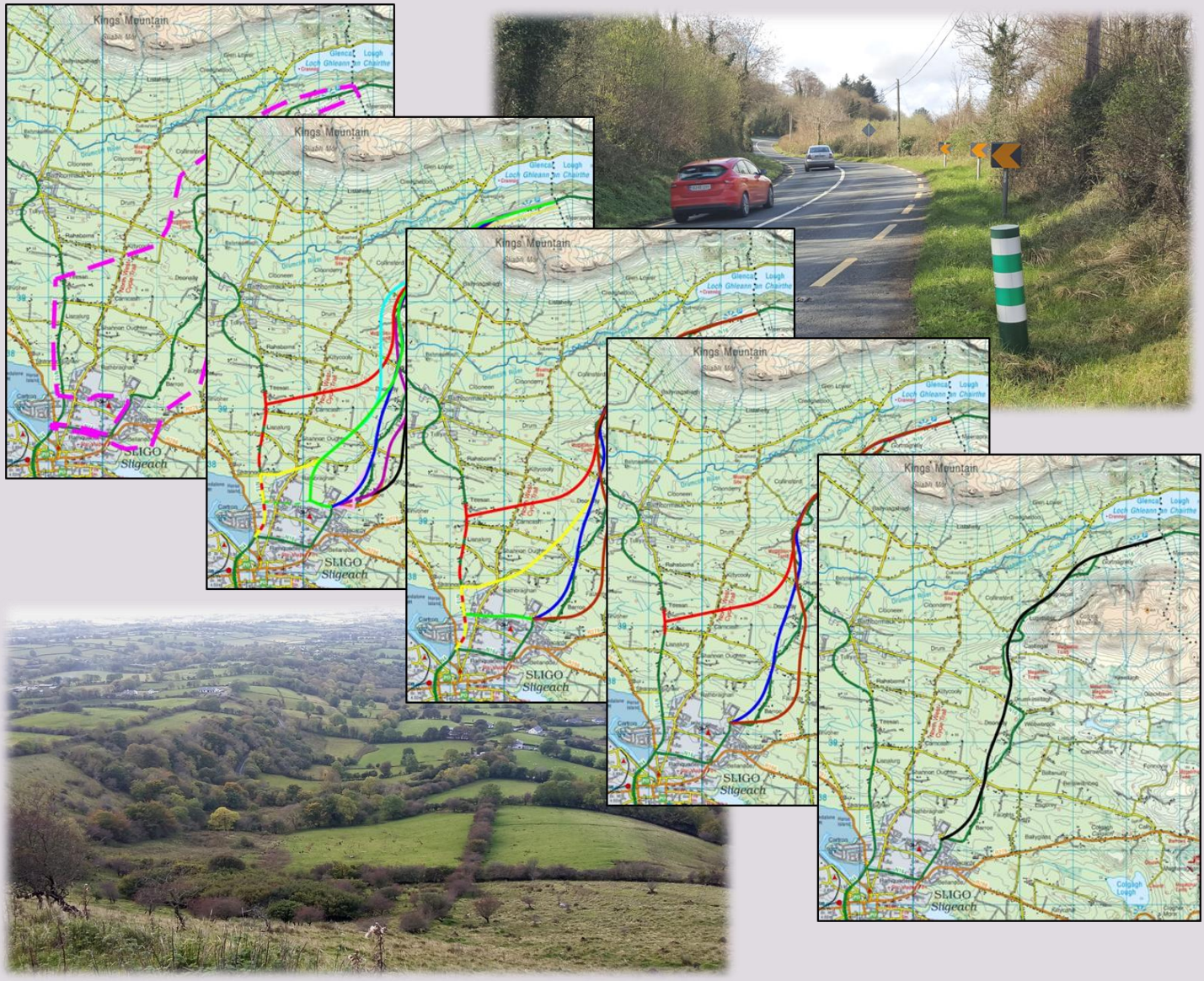
Route Selection Report

Volume 4: Road Safety Audit Stage F

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

N16 Sligo to County Boundary



Land of Hearts Desire

SLIGO COUNTY COUNCIL

TII
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 & Transport Assessment;
  - Part B: Road Engineering, Road Safety Impact Assessment and Options Comparison Estimate);

Volume 3

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

Volume 4

- **Road Safety Audit Stage F;**

Volume 5

- Figures;

Volume 6

- Stage 2, Project Appraisal, Multi Criteria Analysis;

Document Control

Status	Issued For	Signed	Date	Approved
DRAFT	*TII Peer Review*	*Fergus Meehan*[1]	*April 2017*	*Emer Concannon*[2]
FINAL	*Public Info*	*Fergus Meehan*	*July 2017*	*Emer Concannon*

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ACKNOWLEDGEMENTS

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 1-1: N16 Sligo to County Boundary Route Selection Team

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

Design

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

TABLE OF CONTENTS

Tables

ii. Stage F, Road Safety Audit

1 Stage F; Road Safety Audit – Report

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

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

The N16 Sligo to County Boundary

Stage F Feasibility Road Safety Audit

(Oct 2016)

