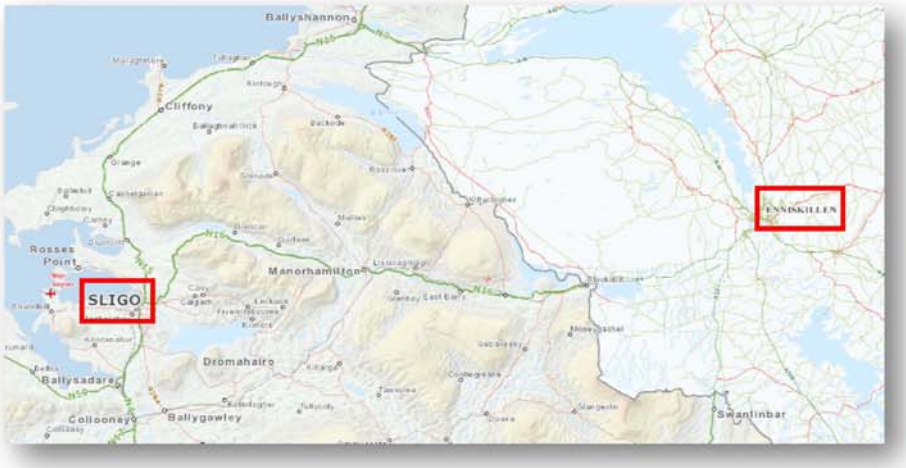


Figure 2-2: N16 Sligo to Enniskillen



[2] www.osi.ie/publicviewer

2.2 Existing Conditions on the National Route

The existing road network in the area is multi-functional and is required to cater for conflicting demands, including accommodating long distance through traffic and locally generated trips.

The route, as it occurs within County Sligo, can be divided into two relatively contrasting sections. The 1.9km section from the N15 near Hughes bridge along Ash Lane past Sligo Institute of Technology as far as the Abbvie Roundabout is subject to a 50kph speed limit and can be classified as urban in nature. The remaining section (8.5km) of the route is Rural in nature and is subject to a 100kph speed limit, it contains sporadic roadside housing development, particularly in the section closer to town.

On the rural section of the route there are approximately eleven clusters of houses (2 or more property entrances) with direct access to the national primary route. The most significant of these clusters occur at *Barroe*, *Doonally* and *Lugatober* townlands. In addition, the route is populated with additional direct house and agricultural entrances.

The entire rural section has a substandard cross section coupled with a grossly inadequate vertical and horizontal alignment (as per section 3.1.4.2.3). This is predominately due to the topography of the area which could be described as hilly to mountainous. Consequently, from *Doonally* townland northwards the road follows a winding somewhat tortuous route around the slope of Copes mountain from an elevation of less than circa (c.) 50m O.D. at Doonally to c. 140m O.D. at the Leitrim Boundary.

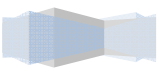
The Urban section from the junction with the N4/N15 and the AbbVie is generally of good standard and would generally comply with the requirements of DN-Geo-03031 (formerly NRA DMRB TD 09) for a 50kph road. Notwithstanding this, capacity checks would be required at each of the junctions along this section of the route during the next stage of the development (Phase 3 of the TII Project Management Guidelines).

There are a significant number of junctions (23) with local roads along the existing route. Safety issues in relation to these junctions are expanded upon in section 3.1.4.2.4 of this report.

2.3 Route Selection

The iterative nature of the Route Selection Design process is outlined in Section 5 of this Report. In summary, the process commenced with the identification of a Constraints Study Area, following an examination of viable options at a broad geographical scale, this was followed by the design of 'Feasible Route Options' which were subjected to a 'Preliminary Options Assessment' resulting in the establishment of 'Refined Route Options'. The assessment of options which were considered to be unviable at a broad geographical scale are also referred to in section 5 of this Report.

The design characteristics applied to each route option at the current stage is expanded upon in section 4 of this report.



3 Need for the Scheme & Problem Definition

3.1 Need for the Scheme

3.1.1 International, National and Regional Development Policies

At a policy and strategic level, there is a clear need for an upgrade to the existing N16, which is repeated in numerous International, National and Regional Development Policies. These are expanded upon in the Route Selection Report and include *inter-alia*:

- TEN-T Trans European Transport Network;
- National Spatial Strategy for Ireland 2002-2020: People, Places and Potential;
- Regional Planning Guidelines for the Border region, 2010-2022;
- Border, Midlands and Western Regional Operational Programme, EU Regional Policy, 2007-2013;
- Smarter Travel, a Sustainable Transport Future, 2009-2020;
- Implementing the NSS: Gateway Investment Priorities Study, 2006; and
- Forfás Regional Competiveness Agenda, 2010;

3.1.2 N16 Specific Studies

Numerous studies commissioned by various organisations including *inter-alia* Transport Infrastructure Ireland (formerly NRA), Irish Central Border Area Network (ICBAN), North West Region Cross Border Group (NWRCBG) and the various Regional Local Authorities have identified the significant deficiencies and the Needs for upgrading of the N16. These reports, in conjunction with scheme specific assessments outlined in the Route Selection Report establish the following recurring themes:

- Average journey times on this route are significantly lower than journey times on other national primary routes (this has significant effects on journey times from Sligo to Belfast);
- There is an under investment in transport infrastructure in the Regional area;
- The geometry is significantly deficient for a national primary route;
- A strategic core East-West Route is best served by a corridor through Sligo-Enniskillen-Dundalk;
- Infrastructural investment on both sides of the border has been dictated by the policies set out in the respective national strategies, and is driven primarily by a desire to link the major population centres within the respective jurisdictions as a first phase, extending to linking population centres across the Island as a second stage. Furthermore, the two strategies are have not historically been integrated on a cross-border basis. This has had a significant effect on any planned upgrades to the N16 in the past;
- There is, according to a number of studies, a close correlation between the standard of a region's transport infrastructure and its development status; internationally, a poor transport infrastructure has been shown to have a major inhibiting impact on investment and both economic and social development, including in the areas of the quality of life, access to both fundamental and specialist amenities (quoting health care as an example), international access and access to major local and national social events;
- The Gateways and Hubs identified in the National Spatial Strategy, other than Dublin, have benefitted substantially in terms of improved employment accessibility. However, Sligo is a

notable exception due in part to the lack of significant upgrades to its national road networks.

3.1.3 Traffic Volumes and Trip Attractions

3.1.3.1 Traffic Volumes

The Traffic Model as developed by Jacobs Engineering, provides an overview of the traffic volume's within the study area. Table 3-1 outlines 2015 traffic statistics at various points along the existing route.

Table 3-1: Indicative N16 Traffic Figures

Location	AADT (2015)	% HGV 2015
N16 - City Centre at Ash Lane	10,500	6%
N16 - City Centre, between the Junction with the R286 and the AbbVie Roundabout	4,600	10%
N16 - Between the AbbVie Roundabout and the junction with the L3406-0 (Drum Road)	3,800	10%
N16 - Between the L3406-0 (Drum Road) and the County Boundary	3,400	11%

3.1.3.2 Trip Attractions

As part of the Irish Census (2011), the Central Statistics Office (CSO) produced the Place of Work, School or College Census of Anonymised Records (POWSCAR) database. The POWSCAR dataset provides detailed data on the journey to work/education at Electoral Division (ED) level. This data includes:

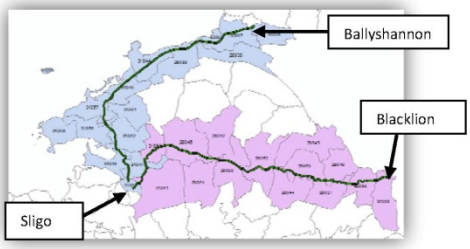
- Origin (residence) and destination (place of work/education);
- Time of departure; and
- Travel mode.

Outputs from the POWSCAR dataset provided the data required to construct journey to work (commuting) and journey to education origin-destination (O-D) demand matrices for use in the TII National Transport Model (NTM). This is the first time that journey to education has been recorded as part of the census. In the previous census (2006) only data on journeys to work was collected.

This information initially proved to be useful in terms of establishing the interaction between the N16, Sligo City (and other routes to the south), and the N15 to the north. In this regard, information was extracted from the NTM for the N16 between Sligo and the boundary with Northern Ireland, and for the N15 between Sligo and Ballyshannon (See Figure 3-1). The results demonstrate that:

- 88% of traffic on both the N15 and N16 are Sligo City bound trips;
- 4% of Traffic on the N16 is attracted to the Rosses Point Area;
- The balance (circa 8%) is attracted to the N15, with 6% of these trips attracted to the area south of Drumcliff;
- The N15 traffic which are attracted to the N16, are primarily attracted to the section of the N16 closest to Sligo;

Figure 3-1: ED Map N15 (Sligo to Ballyshannon)/ N16 (Sligo to Northern Ireland boundary)



3.1.4 Scheme Specific Assessment

In terms of Problem Definition, the following sets out some of the deficiencies which have been established on the N16.

3.1.4.1 Journey Time Assessment

Journey Time assessments were undertaken by the design team as part of Phase 1 of the Project Development. The initial results, indicate that Journey Times appear to be generally reasonable within the urban area, with the exception of some queue delays on the approach to the N16's junction with the N4/N15. However, on the 8.5km rural section, travel times at an average of 70.5kph are significantly below the standards which would be required on a current day national primary route.

3.1.4.2 Safety

The following sections outline the safety deficiencies along the route with particular emphasis on Cross Section, Drainage, Geometry and Junctions. Section 3.1.4.2.6 outlines the accident statistics determined from the Road Safety Authority records.

3.1.4.2.1 *Cross Section*

The cross section of the existing road is described below in terms of notably differing sections.

Section 1: N4/N15 Junction to the N16's junction with the R286

Section 1, consists of 2 number 4.6m wide carriageways with a ghost island and right turning facilities introduced for the entrances to Sligo General Hospital and the Institute of Technology, Sligo. A footway is provided on the right hand side; with a footway, cycleway and green buffer zone provided on the left hand side.

In general the section is urban in nature with boundary walls being the normal definition of the roadside.

Figure 3-2: Section 1; Typical Cross Section

Section 2: N16's junction with the R286 to its junction with the Abbvie Roundabout

Section 2, consists of 2 number 4.3m wide carriageways with a ghost island of varying width provided throughout. A footpath is provided on either side with cycle tracks alternating from one side to the other. The ghost island ends prior to the approach to the Abbvie Roundabout. In general, the section is urban in nature with boundary walls being the normal definition of the roadside.

Figure 3-3: Section 2; Typical Cross Section

Section 3: Abbvie Roundabout to the County Boundary

The rural section (Section 3) of the route generally consists of a single carriageway in each direction with approximate overall widths of 6m to 6.5m. The verge width varies throughout but is generally 1m with localised areas of up to 2.5m.

Figure 3-4: Section 3; Typical Cross Section

3.1.4.2.2 *Drainage*

With the exception of the urban section where drainage in the form of kerb and gully is provided; the remaining rural section of the N16 is generally devoid of a dedicated drainage system. Along the route, verge cuts provide the only means of escape for road runoff, meaning flash floods and aqua-plaining is a common feature following heavy rainfall events. This is exacerbated by the topography of the area, where in some cases the road intercepts sheet flow (following heavy storm events) from the adjacent Copes Mountain.

Figure 3-5: Flooding/Aqua-plaining

3.1.4.2.3 *Geometry*

The geometry of the existing route has been examined, based upon a Topographical centreline survey of the existing road and a subsequent analysis carried out in the Road Design computer package MXRoads.

The TII DMRB specifies a hierarchy of thresholds for the design of roads. These standards represent the various criteria, whose incorporation in the road design would achieve a desirable level of performance in average driving conditions. This is most true in terms of traffic safety, operation, economic effects, environmental effects and sustainability.

> *The first tier of the hierarchy specifies a desirable minimum value which would produce a high standard of road safety and which should be the initial choice. However, the level of service may remain generally satisfactory and a road may not become unsafe where*

these values are reduced. This second tier of the hierarchy is termed a Relaxation. The third tier of the hierarchy is known as a Departure from standard and is generally only applied in situations of exceptional difficulty.[3]

The following provides a summary of the results of this analysis.

Horizontal Geometry

In relation to horizontal geometry, Table 3-2 outlines the minimum radius (R) requirements in relation to 100kph design speed roads. Table 3-3 and Figure 3-6 outline the results of the analysis for curves which are at or below the Desirable Minimum value of 720m. This highlights significant deficiencies with 29 curves at or below the threshold which in design terms would require a departure from standard, moreover for demonstration purposes it is notable that the 18 curves recorded as being at, or less than 180m in radius, which would be a departure for a road with a design speed of 70kph.

These characteristics generally result in poor Stopping Sight Distance (SSD) along the route, a point which is expanded upon in section 3.1.4.2.5 of this report.

Table 3-2: DN-Geo-03031 (formerly NRA TD9; Design Speed related parameters (Horizontal Curves))

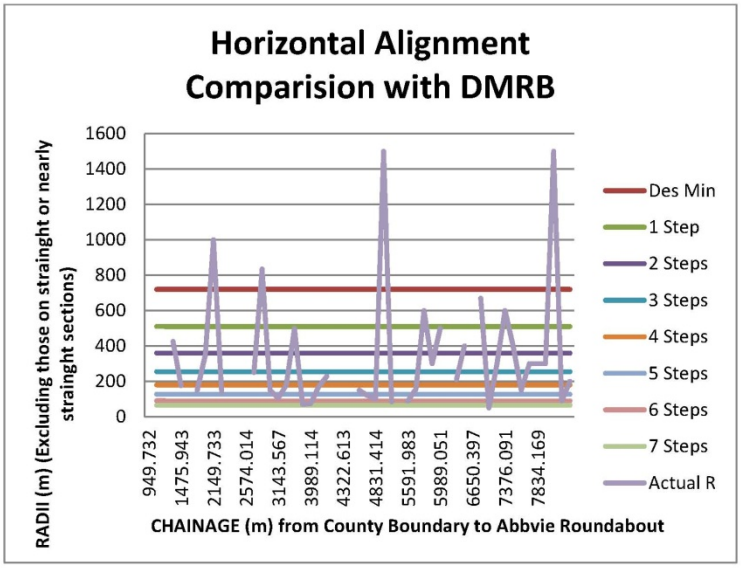
Horizontal Curvature m for Design Speed of 100kph	
Minimum R+ without elimination of Adverse Camber and Transitions	2040m
Minimum R+ with Superelevation of 2.5%	1440m
Minimum R with Superelevation of 3.5%	1020m
Desirable Minimum R with Superelevation of 5%	720m
One Step below Desirable Min R with Superelevation of 7%	510m
Two Steps below Desirable Min R with Superelevation of 7%	360m
Additional Curves which are outside the parameters of Table 1/3 of TD 09	
Three Steps below Desirable Min R with Superelevation of 7%	255m
Four Steps below Desirable Min R with Superelevation of 7%	180m
Five Steps below Desirable Min R with Superelevation of 7%	127m
Six Steps below Desirable Min R with Superelevation of 7%	90m
Seven Steps below Desirable Min R with Superelevation of 7%	90m

Table 3-3: Existing route Geometry in Comparison with Desirable Minimum R

Radius Band	720m	510m	360m	255m	180m	127m	90m	65m
Number of curves below particular band	37	34	29	23	18	8	6	1

[3] DN-Geo-03031 (formerly NRA; DMRB, NRA TD9/12, February 2012)

Figure 3-6: Horizontal Alignment comparison of existing road with DMRB



The deficient geometry occurs throughout the existing route and there are no clear sections where geometry could be considered to be at, or close to standard; by way of example the following outlines the most deficient sections:

- 110m Radius Bend at Barroe;
- 180m Radius Bend at Barroe;
- 180m Radius Bend at Barroe;
- 100m and 300m Radius Bend's at Barroe;
- 200m and 200m Radius Bend's at Doonally;
- 90m and 90m Radius Bend's at Drumkilsellagh;
- 90m, 90m and 200m Radius Bends in Drumkilsellagh and Castlegal;
- 150m and 170m Radius bends in Castlegal and Lugatober;
- 70m and 80m Radius bends in Lugatober;
- 160m, 90m and 90m Radius bends in Lugatober and Lugnagall;
- 160m and 120m Radius bends in Lugnagall;
- 300m, 200m and 100m Radius bends in Lugnagall and Gortnagrelly.

Sections, of such frequently occurring deficient radii, are quite uncommon on the national network. For demonstration purposes, Figure 3-7 outlines from a qualitative perspective how the N16 compares with other national routes in County Sligo. It is obvious from this figurative outline that the N16 has a higher frequency of twists, bends and tight radii than other routes within the County.

