Bonneagar Iompair Éireann
Transport Infrastructure Ireland

TII Publications

GE PE DN CC OP AM RE

Road Safety Audit Guidelines

GE-STY-01027

March 2015

GE General

Standards

About TII

Transport Infrastructure Ireland (TII) is responsible for managing and improving the country's national road and light rail networks.

About TII Publications

TII maintains an online suite of technical publications, which is managed through the TII Publications website. The contents of TII Publications is clearly split into 'Standards' and 'Technical' documentation. All documentation for implementation on TII schemes is collectively referred to as TII Publications (Standards), and all other documentation within the system is collectively referred to as TII Publications (Technical). This system replaces the NRA Design Manual for Roads and Bridges (NRA DMRB) and the NRA Manual of Contract Documents for Road Works (NRA MCDRW).

Document Attributes

Each document within TII Publications has a range of attributes associated with it, which allows for efficient access and retrieval of the document from the website. These attributes are also contained on the inside cover of each current document, for reference. For migration of documents from the NRA and RPA to the new system, each current document was assigned with new outer front and rear covers. Apart from the covers, and inside cover pages, the documents contain the same information as previously within the NRA or RPA systems, including historical references such as those contained within NRA DMRB and NRA MCDRW.

Document Attributes

TII Publication Title	*Road Safety Audit Guidelines*
TII Publication Number	*GE-STY-01027*

Activity	*General (GE)*
Stream	*Safety (STY)*
Document Number	*01027*

Document Set	*Standards*
Publication Date	*March 2015*
Historical Reference	*NRA HA 19*

NRA DMRB and MCDRW References

For all documents that existed within the NRA DMRB or the NRA MCDRW prior to the launch of TII Publications, the NRA document reference used previously is listed above under 'historical reference'. The TII Publication Number also shown above now supersedes this historical reference. All historical references within this document are deemed to be replaced by the TII Publication Number. For the equivalent TII Publication Number for all other historical references contained within this document, please refer to the TII Publications website.

Volume 5 Section 2
Part 2
NRA HA 19/15

An tÚdarás um Bóithre Náisiúnta
National Roads Authority

Road Safety Audit Guidelines

March 2015

St. Martin's House, Waterloo Road, Dublin 4 Tel: +353 1 660 2511 Fax +353 1 668 0009
Email: infoDMRB@nra.ie Web: www.nra.ie

Summary:

This Advice Note provides guidance on undertaking Road Safety Audits on National Roads. It is intended to be read in conjunction with HD 19 Road Safety Audit published by the National Roads Authority.

Published by National Roads Authority, Dublin 2015

VOLUME 5 ASSESSMENT AND PREPARATION OF ROAD SCHEMES

SECTION 2 PREPARATION AND IMPLEMENTATION

PART 2

NRA HA 19/15

ROAD SAFETY AUDIT GUIDELINES

Contents

Chapter

1. INTRODUCTION

1.1 These Guidelines should be read in conjunction with the National Roads Authority (NRA) Design Manual for Roads and Bridges Standard NRA HD 19 Road Safety Audit (NRA DMRB 5.2.2).

1.2 All necessary definitions are given in Chapter 1 of NRA HD 19.

History and Background

1.3 The road safety audit process was initiated when road safety engineers realised that they were carrying out collision remedial schemes on relatively new roads. Adopting the principle of "prevention is better than cure", they decided to use some of the safety experience that they had gained from the remedial work to design safety into new road schemes.

1.4 Since then the concept grew over the years from an informal check of new schemes to the current system of road safety audit as an essential integral part of design and construction procedures.

1.5 Since the year 2000 road safety audit has been a part of NRA DMRB and has been a requirement on all schemes on National Roads. Since 2011 there has been a legal requirement for road safety audit on the Trans European Network – Transport (TEN-T) as EU Directive 2008/96/EC on Road Infrastructure Safety Management was adopted in Ireland as Statutory Instrument No. 472 of 2011, European Communities (Road Infrastructure Safety Management) Regulations 2011.

Scope of Audit

1.6 The standard NRA HD 19 sets out the procedures required to implement road safety audits on National Roads. It defines the requirement for audit and the stages in design and construction at which audits shall be undertaken.

1.7 The primary purpose of a road safety audit is to identify potential safety hazards within the scheme design or construction as they could affect road users. A road safety audit is not a check of compliance with design standards. The audit shall not be concerned with structural safety.

1.8 Road safety audits should consider road safety under all operating conditions and for all road users.

1.9 Recommendations for dealing with identified road safety hazards should make allowance for the fact that strategic decisions on route choice and junction type reflect a balance of factors, including safety. Recommendations requiring major changes in these areas are therefore unlikely to be practicable to implement, particularly after Stage 1 of the road safety audit process.

1.10 These guidelines apply to all road schemes designed in accordance with NRA DMRB which result in new road construction or permanent change to the existing road or roadside layout carried out under agreement of the Overseeing Organisation.