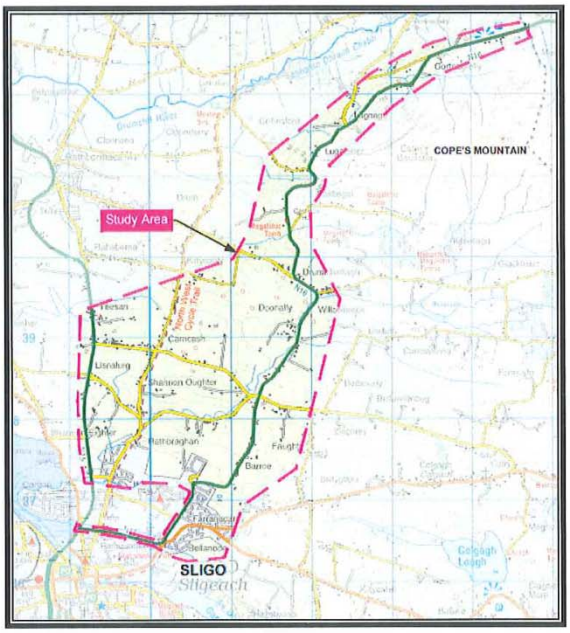
Donegal NRO
Oifig Bóithre Náisiúnta Dhún na nGall

Table of Contents

1.0 INTRODUCTION

1.1 Location

This report describes a Stage F, Feasibility Road Safety Audit, carried out on the proposed N16 Sligo to County Boundary in Co. Sligo.



Map 1: Scheme Location

1.2 Audit Team

The audit team members were as follows:

Brian O'Connor	Kerry NRO	Team leader
Damian McDermott	Donegal NRO	Team member
Karen Hartin	Donegal NRO	Team member

1.3 Audit Information

The audit comprised of an examination of the drawings supplied by Sligo County Council and one site visit. The audit site visit was carried out during the day on 20th of October 2016. The weather conditions were generally dry and bright.

Stage F Phase 1 Road Safety Audit has been carried out in accordance with the requirements of TII GE-STY-D1026. The scheme (route options) has been examined and this report compiled in respect of the consideration of those matters that may have an adverse effect on road safety. It has not examined or verified the compliance with any other standard or criteria. All options presented would provide a significant improvement to safety on this section of the N16. The problems identified in this report are considered to require action in order to improve the safety of the scheme and minimise collision occurrence. The overall number and severity of these problems as well as overall safety considerations of each route option has advised the comparative safety ranking of these schemes in this report.

The N16 is considered to be a strategic route and the options developed are for the most part rural occasionally semi-urban in nature. As such minimal consideration has been given within this audit in respect to pedestrians. In respect to other VRU's it is considered that the audit review of the junction strategy i.e. general type, frequency and location as well as tie-in locations incorporates sufficient deliberation of VRU issues at this Feasibility audit stage.

If any of the recommendations within this road safety audit report are not accepted, a written response is required, stating the reasons for non- acceptance. Comments made within the report under the heading *"Observation"* are intended for information purposes only. Written responses to observations are not required.

In consultation with Sligo County Council, of the eight route option/sub-options presented at public consultation in July 2016, five route options (sub-options) were reviewed under this audit.

Of the five options, two are distinctly bypass routes. All others are online realignment/improvements. The routes are designated by colour.

The routes audited are Red, Yellow, Blue, Brown and Black/Brown.

The audit team have provided an overall relative grading of these route options.

1.4 Description of Scheme

The Scheme is on the N16 which links Sligo, Manorhamilton and Enniskillen. The existing section of the N16 covered by this audit runs from Ashlane/N4/N15 junction near Hughes

Bridge in Sligo town to the county boundary with Leitrim at Meenaphuill. It has an overall length of approximatly 10km.

The Scheme proposes an upgrade to the existing N16 route which has poor existing geometry.