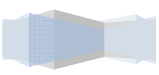
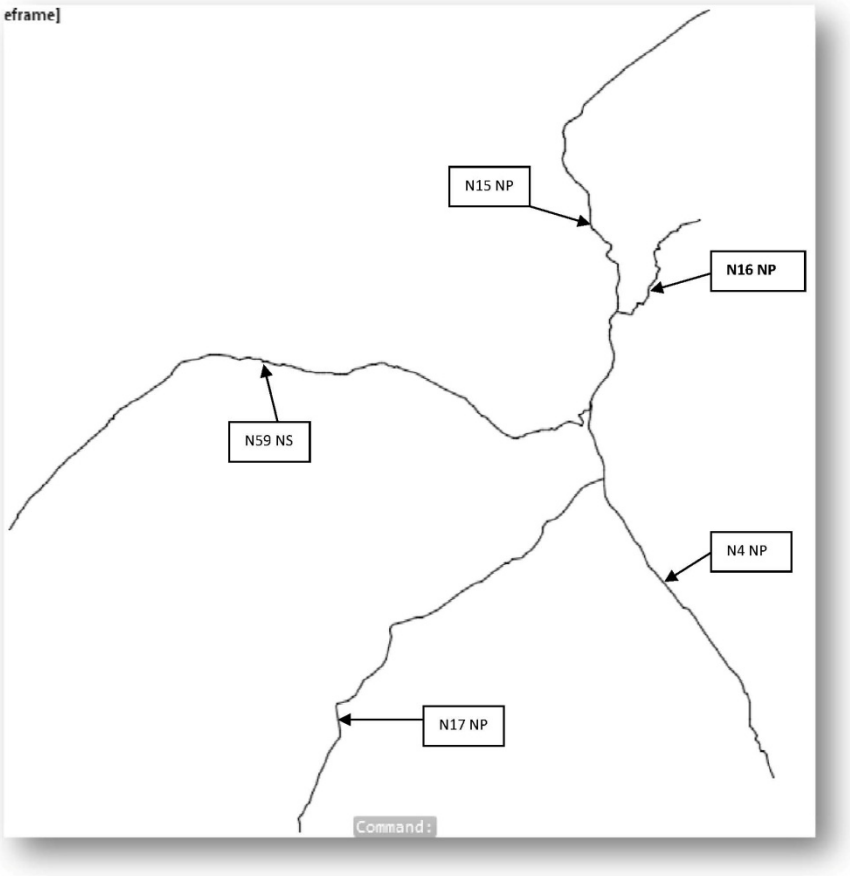


Figure 3-7: Sligo County National Primary and Secondary Network



Vertical Geometry

In relation to vertical geometry, Table 3-4 outlines the minimum requirements in relation to 100kph design speed roads. The analysis indicated a proliferation of various vertical curves along the route, with almost all curves coming under the category of a departure from standard for both the '*HOG*' and the '*SAG*' values. Similar to the demonstration made in relation to the horizontal geometry, it is notable that a significant portion of these curves have 'HOG' and 'SAG' values of below 10 which would be a departure for a road with a design speed of 70kph.

Table 3-4: DN-Geo-03031 formerly NRA TD9; Design Speed related parameters (Vertical Curves))

Vertical Curvature m for Design Speed of 100kph	
Des Min HOG	100
One Step below Des Min HOG	55
Two Steps below Des Min HOG	30

Vertical Curvature m for Design Speed of 100kph	
Des Min SAG	37
One Step below Des Min SAG	26
Two Steps below Des Min SAG	20

Design Speed Calculation

A design speed calculation has been carried out on the existing route to further characterise its deficiencies. This calculation has been carried out in accordance with TII DN-Geo-03031 (formerly TD 09/12) and reveals a design speed in the low end of the 85kph range which indicates a consequential Light Vehicle Mean Speed (wet) of circa 63kph which is well below the current day target for a national primary route.

Figure 3-8: Existing N16 – Design Speed

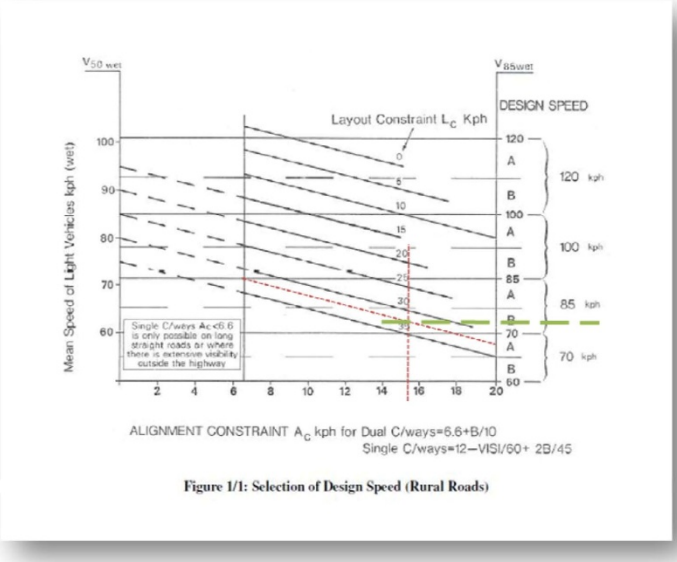


Figure 1/1: Selection of Design Speed (Rural Roads)

3.1.4.2.4 *Junctions*

Section 2.2 of this report, outlines the significant number of junctions with local roads along the existing route.

A significant safety issue in relation to these junctions (more particularly those rural ones) relates to the frequency of the junction, the Stopping Sight Distances which are attainable (in most instances well below the desirable minimum of 215m – see Table 3-5) and in a more isolated location the crossroads occurring at the N16's junction with the L-3407-0/L-3407-22 (see Figure 3-9).

Table 3-5: Junctions on Rural Section (3) of the existing N16

Junction Number	Section No.	Approx. Distance Ref. (Starting at junction with N4/N15)	Townland Location	Stopping Sight Distance	
				SSD to the west/south	SSD to the east/north
L-3407-0	3	3572	Doonally/Barroe	64	140
L-3407-22	3	3572	Barroe	95	135
L-7416-0	3	5066	Drumkilsellagh	107	165
L-3406-0	3	5426	Drumkilsellagh	129	325
L-7415-0	3	6046	Castlegal	93	65
L-74151-0	3	6309	Drum East	90	160
L-7413-0	3	7103	Lugatober	86	195
L-34041-0	3	7748	Lugatober	220	163
L-3404-0	3	7831	Lugnagall	125	108
L-7411-0	3	9216	Gortnagrelly	190	347

Five of the junctions which are situated on bends are particularly dangerous such as that outlined in Figure 3-10.

There are approximately 65 agricultural entrances onto the existing rural section of the route. From a safety point of view, these types of entrances are especially problematic as they encourage slow moving and frequently heavy agricultural traffic onto the national primary network.

The increasing volumes of north-south/east-west traffic on this strategic route corridor will lead to a greater risk of road accidents and a significant loss of amenity to the local residential population.

Figure 3-9: Cross-roads at Doonally where vertical alignment is particularly poor

Figure 3-10: Junction with Drum Road (L-3406-0) which is a link to the N15 and is becoming increasingly busy

3.1.4.2.5 *Overtaking Opportunities and Stopping Sight Distance*

The Rural section from the AbbVie Roundabout to the county boundary has been assessed in terms of overtaking value as having only 3% over its c. 8.5km length. Stopping Sight Distance (SSD) in relation to junction accessibility has already been outlined in section 3.1.4.2.4. In relation to SSD on the mainline, it has been assessed from an exercise undertaken in MX Road that:

- 83% of the route does not achieve a desirable minimum of 215m;
- 69% of the route does not achieve a one step below desirable minimum of 160m;
- 54.4% of the route does not achieve a two step below desirable minimum of 120m;
- 41.4% of the route does not achieve a three step below desirable minimum of 90m;

These rather serious results are further compounded by the fact that junctions and house entrances occur frequently over much of the route, a fact which in new design circumstances would require the full desirable minimum value to be achieved.

The lack of overtaking opportunities and Stopping Sight Distance in combination with frequent junctions and accesses, many of which have restricted visibility is an unacceptable situation with regard to road safety.

The lack of hard stand/verge areas, coupled with agricultural activities which regularly , further limit the opportunities for vehicles to overtake as slower moving agricultural vehicles cannot move in to allow other vehicles to pass, resulting in long tailbacks particularly during spring and summer months. Similarly, vehicles that break down cause delays as there are limited opportunities to pass a stationary vehicle.

3.1.4.2.6 *Accidents*

The following tables and figures outline accident statistics downloaded from the Road Safety Authority website, for the period between 2005 and 2012. In general, it can be seen that there was one fatality occurring on the rural section of the N16 with a further 3 serious injuries on the Urban section and 2 serious on the Rural Section. There have been a total of 38 reported accidents over the 8 year period on the N16 in County Sligo. Separately, although not documented below, it is notable that there was a further fatality in 2016 at *Drumkilsellagh*.

Table 3-6: RSA Collision statistics on URBAN section (2005 – 2012)

No. casualties - fatal	0
No. casualties - serious	3
No. casualties - minor	21
No. casualties - total	24

Table 3-7: RSA Collision statistics on RURAL section (2005 – 2012)

No. casualties - fatal	1
No. casualties - serious	2
No. casualties - minor	11
No. casualties - total	14

Figure 3-11: RSA Accidents; Sligo to Doonally

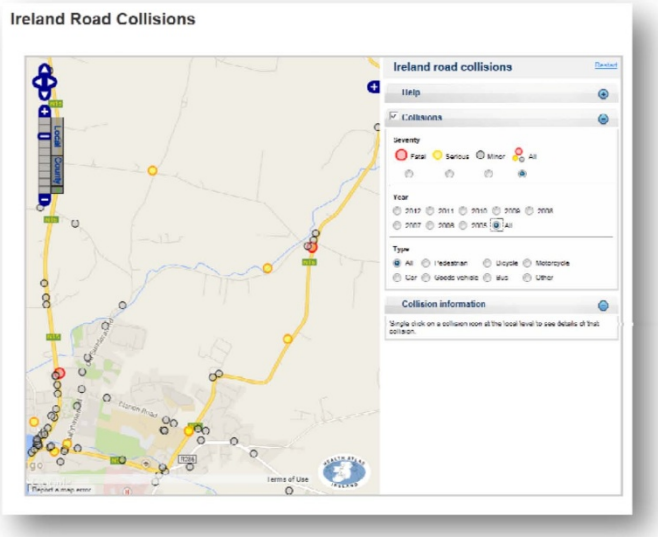


Figure 3-12: RSA Accidents; Doonally to Collinsford

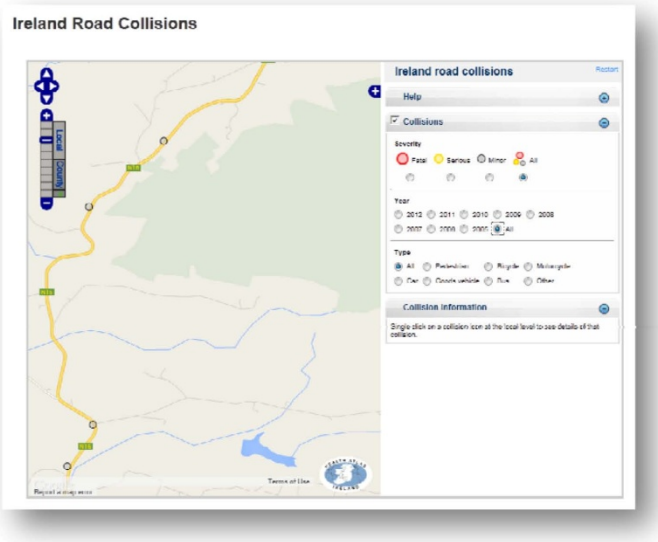
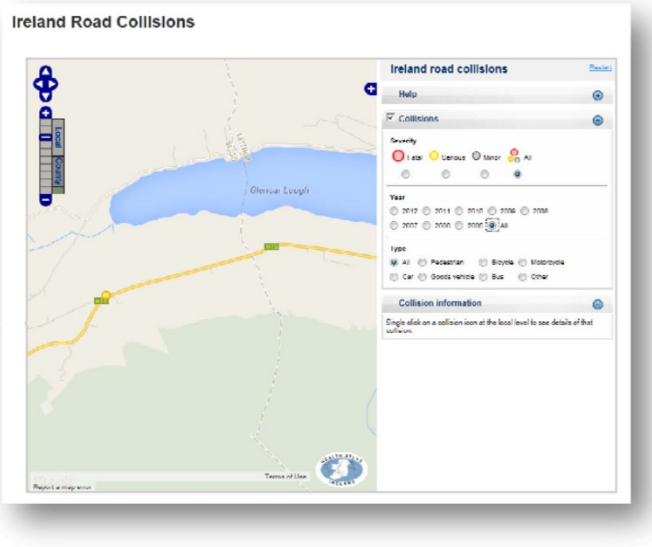


Figure 3-13: RSA Accidents; Collinsford to County Boundary



3.1.4.2.7 *Collision Rates*

Collision Types

Based on information obtained from RSA statistics, Table 3-8 outlines the type of circumstances prevalent in the various collisions. From this, it is notable that *'Rear end, Straight'* and *'Angle'* accidents are significantly above the national averages (although these are based on fatal accidents). This may be caused by poor visibility on sections of the existing road. Interestingly, pedestrian accidents are below the national average, possibly indicating the limited use by cyclists and pedestrians of the route.

Table 3-8: Collision Type

Circumstances	No.	% of Total	National average for fatal accidents
Other	3	13%	10%
Rear end, straight	4	17%	3%
Angle	6	26%	5%
Pedestrian	2	9%	27%
Single vehicle only	8	35%	40%

Fatality and Collision Rates

In terms of fatality rates the RSA states that:

In 2010, the fatality rate per billion vehicle kilometre travelled was 4.5. The 2000 rate was 12.6.[4]
In 2011, the fatality rate per billion vehicle kilometre travelled was 3.9. The 2001 rate was 11.9.[5]

These rates are significantly lower than the extrapolated rate for the Rural section of the N16; which as outlined in Table 3-11 is 13.05 fatalities per billion vehicle km travelled.

The collision rate for rural 2 lane roads nationally, between 2008 and 2010, is 11.3 collisions per 100 million km of travel. The collision rate per 100 million km of travel on the N16 is 24.488 (Urban and Rural combined).

Table 3-9: Vehicle km travelled per N16 Sligo Section (Urban and Rural)

veh km travelled per N16 Sligo Section	
Total Length (km)	10.45
Total veh km per year	11740261.5
Total veh 1mil km per year	11.7402615
Total veh 100mil km per year	0.117402615
Total veh 1bil km per year	0.011740262

Table 3-10:Collision Rate per vehicle km (Urban and Rural combined) of travel on N16

Collisions per veh Km of travel on N16	
Total Collisions	23
Avg Collisions per 1 year	2.875
Collisions per million Km	0.24488
Collisions per 100 million Km	24.488
Collisions per 1 billion Km	244.883

Table 3-11: Collision Rates on Rural section of N16

Total length, Rural	8.52km
AADT	3078 veh/day
Billion km travelled per year	0.009575784
Fatalities per year	0.125
Fatalities per b km	13.05376118

[4] *Road Collision Facts, 2010;* Road Safety Authority

[5] *Road Collision Facts, Ireland, 2011,* Road Safety Authority

TII HD 15 Network Safety Ranking

Notwithstanding the foregoing, GE-Sty-01023 (formerly HD 15) of the DMRB covers the requirements for Network Safety Ranking on National Roads. This safety ranking system is a means for identifying, analysing and classifying parts of the existing road network according to its potential for safety improvement and accident cost savings. (EU, Road Infrastructure Safety Management Directive). This Ranking procedure identifies High Collision Locations as being sites on the Network which has a collision rate twice above the Average

In relation to the N16, the Network Ranking procedure over the periods 2011 – 2013 (See Figure 3-14) and 2012 – 2014 (See Figure 3-15), has identified High Collision Locations in the following areas on the existing network:

- *Ballytivnan*;
- *Barroe* and *Doonally*;
- *Drumkilsellagh*; and
- *Lugatober*

Figure 3-14: TII Collision Rates 2011-2013[6]

[6] Red lines indicate accidents locations which are twice above the national average. Blue lines indicate accident locations which are twice below the national average.

Figure 3-15: TII Collision Rates 2012-2014

4 Scheme Safety Objectives

4.1 Scheme Safety Objectives

The scheme safety objectives, directly relate to resolving the safety problems identified in Section 3 of this report. This is with the objective of increasing the design speed of the N16 to 100kph, in order to make the route more efficient and comparable with other national primary routes throughout the Country.

The safety objectives are defined as follows:

(1) To align the design speed of the N16 with national standards and in so doing to *secure the provision of a safe and efficient network of national roads* as is required in the Roads Act;
(2) To segregate and reduce the number of direct accesses onto the route;
(3) To ensure the safe provision of facilities for Non-Motorised Users;

In order to achieve the foregoing, it is proposed that the scheme will be designed in accordance with the TII Design Manual for Roads & Bridges in order to achieve a target Level of Service D in the design year. A Level of Service D approximately equates to an average inter-urban speed of 80 km/h.

In this regard design objectives will include:

- Improve the N16 route to modern day standards including the provision of safe overtaking areas and appropriate road width;
- To facilitate easy access and efficient movement of people and goods through the region;
- To allow for the development of economic activity in accordance with various National, Regional and Local Policy and Planning Documents;
- To provide an effective highway infrastructure;
- To preserve the environmental amenities of the area.

5 The Consideration of Alternatives

5.1 Introduction

The 'Consideration of Alternatives' is a key element of the planning process, as it represents the rational to a narrowing of options, and it recognises the importance of avoiding impacts at an early stage. The following Chapter sets out the methodology, in relation to how alternatives are considered, in the N16 route selection process.

5.2 Methodology for Considering Alternatives

5.2.1 TII PMG and TII PAG

The methodology for considering alternatives is generally in accordance with the guidelines set out in the TII PMG 2010 and the TII PAG Unit 4.0 (Consideration of alternatives and options). The initial process commenced, following the completion of Phase 1, of the PMG (Feasibility Stage), with a study of the various forms of scheme alternatives. The study, which was carried out at a broad geographical scale, initially considered in a simplistic form, all the possible interventions, for the N16 as it occurs in County Sligo.

5.2.2 Alternatives Considered

5.2.2.1 Range of alternatives

The range of alternatives considered, can generally be classified under the following headings:

- 'Unfeasible' Alternatives;
- 'Do-Nothing' and 'Do-Minimum' Alternatives;
- 'Do-Something' Alternatives, including:
    - Public Transport Alternative;
    - Traffic Management Alternative;
    - Upgrade in accordance with the Design Manual for Roads and Bridges (DMRB);

The following chapter sets out the assessment process in relation to the foregoing.