1.11 These guidelines also cover development schemes which result in a change to the road or roadside layout that is initiated and/or executed for commercial or private development.

1.12 There is little direct overlap between the task of road safety audit (which relates principally to future operational safety of the scheme) and the Safety, Health and Welfare at Work Act and its current Regulations. However, it will be important to ensure that Stage F, 1 and 2 road safety audits are received by the relevant Project Supervisor for the Design Process for the scheme prior to invitation to tender, and placed within the Safety File. Stage 3 and 4 (post-construction) road safety audits should also be placed within the Safety File.

Stages of Audit

1.13 Road safety audits and subsequent actions shall be completed at five specific stages in the preparation of the scheme. These stages are:

Stage F: Route selection stage, prior to route choice;

Stage 1: Completion of preliminary design prior to land acquisition procedures;

Stage 2: Completion of detailed design, prior to tender of construction contract. In the case of Design and Build contracts, a Stage 2 audit shall be completed prior to construction taking place;

Stage 3: Completion of construction, (prior to opening of the scheme, or part of the scheme, to traffic wherever possible).

Stage 4: Early operation at 2 to 4 months post road opening with live traffic.

1.14 In the case of minor schemes some of the stages may be omitted or combined. An indication of requirement of audit stage by scheme type and complexity is shown in **Appendix A**.

1.15 Where no previous stage audit has been undertaken, then those factors that would normally be considered at an earlier stage shall be included as necessary.

1.16 Where a choice of routes is available, Stage F audits should be carried out in two phases. Phase 1 should be a comparative assessment of the routes from a road safety point of view. Once the route has been chosen, Phase 2 of the audit will be carried out on the chosen route, in the standard problem and recommendation format.

1.17 Where stages 1 and 2 are combined there will be only one design stage audit before construction. It is therefore necessary that the level of detail in design submitted for a stage 1/2 audit is the same as that expected for a stage 2 audit.

1.18 Stage 4 audits require an assessment of road safety in the light of actual behaviour of road users during early operation. Approval process for Stage 4 Audit Team is the same as for all other audit stages. A Stage 4 Audit Report, Feedback Form and Exception Report are required as necessary.

1.19 During a Stage 4 audit the Auditor should look out for any signs of collisions since opening. Prior to carrying out the Stage 4 Audit the audit team should request any available collision information from infosafety@nra.ie.

1.20 **Scheme Types**

Road Scheme. A scheme designed in accordance with NRA DMRB which results in new road construction or permanent change to the existing road or roadside layout.

Development Scheme. A scheme which results in a change to the road or roadside layout that is initiated and/or executed for commercial or private development.

Maintenance Schemes

1.21 Like-for-like repair or replacement of existing road infrastructure does not require a Road Safety Audit. This is because the road or roadside layout has not changed from the original design or installation.

Collision Causation

1.22 The contributory factors listed by An Garda Síochána on collision report forms has changed little from 2003. Driver error accounted for 86 per cent of all contributory factors identified in fatal collisions, while the next most listed factor, pedestrian error, accounted for 11 per cent. Road and environmental factors accounted for 3 per cent of all listed contributory factors (RSA Road Collision Facts, 2012).

1.23 Safety principles based on research carried out into road traffic collisions are described in more detail in Chapter 2. The road safety auditor's role is to use safety engineering experience to ask the question "How will all road users cope at all times and in all conditions with this road environment?" to identify safety problems, and to suggest measures that will minimise future collision occurrence and severity.

2. ROAD SAFETY PRINCIPLES

General Safety Principles

2.1 It is important for road safety auditors to try to base their comments on sound safety experience, and where possible, to have the means to back up the recommendations from documented sources. NRA HD 19 Road Safety Audit requires the auditor to be able to produce "background reasoning" for identified problems. The source of some of the information provided below is the Austroads Guide to Road Safety Part 6: Road Safety Audit.

2.2 Road safety audit is a formal procedure that uses experienced auditors with extensive safety engineering knowledge to identify safety deficiencies in road schemes. A broad experience in road, traffic and safety engineering will ensure that a road safety auditor has the knowledge and ability to refer back to the basic principles in road safety, and ask a series of pertinent questions:

a) Does the design layout create confusion or ambiguity for road users that could lead to potential road traffic collisions?

b) Is there too much or too little information for road users?

c) Is there too little or too much visibility, or an obstruction to road users' view?

d) Does the layout create hazards or obstacles to road users that could contribute to an increased risk of injuries?

2.3 If there is a "yes" answer to any of these questions, then the safety of the scheme could be compromised and remedial measures may be required to remove this potential or actual deficiency. Drivers and other road users have to perceive and process vast amounts of sensory and visual information to negotiate a road layout. The Designer's role is to provide a safe road environment that should:

a) provide adequate information for road users of the layout and conditions ahead;

b) provide adequate warning of hazards or unusual layouts ahead;

c) provide positive control of road users' passage through conflict points or unusual sections;

d) provide a road performance that can "forgive" road users' errors or inappropriate behaviour.