1.5 Information provided to Audit team

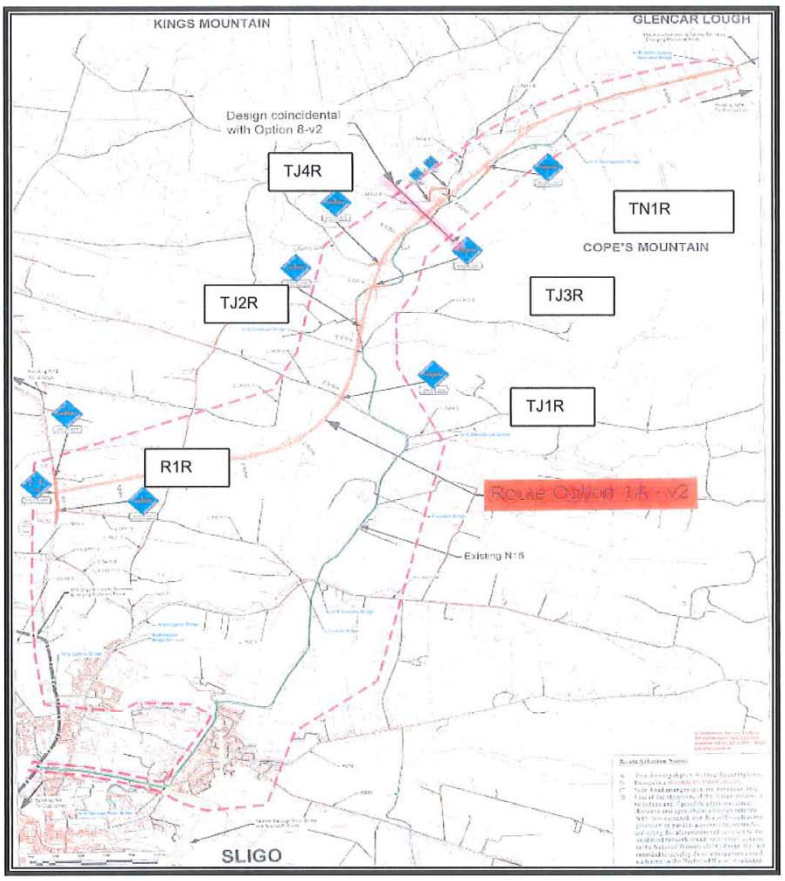
Drawings detailing the proposed route options were provided. Detail of this information is included in Appendix A. Discussions with the design team have taken place in advance and throughout the process of the audit. Five principle options were provided for review. It is understood that this has subsequently been reduced to three. The number of routes subsequently brought forward by Sligo County Council does not effect this audit or its finding. As such this audit presents all five routes as provided and reviewed at the time of audit.

2.0 ITEMS ARISING FROM THE AUDIT

2.1 Option 1: Red Route (R)

The overall length is 7.6km

The scheme includes online and offline sections. Of the 4.2km online section, 2.8km is Urban and plans allow for mainly junction upgrades in this area. The remainder of the online sections are principally at the tie-in with Leitrim Co. boundary. There are no departures.



Map 2: Red Route

2.1.1 *Item :1 Roundabout 1 Red (R1R)*

Problem

Roundabout 1 is located on the N15 approximately 2.7km from the urban area / Hughes Bridge. This location is rural in character and a junction of this type would not be expected.

Hazard

Vehicles may approach this junction at high speed.

2.1.2 *Item 2: T-Junction 1 (TJ1R)*

Problem

This junction is on an offline section of new road. This new junction may result in considerable turning movements at this location due to it being a possible alternate access for traffic not wishing to bypass the town.

Currently there is congested development in the vicinity of this proposed junction. There are also direct private accesses in close proximity to the junction. These factors will provide difficulty for both safe design and construction. The local road is also unlikely to be of sufficient standard to carry this additional traffic and there are no details of any improvements in respect to this road. The existing connecting N16 road is also substandard and further improvements may be required on existing junctions in order to improve safety.

Hazard

Additional turning movements on the new road and incorporating existing roads and private direct accesses in the vicinity of the junction could result in head-on, rear end and right turn collisions.

2.1.3 *Item 3: T Junctions 3, 4, 5 (TJ3R, TJ4R, TJ5R)*

Problem

T junctions 3, 4 and 5 are in close proximity to each other. From examination of the plans provided there are possible opportunities for rationalisation.

Hazard

Frequent additional turning movements, general movement north to south across the new road and the frequency and proximity of these junctions may result in an increased risk of head-on, rear end and right turn collisions.

2.1.4 *Item 4: Road Closures*

Problem

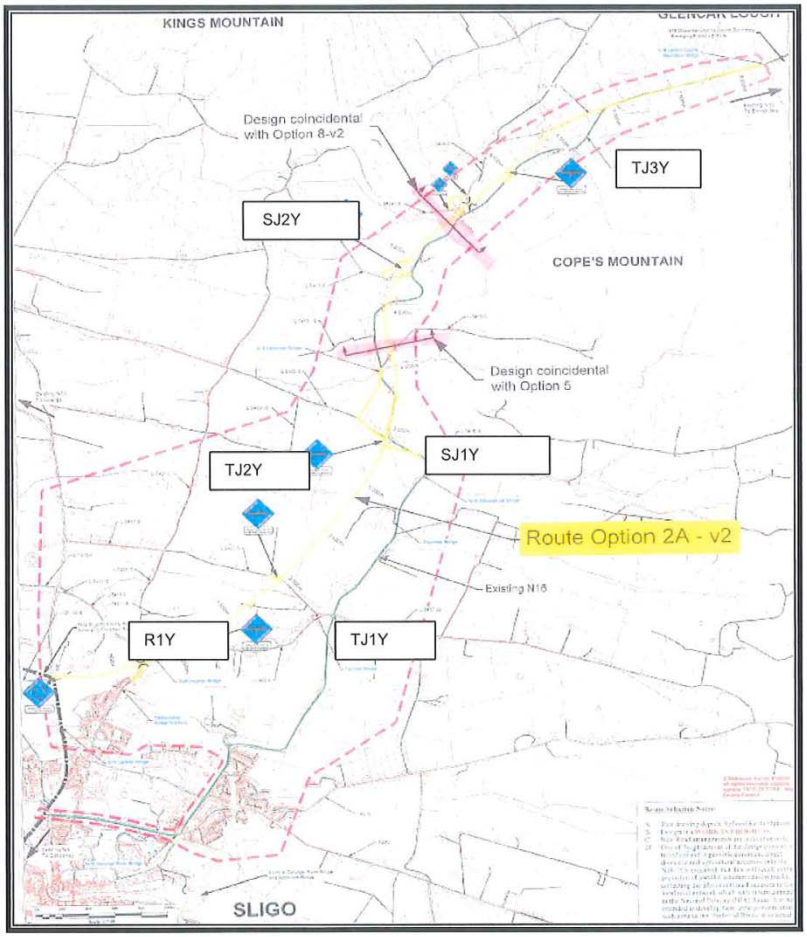
The new road results in the closure of 8 existing roads. At each of these there will be issues in regard to see-through and safe termination.