5.3 Unfeasible Options

The first step in the process as already outlined, was the consideration at a wide geographical scale, of those options which were subsequently considered to be unfeasible. These options generally included:

- Consideration of 1996 routes;
- Potential regional road corridors;
- N16/N15 inter connection.

Sections 5.3.1, 5.3.2 and 5.3.3 of this report, outlines the assessment of these foregoing options.

5.3.1 Consideration of 1996 Routes

5.3.1.1 General

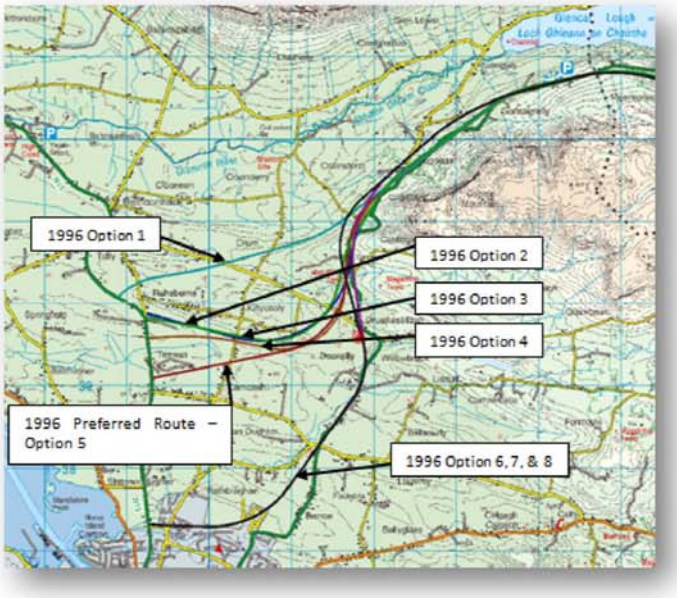
In examining Feasible Route Options for the N16, a review was initially undertaken of the routes put forward in the 1996 Route Assessment Report. In considering these routes, it is important to acknowledge that the process (at that time) predated the TII Project Management Guidelines. It is

also worthwhile to note, that although some landowners may have been contacted, wider consultation in the overall study area was not an active requirement.

At that time, 8 routes were initially established, with the Preferred Route considered to be the Red Route as depicted in *Figure 5-1* (Option 5 of the 1996 routes). Options 1, 2, 3 and 4 (1996 options) occurred to the north of the 1996 Option 5, and were coloured cyan, blue, green and brown respectively.

1996 Options 6, 7 and 8, were three additional options which generally merged into one black route south of *Drumkilsellagh*.

Figure 5-1: Preliminary Options Assessment 1995/1996



5.3.1.2 Review of 1996 Options 1, 2, 3 & 4

5.3.1.2.1 *The interaction of the N16 with the N15*

An important assumption made at the time of the 1996 assessment, was that the N15 would be upgraded to a Dual Carriageway cross section online. At the time, this influenced the N16 Route selection design process, insofar as, such an arrangement provided an attractive tie in point (to the N15) for some routes. This assumption was however compromised in 2006, with the selection of a Route Corridor for the N15, staggered to the west of the existing N15, at a point just north of Sligo Urban Area as outlined in Figure 5-2.

It was considered that the N15's subsequent design influence on the route options put forward for the N16 in 1996, would be to affect certain aspects of some route options. This includes *inter-alia*:

- Increased aspects of physical engineering;
- Decreased journey time benefits; and

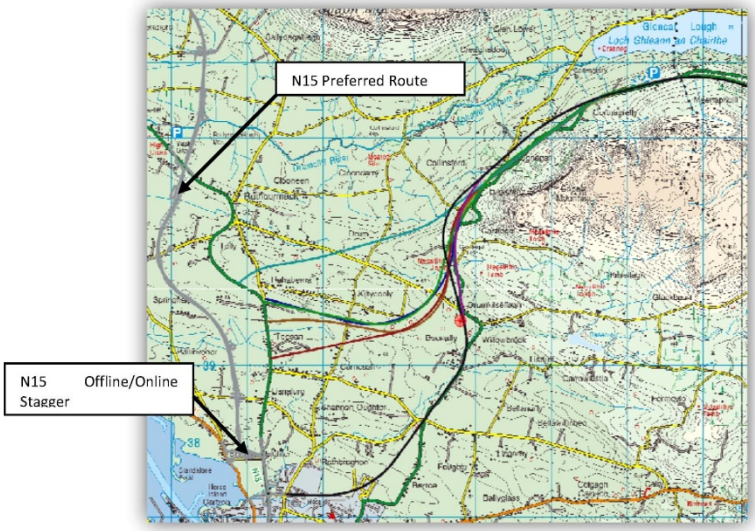
- Safety impacts.

It was felt in this regard, that such influences could be significant enough, to render some of the previously considered routes, unfeasible from a current day perspective.

In general, when the N16 connection point to the N15 is considered, the following resulting effects are obvious. These effects increase the further north any such junction is positioned on the N15.

- In a 'Do-Nothing' scenario for the N15 and a 'Do-Something' scenario for the N16:
  - N16 traffic would be diverted onto the existing N15 route, thereby potentially impacting upon traffic conditions on the latter[7]; or
  - An additional localised upgrade (in addition to any future realignment specific to the N15) could potentially be required for the N15, from the N16 connection point back to the Inner Relief Road (or its extensions, e.g. Hughes Bridge widening);
- In a 'Do-Something' scenario for the N15 and a 'Do-Something' scenario for the N16, either:
  - A full grade separated junction would be required connecting the proposed N16 to the proposed N15 (See also section 5.3.3 of this report); or
  - The localised upgrades described above for the N15 in its 'Do-Nothing' scenario, would potentially also be required in the 'Do-Something' scenario;

Figure 5-2: N15 Sligo to County Boundary Preferred Route and 1996 Routes



In order to assist in the selection process, a trip attractions assessment of the N16 was carried out, with reference to the currently available National Transport Model information and POWSCAR data. This assessment has already been expanded upon in section 3.1.3.2 of this report.

[7] A point, which requires consideration during the 'Preliminary Options Assessment'.

5.3.1.2.2 *Conclusion on 1996 Options 1, 2, 3 and 4*

Based on the foregoing, it was established that those options north of Option 5 (Preferred Route, 1996) were unfeasible from a current day perspective. To summarise, the basis for this conclusion is as follows:

- The attraction point, for c. 92% of traffic on the N16 is Sligo, or a point south of the Rosses Point junction. Therefore, journey times would be increased the further north on the N15 which any N15/N16 junction would be placed;
- The closer any such junction can be located to the N15's online/offline stagger point would result in the following:
    - A reduction in the need for a grade separated junction to cater for both schemes in a 'Do-Something' scenario;
    - A reduction in the length over which additional traffic is added to the N15 in a 'Do-Something' or the 'Do-Nothing scenario'. This results in a lesser need for improvements on the N15 as a result of a connecting N16 scheme;
- Geometry and existing junctions on the existing N15 in the *Teesan/Rahaberna* area (general area of Options 1, 2, 3 & 4 connections) make a connection less desirable;

5.3.1.2.3 *Conclusion on 1996 Options 6, 7 & 8*

Although Options 6, 7 and 8 of the 1996 routes, gave a more direct entry point into Sligo, it is observant at this stage, that the aforementioned routes would have unavoidable direct significant impacts on the since constructed AbbVie Pharmaceutical Plant and a new housing estate in *Rathbraghan*. For this reason, these options were also considered unfeasible from a current day perspective.

5.3.2 **Potential regional road corridors**

5.3.2.1 Cross Country Routes between Sligo and Manorhamilton

There are a number of cross country routes, which in addition to the N16 provide alternative connections between the town of Manorhamilton and Sligo. These routes were each examined in terms of their physical constraints – As outlined below, this revealed that none of these options could be considered 'Feasible Route Options'.

From an economic perspective, it is notably significant, that each of the proceeding corridors would require full construction works over their entirety within both counties Sligo and Leitrim. This is notable in comparison to the N16 where approximately 5.5km are already improved in County Leitrim, meaning the costs and impacts associated with any versions of the foregoing, would not compare with shorter improvements required on the N16.

5.3.2.1.1 *Manorhamilton to Sligo (via Dromahair, East and Calry)*

This alternative travel route, traverses on regional roads R280, R287, R288 (through the village of Dromahair) and the R286 before entering Sligo at *Bellanode*. The route measures approximately 32.4km which is over 8km longer than the main N16 national primary route.

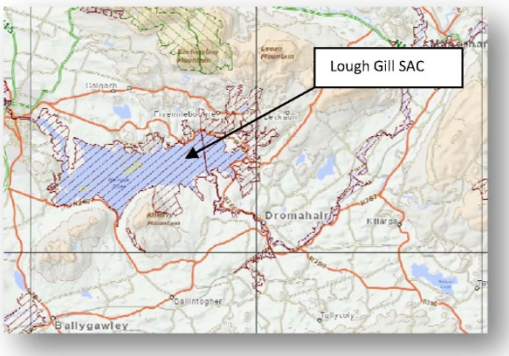
On an examination of any possible realignment of this route, which would seek to shorten the above distance, the following significant constraints are obvious:

- The Bonet River;
- Carrigeencor Lough;
- Lough Anarry;

- Benbo Mountain and the high lands around *Aghameelta Barr, Bohy, Coorycullen* and *Rubbal*;
- The village of Dromahair;
- Lough Gill and the highland areas between *Moneyduff* and *Fivemilebourne*;
- Colgagh Lough;
- Considerable residential development along the regional and local roads between *Kiltycahill* and Sligo; and
- Lough Gill SAC (See *Figure 5-3*).

Considering the foregoing constraints; it was concluded that this particular corridor did not lend itself to the design of any 'Feasible Route Option(s)'.

Figure 5-3: Lough Gill SAC



5.3.2.1.2 *Manorhamilton to Sligo (via Dromahair (north) and Carrowroe)*

This alternative travel route traverses westward from Manorhamilton on the N16, before turning off on a local county road in Leitrim and travelling in a southerly direction to connect with the R288 in the village of Dromahair. It continues to the R287, before entering Sligo at *Carrowroe* where it connects with the R284 (old Dublin Road). The route measures approximately 28.2km, which is over 4km longer than the main N16 national primary route.

On an examination of any possible realignment of this route, which would seek to shorten the above distance, the following significant constraints are obvious:

- The Bonet River;
- Carrigeencor Lough;
- The village of Dromahair;
- Killery Mountain;
- Slieve Dargan Mountain;
- Lough Gill;
- Considerable residential development along the regional and local roads between *Aghamore* and *Carrowroe*; and
- Lough Gill SAC.

Considering the foregoing constraints; it was concluded that this particular corridor did not lend itself to the design of any 'Feasible Route Option(s)'.

5.3.2.1.3 *Manorhamilton to Sligo (via Dromahair (west) and Carrowroe)*

This alternative travel route, traverses south from Manorhamilton on regional road R280, before diverting south west on regional road R287 and diverting to the west in Dromahair along the R287 which it follows before entering Sligo at Carrowroe, where it connects with the R284 (old Dublin Road). The route measures approximately 29.6km which is over 5.5km longer than the main N16 national primary route.

On an examination of any possible realignment of this route, which would seek to shorten the above distance, the following significant constraints are obvious:

- The Bonet River;
- The village of Dromahair;
- Killery Mountain;
- Slieve Dargan Mountain;
- Lough Gill;
- Considerable residential development along the regional and local roads between *Aghamore* and *Carrowroe*; and
- Lough Gill SAC.

Considering the foregoing constraints; it was concluded that this particular corridor did not lend itself to the design of any 'Feasible Route Option(s)'.

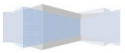
5.3.2.1.4 *Manorhamilton to Sligo (via Shanvaus Cross and Calry)*

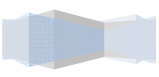
This alternative travel route, traverses west from Manorhamilton on the N16 before diverting off to the south at a junction known locally as Shanvaus Cross. The route follows the R286 southwards before connecting with the R278 which travels in a predominately westerly direction entering Sligo in *Bellanode*. The route measures approximately 21.5km, which is approximately 2.5km shorter than the main N16 National Primary Route.

On an examination of any possible realignment of this route, which would seek to shorten the above distance, the following significant constraints are obvious:

- Benbo Mountain to the east;
- Highlands in *Morerah* to the west;
- Doon Lough and small mountainous outcrops in its environs;
- Small mountainous outcrops interspersed with Drumlin deposits in the *Newtownmanor, Fivemilebourne, Carrickoneilleen* and *Colgagh* areas;
- Considerable residential development adjacent the regional roads along its entirety, but particularly west of *Loughanelteen*; and
- Lough Gill SAC.

Considering the foregoing constraints; it was concluded that this particular corridor did not lend itself to the design of any 'Feasible Route Option(s)'.





5.3.3 N16/N15 Inter Connection

Consideration was given at an early stage of the project to the viability of a connection between the 1996 Preferred Route (Current Feasible Route Option 01A) and the proposed N15 Sligo to County Boundary Realignment. This particular option was considered unfeasible for the following reasons:

(1) Engineering:
Such an option would require significant additional engineering features including *inter alia*:

- An overbridge across the existing N15 at *Teesan*;
- A full grade separated Junction including an overbridge arrangement to cross over the proposed N15 Sligo to County Boundary Scheme;

(2) Journey Times:
Such an option would add journey times, to the Sligo destined traffic on the N16. An approximate estimate, in the absence of a full design, indicates an additional length of between approximately 0.7km and 0.8km would be arising. Such an arrangement is counterproductive, as it reduces the economic benefits, while also making alternative routes into Sligo more attractive – such as the existing N16 at its connection with the Drum Road.

(3) Traffic Patterns:
The primary benefits of such an option would be to provide improved access to the north, however it is obvious from traffic information gathered from the National Transport Model that that such a demand does not currently exist to any notable degree;

(4) Project Twining:
Such an option would require merging the N16 Sligo to County Boundary Scheme with the N15 Sligo to County Boundary Scheme. Such a project would be considered to be unviable in the current economic climate.

(5) Other adjacent schemes:
The long term importance of the 'Sligo Western Bypass' is noted in the Sligo & Environs Development Plan as follows:
"Sligo City requires a Western Bypass to enable traffic not wishing to access the city to pass with ease from North to South and vice versa. A modern well planned bypass will augment Sligo's infrastructure and attractiveness for inward investment allowing it to fulfil its potential as a Gateway City.
A Feasibility Report for the 'Sligo Western Bypass', was completed in December 2008. A full route selection process did not take place at that time; however, the aforementioned Development Plan in objective T1.5.a, has stated the following restriction in relation to any future project:

At its Special Meeting of 17 November 2008, Sligo County Council resolved:
"that the Western/City Bypass should be located west of the Second Sea Road with a view to ensuring that the accepted negative impact on those people living between the two Sea roads be prevented"
The resulting effect is that any future long term strategic bypass, if deemed viable, is likely to intercept the proposed 'N15 Sligo to County Boundary' scheme somewhere in the townland of *Ballyvoher*. Connecting the proposed N16 in the vicinity of this location, could ultimately impact on the Route Selection for the 'Sligo Western Bypass' – it would also increase the scale of complexity for a junction in this area, which would require significant engineering works.

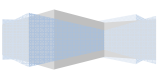


Figure 5-4: Option 1A/1B and the interaction with the N15

On the basis of the foregoing and considering that an at grade roundabout in *Teesan*, would ultimately (if it is deemed required at a future stage), permit an extension westwards to the proposed 'N15 Sligo to County Boundary' scheme, or the 'Sligo Western Bypass', a conclusion was made that a connection between the N16 Option 1A/1B and the 'N15 Sligo to County Boundary' scheme is not a viable consideration at the current time (i.e. In terms of the N16 Route Selection process).

5.4 'Do-Nothing' & 'Do-Minimum' Scenarios

One of the initial steps in the route selection process was the consideration of 'Do-Nothing' and 'Do-Minimum' options/alternatives.

These alternatives, in relation to this study, are identified and considered as outlined in sections 5.4.1 and 5.4.2.

5.4.1 Do-Nothing Alternative

The 'Do-Nothing' alternative comprised an investigation of the existing road infrastructure and its ability to meet future demands for traffic and safety without any upgrade, or junction improvement works, other than routine maintenance. The results of this process, has already been outlined in section 2.2 and section 3 of the 'Road Safety Impact Assessment' report.

In the case of the existing N16, the Do-Nothing scenario represents the base case, i.e. the route in its current form with only routine maintenance accounted for in its current and future ability to meet traffic and safety demands. Given the significant deficiencies, already described in the foregoing sections, the 'Do-Nothing' is not considered a viable alternative in providing a 'safe' and 'efficient' national road network.

5.4.2 Do-Minimum Alternative

The TII Project Appraisal Guidelines states that the 'Do-Minimum' alternative, should include those transportation facilities and services that are either committed, or planned within the appraisal period. To provide a basis of comparison, the 'Do-Minimum' alternative must include the following features:

- The maintenance of existing facilities and services in the study area;

- The completion and maintenance of committed projects, or, policies in the study area that have successfully completed their environmental review; and
- The continuation of existing transportation policies.

The 'Do-Minimum' alternative for the N16 project was based on the definition that only 'committed' improvements are included, meaning typically those that have been progressed through planning and are either under construction, or, are programmed into the capital expenditure budget.