2.4 Current design standards should be used. Advance information and warning should be used to inform road users of the layout ahead. However, driver overload should be avoided as it may cause road users to focus too much on the unimportant data and shed vital information. Conflicting information, an overabundance of road signs or a lack of delineation can cause overload.

Therefore a "safer" road environment can be defined as a layout that:

a) provides clear, concise and phased release of road user information;

b) provides a consistent standard of road design and traffic control;

c) provides adequate warning of hazards.

Designing for the Road User

2.5 It is important that a road improvement caters for all road users. Often the needs of the motorist are incorporated within a scheme whilst the needs of the vulnerable road user are ignored. The vulnerable road users that need to be considered include, but are not limited to, the following:

a) pedestrians – the old, young and those with mobility or sight impairment;

b) cyclists – children, commuters and leisure users;

c) equestrians;

d) motorcyclists.

2.6 Each vulnerable road user has different needs from the road network and it is important that Designers and auditors are aware of their specific requirements. In the urban environment the pedestrian is likely to be the principal user and designs must incorporate safe crossing locations, adequate visibility to and from the crossings and appropriate lighting.

2.7 In addition to the needs of vulnerable road users, particular attention should be paid to the needs of heavy goods vehicles, buses or other specialist vehicles.

2.8 To assist in the determination and needs for all road users, it is essential that traffic data and local road user surveys are used to shape the design process and tailor a 'safer' environment.

Roadway Elements and Safety

Design Context

2.9 Safe road design varies from the urban to the rural road network, and there are external factors in each environment which are beyond the Designer's control. This can create a situation in which a design that would be safe in one environment could be unsafe in another environment. These external factors can include traffic volumes, population density, noise, or road user familiarity.

2.10 The function of a road should be clear to all road users, and a well-planned and defined road hierarchy can assist in providing a safe road network.

Junctions

2.11 The most important point to consider with respect to the safety of junctions is that both the layout and control method should be simple and clear, with defined priorities for all road users.

2.12 The assumption that 'straight on' traffic has priority is widely accepted, and it needs to be remembered that alterations to this, despite reinforcement with signs and lines, can still be confusing if visual clues such as fences, kerbing or lighting remain unchanged.

2.13 It is important to attempt to make any minor approach perpendicular to the main road, and junctions with acute angles should be avoided. These angled junctions pose a particular problem for the elderly or those with restricted neck movements, and forward and side visibility is often restricted. Similarly, it is advisable to avoid intersections on the inside of bends as foliage often encroaches into sight lines after several years.

2.14 Roundabouts used as a form of junction control have their own rules and design requirements. It is important that a roundabout looks like a roundabout from all approaches and for all users, in order to prevent potential conflict. One of the primary requirements in good roundabout design is that the

radius is tight on each entry; this ensures a slow entry and lower circulating speed and facilitates crossing pedestrians.

2.15 Visibility is a key requirement for all junction types; all road users need to see and be seen by others. Care should be taken with siting street furniture such as signs and vegetation within visibility splays. Vulnerable road users often experience difficulties crossing junctions. It is important that their needs are provided for and that safe crossing places are implemented where required.

2.16 Where a scheme is designed using standards other than the NRA DMRB, then the audit team must be informed of this. On National Roads, Road Safety Audits must be carried out in accordance with NRA HD19.

Links

2.17 Links that are well designed with few private access points traditionally have a good safety record. However, within the urban environment strict access control is less relevant.

2.18 In rural areas the principal factors affecting the safety of road links are:

a) ***Private access control*** - on high speed roads there is a direct correlation between the number of access points onto links and the collision numbers on any given road;

b) ***Proximity of junctions*** - the majority of collisions take place at junctions; it is essential that junction spacing is maximised and consistent junction types are used;

c) ***Horizontal & vertical curves*** - collision frequency increases at crests and dips (vertical curvature) and increasing the degree of horizontal curvature along the alignment, increases collision frequency;

d) ***Visibility*** - adequate forward visibility to junctions, crossings and safe stopping distances is crucial to ensure a safe road design;

e) ***Design Speed*** - the design speed influences the likely pre-crash impact speed in a road traffic collision. Therefore, it is important that the road environment and design speed selected are appropriate and where possible excess speed is discouraged;

f) ***Combinations of elements*** – where two or more sub-standard design elements are combined, it is more likely that a hazard will emerge.

Road Features

2.19 The relationship between cross-sectional elements and safety is affected by the type and volume of traffic, and also by the surrounding environment.

Cut-off former alignments. Where new road alignments create short sections of redundant links on the former alignment, these sections of "old" road can lead to serious misjudgement by drivers if they are left untreated. The width and features of the former road can mislead drivers into the belief that they are on a major route, encouraging high speeds. Such drivers will not be anticipating any road closure or road realignment leading to a new junction, and may lose control upon reaching them. Road widths should be reduced, junctions realigned, and road markings and signs replaced to reflect the change in standard of road.