Hazard.

Unexpected terminations and see-through may result in collisions with new road embankment/cut areas especially at night.

2.2 Option 2: Yellow Route (Y)

The overall length is 8.2km. The scheme includes online and offline sections. Of the 3.2km online sections, 1.7km is at the Urban southern end and the remainder is at the county boundary tie-in . The plans allow for new and existing junction upgrade. 6.5km of the route is rural. There are no departures.



Map 3: Yellow Route

2.2.1 *Item 5: Roundabout 1 (R1Y)*

Problem 5.1

Roundabout 1 is on the N15 and it will have a steep downhill Northern approach.

Hazard

Traffic may approach this roundabout too fast to stop in time. This may lead to side impact collisions from overrun onto the roundabout and rear end collisions from late or sudden braking.

Problem 5.2

There is a proposed private access in close proximity to the northern access to Roundabout 1

Hazard

This access may cause unexpected turning movements on the busy N15 resulting in side impact or rear end collisions.

2.2.2 *Item 6: T-Junction 1 and 2 (TJ1Y, TJ2Y)*

Problem

T-junctions 1 and 2 are in close proximity to each other. The interconnection of roads to an underbridge allowing access under the bypass route and staggered junction 1 (SJ1Y) are also in this area.

Consideration should be given to rationalisation of these junctions through design.

Hazard

Frequent additional turning movements and general movement north to south across the new road may result in head-on, rear end and right turn collisions

2.2.3 *Item 7: T Junctions 3 (TJ3Y),*

Problem

An opportunity may exist to rationalise the numerous junctions in this area, possibly utilising the proposed staggered junction 2 (SJ2Y).

Hazard

Frequent additional turning movements and general movement north to south across the new road may result in head-on, rear end and right turn collisions

2.2.4 *Item 8: Road closures*

Problem

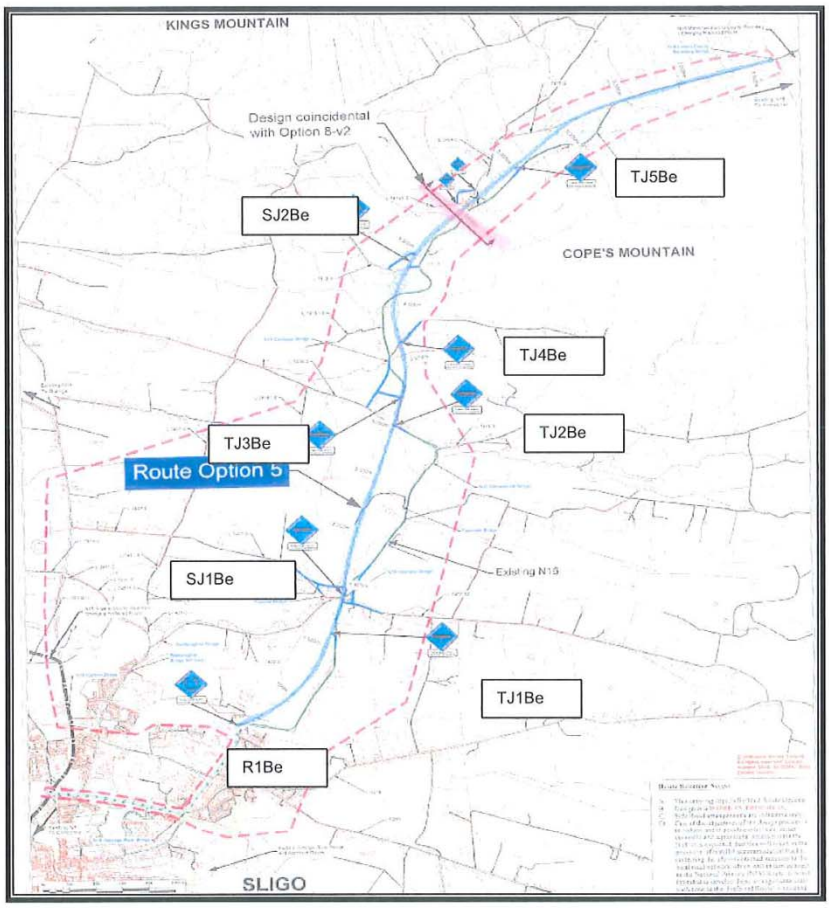
The new road results in the closure of 12 existing roads. At each of these, there will be issues in regard to see-through and safe termination.