Funding for the construction of a new bridge over the Garvogue River in the east of Sligo has been granted through the government's capital expenditure programme. This river crossing will supplement the three existing bridges in the area whilst increasing traffic permeability and thereby route choice within the urban area. It is also identified as a strategy transport objective in the Sligo and Environs Development Plan 2010 – 2016. Consequently, the proposed Eastern Garvogue Bridge (EGB) is included in the 'Do Minimum' scenario for the N16 Route Selection – This is most relevant in terms of traffic modelling and any ensuing effects arising.

The 'Do-Minimum', from an N16 road network perspective, is considered to be similar to the 'Do-Nothing' scenario as outlined in section 5.4.1.

5.5 'Do-Something' Alternatives

5.5.1 Public Transport Alternative;

Public Transport can generally be defined as bus and train transport available for shared use by the general public. In the case of the N16/A4 strategic route, the only form of Public Transport available is the operating Bus Service provided by both public and private operators.

The Need for an upgrade to the N16 has been set out in section 3 of this RSIA. The Public Transport Alternative will not satisfy the Need for the following reasons:

- Point to Point 'Public Transport' will not adequately cater for the dispersed nature of the geographical zone which is attracted to the N16;

5.5.2 Traffic Management Alternative;

5.5.2.1 Traffic Management Alternatives

The Traffic Management Alternatives (TMA) as defined in the TII PAG *represent those which seek to respond to transportation problems by maximising the value of existing infrastructure*[8]. As recommended by PAG, the Traffic Management alternatives can include:

- *Removal of bottlenecks through targeted local investment;*
- *Local road safety improvements;*
- *Fiscal or Traffic Control measures to manage traffic demand;*
- *Public Transport Priority, capacity and/or public transport services;*
- *Corridor or area-wide improvements to pedestrian or cycling provision; and*
- *Intelligent Transport Systems to improve reliability, safety and operating capacity.*

This option is deemed to represent the *'best'* that can be done using existing infrastructure, it is noted that in some cases this option may also fit into the Do Something DMRB upgrade outlined below.

Section 2.3.5 of the *Guidelines on a Common Appraisal Framework for Transport Projects and Programme* refers to a Management Option as follows:

[8] TII Project Appraisal Guidelines, 2011, Unit 4.0, Definition of Alternatives.

> *Investment options will not always represent the most appropriate response to identified needs or objectives. Better management or pricing of existing networks and services may either reduce demand or expand the effective capacity of networks. A management option may also be more environmentally acceptable...*

The deficiencies requiring intervention in the road network, which have already been outlined in section 3, determine the form of any Traffic Management Alternative, i.e. the latter four categories described above will not resolve the safety and efficiency deficiencies imparted by the route.

In this regard, possible Traffic Management Alternatives for the N16 have been determined to include local road safety measures and the removal of bottlenecks[9] through targeted local investment.

5.5.2.2 Assessment

In order to establish if the N16 would lend itself to targeted local investment, or local road safety improvements, a geometric design assessment has been carried out, to establish the extent and associated effects ...*of the best that can be done*... with the existing alignment.

The approach taken, to satisfy the foregoing, was to develop design's which would match as far as is practicable, the corridor of the existing N16, while at the same trying to improve the significant geometric deficiencies. As it is clear, that a design prepared for a 100kph design speed (which is standard for national primary roads) will require significant areas of greenfield realignment, it was considered appropriate to consider reducing the tiers of design standards, from that which would normally be appropriate on national primary roads, and to establish if this would provide any greater benefits over the standard approach, specifically in terms of cost and environmental impacts.

In order to achieve this, two separate design options were prepared for the rural section between the AbbVie Roundabout and the County Boundary with Leitrim. The first design option; was a one step reduction in design speed terms, from 100kph to 85kph (which would be a typical design speed for regional roads and good quality local primary roads). The second design option, was a two step reduction in design speed terms from 100kph to 70kph (which would be a typical design speed for lower quality regional roads and local primary roads).

The characteristics of these designed options were then tabulated, in order to establish if they provided viable options which would be economically, or environmentally better solutions to a standard 100kph design option. The resulting effect is outlined broadly in *Table 5-1*, the main observations are:

- Between 51%[10] and 46%[11] of the route will still require greenfield realignment. This is owning to the poor nature of the existing horizontal geometry;
- Of the remaining sections which are online, full vertical reconstruction[12] will be required over approximately 42%[11] and 48%[10]. This is primarily as a result of the poor nature of the existing vertical geometry;

The foregoing points, from an engineering perspective mean that a reduction in 'Design Speed' will not significantly reduce the engineering aspects associated with the realignment. In addition, it is

[9] 'Bottlenecks', for the purposes of this assessment, are defined to be a serious of substandard horizontal and vertical curves, resulting in 'Stopping Sight Distances' which have the effect of reducing speeds and causing platoon's of traffic;

[10] 70kph Design Speed

[11] 85kph Design Speed

[12] Full reconstruction considered where the vertical alignment deviates from the existing by greater than 0.6m

considered that the 42% to 48% of online improvements would only (due to the vertical differences) serve to require a closing of the national primary route in order for upgrade works to be undertaken. Further points which are also of significance include:

- There is significant impacts on property at locations where road widening and realignment is required;
- A significant number of direct access arrangements remain, particularly around cluster locations such as at *Barroe* and *Doonally* townlands;

Additionally, the aforementioned designs will not be, as '*safe*' or '*efficient*' as the comparable 100kph designs.

Table 5-1: Traffic Management Alternative – Some Characteristics

Characteristics of TMA	*Design Speed*	
	70kph	85kph
Length of Option (m)	7,985m	7,943m
Length of Option which requires Greenfield Realignment (m)	4,070m	3,650m
Length of Option ONLINE BUT which require full vertical reconstruction (km)	3,395m	3,814m
Properties potentially required under a CPO (no.)	8	13
Properties where garden space is required (no.)	30	22
No. of Direct Accesses which remain (no.)	38	27

In consideration of the foregoing assessment, it can be concluded that the Traffic Management Alternative is not a viable intervention.

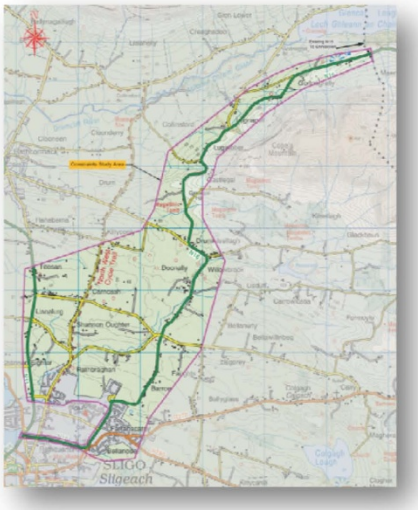
5.5.3 Upgrade in accordance with the DMRB

The process as outlined; evolved to indicate, that the only viable solution to the interventions required, on the N16 in County Sligo, is an upgrade which is consistent with the requirements of a national primary road and the DMRB. The following sections, outlines the process used to develop the 'Feasible Route Options' for this solution.

5.5.3.1 Constraints Study Area

The definition of the Constraints Study Area (See Figure 5-5), was guided by the initial assessment of unfeasible options, which has already been described in section 5.3 of this report.

Figure 5-5: Constraints Study Area – July 2015



5.5.3.2 Road Development Guidelines

National road projects are planned and delivered in accordance with a common framework that helps to ensure a consistency in the approach throughout the national road network. This common framework is described in a hierarchy of documents including *inter-alia* the following:

- The TII; Project Management Guidelines;
- The TII; Project Appraisal Guidelines;
- The TII; Cost Management Manual; and
- Environmental Legislation, Regulations and Guidelines;

5.5.3.2.1 *TII Project Management Guidelines and Project Appraisal Guidelines*

The TII Project Management Guidelines, is intended as the main guidance document with regard to the management of all national road projects from inception through planning, execution and closeout. It forms the overarching document that ties together the other elements of the project development process. The route selection process is Phase 2 of a 7 Phase process.

The TII Project Appraisal Guidelines (PAG) was published in October, 2016. These new Guidelines apply to the appraisal process of national road projects and programmes. The PAG incorporates the requirements of project appraisal which are set out in the following governmental publications:

- 'The Public Spending Code', Department of Public Expenditure and Reform, publicspendingcode.per.gov.ie; and
- 'Common Appraisal Framework for Transport Projects and Programmes', Department of Transport, Tourism and Sport (2016).

The route selection and appraisal process is project specific, but follows the guidelines set out in the TII Project Management Guidelines and the current recommendations in the new PAG, i.e.

5-38

6.1 Narrowing of Options
Throughout the planning and project development process the primary nature of the decisions to be made is a selection of the preferred option through a narrowing of

options. The Option Selection (Phase 2) process is split into three distinct stages within the TII Project Management Guidelines, each requiring a greater level of assessment and appraisal. The three stages are referred to as:

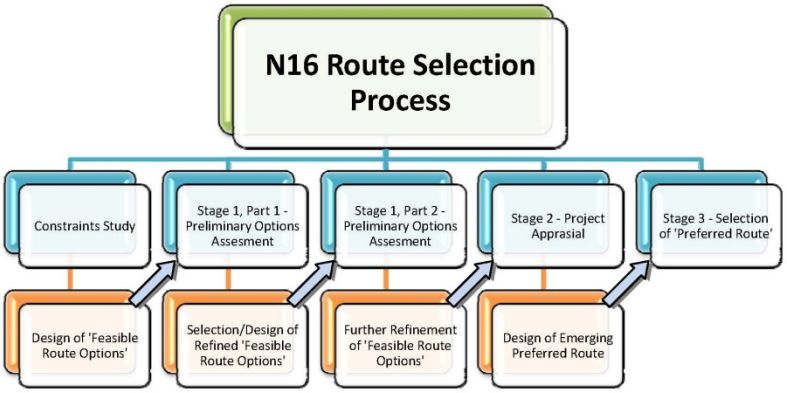
- *Stage 1: **[Preliminary Options Assessment]**[13];*
- *Stage 2: **[Project Appraisal Matrix]**; and*
- *Stage 3: **[Selection of a Preferred Option]**.*

***Stage 1 - Preliminary Options Assessment** - develop a number of feasible options and carry out a Multi-Criteria Analysis (MCA) under the assessment criteria of **[Engineering]**, **[Environment]** and **[Economy]**. This will result in a refined number of options (minimum of 4, Do-Nothing or Do-Minimum and a least 3 Do-Something Options)...*

***...Stage 2 - Project Appraisal Matrix** - following Stage 1, carry out a full CBA and MCA of the quantifiable and non-quantifiable impacts of these options (under the six CAF Criteria of Economy, Safety, Environment, Accessibility & Social Inclusion, Integration and Physical Activity)...*

***...Stage 3 - Preferred Option** - after the completion of Stage 2, select a Preferred Option for the Scheme. Following this, prepare a Project Appraisal Balance Sheet (PABS) to summarise the impact of the Preferred Option.*[14]

Figure 5-6: Stages of N16 Route Selection



5.5.3.2.2 *TII Cost Management Manual*

The TII Cost Management Manual, has been used in the development of the 'Options Comparison Estimate' which is described in the main body of the Route Selection Report.

5.5.3.2.3 *Environmental Legislation, Regulation and Guidelines*

The TII has developed a comprehensive suite of Environmental Guidelines for the planning, design and construction phases of National Road Projects. These have guided the surveys and assessment methodologies for each of the appropriate environmental topics in order to assist in the identification of the preferred route corridor.

[13] Authors emphasis

[14] Project Appraisal Guidelines for National Roads Unit 4.0 - Consideration of Alternatives and Options, PE-PAG-02013, October 2016

5.5.3.3 Selection of Road Type

An assessment of the Road Type to be put forward for the N16 realignment between Sligo and the County Boundary has been undertaken and is set out in the main body of the Route Selection Report.

The assessment was carried using the following criteria:

(1) The Guidance set out in the DMRB;

(2) Consistency of Network Layout;

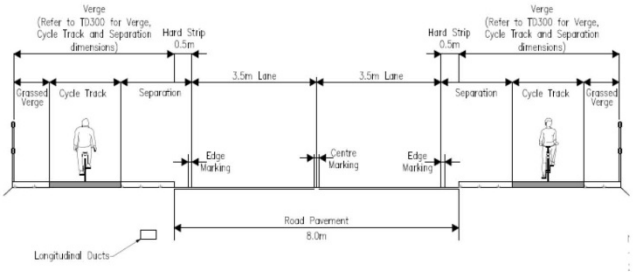
(3) Reducing the Environmental Impacts; and

(4) Scale/Construction Costs;

The assessment concluded the most appropriate Road Type to be a Type 2 Single Carriageway (See *Figure 5-7*) which generally consists of;

- 2 no. 3.5m carriageways supported by 0.5m hard strips and 4.5m grass verges (5m total) on each side. In this cross section, there is a requirement for the provision of cyclist/pedestrian facilities on both sides (one way). It is proposed for the purposes of establishing Road Type at Route Selection Stage to consider a two way facility (on one side) which will cater for cyclists and pedestrians, this results in a 3m wide paved track offset 1.5m from the edge of the paved surface, resulting in an increase in the grassed verge area of 1m on one side – Depending on the route selected;

Figure 5-7: Type 2 Single Carriageway



5.5.3.3.1 *Junction Strategy*

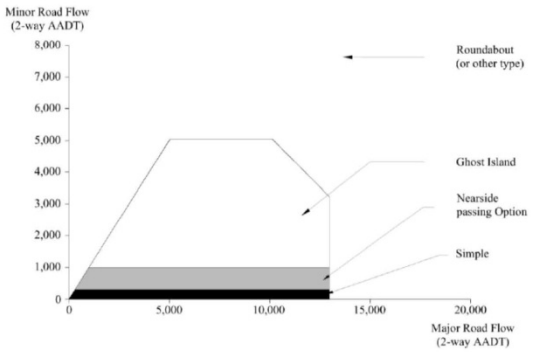
The junction strategy will be influenced by projected traffic volumes, however for the purposes of Initial Sketch Arrangement (at Route Selection Stage) and in accordance with the DMRB DN-Geo-03043 (formerly TD 41-42/11), the junction types are currently proposed to be:

- Simple T Junctions, or, staggered Right – Left junctions, for side road traffic with less than 300 AADT. This arrangement may be supplemented with Ghost Islands, where the AADT on the side road is in excess of 300;
- Roundabouts for:
  - Change in cross section;
  - Tie in points to the urban area;
  - Cross road situations in the Urban Area; or
  - Very highly trafficked local roads;
- Traffic Signals may also be appropriate for cross road situations in the urban area.

Figure 5-8: DMRB DN-Geo-03043 (Formerly TD 41-42/11 – Possible Junction Types for Different Major Road Carriageway Types)

Carriageway Type		Junction/Direct Access Type								
		Simple (Fig. 1/1)			Ghost Island (Fig.1/2)			Single Lane Dualling (Fig. 1/3)		
Standard	Location									
S2	Urban	Yes	Yes	Maybe	Yes	Yes	No	No	No	No
	Rural	Yes	Yes	No	Yes	Yes	No	No	No	No

Figure 5-9: DN-Geo-03043 (formerly - TD 41-42/11 – Approximate Level of Provision of T-junctions on New Single Carriageway Roads for Various Major and Minor Road Design Year Traffic Flows)



5.5.3.3.2 *Treatment of Direct Accesses (lightly trafficked and minor junctions)*

TII DMRB DN-Geo-03043 (formerly TD 41-42/11) provides further guidance in relation to the treatment of direct accesses and minor junctions:

> *There is a potential saving in collisions where there is a reduction in the number of lightly trafficked direct accesses and minor junctions made directly on to each national road. Such accesses can be joined together with a link or service road before they join the main carriageway of the national road. Options for such indirect connections should always be explored, as should providing the access from the local road network.*

The design process for the N16 will adopt this approach, insofar as is reasonably practicable. The incorporation of these accesses into side roads, via the potential provision of parallel tracks, will concentrate turning movements onto and off the proposed N16, thereby improving safety aspects and Full Overtaking Sight Distance on the mainline.

Notwithstanding the foregoing, it should be noted, that each direct access arrangement will be considered on a case-by-case basis. There may be instances where it is impracticable, or where significant engineering (via the provision of parallel tracks) makes the collection (to the local network) of some of these accesses unviable.

The case-by-case basis will focus on *inter-alia*:

- Journey Time and Community Severance; and
- Value Engineering;

5.5.3.4 Feasible Route Options

5.5.3.4.1 *Description of Feasible Route Options*

The development of Route Options is an iterative one and commenced with the development of 'Feasible Route Options'. There were 11 initial FRO's, with 2 additional extension's to Options 1 and 2, giving a total of 13. These options are described grammatically in section 5.3 of the Main Report (Volume 1 of the Report Selection Report) and figuratively in Volume 5 of the Route Selection Report. The routes can be separated into Four Strategic Options as outlined below:

- N15 (connection at Teesan Td.) to the County Boundary:
  - Red – Feasible Route Option 01A;
  - Red – Feasible Route Option 01A/01B;
- N15 (connection at *Shannon Oughter*) to the County Boundary:
  - Yellow - Feasible Route Option 02A
  - Yellow - Feasible Route Option 02A/2B
- *Rathbraghan* to the County Boundary:
  - Green - Feasible Route Option 03
  - Light Blue - Feasible Route Option 04
  - Lime Green - Feasible Route Option 10
  - Grey – Feasible Route Option 11
- AbbVie Roundabout to the County Boundary:
  - Blue - Feasible Route Option 05;
  - Pink - Feasible Route Option 06;
  - Brown - Feasible Route Option 07;
  - Black - Feasible Route Option 08;
  - Purple - Feasible Route Option 09;

5.6 Appraisal

5.6.1.1 Stage 1 - Preliminary Options Assessment

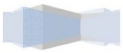
The Feasible Route Options, as described in section 5.5.3.4.1, were subjected to the Stage 1, Part 1, Preliminary Options Assessment, which is described in full within section 8 of the Main Report.