Lane width. Lane widths can be critical in affecting safety; where they are too narrow vehicles may collide on horizontal curves, and there may also be inadequate space for two-wheeled vehicles. Where lane widths are too wide the alignment may encourage excess speed.

Hard shoulder. On high speed links there is a safety benefit to be gained by the provision of a hard shoulder.

Parked vehicles. Vehicles parked on the carriageway affect the road environment, layout and consequently safety. Safety problems experienced with parked vehicles are:

a) parked vehicles causing physical obstructions which are sideswiped or run into;

b) vehicles slowing down or reversing to park causing sudden braking or nose-to-tail shunts;

c) parked vehicles which deflect oncoming vehicles into adjacent vehicle paths;

d) parked vehicles blocking visibility for any road user;

e) parked vehicles between which pedestrians emerge.

To reduce the risk of parked vehicles contributing to a collision it is important that designs should minimise parking in traffic lanes and hard shoulders and in close proximity to junctions.

Roadside vegetation. Trees and foliage can greatly enhance the environmental impact of the street scene. However, if left un-maintained they can restrict visibility considerably and can be a hazard to pedestrians and cyclists. In addition to this, saplings grow into large trees, which can provide an unforgiving road hazard in the event of a road traffic collision.

Forgiving Roadsides

2.20 Road safety research has shown that single vehicle non-pedestrian collisions are a significant problem on motorways, dual carriageways and inter-urban high speed single carriageway roads (NRA Road Safety Section research based on RSA Road Collision Facts, 2012).

2.21 In these collisions a high proportion of vehicles that leave the roadside go on to strike trees, fences, lighting columns, road structures or other items of unprotected street furniture.

2.22 A primary consideration when designing a road is to minimise the hazards to which the motorist is exposed. This can largely be achieved by removing the hazards from the immediate roadside through careful design. The width of land which should be kept clear of hazards so as to be available for use by errant vehicles is termed the Clear Zone. Details of Clear Zone widths are available in NRA TD19.

2.23 Post and rail fences have been identified as a hazard when in close proximity to the roadside, due to rails being able to penetrate a vehicle that impacts the fence. Post and rail fences within the Clear Zone should be treated as hazards and as such should be mitigated. A Post and Tension Mesh Fence (RCD/300/20) has been developed as an alternative to timber post and rail fence within the Clear Zone.

2.24 A hierarchy of treatment is set out in the design standard for Safety Barriers NRA TD 19 to minimise the consequence of this type of collision, and the order of preference for mitigation measures is as follows:

a) Remove the hazard.

b) Relocate the hazard.

c) Re-design the hazard to reduce the risk to road users e.g. by introducing a passively safe sign post.

d) Revise the road layout or cross-section to lower the risk, e.g. by increasing the width of the hard shoulder, improving the road alignment, etc.

e) Reduce impact severity (e.g. by using a breakaway feature or by setting a culvert flush with the existing ground).

f) Provide a suitable safety barrier.

3. ROAD SAFETY AUDIT PROCESS

Procedure on National Roads

3.1 The requirements for carrying out road safety audit on National Roads are described in the NRA Design Manual for Roads and Bridges Standard NRA HD 19 Road Safety Audit.

3.2 This chapter describes the road safety audit process in detail. The flowchart in **Appendix B** shows the critical steps in the process, both for road schemes designed by the Employer and those designed by the Contractor. In the interest of brevity the process described here is for road schemes designed by the Employer.

Procedure elsewhere

3.3 International Standards can be found (amongst others) in the UK, Australia, New Zealand and Denmark.

Audit Team Make-up

3.4 A road safety Audit Team should comprise at least two people who are independent of the Design Team. This independence is vital to ensure that the Design Team does not influence the recommendations of the road safety audit and therefore compromise safety at the expense of another issue. Team members should have recent relevant experience of undertaking road safety audits and should also have more general road safety engineering experience.

3.5 In most situations the Audit Team will comprise a senior person who will adopt the role of Audit Team Leader and a second person, who will be the Audit Team member.

3.6 Training of road safety auditors is essential and any Audit Team member should have attended recognised road safety engineering training and road safety audit training courses.

3.7 The current NRA training and experience requirements for Road Safety Audit Teams are subject to change and are available to download from the NRA standards website: http://nrastandards.nra.ie/images/stories/Standards/Other_Standards_Docs/nrahd19_quals.pdf.

Audit Team Approval

3.8 It is the responsibility of the Employer to obtain approval for the Audit Team for each audit. The scheme, and each audit for that scheme, must be registered on the NRA Road Safety Audit Approvals System (RSAAS) at https://nraaudit.nra.ie/NRARoadSafetyAudits.