Hazard.

Unexpected terminations and see-through may result in collisions with new road embankment/cut areas especially at night.

2.3 Option 3: Blue Route (Be)

The overall length is 7.7km. Approx. 6.2km is offline with 1.5km online at the tie-in with Leitrim Co. boundary. The plans allow for new and existing junction upgrade. There are no departures.



Map 4: Blue Route

2.3.1 *Item 9: Staggered Junctions (SJ1Be and SJ2Be)*

Problem

Staggered junction 1 is at a challenging location regarding gradients; it is likely that high embankments and therefore associated safety provisions will be required in the design at this location.

Hazard

Inadequate protection measures at this location may cause traffic to leave the road leading to potentially fatal injuries.

2.3.2 *Item 10: T-Junction 2, TJ2Be*

Problem

There are a significant number of junctions accessing the new road over a short length of the new realigned N16. Consideration may be given to the staggered junction 1 (SJ1Be) as the sole or principle access. All the junctions are in close proximity and the plans would indicate an opportunity for rationalisation.

Hazard

Frequent additional slow turning movements and general movement north to south across the new high speed main road may result in head-on, rear end and right turn collisions

2.3.3 *Item 11:T-Junction 5 and Staggered Junction 2 (TJ5Be and SJ2Be)*

Problem

These junctions are in close proximity to each other. With the additional proximity and interconnection of the existing road network in the vicinity, it appears that, there are opportunities for rationalisation of these 2 Junctions.

Hazard

Frequent additional turning movements and general movement north to south across the new road may result in head-on, rear end and right turn collisions

2.3.4 *Item 12: Road closures*

Problem

The new road results in the closure of approximately 13 existing roads. At each of these, there will be issues about see-through and safe termination.

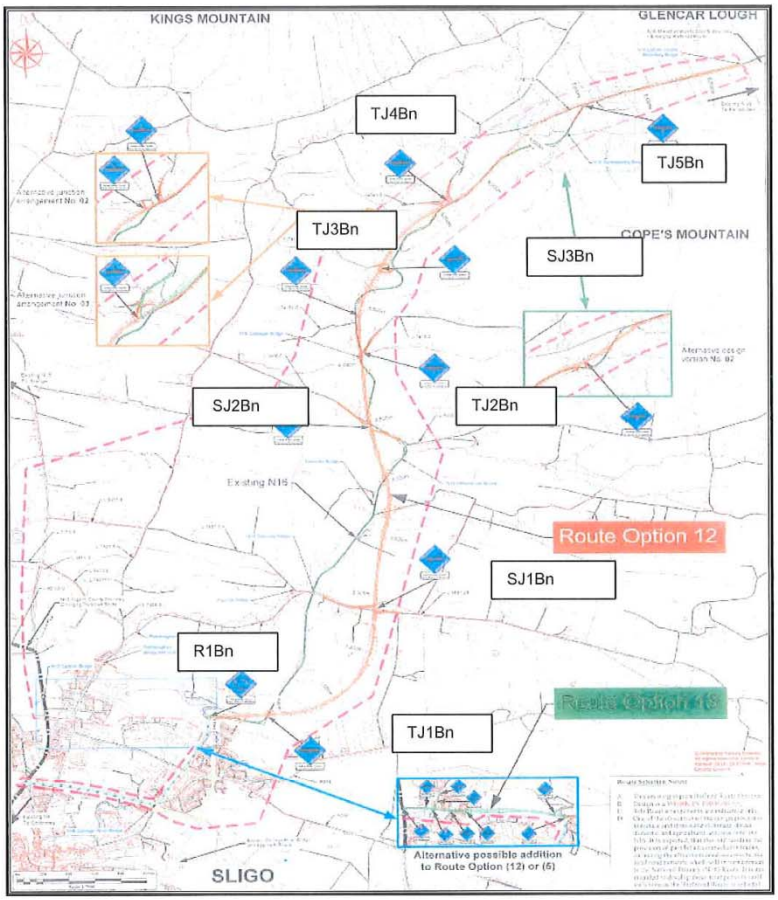
Hazard.

Unexpected terminations and see-through may result in collisions with new road embankment/cut areas especially at night.

2.4 Option 4: Brown Route (Bn)

The overall length is 8.3km

The scheme includes online and offline sections. Of the total length, 1.5km is online at the tie-in with Leitrim Co. boundary. The plans allow for new and existing junction upgrade. There is one departure relating to the Horizontal Curve.



Map 5: Brown Route

2.4.1 *Item 13: Staggered Junctions 3 and T Junctions 2, 3 and 4 (SJ3Bn, TJ2Bn, TJ3Bn TJ4Bn)*

Problem

These junctions are all in close proximity to each other. Opportunities for rationalisation should be examined.