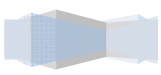
The assessment was undertaken by a multi disciplinary range of specialists, as outlined in *Table 5-2*.

The RSIA forms one element of the Preliminary Options Assessment.

Table 5-2: Preliminary Options Assessment

POA Framework Category	Discipline	Body Responsible
Engineering	Engineering	SCC National Roads Project Office
Engineering	Road Safety Impact Assessment	SCC National Roads Project Office
Engineering	Traffic	Jacobs Engineering
Economics	Cost Estimate	SCC National Roads Project Office
Environment	Landscape & Visual	RPS Ireland Ltd.





POA Framework Category	Discipline	Body Responsible
Environment	Flora, Fauna & Fisheries	RPS Ireland Ltd.
Environment	Agricultural Property	John Bligh & Associates
Environment	Non-Agricultural Property (Domestic, Industrial, Commercial etc.)	John Bligh & Associates
Environment	Noise & Vibration	Envest Environmental
Environment	Air Quality & Climate Change	Envest Environmental
Environment	Hydrology & Hydrogeology	Hydro Environmental
Environment	Soils & Geology	Roughan & O'Donovan
Environment	Archaeology & Cultural Heritage	ACSU
Environment	Architectural Heritage	ACSU
Environment	Socio Economic	Optimize Consulting
Environment	Urban Planning	The Planning Partnership

5.6.1.1.1 *Scorecards and Sectional Splits*

5.6.1.1.2 *Assessment*

Overview

The first stage of the refinement process included an examination of the following:

(1) The 'Preliminary Options Assessment' reports as already outlined in the foregoing sections of this chapter;
(2) The completed scorecards;
(3) Discussions at the Multi Disciplinary Workshop;

The Preliminary Options Assessment' reports informed the scorecard described at (2), which in turn facilitated a number of reviews from differing perspectives including 'Full Scores Compilation' and 'Averaging as per Framework Matrix Criteria'. The outputs from points (1) and (2), facilitated interactive discussions between the Multi Disciplinary Team during the workshop described in section below.

It is important to note, that the matrices described in the proceeding sections of this report should be interpreted as guiding tools, as opposed to an exact science in terms of comparing individual route options. It is these tools, together with collaborative professional judgement and localised assessment of route impacts which ultimately dictate the refinement and selected of the optimal routes.

Full Scores Compilation

The 'Full Scores Compilation' considered each assessment discipline in its own individual right. It sums up the total scores to give a total cumulative score and then applies the ranking structure outlined in Table 5-3.

Table 5-3: Application of Ranks to 'Preferences'

Relative Rank		Preference	Preference Rank
From	To		
1	2	Very High Preference	1
3	4	High Preference	2
5	9	Medium Preference	3
10	11	Low Preference	4
12	13	Very Low Preference	5

Averaging as per Framework Matrix Criteria

In cognisance of the fact that there is no weighting applied in the case of the 'Full Scores Compilation' a comparable exercise was carried out which averaged the scores for each discipline under the 'Preliminary Options Assessment' framework categories of; 'Engineering', 'Economy' and 'Environment'. This permitted an additional broad comparable to the 'Full Scores Compilation'.

Multi-Disciplinary Workshop

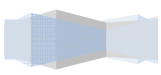
A first Draft of the various multi disciplinary reports was completed in advance of a Workshop held on the 1st of June, 2016. The workshop facilitated interactive discussions in relation to 'Feasible Route Options' and their perceived impacts. It resulted in a general consensus, as to which parts of the various 'Feasible Route Options' should proceed to the next stage of the assessment and where there was a requirement for further localised assessment.

Discussions at the workshop were guided initially by the outputs of the aforementioned Scorecards – This allowed for a more in depth critical analysis of each particular section. The aim was to establish a consensus in relation to which options were less preferable to others, or, if there were situations where some options could be improved via design changes. The opinion's of each particular specialist was provided, with a particular focus on core aspects of the particular studies, i.e. those areas which were expected should, or could, influence the selection of a Preferred Route. Interactive group discussions, focussed generally on the following aspects:

- Initial ranking of route options (in terms of the scorecards);
- Clusters of positive ranks (i.e. 'Very High Preference', 'High Preference' and in some cases the upper ends of 'Medium Preference' ranks);
- Clusters of negative ranks (i.e. 'Very Low Preference', 'Low Preference' and in some cases the lower ends of the 'Medium Preference' ranks);
- Profound, or Significant localised impacts;
- Desirable and undesirable lines; and
- Potential amalgamated, modified options.

5.6.1.1.3 *Refined Route Options*

The outcome of the 'Preliminary Options Assessment' is outlined in section 7 of the Main Report. This resulted in a refinement of the route options, which included discounting of certain options and applying design changes to others which also included the breaking down and amalgamation of certain sections.



These options are described grammatically in section 8.1 of the Main Report (Volume 1 of the Route Selection Report) and figuratively with Volume 5 of the Route Selection Report. The routes can be separated into three Strategic Options as outlined below:

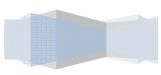
- N15 (connection at Teesan Td.) to the County Boundary:
  - Red – Feasible Route Option 01A – v2;
  - Red – Feasible Route Option 01A/01B – v2;
- N15 (connection at Shannon Oughter) to the County Boundary:
  - Yellow - Feasible Route Option 02A – v2;
  - Yellow - Feasible Route Option 02A/02B – v2;
- AbbVie Roundabout to the County Boundary:
  - Black - Feasible Route Option 8 – v2;
  - Purple - Feasible Route Option 12;

5.6.1.2 Stage 2 - Project Appraisal Matrix

The Refined Route Options as described in 5.6.1.1.3, were subjected to the Stage 2 (Project Appraisal Matrix) which is available within section 9 of the Main Report (Volume 1 of the Route Selection Report). The objectives of the scheme are appraised in accordance with the national transport planning policy using the common appraisal framework based on the following five criteria:

- Economy
- Safety
- Environment
- Accessibility
- Integration

This appraisal will be developed during the proceeding Phases of the NRA (now TII) Project Management Guidelines.



6 Analysis of Road Safety Impacts

6.1 General

Prior to undertaking the assessment, The RSIA team, examined the overall context of the 'Feasible Route Options' and how they may interact with the receiving environment, in relation to road safety impacts. A general consensus having regard to the nature of the proposal, concluded with the establishment of a set of criteria, which could be used to undertake the assessment; these criteria and the reasoning for their selection are outlined below:

(1) Length
- The 'Length' of each particular 'Feasible Route Option' was considered important, insofar as the length of a route generally dictates the journey times (considering an average 'Level of Service' applied to each Route Option) – this has implications in terms of the likelihood of accidents on a given route, considering similar designs for each route option;

(2) Junctions & Side Roads
- It is generally recognised in road design, that there is a relationship between accident statistics and the frequency of junctions. In this regard, assuming uniform junction design(s) across each 'Feasible Route Option', the density of the number of junctions attached to a particular route was assessed. Additionally, connections between the realigned local roads and the existing local network were also assessed, recognising that in some cases the connection between the new and existing local network may provide for differing cross sections or symmetries of layout;

(3) Online Sections - Direct House Accesses
- The general objective, in relation to the design of 'Feasible Route Options' and where they interact with direct accesses, is that these direct accesses will, where feasible, be grouped together and reconnected back into the national network through adjoining local road connections. There are instances however, where this will be difficult (and in some cases not possible) such as at online sections where house and agricultural entrances directly abut the national road. In a similar manner to point (2) above, this will increase the density of junctions and in this regard is assessed accordingly in the RSIA;

(4) Tie In to National Network (North & South)
- Tie-In's from a road safety perspective, were considered important by the assessment team for two particular reasons:
  - They can result in instances where a newly upgraded road is connected to a substandard section; this can result in an inconsistency of road layout and increased speeds coming into deficient sections;
  - They generally result in online works which increases the requirements for Traffic Management during construction;

In this regard, the Tie-In's at the terminus points have been assessed in terms of how they interact with the existing Network.

(5) Impact on the existing National & County Network – Including Vulnerable Road Users
- New roads by their nature have the potential to impact on, or change the characteristics of the residual road network. This may include for example, an

increase in traffic on some local roads. With the aid of the Traffic Model outputs, these interactions were assessed in the RSIA.

- In addition, this element of the assessment, focused on vulnerable road users which generally includes those people who do not have the perceived safety of being inside a car behind them. In the main these users include pedestrians and cyclists. The assessment examined areas along 'Feasible Route Options' where there was likely to be significant interaction in the urban area/and or locations where there would be expected to be sensitivities in relation to vulnerable road users.

6.2 Route Options Assessment

6.2.1 Assessment

The following paragraphs, outlines the approach taken to the assessment and the results which were arrived at.

6.2.1.1 Assessment Phases

The RSIA was undertaken over two different phases; the first element of the assessment was undertaken on the full suite of Feasible Route Options prior to their publication in January 2016. This element of the assessment which is outlined in the proceeding section 6.2.1.3, was used to inform the 'Preliminary Options Assessment' which included an examination of numerous other multi disciplinary assessments under three broad headings of Engineering, Economy, and Environment. The RSIA is included in the Engineering section of the assessment.

This process resulted in a refinement of route options, which from a RSIA perspective resulted in a second stage of similar assessment – the results of this are outlined in section 6.2.3.

6.2.1.2 Extents

For the majority of assessments undertaken as part of the Route Selection process, a common point starting point was established, as being the junction of the N4/N15/N16 in Sligo (See Figure 6-1).

A deviation from this approach was considered appropriate in relation to the RSIA. This was due to the fact that the Traffic Model carried out for the project, indicates as per the select link analysis outlined in Figure 6-2, that differing attraction points are apparent for traffic entering, or, exiting Sligo. An example of this is the fact that, the N16/R286/Molloway Hill junction remains an attraction point the 'Do-Something' scenario for those options which traverse to the N15 north of Sligo (FRO 01A, 01A/01B, 02A/02B, 03, 04, 10 &11), i.e. traffic on these routes, will seek to utilise junctions connecting to the existing N16 to the west, in order to retain this connection point.

Considering the foregoing, to utilise a common starting point would skew the results (an example being a direct comparison of 'Lengths'), insofar as, there are in effect, two separate attraction points (for those options mentioned above) as observed by results from the Traffic Model.

In this regard, it was deemed appropriate to have two separate starting/terminus points in Sligo. For the foregoing options which traverse to the north of the N15, the appropriate terminus point was considered to be the N4/N15/N16 junction as per Figure 6-1. For the remaining options (Options 05, 06, 07, 08 & 09), the terminus point was varied to be the established attraction point at the N16's junction with the R286 and Molloway Hill as per Figure 6-3. This allows for the assessment to be undertaken on a reasonable basis considering the traffic flow implications on the Route Selection Process.

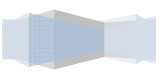


Figure 6-1: Junction of N4 (Victoria Road)/N15/N16 (Duck Street/Ash Lane)

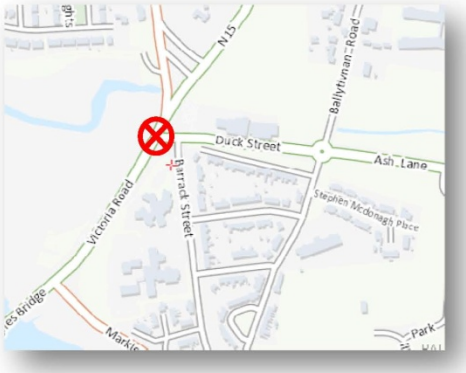


Figure 6-2: Select Link Analysis – Do-Nothing (AM Peak)

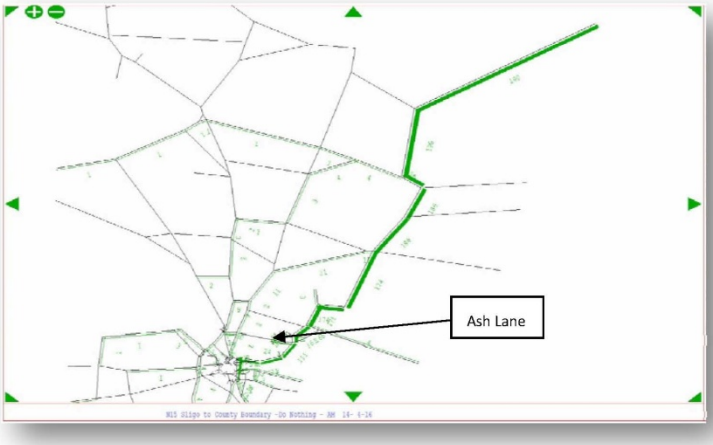
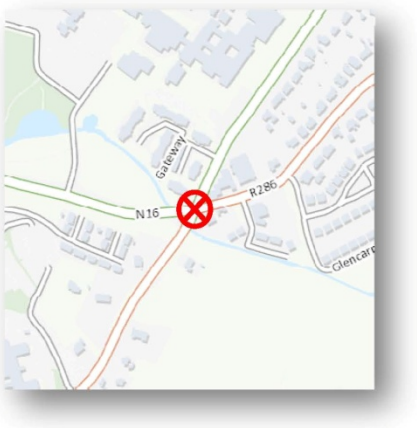


Figure 6-3: Junction of N16/R286/Molloway Hill



The assessment was undertaken over the full length of the various Route Options, rather than using the sectional splits as is the case in other assessments undertaken in the 'Preliminary Options Assessment'. This was in consideration of the fact that there was little difference between the Route Options from a Road Safety Impact Assessment purpose in the rural area, north of the L-3406-0 (Drum Road).

6.2.1.3 Feasible Route Options

As already outlined, there were initially 13 Feasible Route Options developed for the N16 Sligo to County Boundary Realignment.

The following paragraph's outline the results of the RSIA for these initial options.

6.2.1.4 Length

The 'Length' assessment is as outlined in Table 6-1. The resulting ranking adopted is outlined in Table 6-8.

Table 6-1: Route Lengths Assessment

	Travel Distance			
FRO	Physical Works Length (m)	Additional journey TO N15 Jn with N16 (m)	Additional journey TO N16 Jn with R286/Molloway Hill (m)	Total Journey Distance (m)
Option 01A	7,125	2,500		9,625
Option 01A/1B	9,625	-		9,625
Option 02A	8,180	1,180		9,360
Option 02A/02B	9,360	-		9,360
Option 03	8,220	680		8,900
Option 04	8,310	680		8,990

FRO	Travel Distance			
	Physical Works Length (m)	Additional journey TO N15 Jn with N16 (m)	Additional journey TO N16 Jn with R286/Molloway Hill (m)	Total Journey Distance (m)
Option 05	7,680		840	8,520
Option 06	7,880		840	8,720
Option 07	8,110		840	8,950
Option 08	8,130		840	8,970
Option 09	8,020		840	8,860
Option 10	8,220	680		8,900
Option 11	8,220	680		8,900

The longest travel routes are established to be Options 01A, 01A/01B followed by Options 02A, 02A/B. The shortest travel routes are Options 05 and 06 followed closely by Options 03, 09, 10 and 11.

6.2.1.5 Junctions & Side Roads

The 'Junctions & Side Roads' assessment is as outlined in Table 6-3. The resulting ranking adopted is outlined in Table 6-8. These results are comparable against accesses on the existing N16 which are outlined in Table 6-2.

Table 6-2: Existing N16 accesses[15]

Cross roads	T-Junctions	Individual accesses	Agricultural accesses
1	10	50	65

Table 6-3: Junctions and Side Roads Assessment - Total

Section and FRO		National Staggered		Local Staggered		National/Local Simple T		Roundabout and Traffic Signals			Side Roads affected		Calculation of Total Index		
	FRO	Staggered - National to Local	Factor (x2)	Staggered - Local to Local	Factor (x2)	Simple T - National to Local	Simple T - Local to Local	Roundabout - National to National	Roundabout - Other	Roundabout, or, Cross Roads with Traffic Lights	Local Roads (connection points)	Existing National (conection points)	National Network Index	Local Network Index	Total Index
TOTAL	Option 01A	2	4	0	0	5	3	1	0	0	8	4	10	15	25
	Option 01A/1B	3	6	0	0	7	5	3	1	3	19	4	19	29	48
	Option 02A	1	2	0	0	5	2	1	0	1	9	4	9	15	24
	Option 02A/02B	1	2	0	0	7	4	2	1	3	17	4	14	26	40
	Option 03	1	2	0	0	6	8	2	0	2	16	4	12	28	40
	Option 04	1	2	0	0	5	6	2	0	2	16	1	11	23	34
	Option 05	2	4	0	0	6	8	1	0	0	5	5	11	18	29
	Option 06	2	4	0	0	6	8	2	0	0	5	5	12	18	30
	Option 07	2	4	1	2	6	3	1	0	0	4	4	11	13	24
	Option 08	3	6	1	2	5	2	1	0	0	5	6	12	15	27
	Option 09	2	4	1	2	6	2	1	0	0	5	5	11	14	25
	Option 10	2	4	0	0	5	8	2	0	2	15	5	13	28	41
	Option 11	1	2	0	0	6	8	2	0	2	15	4	12	27	39

[15] Measured on the rural section

6.2.1.6 Online Sections - Direct House Accesses

The 'Online Sections – Direct House Accesses' assessment is as outlined in Table 6-4. The resulting ranking adopted is outlined in Table 6-8.