3.9 For each audit the Employer must seek approval through RSAAS for the proposed Audit Team. Acceptance will be of individuals, rather than of consultancy firms bidding for the work, and it should be noted that each stage of audit is a single audit. Approval cannot be obtained for an Audit Team before the previous stage of audit for that scheme has been completed and all reports, including Feedback Form and Exception Report, if any, have been uploaded to RSAAS.

3.10 Quality checks will be carried out on a sample of completed road safety audits and the results of these checks may be taken into account when Audit Teams are being approved.

3.11 Although it is recommended that where possible the same Audit Team is used throughout the scheme delivery to ensure a consistent approach, it may in certain circumstances be necessary for NRA to refuse approval for a team.

Audit Brief

3.12 The Employer shall prepare an audit brief, seek approval of the Audit Team and then appoint the Audit Team.

3.13 The list below describes the necessary information that should be provided for each road safety audit. This list should be treated as a checklist and should be completed and given to the Audit Team as part of the audit brief.

a) Design Brief or design report that describes the scheme and objectives;

b) Departures from Standard;

c) Scheme Drawings;

d) Other scheme details, e.g. signs schedules, traffic signal staging;

e) Collision data for existing roads affected by the scheme;

f) Traffic surveys, including pedestrian and cycle movements, for existing roads affected by the scheme;

g) Previous Road Safety Audit Reports and Designer Responses /Feedback Form

h) Previous Exception Reports;

i) Date Audit Report is required;

j) Any other relevant information.

Site Visits

3.14 A site visit shall be carried out at the first audit stage being undertaken by an Audit Team. Site visits shall also be carried out at Stage 2, unless otherwise agreed with the Employer, and always at Stage 3 and Stage 4. These shall be carried out by all members of the Audit Team at every stage requiring a site visit. The team shall take into account the topography, local amenities, tie-ins of the scheme and any other relevant details. Photographs shall be collected and stored for future reference.

3.15 The Stage 3 and Stage 4 site visits shall be made during both daylight and darkness. The Employer's Representative shall, when relevant, invite a representative of the Gardaí and the local road authority to attend the visits. It may not be necessary to invite the Gardaí to some of the more minor schemes.

Checklists

3.16 An example of a road safety audit checklist is shown in **Appendix E**. Road safety auditors should use this or other lists when carrying out their work. However, checklists should be used intelligently, and not simply as a "tick box" system. It is recommended that they are used at the end of the process, to ensure that no major potential safety issue has been overlooked.

Road User Role Play

3.17 One of the most important checks carried out involves assessing the safety of the scheme from different potential road users' perspectives. The road safety auditor should always be asking the question: "What is it about this scheme that will lead road users to fail to cope with the road environment?"

3.18 During the design stages the auditor has to imagine what it would be like to walk, cycle and drive the scheme. "Driving" should include cars, vans, trucks and buses. "Walking" should be considered from the perspective of the elderly, the child, the wheelchair user and those with sight impairment. Cycling includes children, leisure cycling, and utility or commuter cycling. Where appropriate, the needs of the equestrian should be considered.

Methodology for Design Stage Audits

3.19 Road safety audit is carried out at five key stages which can be divided into two categories:

a) *Design Stage* - Stages F, 1 and 2,

b) *Construction and Early Operation Stage* - Stages 3 and 4.

3.20 The section below describes a working method for carrying out design stage Audits.

a) The Audit Team looks through drawings and other information to understand the scheme concept;

b) Consideration should be given to clarifying the audit brief through a meeting between the Audit Team, the Employer and the Designer, particularly on larger or more complex schemes;

c) The Audit Team visits the site. The weather and any other relevant circumstances should be recorded;

d) Each team member systematically and independently examines all drawings and other information provided and records any comments;

e) The team members discuss their individual findings;

f) The Audit Team decides which comments are related to safety and discuss possible recommendations. Any comments recorded by team members that do not go forward to the final report should be noted in the auditors own records, together with a reason stating why that issue is not to be included;

g) One team member produces a draft audit report. The report format is discussed in more detail in 3.30 – 3.36;

h) The other Audit Team members check the report and edit if necessary;

i) If required, the Audit Team Leader attends a meeting with the Designer and Employer to discuss the draft report;

j) The Audit Team produces the final report, signed by all members of the team and submits it to the Employer;

k) The Employer issues the audit report to the Designer who reviews the report. The Designer's Response process is then completed as described in clauses 3.40 to 3.49.

Methodology for Construction Stage Audits

3.21 At Stage 3 it is recommended that the Employer's Representative should be available for consultation with the Audit Team as required on the day of the audit.

3.22 At any construction stage audit the organisation responsible for future road maintenance, either road authority, PPP consortium or other organisation may also want to send a representative.

3.23 The Gardaí may have specific local information and knowledge of safety issues. The Garda District Superintendent may be notified in advance of any construction stage audit and given the opportunity to either send a representative to meet the Audit Team on the day of the audit or submit comments to the Audit Team.