Hazard

Frequent junctions, additional turning movements and general movement north to south across the new road may result in head-on, rear end and right turn collisions

2.4.2 *Item 14: Road closures*

Problem

The new road results in the closure of approximately 15 existing roads. At each of these, there will be issues concerning see-through and safe termination.

Hazard.

Unexpected terminations and see-through may result in collisions with new road embankment/cut areas especially at night.

2.4.3 *Item 15: Staggered Junction 1 (SJ1Bn)*

Problem

Staggered junction 1 is at a challenging location regarding gradients; it is likely that high embankments will need to be integrated into the design. Adequate protection for all road users need to be incorporated into the design at this location

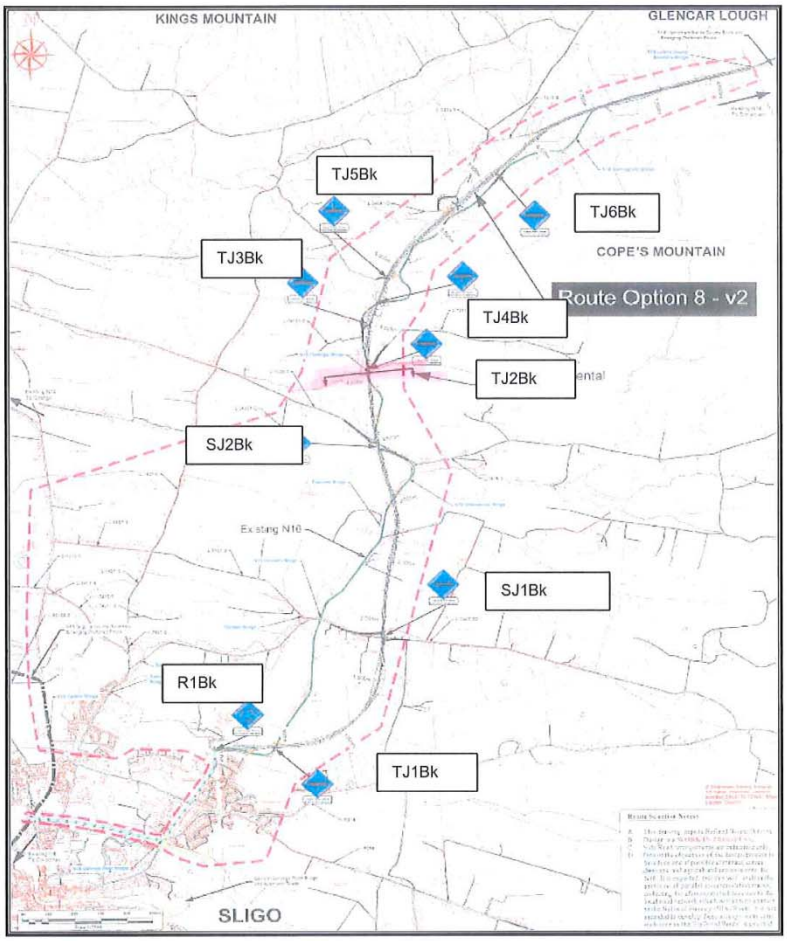
Hazard

Inadequate protection measures at this location may cause traffic to leave the road leading to potentially fatal injuries.

2.5 Option 5: Black Route Bk

The overall length is 8.2km

The scheme includes online and offline sections. Of the total length, 1.5km is online at the tie-in with Leitrim Co. boundary. The plans allow for new and existing junction upgrade. There are no departures.



Map 6: Black Route

2.5.1 *Item 16: T Junctions 4, 5 and 6 (TJ4Bk, TJ5Bk, TJ6Bk)*

Problem

These junctions are all in close proximity to each other and appear to have opportunities to allow the number of junctions to be rationalised.

Hazard

Frequent additional turning movements and general movement north to south across the new road may result in head-on, rear end and right turn collisions

2.5.2 *Item 17: Road closures*

Problem

The new road results in the closure of approximately 14 existing roads. At each of these, there will be issues concerning see-through and safe termination.

Hazard.

Unexpected terminations and see-through may result in collisions with new road embankment/cut areas especially at night.

3.0 PREFERENCE OF DESIGN OPTIONS (STAGE F: ROAD SAFETY AUDIT)

Following on from the safety concerns outlined in the previous section this is a summary of the main points/issues identified on each option.

3.1 Red Route

The Red Route is the shortest with the least number of junctions and local/existing road closures. The location of the roundabout 2.7km from Hughes Bridge is not ideal, it is unexpected in a rural location on a 100kph section. Trafic not bypassing the town is likely to leave the red route at Junction TJ2R, where the local road network is not of sufficient standard to carry this additional traffic. This option provides linkages to other strategic roads planned in the area.