Table 6-4: Online Sections Assessment

FRO	Notes	Rank
Option 01A	Numerous Direct Accesses occur on the N15, particularly in the Rural Area. The N16 would add additional traffic therefore exacerbating the effects	11
Option 01A/1B	Numerous Direct Accesses occur on N15. The N16 would add additional traffic therefore exacerbating the effects	12
Option 02A	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these are not considered to be dense and all occur within the 50kph Speed Limit.	6
Option 02A/02B	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these are not considered to be dense and all occur within the 50kph Speed Limit.	6
Option 03	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these are not considered to be dense and all occur within the 50kph Speed Limit. The effects of adding additional traffic to the 'Residential Area' in Glendallon and Woodlands is assessed separately under Tie-South, Vulnerable Road Users and Urban Interaction.	6
Option 04	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these are not considered to be dense and all occur within the 50kph Speed Limit. The effects of adding additional traffic to the 'Residential Area' in Glendallon and Woodlands is assessed separately under Tie-South, Vulnerable Road Users and Urban Interaction.	6
Option 05	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these also occur in the 'Do-Nothing' scenario and are all within the 50kph Speed Limit.	6
Option 06	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these also occur in the 'Do-Nothing' scenario and are all within the 50kph Speed Limit.	6
Option 07	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these also occur in the 'Do-Nothing' scenario and are all within the 50kph Speed Limit.	6
Option 08	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these also occur in the 'Do-Nothing' scenario and are all within the 50kph Speed Limit.	6
Option 09	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these also occur in the 'Do-Nothing' scenario and are all within the 50kph Speed Limit.	6
Option 10	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these are not considered to be dense and all occur within the 50kph Speed Limit. The effects of adding additional traffic to the 'Residential Area' in Glendallon and Woodlands is assessed separately under Tie-In South, Vulnerable Road Users and Urban Interaction.	1
Option 11	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these are not considered to be dense and all occur within the 50kph Speed Limit. The effects of adding additional traffic to the 'Residential Area' in Glendallon and Woodlands is assessed seperately under Tie-South, Vulnerable Road Users and Urban Interaction.	1

6.2.1.7 Tie In (North)

The 'Tie In (North)' assessment is as outlined in Table 6-5. The resulting ranking adopted is outlined in Table 6-8.

Table 6-5: Tie-In (North) Assessment

FRO	Notes	Rank
Option 01A	This Option is online for circa 1km at the County Boundary	7
Option 01A/1B	This Option is online for circa 1km at the County Boundary	7
Option 02A	This Option is online for circa 1km at the County Boundary	7
Option 02A/02B	This Option is online for circa 1km at the County Boundary	7
Option 03	This Option is online for circa 1km at the County Boundary	7
Option 04	This Option is online for circa 1km at the County Boundary	7
Option 05	This Option is online for circa 1km at the County Boundary	7
Option 06	This Option is online for circa 1km at the County Boundary	7
Option 07	This Option is online for circa 1km at the County Boundary	7
Option 08	This Option is online for circa 1km at the County Boundary	7
Option 09	This Option is online for circa 1km at the County Boundary	7
Option 10	This Option runs to the south of the existing N16 at the County Boundary and is fully offline.	1
Option 11	This Option runs to the north of the existing N16 at the County Boundary and is fully offline.	1

6.2.1.8 Tie In (South)

The 'Tie In (South)' assessment is as outlined in Table 6-6. The resulting ranking adopted is outlined in Table 6-8.

Table 6-6: Tie-In (South) Assessment

FRO	Notes	Rank
Option 01A	This Option ties into the existing N15 via an online Roundabout. Other than Tie-In works, this option does not include an upgrade of the existing N15. In addition there are a number of properties along the road edge in this area.	6
Option 01A/1B	This Option ties into the existing N15 via an online Roundabout. There is a full online upgrade on the N15 southbound into Sligo	1
Option 02A	This Option ties into the existing N15 via an online Roundabout. This provides a strategically good tie in point for the future 'N15 Sligo to County Boundary Scheme'. However, there is a steep incline gradient on the existing N15 southbound approach.	8
Option 02A/02B	This Option ties into the existing N15 via an online Roundabout. This provides a strategically good tie in point for the future 'N15 Sligo to County Boundary Scheme'. However, there is a steep incline gradient on the existing N15 southbound approach. In addition, there is a full online upgrade on the N15 southbound into Sligo.	6
Option 03	This Option Ties-In online at the N15 in Cartron with a Roundabout arrangement. However, before doing so it passes through a residential area at Glendallon and Woodlands	10
Option 04	This Option Ties-In online at the N15 in Cartron with a Roundabout arrangement. However, before doing so it passes though a residential area at Glendallon and Woodlands	10

FRO	Notes	Rank
Option 05	This Option ties into the existing AbbVie roundabout (which will be upgraded as part of the Route Options) at Ballytivnan. There is less room for appropriate roundabout deflections, flares and corner radii than Options 07, 08 and 09, therefore it does not score as highly as those options.	5
Option 06	This Option ties into the existing AbbVie roundabout (which will be upgraded as part of the Route Options) at Ballytivnan. Before this Tie-In, there is a second roundabout to the east. As a result of the double roundabout arrangement, this option does not score as highly as Options 05, 07, 08 and 09.	9
Option 07	This Option ties into the existing AbbVie roundabout (which will be upgraded as part of the Route Options) at Ballytivnan. Of Options 05, 08 and 09 - This option allows for better deflections, flares and corner radii.	2
Option 08	This Option ties into the existing AbbVie roundabout (which will be upgraded as part of the Route Options) at Ballytivnan. There is more room for appropriate roundabout deflections, flares and corner radii than Option 05, therefore it scores higher.	3
Option 09	This Option ties into the existing AbbVie roundabout (which will be upgraded as part of the Route Options) at Ballytivnan. There is more room for appropriate roundabout deflections, flares and corner radii than Option 05, therefore it scores higher.	3
Option 10	This Option Ties-In online at the N15 in Cartron with a Roundabout arrangement. However, before doing so it passes through a residential area at Glendallon and Woodlands	10
Option 11	This Option Ties-In online at the N15 in Cartron with a Roundabout arrangement. However, before doing so it passes through a residential area at Glendallon and Woodlands	10

6.2.1.9 Impact on the existing National & County Network – including impacts on Vulnerable Road Users

The select link analysis, carried out as part of the Traffic Model, is outlined for the various options in Figure 6-4, Figure 6-5, Figure 6-6, Figure 6-7, Figure 6-8, Figure 6-9, Figure 6-10, Figure 6-11, Figure 6-12 and Figure 6-13. In general, the analysis shows how traffic on the proposed options is dispersed (illustrated by the thickness of the green links in the proceeding Figures) as it enters Sligo.

The results of the 'National & County Network' assessment are outlined in Table 6-7. The resulting ranking adopted is outlined in Table 6-8.

Figure 6-4: 2017 AM – Do-Nothing Inbound

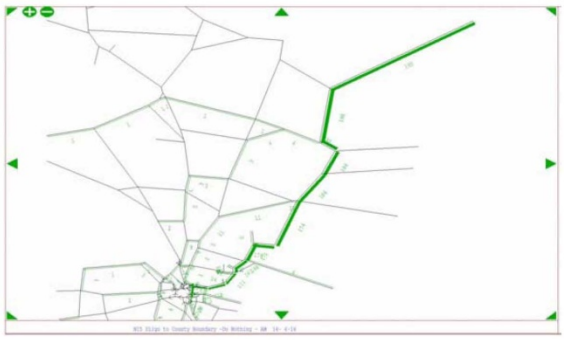


Figure 6-5: 2017 AM – Do-Minimum Inbound

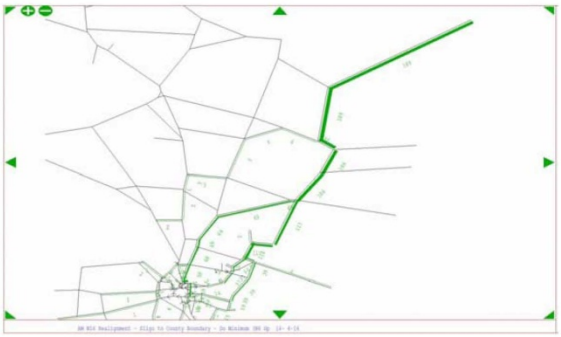


Figure 6-6: 2017 AM – Option 01A

Figure 6-7: 2017 AM – Option 01A/01B

Figure 6-8: 2017 AM – Option 02A

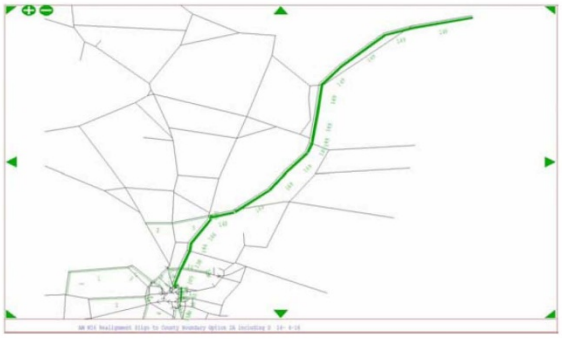


Figure 6-9: 2017 AM – Option 02A/02B

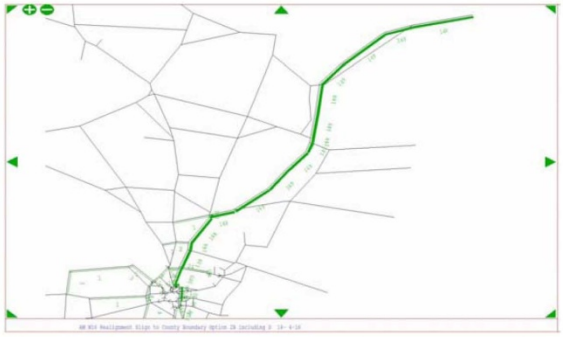


Figure 6-10: 2017 AM – Options 03, 04, 10 & 11

Figure 6-11: 2017 AM – Option 05

Figure 6-12: 2017 AM – Option 06

Figure 6-13: 2017 AM – Options 07, 08 & 09

Table 6-7: Impact on existing National and County Network Assessment

FRO	Notes	Rank
Option 01A	This Option as indicated by the Traffic Modelling Report, impacts significantly on local roads, particularly the L-7421-0 (Old Bundoran Rd.) and the L-9005-0 (Ballytivnan Rd.). In addition, a significant volume of residual traffic remains on the existing N16 between this options junction with the L-3406-0 (Drum Rd.). This has a resulting effect of impacting on the pattern of vulnerable road users.	13

FRO	Notes	Rank
Option 01A/1B	This Option as indicated by the Traffic Modelling Report, impacts significantly on local roads, particularly the L-7421-0 (Old Bundoran Rd.) and the L-9005-0 (Ballytivnan rd.). In addition, a significant volume of residual traffic remains on the existing N16 between this options junction with the L-3406-0 (Drum Rd.). This has a resulting effect of impacting on the pattern of vulnerable road users.	13
Option 02A	This Option as indicated by the Traffic Modelling Report, impacts significantly on local roads, particularly the L-9005-0 (Ballytivnan rd.). In addition, a significant volume of residual traffic remains on the existing N16 between this options junction with the L-3406-0 (Drum Rd.). This has a resulting effect of impacting on the pattern of vulnerable road users.	11
Option 02A/02B	This Option as indicated by the Traffic Modelling Report, impacts significantly on local roads, particularly the L-9005-0 (Ballytivnan rd.). In addition, a significant volume of residual traffic remains on the existing N16 between this options junction with the L-3406-0 (Drum Rd.). This has a resulting effect of impacting on the pattern of vulnerable road users.	11
Option 03	This Option as indicated by the Traffic Modelling Report, impacts significantly on local roads, particularly the L-9005-0 (Ballytivnan rd.). In addition, a significant volume of residual traffic remains on the existing N16 between this options junction with the L-3406-0 (Drum Rd.). Other points of sensitivity from a vulnerable road users perspective includes: The Woodlands residential estate, Glendallon residential estate, Beechwood Court residential estate, communities facilities including basketball/football courts, community footpaths etc. This has a resulting effect of impacting on the pattern of vulnerable road users.	11
Option 04	This Option as indicated by the Traffic Modelling Report, impacts significantly on local roads, particularly the L-9005-0 (Ballytivnan rd.). In addition, a significant volume of residual traffic remains on the existing N16 between this options junction with the L-3406-0 (Drum Rd.). Other points of sensitivity from a vulnerable road users perspective includes: The Woodlands residential estate, Glendallon residential estate, Beechwood Court residential estate, communities facilities including basketball/football courts, community footpaths etc. This has a resulting effect of impacting on the pattern of vulnerable road users.	11
Option 05	This Option maintains the current Traffic carrying capacity of the existing N16. It does not add residual traffic to other routes. This option carries traffic into Sligo in a similar manner to the existing situation, therefore there are not considered to be any significant changes in terms of impacts on vulnerable road users.	1
Option 06	This Option as indicated by the Traffic Modelling Report, impacts on local roads particularly the L-7422-0 and the L-9005-0 (Ballytivnan rd.).	5
Option 07	This Option maintains the current Traffic carrying capacity of the existing N16. It does not add residual traffic to other routes. This option is considered less appropriate, than Option 05, from a Vulnerable Road Users perspective due to the impacts on communities at Barroe.	3
Option 08	This Option maintains the current Traffic carrying capacity of the existing N16. It does not add residual traffic to other routes. This option is considered less appropriate, than Option 05, from a Vulnerable Road Users perspective due to the impacts on communities at Barroe.	3
Option 09	This Option maintains the current Traffic carrying capacity of the existing N16. It does not add residual traffic to other routes. This option is considered less appropriate, than Option 05, from a Vulnerable Road Users perspective due to the impacts on communities at Barroe.	3
Option 10	This Option as indicated by the Traffic Modelling Report, impacts significantly on local roads, particularly the L-9005-0 (Ballytivnan rd.). In addition, a significant volume of residual traffic remains on the existing N16 between this options junction with the L-3406-0 (Drum Rd.). Other points of sensitivity from a vulnerable road users perspective includes: The Woodlands residential estate, Glendallon residential estate, Beechwood Court residential estate, communities facilities including basketball/football courts, community footpaths etc. This has a resulting effect of impacting on the pattern of vulnerable road users.	11
Option 11	This Option as indicated by the Traffic Modelling Report, impacts significantly on local roads, particularly the L-9005-0 (Ballytivnan rd.). In addition, a significant volume of residual traffic remains on the existing N16 between this options junction with the L-3406-0 (Drum Rd.). Other points of sensitivity from a vulnerable road users perspective includes: The Woodlands residential estate, Glendallon residential estate, Beechwood Court residential estate, communities facilities including basketball/football courts, community footpaths etc. This has a resulting effect of impacting on the pattern of vulnerable road users.	11

6.2.2 'Feasible Route Options - Conclusion of Analysis

6.2.2.1 Overall Assessment

The results of the overall assessment are outlined in Table 6-8. In conclusion, it is apparent that Option 01A/01B has the highest number of 'Very Low Preference' ranks owning to aspects related to its Length, Junctions & Side Roads, Online Sections and impacts on the existing National & County Network; this is followed closely by Option 01A, which also scores poorly under Length, Online Sections and impacts on the existing National & County Network.

Options 02A/B and Option 4 are in the overall 'Low Preference' rank while Options 02A, 03, 06, 10 and 11 are in the overall 'Medium Preference' rank. Each of these options (with the exception of Option 06) have an attributed 'Very Low Preference' or 'Low Preference' scored against them under two, or more, of the various assessment criteria which the RSIA was undertaken with.

The best overall ranking option is Option 05, 07 and 09 (Very High Preference) followed by Option 08 which has an overall 'High Preference' rank. It is also notable however, that there are no 'Very Low Preference' or 'Low Preference' ranks attributed to options 05, 06, 07, 08 or 09. It can therefore be deduced from an RSIA perspective, that the latter options are the most favourable from an RSIA perspective.

Table 6-8: Master RSIA Matrix Framework – Feasible Route Options

Elemental Criteria		RSIA 'FEASIBLE ROUTE OPTIONS' RANKING													
		Do-Nothing/Do Minimum	(COLOUR) OPT 1A	(COLOUR) OPT 1B (with N15 improvements)	(COLOUR) OPT 2A	(COLOUR) OPT 2B (with N15 improvements)	(COLOUR) OPT 3	(COLOUR) OPT 4	(COLOUR) OPT 5	(COLOUR) OPT 6	(COLOUR) OPT 7	(COLOUR) OPT 8	(COLOUR) OPT 9	(COLOUR) OPT 10	(COLOUR) OPT 11
Length	Opt. Rank	N/A	13	13	10	10	4	7	1	2	7	7	3	4	4
	Matrix Rank	N/A	5	5	4	4	2	3	1	1	3	3	2	2	2
Junctions & Side Roads															
SOUTH															
Junctions & Side Roads - Local Network Connections	Opt. Rank	N/A	1	13	4	12	11	8	6	7	1	4	1	9	9
	Matrix Rank	N/A	1	5	2	5	4	3	3	3	1	2	1	3	3
CENTRAL															
Junctions & Side Roads - Local Network Connections	Opt. Rank	N/A	1	1	4	4	10	1	8	8	10	12	12	4	4
	Matrix Rank	N/A	1	1	2	2	4	1	3	3	4	5	5	2	2
NORTH															
Junctions & Side Roads - Local Network Connections	Opt. Rank	N/A	12	12	1	1	1	1	8	8	1	1	1	11	8
	Matrix Rank	N/A	5	5	1	1	1	1	3	3	1	1	1	4	3
TOTAL															
Junctions & Side Roads - Local Network Connections	Opt. Rank	N/A	3	13	1	10	10	8	6	7	1	5	3	12	9
	Matrix Rank	N/A	2	5	1	4	4	3	3	3	1	3	2	5	3
Online Sections - Direct House Accesses	Opt. Rank	N/A	11	12	6	6	6	6	6	6	6	6	6	1	1
	Matrix Rank	N/A	4	5	3	3	3	3	3	3	3	3	3	1	1
Tie In (North)	Opt. Rank	N/A	7	7	7	7	7	7	7	7	7	7	7	1	1
	Matrix Rank	N/A	3	3	3	3	3	3	3	3	3	3	3	1	1
Tie In (South)	Opt. Rank	N/A	6	1	8	6	10	10	5	9	2	3	3	10	10
	Matrix Rank	N/A	3	1	3	3	4	4	3	3	1	2	2	4	4
Impact on the existing National & County Network - including vulnerable road users	Opt. Rank	N/A	13	13	11	11	11	11	1	5	3	3	3	11	11
	Matrix Rank	N/A	5	5	4	4	4	4	1	3	2	2	2	4	4
Overall Score	Opt. Rank	N/A	53	59	43	50	48	49	26	36	26	31	25	39	36
Score (Incl. L)	Matrix Rank		5	5	3	4	3	4	1	3	1	2	1	3	3

6.2.3 Refined Route Options

The Preliminary Options Assessment process and the rational to the refinement of Route Options is set out in section 7 and 8 of the Main Report (Volume 1 of the Route Selection Report).