3.24 At stages 3 and 4 it is the responsibility of the Employer's Representative where relevant to notify the Gardaí and other observers of the audit. The NRA Road Safety Section should be notified of the proposed dates of the construction stage audits, to enable shadow audits to be carried out.

3.25 Observers to the construction stage audits are not part of the road safety Audit Team and thus do not sign the audit report, but their presence should be recorded.

3.26 A suggested working method for undertaking construction stage road safety audits is as follows:

a) The Audit Team visits the site during daylight;

b) The Audit Team drives, walks and cycles the route as appropriate;

c) One team member takes notes of all the possible safety issues;

d) Another team member takes photographs of all the possible safety issues;

e) Before leaving the site a team meeting is held to ensure that the note-taker has covered all safety issues;

f) The Audit Team visits the site during darkness; walking driving and cycling as appropriate;

g) One team member produces a draft audit report and circulates it to all present at the site visit;

h) As there is often pressure to open new road schemes as soon as they are completed it may be possible to provide the Employer's Representative with a copy of the notes taken during the stage 3 visit, or a brief summary list, shortly afterwards. The Employer's Representative may find it convenient to start to act upon these notes prior to receiving the formal stage 3 audit report.

i) The report is edited following comments from the other team members and observers;

j) If required, the Audit Team Leader attends a meeting with the Designer and Employer's Representative to discuss the draft report;

k) The Audit Team produces the final report, signed by all members of the team and submits it to the Employer;

l) The Employer issues the audit report to the Designer who reviews the report. The Designer's Response process is then completed as described in clauses 3.40 to 3.49.

3.27 In the case of greenfield road alignments particular care should be taken in examining the tie-ins to the existing alignment, the treatments to cut-off sections of the existing alignment and any road closures, as there may be difficulty in seeing clearly how these sections will operate after road opening. For road schemes that are to have a stage 4 audit these areas will be seen at that stage in operation, but for those smaller schemes for which a stage 4 audit is not required it may be necessary to return immediately after opening to complete the stage 3 audit by examining the tie-ins in operation.

Pre-Stage 3 Audits

3.28 For larger schemes it may be convenient to carry out a pre-stage 3 audit shortly before completion. This is because there is often pressure to open new road schemes as soon as they are completed, and

recommendations in the stage 3 audit might take some time to implement. It also might prevent costly removal or relocation of some components such as signs and crash barrier.

3.29 If the recommendations from the pre-stage 3 audit are acted upon, then both final stage 3 audit and implementation of its recommendations will be less onerous.

Stage 4 Audit

3.30 A suggested working method for a road safety audit at the early operation stage is as follows:

a) The Audit Team reviews all available information on collisions since scheme opening. This information should be supplied by the Designer as part of the audit brief, and is available from infosafety@nra.ie;

b) The Audit Team visits the site during daylight, walking, driving and cycling the entire scheme, including affected side roads, as appropriate;

c) The Audit Team notes any evidence of collisions or of vehicles leaving the road;

d) The Audit Team observes road user behaviour for a period. This should be done throughout the scheme at any location that is considered critical, such as those that have been highlighted in previous road safety audit reports, or those where collisions or incidents have occurred. Particular attention should be paid to the tie-ins to the existing road network at the edges of the scheme. To allow for changes in traffic flows through the day it may be necessary to make these observations at more than on

e) One team member takes photographs of all the possible safety issues;

f) The Audit Team visits the site during darkness; walking, driving and cycling as appropriate;

g) One team member produces a draft audit report and circulates it to all present at the site visit;

h) The report is edited following comments from the other team members and observers;

i) If required, the Audit Team Leader attends a meeting with the Designer and Employer's Representative to discuss the draft report;

j) The Audit Team produces the final report, signed by all members of the team and submits it to the Employer;

k) The Employer issues the audit report to the Designer who reviews the report. The Designer's Response process is then completed as described in clauses 3.40 to 3.49.

Audit Report

3.31 After carrying out a road safety audit a formal report is written. The following items should be included within the audit report:

a) A brief description of the scheme being audited, and the audit stage;

b) The dates when the audit was carried out (and the date of the site visit);

c) The weather and road conditions during the site visit;

d) A list of the Audit Team members and any other personnel attending the site visit;

e) A series of road safety problems and recommendations for action; it may be useful to include a plan and/or photograph showing the location of the problems;

f) A statement signed by the Audit Team members to certify that they have examined the scheme and that they are independent of the Designer;

g) For design stage audits, a list of all plans and other information examined;

h) Feedback Form for completion by the Designer, Employer and the Audit Team Leader.

3.32 The main element of the report is the section on problems and recommendations and the following points should be borne in mind when writing this section:

a) All problems identified in a road safety audit report must relate to road safety problems. Non-safety items identified can be itemised in a separate report or letter;

b) All safety problems highlighted should be stated as clearly as possible. A clear identification of a problem will help the Design Office or Design Team to consider not only the recommendation in the report but also to consider alternative ways to overcome the safety problem.