3.2 Yellow Route

The Yellow Route has the least amount of T-Junctions and has one of the fewest number of road closures. The approach to the first roundabout from the northern direction is on a steep downward gradient. As this route is closer to the existing N16 route and Sligo town it is more likely that traffic will stay on the improved route for longer than change to the retained existing route. Modifications to this route could provide similar traffic pattern to the eastern realignment options while offering more benefits for strategic traffic when compared to the red route. This option provides linkages to other strategic roads planned in the area.

3.3 Blue Route

The Blue Route is the second shortest route and has fewer junctions than other eastern realignment options. There are opportunities to further rationalise junctions with some link road proposals or utilisation of the existing network. The staggered juctions, in particular SJ1Be, will have to be carefully designed because of the level differences between the existing and proposed alignments anticipated in thelr vicinity.

3.4 Brown Route

The Brown Route is the longest with the most junctions and local/existing road closures. Many of the junctions are in close proximity to each other. Compared to other routes there are fewer opportunities, if any, for rationalisation. The staggered juction will have to be carefully designed from a safety point of view with the gradient and level differences anticipated in the area.

3.5 Black Route

The Black Route is very similar to the brown route however with slightly less local/existing road closures. There are a significant number of junctions in close proximity to each other but there appears to be some opportunity for rationalisation. The staggered juctions will have to be carefully designed from a safety point of view with the gradient level differences anticipated in the area.

3.6 Ranking of Route Options

This is a Stage F (Feasibility) Phase 1 Road Safety Audit.

The Safety Audit team carried out a full review of all relevant drawings and documents in relation to the developed route options. In addition the team visited the site. Some of the main safety considerations in comparing the routes at this preliminary stage included overall length, number, type and arrangement of junctions, general impact and interface with the existing network, potential design issues and other potential residual risks. A summary of some of the comparitive items reviewed is given below Table 3.1.

OPTION	Ref.	Length(km) (Online)	No of Junctions	Clustering / Type and location of junctions	Interface with existing network /Road Closures
Red	R	7.6 (4.2)	6	Medium	8
Yellow	Y	8.2 (3.2)	6	low	12
Blue	Be	7.7 (1.5)	8	Medium	13
Brown	Bn	8.3 (1.5)	9	Medium	15
Black	Bk	8.2 (1.5)	9	High	14

Table 3.1 Comparitive advantages /disadvantages (non-exhaustive/selected)

The audit team has concluded that the route option proposals, as provided, rank as shown in the table below in terms of road safety. The ranking shown is Table 3.2 is purely a relative grading of the route options in respect to each other. All the proposed options represent a significant improvement to the existing poorly aligned N16 and a potential significant improvement to safety on that route.

OPTION	Ref.	RANK
Yellow	Y	1
Blue	Be	2
Red	R	3
Brown	Bn	4
Black	Bk	5

Table 3.2 OPTION RANKING

4.0 AUDIT TEAM STATEMENT

We certify that we have examined the drawings and other information listed in Appendix B and visited the site during the day of the 20th of October 2016. We further certify that we are independent from the design team for the scheme. This examination has been carried out with the sole purpose of identifying any features of the design that could be removed or modified to improve the safety of the scheme. The problems that we have identified have been noted in the report, together with suggestions for improvement that in our opinion should be studied for implementation.

Signed Brian O Connor ..... Brian O Connor

date 16/06/2017

signed ..... Damian McDermott

date 31/03/2017

signed Karen Hartin ..... Karen Hartin

date 31/03/2017

2 Stage F; Road Safety Audit – Design Team Response

2.1 Design Team Response

The following table outlines design team comments/responses on the Stage F, Road Safety Audit undertaken as part of the N16 Sligo to County Boundary Route Selection.

Table 2-1: Stage F; Road Safety Audit – Design Team Response

Item	RSA Heading Reference	Design Team Response	Comment
General			
General	Nb.	See comment	The Road Safety Audit, for programme reasons was carried out in advance of the final refinement of route options for 'Stage 2 – Project Appraisal'. This resulted in the elimination of a number of routes including 01A/01B (option 01A-v2 but with online N15 improvements), 02A-v2, 02A/02B-v2 (option 02-v2 but with online N15 improvements) and 08-v2. These routes generally did not compare well against other routes for reasons pertaining to economics and a range of environmental disciplines. Road Safety was factored into this decision in the Engineering criteria and as part of the Road Safety Impact Assessment. This refinement did not materially change any of the routes which subsequently progressed to 'Stage 2 - Project Appraisal'.
Red Route			
2.1	Description	See comment	The overall route length is referred to as '7.6km'; however, the audit refers to online sections, some of which pertain to the existing N15 improvements, which are part of option 01A/01B-v2. It would be useful to note this in the audit. The overall length of option 01A/01B-v2 is 9.625km.
2.1.1	Problem	Accepted	In the event of Option 01A-v2, or 01A/01B-v2 becoming the Preferred Route: - The 'Problem' shall be considered at design stage.
2.1.2	Problem	Accepted	In the event of Option 01A-v2, or 01A/01B-v2 becoming the Preferred Route: - The local road and required junctions will be upgraded and reconfigured if required.
2.1.3	Problem	Noted	Although the plans may indicate further potential for linking side roads, the topography which is mountainous makes it very difficult from an engineering, environment and