In total, there were 6 Refined Route Options arising from the Preliminary Options Assessment. In addition, 2 options were supplemented with a possible extension. In undertaking the RSIA on the Refined Route Options, it was decided that to undertake separate iterations of Option 12 (discrete differences) would not benefit the RSIA and to do so would only serve to complicate the assessment beyond a level which was required. Additionally, the supplementary Option 13 to those options entering at the AbbVie roundabout was not tabulated in the assessment; however section 6.2.4.2 of this assessment provides a qualitative assessment of same.

In a similar manner to the 'Feasible Route Options', each 'Refined Route Option' was applied a 'Preference' score based on the assessed ranking as outlined in Table 6-9.

Table 6-9: Application of Ranks to 'Preferences'

Rank		Preference
From	To	
1		Very High Preference
2		High Preference
3	5	Medium Preference
6		Low Preference
7		Very Low Preference

The following paragraphs outline the results of the RSIA for the Refined Route Options.

6.2.3.1 Length

The 'Length' assessment is as outlined in Table 6-10. The resulting ranking adopted is outlined in Table 6-15.

Table 6-10: Route Lengths Assessment

	Travel Distance			
FRO	Physical Works Length (m)	Additional journey TO N15 Jn with N16 (m)	Additional journey TO N16 Jn with R286/Molloway Hill (m)	Total Journey Distance (m)
Option 01A - v2	7,125	2,500		9,625
Option 01A/1B - v2	9,625	-		9,625
Option 02A - v2	8,180	1,180		9,360
Option 02A/02B - v2	9,360	-		9,360
Option 05	7,680		840	8,520
Option 08 - v2	8,130		840	8,970

FRO	Travel Distance			
	Physical Works Length (m)	Additional journey TO N15 Jn with N16 (m)	Additional journey TO N16 Jn with R286/Molloway Hill (m)	Total Journey Distance (m)
Option 12	8,270		840	9,110
Option 12 - v2	As per '12'	As per '12'	As per '12'	As per '12'
Option 13	Addenda Option	Addenda Option	Addenda Option	Addenda Option

6.2.3.2 Junctions & Side Roads

The 'Junctions & Side Roads' assessment is as outlined in Table 6-11. The resulting ranking adopted is outlined in Table 6-15.

Table 6-11: Junctions and Side Roads Assessment – Total

Section and RRO		National Staggered		Local Staggered		National/Local Simple T		Roundabout and Traffic Signals			Side Roads affected		Calculation of Total Index		
	RRO	Staggered - National to Local	Factor (x2)	Staggered - Local to Local	Factor (x2)	Simple T - National to Local	Simple T - Local to Local	Roundabout - National to National	Roundabout - Other	Roundabout, or, Cross Roads with Traffic Lights	Local Roads (connection points)	Existing National (conection points)	National Network Index	Local Network Index	Total Index
TOTAL	Option 01A - v2	0	0	0	0	7	3	1	0	0	6	6	8	15	23
	Option 01A/1B - v2	1	2	0	0	9	6	3	1	2	15	5	16	27	43
	Option 02A - v2	2	4	0	0	3	5	1	0	0	4	5	8	14	22
	Option 02A/02B - v2	2	4	0	0	5	8	2	1	2	12	5	13	26	39
	Option 05	2	4	0	0	5	8	1	0	0	4	7	10	19	29
	Option 08 - v2	2	4	0	0	6	4	1	0	0	6	6	11	16	27
	Option 12 Avg	3	6	0	0	5	1	1	0	0	7	5	12	13	25
	Option 13	3	6	0	0	6	12	1	0	2	14	7	14	32	46

6.2.3.3 Online Sections - Direct House Accesses

The 'Online Sections – Direct House Accesses' assessment is as outlined in Table 6-12. The resulting ranking adopted is outlined in Table 6-15.

Table 6-12: Online Sections Assessment

FRO	Notes	Rank
Option 01A - v2	Numerous Direct Accesses occur on the N15, particularly in the Rural Area. The N16 would add additional traffic therefore exacerbating the effects	6
Option 01A/1B - v2	Numerous Direct Accesses occur on N15. The N16 would add additional traffic therefore exacerbating the effects	7
Option 02A - v2	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these are not considered to be dense and all occur within the 50kph Speed Limit.	2
Option 02A/02B - v2	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these are not considered to be dense and all occur within the 50kph Speed Limit.	2
Option 05	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these also occur in the 'Do-Nothing' scenario and are all within the 50kph Speed Limit.	2
Option 08 - v2	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area,	2

FRO	Notes	Rank
	however these also occur in the 'Do-Nothing' scenario and are all within the 50kph Speed Limit.	
Option 12	No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these also occur in the 'Do-Nothing' scenario and are all within the 50kph Speed Limit.	2
Option 12 - v2	As per '12'	As per '12'
Option 13	*No significant impacts arising from 'Online Sections'. Direct accesses occur within the urban area, however these are not considered to be dense and all occur within the 50kph Speed Limit. The effects of adding additional traffic to the 'Residential Area' in Glendallon and Woodlands is assessed separately under Tie-in (South), Vulnerable Road Users and Urban Interaction.*	Addenda Option (FRO Rank 'Medium Preference')

6.2.3.4 Tie In (North)

The RSIA for the Refined Route Options did not extend to consider the Tie In (North) as the arrangements are similar for each option.

6.2.3.5 Tie In (South)

The 'Tie In (South)' assessment is as outlined in Table 6-13. The resulting ranking adopted is outlined in Table 6-15.

Table 6-13: Tie-In (South) Assessment

FRO	Notes	Rank
Option 01A - v2	This Option ties into the existing N15 via an online Roundabout. Other than Tie-In works, this option does not include an upgrade of the existing N15. In addition there are a number of properties along the road edge in this area.	6
Option 01A/1B - v2	This Option ties into the existing N15 via an online Roundabout. There is a full online upgrade on the N15 southbound into Sligo	1
Option 02A -v2	This Option ties into the existing N15 via an online Roundabout. This provides a strategically good tie in point for the future 'N15 Sligo to County Boundary Scheme'. However, there is a steep incline gradient on the existing N15 southbound approach.	6
Option 02A/02B - v2	This Option ties into the existing N15 via an online Roundabout. This provides a strategically good tie in point for the future 'N15 Sligo to County Boundary Scheme'. However, there is a steep incline gradient on the existing N15 southbound approach. In addition, there is a full online upgrade on the N15 southbound into Sligo.	5
Option 05	This Option ties into the existing AbbVie roundabout (which will be upgraded as part of the Route Options) at Ballytivnan. There is less room for appropriate roundabout deflections, flares and corner radii than Option 12, therefore it does not score as highly as that option.	5
Option 08 - v2	This Option ties into the existing AbbVie roundabout (which will be upgraded as part of the Route Options) at Ballytivnan. There is more room for appropriate roundabout deflections, flares and corner radii than Option 05, therefore it scores higher.	4
Option 12	This Option ties into the existing AbbVie roundabout (which will be upgraded as part of the Route Options) at Ballytivnan. There is more room for appropriate roundabout deflections, flares and corner radii than Option 05, therefore it scores higher.	4
Option 12 - v2	As per '12'	As per '12'

FRO	Notes	Rank
Option 13	*This Option Ties-In online at the N15 in Cartron with a Roundabout arrangement. However, before doing so it passes through a residential area at Glendallon and Woodlands*	Addenda Option (FRO Rank 'Low Preference')

6.2.3.6 Impact on the existing National & County Network – including impacts on Vulnerable Road Users

The results of the 'National & County Network' assessment are outlined in Table 6-15. The resulting ranking adopted is outlined in Table 6-15.

Table 6-14: Impact on existing National and County Network Assessment

FRO	Notes	Rank
Option 01A - v2	This Option as indicated by the Traffic Modelling Report adds circa 2,500 AADT to the N15 at Teesan. In addition, a significant volume of residual traffic remains on the existing N16 between this options junction with the L-3406-0 (Drum Rd.). This has a resulting effect of impacting on the pattern of vulnerable road users.	6
Option 01A/1B - v2	This Option as indicated by the Traffic Modelling Report adds circa 2,500 AADT to the N15 at Teesan. In addition, a significant volume of residual traffic remains on the existing N16 between this options junction with the L-3406-0 (Drum Rd.). This has a resulting effect of impacting on the pattern of vulnerable road users.	6
Option 02A - v2	This Option as indicated by the Traffic Modelling Report, adds circa 2,500 AADT to the N15 at Teesan. In addition, a significant volume of residual traffic remains on the existing N16 between this options junction with the L-3406-0 (Drum Rd.). This has a resulting effect of impacting on the pattern of vulnerable road users.	4
Option 02A/02B - v2	This Option as indicated by the Traffic Modelling Report, adds circa 2,500 AADT to the N15 at Teesan. In addition, a significant volume of residual traffic remains on the existing N16 between this options junction with the L-3406-0 (Drum Rd.). This has a resulting effect of impacting on the pattern of vulnerable road users.	4
Option 05	This Option maintains the current Traffic carrying capacity of the existing N16. It does not add residual traffic to other routes. This option carries traffic into Sligo in a similar manner to the existing situation, therefore there are not considered to be any significant changes in terms of impacts on vulnerable road users.	1
Option 08 - V2	This Option maintains the current Traffic carrying capacity of the existing N16. It does not add residual traffic to other routes. This option is considered less appropriate, than Option 05, from a Vulnerable Road Users perspective due to the impacts on communities at Barroe.	2
Option 12	This Option maintains the current Traffic carrying capacity of the existing N16. It does not add residual traffic to other routes. This option is considered less appropriate, than Option 05, from a Vulnerable Road Users perspective due to the impacts on communities at Barroe.	2
Option 12 - v2	As per '12'	As per '12'
Option 13	*This Option as indicated by the Traffic Modelling Report, impacts significantly on local roads, particularly the L-9005-0 (Ballytivnan rd.). It also impacts on the residential through Woodlands and Gendallon housing estates.*	Addenda Option (FRO Rank 'Low Preference Rank')

6.2.4 'Refined Route Options - Conclusion of Analysis

6.2.4.1 Overall Assessment

The results of the overall assessment are outlined in Table 6-15. In conclusion, it is apparent that Option 01A/01B – v2 has the highest number of 'Very Low Preference' and 'Low Preference' ranks owning to aspects related to its Length, Junctions & Side Roads, Online Sections and impacts on the existing National & County Network; this is followed closely by Option 01A, which also scores poorly under Length, Online Sections, Tie In South and impacts on the existing National & County Network.

Options 02A and 02A/B – v2 are both in the Medium Preference ranking category, however, in relation to these options the following is notable:

- 'Low Preference' ranks are recorded against:
    - Option 2A in relation to Length and impacts on the Tie In South;
    - Option 02A/B in relation to Junctions & Side Roads;

The best overall ranking options are Options 05, 08 – v2 and 12, each of which have an overall 'High Preference' rank. It is also notable, that there are no 'Very Low Preference' or 'Low Preference' ranks attributed to these options. Therefore it can be deduced that the best options from an overall RSIA perspective are 05, 08 – v2 and 12.

Table 6-15: Master RSIA Matrix Framework – Refined Route Options

Elemental Criteria		RSIA 'FEASIBLE ROUTE OPTIONS' RANKING								
		Do-Nothing/Do Minimum	(RED) OPT 1A - v2	(RED) OPT 1A/B - v2	(YELLOW) OPT 2A - v2	(YELLOW) OPT 2A/B - v2	(BLUE) OPT 5	(BLACL) OPT 8 - v2	(BROWN) OPT 12	(GREEN) OPT 13
Length	Opt. Rank	N/A	6	6	4	4	1	2	3	0
	Matrix Rank	N/A	**4**	**4**	**3**	**3**	**1**	**2**	**3**	**0**
Junctions & Side Roads										
SOUTH										
Junctions & Side Roads - Local Network Connections	Opt. Rank	N/A	1	7	1	6	5	1	1	0
	Matrix Rank	N/A	1	5	1	4	3	1	1	0
CENTRAL										
Junctions & Side Roads - Local Network Connections	Opt. Rank	N/A	3	3	1	1	5	7	5	0
	Matrix Rank	N/A	3	3	1	1	3	5	3	0
NORTH										
Junctions & Side Roads - Local Network Connections	Opt. Rank	N/A	1	1	1	1	1	1	1	0
	Matrix Rank	N/A	1	1	1	1	1	1	1	0
TOTAL										
Junctions & Side Roads - Local Network Connections	Opt. Rank	N/A	2	7	1	6	5	4	3	0
	Matrix Rank	N/A	**2**	**5**	**1**	**4**	**3**	**3**	**3**	**0**
Online Sections - Direct House Accesses	Opt. Rank	N/A	6	7	2	2	2	2	2	0
	Matrix Rank	N/A	**4**	**5**	**2**	**2**	**2**	**2**	**2**	**0**
Tie In (North)	Opt. Rank	N/A	0	0	0	0	0	0	0	0
	Matrix Rank	N/A	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Tie In (South)	Opt. Rank	N/A	6	1	6	5	5	4	4	0
	Matrix Rank	N/A	**4**	**1**	**4**	**3**	**3**	**3**	**3**	**0**
Impact on the existing National & County Network - including vulnerable road users	Opt. Rank	N/A	6	6	4	4	1	2	2	-
	Matrix Rank	N/A	**4**	**4**	**3**	**3**	**1**	**2**	**2**	**0**
Overall Score	Opt. Rank	N/A	**26**	**27**	**17**	**21**	**14**	**14**	**14**	
Rank			**6**	**7**	**4**	**5**	**1**	**1**	**1**	

6.2.4.2 Option 13

Option 13, has been selected in the Refined Route Options as a possible addenda Option to those which enter at the AbbVie Roundabout (05, 08-v2 and 12). The provision of this extra link to these options would reduce the positivity of their overall rank to 'Medium Preference' due to impacts in relation to 'Tie In (South)' and 'Impacts on the existing National and County Network'

5 Options Comparison Estimate

5.1 Introduction

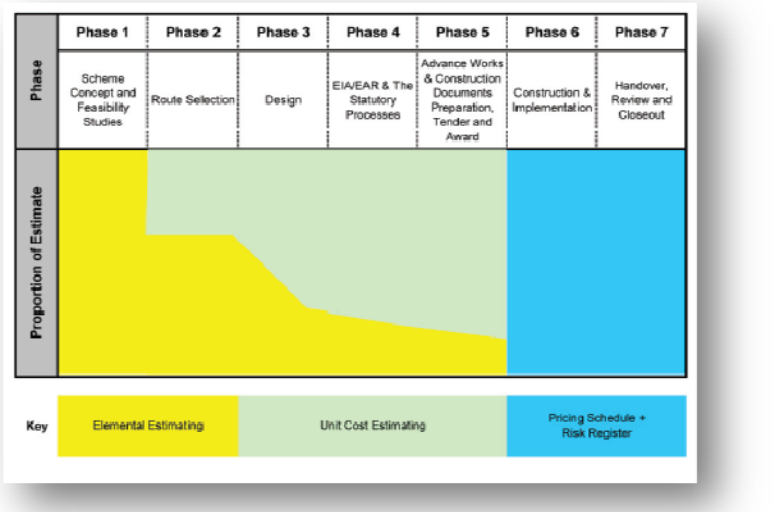
The following section sets out the establishment of the base cost estimate to assist in the Options Comparison Estimate for the N16 Sligo to County Boundary, Route Selection.

Estimates at this stage of the scheme development are notional in nature and are for the principal purpose of options comparison. In this regard, the provision of any figures in this Route Selection Report, shall in no way prejudice, future estimates or land valuations which will take place during the proceeding design, statutory procedures, land purchase and construction contract phases.

5.2 Base Cost Estimate

The estimating strategy recommended by the TII Cost Management Manual and adopted for this Route Selection Report, is a combination of Elemental and Unit Cost Estimate (Figure 5-1).

Figure 5-1 Route Selection Estimating Methodology[11]



Elemental costs are arrived at, by '*multiplying quantities of elements by monetary rates with lump sum provisions for some elements*'[11]. Unit cost estimating is *'based on breaking down project elements into various works activities and then multiplying the resultant quantities for each activity by unit costs'*[11]. As the scheme information at the Route Selection Stage is rudimentary in nature, the base cost estimate mainly consists of elemental estimating, with some exceptions for key features.

The estimate (which includes risk contengencies) was derived for each route option, using the 7 cost headings as per the Cost Management Manual, namely:

(1) Planning and Design;

(2) Land and Property;

(3) Archaeology;

[11] TII Cost Management Manual, March 2010

(4) Advance Works and Other Contracts;

(5) Main Construction Contract;

(6) Main Contract Supervision; and

(7) Residual Network.