3.33 Road safety Audit Teams should exercise caution in documenting differences in the potential severity of problems, as a problem would not be described in the report unless it were considered to affect the safety of the scheme to some extent. It is recommended that a meeting between Audit Team, Designer and Employer is used as the primary means to discuss the relative importance of issues raised within the draft report.

3.34 Recommendations should not be overly prescriptive. The Audit Team should word recommendations so that the Designer has some choice in the measures to be implemented. It is possible that the Designer can devise an amendment to the design that has not occurred to the Audit Team, yet overcomes the potential safety problem. The essential matter is not that a certain measure be implemented but that the problem be removed.

3.35 Recommendations should be as practical as possible and be relative to the overall scheme cost. There is little value in putting forward a recommendation that will add more than a small percentage increase to the cost of a scheme. Costs and benefits are discussed in more detail in chapter 4.

3.36 It must be recognised that the implementation of certain measures such as a change to design standards or policy will be outside the authority of the Designer and Employer. Recommendations to implement such measures should not be included, although such measures may be discussed within the report.

3.37 Safety problems that remain unaddressed throughout the audit process should be repeated at subsequent audit stages. Recommendations may change as appropriate to the stage the design has reached. For example, a Stage 1 audit on a realignment scheme might identify problems with the position of a particular junction, and would consequently recommend either closure or relocation. At Stage 2, if the design shows the junction in its originally proposed location the auditors should note this and recommend alternative measures to mitigate the problem such as additional signing, road markings, change of road surface, etc.

3.38 A sample Road Safety Audit Report is shown in **Appendix F**.

Issue of the Report

3.39 The final agreed report should be signed by all members of the team. The presence of any auditor trainee on the audit should be recorded as part of the report, but they are not regarded as full members of the team and should not sign the report.

3.40 The report is sent to the Employer, who considers it in consultation with the Designer.

Designer's Response

3.41 The recipient of a road safety audit report will be the Employer, who will have to decide whether or not to act on the recommendations contained within the report.

3.42 The Employer and Designer consider the report and the Designer, in consultation with the Employer, provides a Designer's response. The recommended form of Designer's response is a Feedback Form, as given in **Appendix C**.

3.43 The response from the Designer shall state clearly whether each problem is accepted and whether each recommendation is accepted.

3.44 In most cases both problem and recommendation will be accepted and the Employer will instruct the Designer to make changes in response to the audit report. In the case of acceptance of a problem, yet rejection of the associated recommendation, the Designer should propose an alternative recommendation to address the problem. If it is not possible to fully address a safety issue because of external factors beyond the Employer's control then these reasons should be given, along with any alternative mitigating measures that could be implemented.

3.45 If the Designer does not accept that an issue is a safety problem at all, then reasons for this should be given.

3.46 The Audit Team then review the Designer's Response and for each rejected problem or recommendation the Audit Team Leader shall indicate whether the alternative proposal or reasons are accepted.

3.47 The Audit Team may view a problem differently in the light of new information given by the Designer in feedback. The team may also accept that an alternative recommendation given by the Designer will have a genuine safety benefit. In each of these cases the team should indicate acceptance of these reasons or alternative recommendations in the feedback form.

3.48 The final feedback form, completed and signed by Designer and Audit Team Leader, is also signed by the Employer to acknowledge completion of the design response procedure.

3.49 If necessary the draft road safety audit report may be discussed at a meeting between the Audit Team, Designer and Employer (in consultation with the NRA Road Safety Section if required). For Stage 1 and 2 Audits this meeting may take place some days after the report has been completed. Due to time pressures for Stage 3 audits it is suggested that the meeting takes place immediately after the Stage 3 site visit. The purpose of the meeting is to clarify issues raised within the audit report. The auditors should be prepared to indicate the importance of issues raised within the report, and to justify why the problems are genuine safety issues. They should not be subjected to external pressure to change their report. However, once issues have been clarified the auditors may feel that they can amend sections of the report.

3.50 A copy of both the final road safety audit report and the feedback form should be uploaded by the Employer to RSAAS.

Re-audit

3.51 Where the agreed measures include major changes, it may be necessary to carry out a re-audit of that part of the scheme. The need for this should be discussed between the Audit Team Leader and Designer, and if it is agreed that a re-audit is necessary then this should be carried out as soon as possible.

3.52 The audit report for the re-audit should be added to the original audit report as an annex, and any issues raised should go through the design response procedure as normal.

Exception Report

3.53 For those cases where the Designer and the Audit Team cannot agree appropriate means of addressing an underlying safety problem identified by the audit, an Exception Report must be prepared as indicated in Table 3/1.

3.54 The Exception Report should be prepared by the Employer. It must address only those items in the audit report for which an Exception Report is necessary.