Item	RSA Heading Reference	Design Team Response	Comment
			economic perspective. This has been considered during the design of Feasible Route Options and will be considered further during the design process of the Preferred Route – however further scope for rationalisation of junctions is considered limited .
2.1.4	Problem	Accepted	In the event of Option 01A-v2, or 01A/01B-v2 becoming the Preferred Route: - The 'Problem' shall be considered at design stage.
Yellow Route			
2.2	Description	See comment	The overall route length is referred to as '8.2km'; however, the audit refers to online sections, some of which pertain to the existing N15 improvements, which are part of option 02A/02B-v2. It would be useful to note this in the audit. The overall length of option 02A/02B-v2 is 9.36km.
2.2.1	Problem 5.1 Problem 5.2	Accepted	N/A
2.2.2	Problem	Noted	It should be noted that the 'interconnection' of local roads separate the local traffic from the national traffic. Rationalisation has been considered during the design of route options, however in this case, for significant socio-economic severance reasons this was not incorporated into the Feasible Route Option.
2.2.3	Problem	Noted	Although the plans may indicate further potential for linking side roads, the topography which is mountainous makes it very difficult from an engineering, environment and economic perspective. This has been considered during the design of Feasible Route Options and will be considered further during the design process of the Preferred Route – however further scope for rationalisation of junctions is considered limited.
2.2.4	Problem	Accepted	In the event of Option 02A, or 02A/02B becoming the Preferred Route: - The 'Problem' shall be considered at design stage.
Blue Route			
2.3.1	Problem	See comment	Although the existing alignment presents a 'challenging gradient' as referred to in the audit, the new 'Staggered Junction 1' is located on a vertical gradient of less than 1%, therefore it is not considered to be a challenging location in terms of gradient. In addition all approach side road gradients to the new alignment are less than 2%. In addition, it should also be noted that the road verge in

Item	RSA Heading Reference	Design Team Response	Comment
			accordance with DMRB requirements will be in the order of 4.5m to 5m. Embankments at the junction location are in the order of 2-3m; Should this route become the preferred option, the side slopes will be designed at design stage – this shall be carried out in accordance with the risk assessment procedures outlined in TD 19/14 (Safety Barriers)
2.3.2	Problem	Noted	Although the plans may indicate further potential for linking side roads, the topography which is mountainous makes it very difficult from an engineering, environment and economic perspective. This has been considered during the design of Feasible Route Options and will be considered further during the design process of the Preferred Route – however further scope for rationalisation of junctions is considered limited.
2.3.4	Problem	Accepted	In the event of Option 05 becoming the Preferred Route: - The 'Problem' shall be considered at design stage.
Brown Route			
2.4	Description	See comment	...'departure'... should read ...'relaxation'...
2.4.1	Problem	Noted	Although the plans may indicate further potential for linking side roads, the topography which is mountainous makes it very difficult from an engineering, environment and economic perspective. This has been considered during the design of Feasible Route Options and will be considered further during the design process of the Preferred Route – however further scope for rationalisation of junctions is considered limited.
2.4.2	Problem	Accepted	In the event of Option 12 becoming the Preferred Route: - The 'Problem' shall be considered at design stage.
2.4.3	Problem	See comment	The new 'Staggered Junction 1' is located on a vertical gradient of less than 1%, therefore it is not considered to be a challenging location in terms of gradient. In addition all approach side road gradients to the new alignment are less than 3%. In addition, it should also be noted that the road verge in accordance with DMRB requirements will be in the order of 4.5m to 5m. Embankments at the junction location are in the order of 2-3m; Should this route become the preferred option, the side slopes will be designed at design stage – this shall be in consideration of the risk assessment process outlined in TD 19/14 (Safety Barriers).

Item	RSA Heading Reference	Design Team Response	Comment
Black Route			
2.5.1	Problem	Noted	Although the plans may indicate further potential for linking side roads, the topography which is mountainous makes it very difficult from an engineering, environment and economic perspective. This has been considered during the design of Feasible Route Options and will be considered further during the design process of the Preferred Route – however further scope for rationalisation of junctions is considered limited.
2.5.2	Problem	Accepted	In the event of Option 8-v2 becoming the Preferred Route: - The 'Problem' shall be considered at design stage.
Preference of Design Options (Stage F: Road Safety Audit)			
3.2	Yellow Route	See comment	The audit states that: 'As this route is closer to the existing N16 route and Sligo town it is more likely that traffic will stay on the improved route for longer than change to the retained existing route'... As per information issued, the traffic model predicts that a similar portion (50%) of traffic will remain on the existing deficient section of the N16, over a similar length to Option 01A. Modifications of this route were examined, but would require significant socio-economic severance impacts and were therefore not progressed.
Section 3.1 to 3.5	All routes	See comment	Comments already made in relation to gradients, embankments, junction rationalisation, etc., are similar to those already outlined in this document.