This estimate type is also required to undertake and complete the Cost Benefit Analysis (TuBA) for those options which proceed to Stage 2 (Project Appraisal – See section 9 of Volume 1). All final costs for each of the estimates are exclusive of VAT.

The following sets outs the criteria for the establishment of the base cost.

5.2.1 Planning and Design

Planning and Design, typically includes aspects relating *inter-alia* to Design, Traffic Studies, Ground Investigation, Detailed Topographical Surveys, Environmental Studies, Reporting (Design, Appraisal and Environmental) and Project Appraisal. Based on schemes of a similar nature, a cost of €100,000 per km has been applied to each particular route option.

5.2.2 Land and Property

The TII Cost Management Manual recommends at Phase 2, that land take should be broken down into *'... types of land usage, property acquisitions and appropriate rates used for acquisition, other impacts, fees and goodwill payments...'.* In this regard, an evaluation was carried out to determine, the differing land/property types within the study area. This concluded, that the following were the main property categories which would influence cost estimates:

- Agricultural Lands, catering mainly for beef and sheep, with some localised smaller dairy enterprises;
- Key Dairy Enterprises;
- Development Lands;
- Domestic Property.

Land Use, within the 'Southern' section of the study area (See Figure 5-2 for details of sections), consists of agricultural land, residential areas and zoned development lands relating to the Sligo and Environs Development Plan. Land use, within the 'Central' and 'Northern' sections of the study area is predominantly comprised of agricultural lands. In general, the recommendation was that development lands, be confined to the aforementioned zoned lands, as outlined in Figure 5-3; this was with the exception of isolated one off sites which may occur outside this area.

In recognition of sensitivities relating to land and property locations, an independent general valuation was provided for development lands, agricultural lands and houses in the southern, central and northern sections of the study area respectively.

Approximate land areas were established based on an assumed consistent corridor with of 50m for each of the Route Options.

Figure 5-2: Sectional Splits

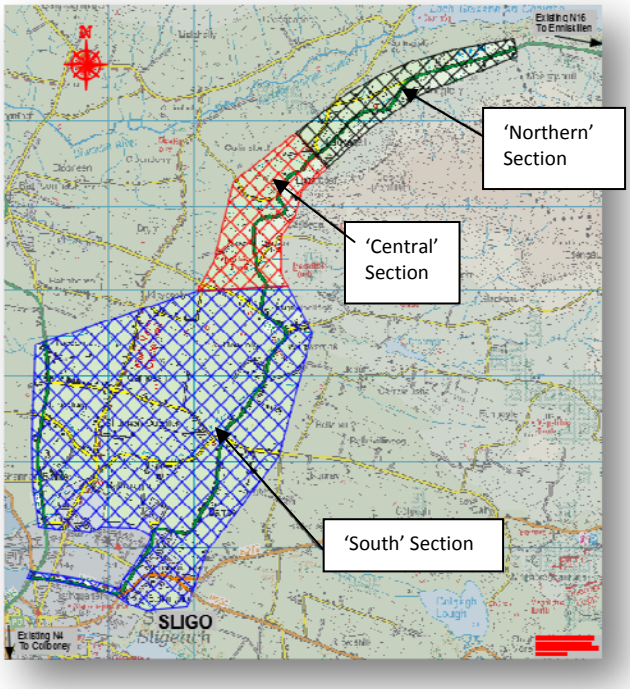
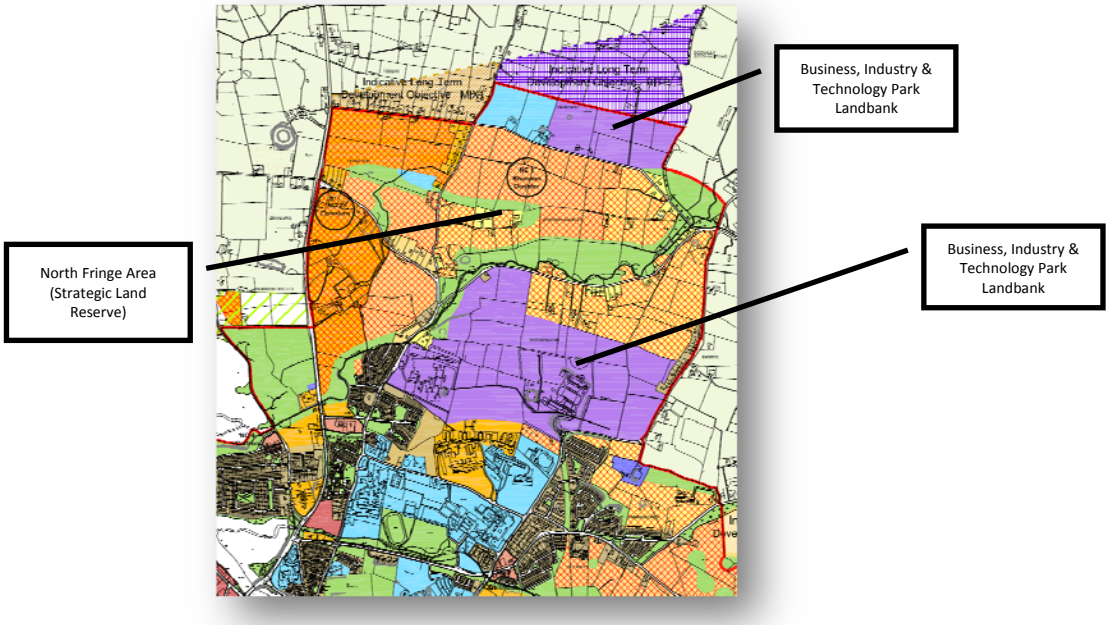


Figure 5-3: North Sligo Zoning[12]



In relation to agricultural lands, a further assessment was carried out, on lands which could be considered to be materially different from that which was typically encountered within the study area. The only areas where it was considered that there may be material differences included those

[12] SEDP Map 1_Zoning Map_(Variation No2_- 3 October 2011)

lands, which could be considered 'Key Dairy Enterprises'. In this regard, an evaluation was carried out of the impacts and associated potential land costs with reference to these enterprises. Initial cost estimates were developed under the headings outlined below and applied accordingly to the Land and Property cost estimate:

- Severance/Injurious Affection;
- Disturbance;
- Reinvestment costs;
- Accommodation works;

Where appropriate, Goodwill payments were also applied to the cost estimate, these payments are based on the IFA, TII and DTTAS agreement rates as issued in the TII Circular No. 02/2016.The rate for qualifying land is currently €3,000 per acre.

Claimant's Fees were also provisionally established for the Land and Property element of the base cost estimate. These fees relate to costs associated with the claimant's solicitor and valuer. The value obtained is based on land/property costs (excluding the Goodwill payments) multiplied by the applicable percentages, i.e. 1% for solicitors and 2.5% for valuers.

5.2.3 Archaeology

Cost estimates for Archaeology were calculated on the basis of total area within the construction footprint; a per-acre rate of €4,856 was used. This rate was based on schemes of similar scale/nature.

5.2.4 Advance Works and Other Contracts

The cost estimate for Advance Works and Other Contracts was calculated based on the mainline length of each route option; a per-km rate of €500,000 was used. This rate was based on schemes of similar scale/nature and consists of Fencing, Statutory Undertakers, Site Clearance and Additional Ground Investigations.

5.2.5 Main Construction Contract

The cost estimate for the Main Construction Contract is based on elemental costing. This was considered a more appropriate approach than undertaking, unit cost estimates of each particular route, which would not provide any greater degree of benefits in terms of accuracy, owing principally to the current stage of the project and the level of detail which is available. By way of example the following outlines some key requirements for unit cost estimates, not available at Route Selection Stage:

- Ground Investigation has not been carried out; therefore it is not possible to accurately establish, earthworks quantities in terms of extents of soft ground, or general material acceptably for reuse in construction;
- Parallel access arrangements have not been established for adjacent properties;
- The drainage design has not been carried out;

In order to establish an elemental estimate, which was as accurate as could be considered reasonably practicable at Route Selection Stage, a review of similar comparables both, within County Sligo and other adjacent Counties was undertaken. The schemes examined included:

- N5 Ballaghadereen Bypass, Roscommon County Council;
- N15 Blackburn Bridge Realignment, Donegal County Council;

- N59 Farnaharpy to Ballygreighan Realignment, Sligo County Council;
- N4 Ardloy Realignment, Sligo County Council;
- N59 Kilbride Realignment, Mayo County Council;
- N56 Boyoughter to Kilkenny Realignment, Donegal County Council

This resulted in the establishment, of an elemental cost for the mainline construction of a Type 2 Single Carriageway, of €1.7m per km. This figure is factored, to exclude structures and other notable ancillary infrastructure aspects not expected to be encountered in the case of the N16.

Project specific aspects, of additional ancillary infrastructure were then added to this figure, based on values derived from other schemes and as outlined in Table 5-1.

Table 5-1 Main Construction Contract cost elements

Construction Element	Unit	Rate
Roundabout on National Primary road	no.	€0.5m[13]
Underbridge	no.	€0.6[14]
Riverbridge – Mainline	no.	€0.414

In addition to the foregoing, a detailed design was previously carried out for the N15 Dual Carriageway upgrade, which constitutes part of Options 01B/01B and 02A/02B, and occurs between the N15/N4's junction with the N16, in Sligo, and the N15's junction with Scotsman's Walk in Shannon Eighter. In the event of these options becoming the optimal N16 route, it has been considered for the purposes of the N16 Route Selection, that this section will be required to be completed as part of a separate independent N15, prior to tie in works taking place. This is in consideration of the significantly disproportionate difference in traffic levels (1[15]:5[16]).

Notwithstanding this, for reference purposes, it has been established from cost estimating, carried out at 'Design Stage' of the 'N15 Urban Improvement Scheme – Phase 3' that the construction cost to improve this section would be approximately €18m – this figure will be documented in the OCE tables but does not influence the ranking assessment.

5.2.6 Main Contract Supervision

The cost estimate for Main Contract Supervision was calculated based on the mainline length of each route option and the appropriate staffing arrangement which would be required to supervise the project; a per-km rate of €87,296.83 was used.

5.2.7 Residual Network

There are consequential effects arising from constructability issues which are likely to arise on some options due to their interaction with live traffic. These costs are generally contained in the foregoing section dealing with the Main Construction Contract. However, it is likely that diversion on the local and regional network will be required in some cases in order to construct the proposed N16. To

[13] Calculated on a pro-rata basis in comparison with the Type 2 Single Carriageway, with additional infrastructure added;

[14] Calculated based on an average deck area with associated cost estimate per m^2

[15] N16

[16] N15

quantify same, an estimate has been prepared of costs which potentially could accrue on these diversion networks as a result of traffic management measures being required during the construction period.

The costs have been established based on the perceived length of construction on sections where it is likely that diversionary routes will be required. To establish an associated cost, a repair cost figure of €10,000 has been applied for each week traffic is required to be diverted to the local/regional network. This is on the basis that damages are likely to increase exponentially with time. In addition, traffic management costs of €13,750 are applied to the diversionary route, also per week.

5.2.8 Risk and Contingencies

Due to the stage of the project and in the absence of a detailed Risk Assessment, and Quantified Risk Assessment, a scoping exercise was carried out which established the appropriate percentages of Risk Contingencies to be applied to each of the 7 Cost Headings at Route Selection Stage. As a base comparable, formal Risk Contingencies on other schemes which are at a more advanced stage were examined. Table 5-2 outlines the justification for the Risk Contingencies applied.

Table 5-2: Risk Contingencies

Route Option Number	Project Risk Incl.	Justification for Project Risk Value
Planning & Design	10%	10% from an examination of other schemes is considered appropriate
Land & Property	10%	10% from an examination of other schemes is considered appropriate
Archaeology	15%	15% from an examination of other schemes is considered appropriate
Advance Works & Other Contracts	10%	10% from an examination of other schemes is considered appropriate
Main Construction Contract	5%	An examination was undertaken of a comparable scheme which was subject to a Risk Assessment and QRA. The Project Specific Risk was approximately 10% in this base case. This value was not considered appropriate for the N16 Route for a number of reasons including, inter-alia: The comparable scheme: - Crossed significant volumes of soft ground; - Occurred in an area of heavily karstified geology; and - Earthworks volumes were well in excess of those anticipated on the N16. Considering the foregoing, for Route Selection purposes, a value of 5% was considered appropriate.
Main Contract Supervision	5%	This is retrospective to the value attributed to the Main Construction Contract
Residual Network	0%	No Risk contingency is applied to the Residual Network

5.3 Comparative Analysis

5.3.1 Feasible Route Options

Table 5-3 outlines the comparative analysis carried out for the Feasible Route Options. In conclusion, the following is apparent in relation to the various sectional splits. The ranking

procedure adopted, does not consider the N15 Dual Carriageway improvements which are part of Options 01A/B and 02A/B.

5.3.1.1 Southern Section

The most expensive options to construct are generally options 03, 04 10, 11. In this regard these options are given 'Low' preference ranks. 'Medium' preference options are considered to be Options 01A/01B, 02A, 02A/02B, 06 and 07. The best ranked options in the Southern Section are Options 01 and 08 ('Very High' preference) followed by Options 05 and 09 ('High' preference).

5.3.1.2 Central Section

The most expensive options to construct are generally options 01A and 01A/01B ('Very Low' preferences) followed by option 02A and 02A/02B ('Low' preference). 'Medium' preference options are considered to be Options 03, 04, 06, 10 and 11. The best ranked options in the Central Section are Options 08 and 09 ('Very High' preference) followed by Options 05 and 07 ('High' preference).

5.3.1.3 Northern Section

The most expensive options to construct are generally options 05 and 06 ('Very Low' preferences) followed by option 10 ('Low' preference). 'Medium' preference options are considered to be Options 01A, 01A/01B, 02A, 03 and 04. The best ranked options in the Northern Section are Options 02A/02B, 07, 08, 09 and 11 ('Very High' preference).

Table 5-3: Feasible Route Options – Comparative Estimates

FRO	South			Central		North	
	Approx Cost (€ Million)	N15 Dual Carriageway Cost	Preference Rank	Approx Cost (€ Million)	Preference Rank	Approx Cost (€ Million)	Preference Rank
Option 01A	€ 9.01		1	€ 7.89	5	€ 7.28	3
Option 01A/1B	€ 12.89	€ 21.37	3	€ 7.89	5	€ 7.28	3
Option 02A	€ 12.38		3	€ 6.85	4	€ 6.96	1
Option 02A/02B	€ 12.38	€ 21.37	3	€ 6.85	4	€ 6.96	1
Option 03	€ 14.96		4	€ 6.57	3	€ 7.07	3
Option 04	€ 14.61		4	€ 6.59	3	€ 7.09	3
Option 05	€ 11.75		2	€ 5.92	2	€ 8.25	5
Option 06	€ 12.97		3	€ 5.93	2	€ 8.25	5
Option 07	€ 11.87		3	€ 5.68	2	€ 6.96	1
Option 08	€ 11.74		1	€ 5.40	1	€ 6.96	1
Option 09	€ 11.79		2	€ 5.40	1	€ 6.96	1
Option 10	€ 14.96		4	€ 6.56	3	€ 7.70	4
Option 11	€ 14.96		4	€ 6.56	3	€ 6.93	1

5.3.2 Refined Route Options

Table 5-4 outlines the comparative analysis carried out for the Refined Route Options. In conclusion, the following is apparent in relation to the various sectional splits. Similar to the Feasible Route Options, the ranking procedure adopted, does not consider the N15 Dual Carriageway improvements which are part of Options 01A/B-v2 and 02A/02B-v2.

5.3.2.1 Southern Section

The most expensive options to construct are generally options 02A and 02A/02B. In this regard these options are given 'Low' preference ranks. 'Medium' preference options are considered to be Options 01A/01B-v2 and 05. The best ranked options in the Southern Section are Option 01A-v2 ('Very High' preference) followed by Options 08-v2 and 12 ('High' preference).

5.3.2.2 Central Section

The most expensive options to construct are generally options 02A-v2, 02A/02B-v2 and 05 ('Medium' preferences). All the other options are generally similar with 'Very High' preference ranks.

5.3.2.3 Northern Section

In the north section, option 12 is the best ranked option with a 'Very High' preference rank. All the other options are generally similar with 'High' preference ranks.

Table 5-4: Refined Route Options – Comparative Estimates

RRO	South			Central		North		Total				
	Approx Cost (€ Million)	N15 Dual Carriageway Cost	Preference Rank	Approx Cost (€ Million)	Preference Rank	Approx Cost (€ Million)	Preference Rank	Approx Cost (€ Million)	Length	N15 Dual Carriageway Cost	Rank	Preference Rank
Option 01A - v2	€ 9.69		1	€ 5.09	1	€ 8.27	2	€ 23.05	7.6	€ -	1	1
Option 01A/1B - v2	€ 12.49	€ 21.37	3	€ 5.09	1	€ 8.27	2	€ 25.86	8.6	€ 21.37	5	3
Option 02A - v2	€ 13.01		4	€ 5.64	3	€ 8.27	2	€ 26.92	8.2	€ -	6	4
Option 02A/02B - v2	€ 13.01	€ 21.37	4	€ 5.64	3	€ 8.27	2	€ 26.92	8.2	€ 21.37	6	4
Option 05	€ 11.75		3	€ 5.66	3	€ 8.27	2	€ 25.68	7.7	€ -	4	3
Option 08 - v2	€ 11.56		2	€ 5.05	1	€ 8.27	2	€ 24.87	8.2	€ -	3	3
Option 12	€ 11.56		2	€ 5.09	1	€ 7.57	1	€ 24.21	8.3	€ -	2	2