3.55 An Exception Report will take one of the two following forms:

a) Where the Designer accepts an identified problem, but Designer and Audit Team cannot agree on an appropriate recommendation, the Exception Report should describe the reasons why the Audit Team recommendation cannot be implemented and outline the alternatives considered and the difficulties involved in implementing them.

b) Where the Designer does not accept that the identified problem exists, the Exception Report should produce some evidence as to why the problem is not valid.

3.56 While the road safety auditor concentrates on road safety issues, the Employer will have to weigh up the various consequences of implementing the recommendations within the audit report.

Table 3/1: Feedback Form Responses, Requirement for Exception Report

Problem accepted	Recommended measure accepted	Alternative measures or reasons accepted by auditors	Exception report needed
Yes	Yes	-	**NO**
Yes	No	Yes	**NO**
Yes	No	No	**YES**
No	No	No	**YES**

3.57 There will inevitably be some conflict between safety and other issues within the audit process. Some examples are given below:

a) Large conspicuous road signs are generally a good idea from a safety point of view, but they can have an adverse effect on visual intrusion;

b) Street lighting generally improves road safety but has implications for light pollution;

c) Multi-lane approaches to roundabouts can have a poor safety record but will reduce traffic delays.

3.58 When writing an Exception Report it should be noted that both the Road Safety Audit Report and Exception Report could be used in future litigation.

3.59 Exception Reports must be sent to the Director of the funding authority and Overseeing Organisation for decision. The final decision to accept or reject the disputed problem or recommendations rests with the funding authority for the scheme. For National Roads this is NRA.

3.60 The Exception Report Decision Form, given in **Appendix D**, must be returned to the Employer for action on the decision.

Audit Completion

3.61 The audit stage is completed when the feedback form has been accepted and signed by all three parties as described in clause 3.47. In the event of an Exception Report, the audit stage will be complete when the Authority has issued the exception report decision form.

3.62 Completion of this process is required prior to any new section being opened to traffic.

3.63 The Employer shall upload copies of the Final Audit Report, including completed Feedback Form and Exception Report, if any, to the NRA Road Safety Audit Approvals System at https://nraaudit.nra.ie/NRARoadSafetyAudits.

3.64 Copies shall also be sent to the following:

a) Designer

b) Employer's Representative

c) Audit Team Leader

4. ROAD SAFETY AUDIT ISSUES

Costs and Benefits

4.1 The costs attributed to a road safety audit can be divided into two distinct components.

a) Firstly there is the cost of the audit itself. The cost of a road safety audit is related to the time spent to complete it, rather than the cost of the scheme itself. It takes less time to audit a scheme involving a new link road with a simple junction at each end than it does to audit a complex traffic signal junction in an urban area. Research carried out by the Chartered Institute of Highways & Transportation (CIHT) found that the average time taken to complete an audit was 25 hours.

b) The second element of cost relates to the implementation of the recommendations contained within the audit report. In general, these costs are not significantly high and items identified at Feasibility Stage and Stages 1 and 2 may have no cost implications at all (although they may require some re-design time). There are, however, some instances where audit recommendations, particularly at Stage 3, will add to the cost of a scheme.

4.2 It is difficult to identify the benefits of carrying out a road safety audit on a scheme in a quantitative way. When an audit has been carried out, the scenarios are that either the recommendations are implemented or they are not. Although the subsequent collision record can be examined, only one of the scenarios can be evaluated. It is not possible to judge how an individual scheme that has been audited would have performed had the audit not been carried out.

4.3 Some work carried out in New Zealand suggests that the benefit to cost ratio for road safety audits is in the order of twenty to one. In Denmark, the first year rate of return for road safety audits has been estimated as over 149%. This figure was based on estimates for collision savings that might be made by introducing audit recommendations.

4.4 A further qualitative benefit is the extent to which design engineers receive improved safety awareness through the road safety audit process. Local authorities in the UK who have carried out this work over a decade or more have noticed a reduction in the number of problems being identified by auditors.

Risk Assessment

4.5 A road safety auditor may sometimes identify a safety issue and make a recommendation that has only a small safety benefit, the cost of implementation of which far outweighs any benefit to be gained. It is therefore suggested that auditors carry out an informal risk assessment of each problem documented, assessing both the probability of such a collision occurring and the severity of outcome of the predicted collision. This should be done for both possible situations, with and without the recommendation implemented, so that the expected reduction in risk resulting from implementing each recommendation can be obtained.

4.6 An effective tool in risk assessment is a matrix of likelihood (risk) against outcome severity (hazard) such as that shown in table 4/1. This gives weighting to each risk and to each hazard which are then combined to give a weighting that takes account of both likelihood of occurrence and likely severity of outcome.

4.7 The post-audit meeting between Audit Team, Designer and Employer can be used as the primary means to discuss the relative importance of issues raised within the draft report.

4.8 The information from the risk assessment can be used by the Employer to help decide whether or not to implement the recommendations.

Table 4/1: Risk Assessment Matrix

		Likelihood of Occurrence			
		Probable (more than once per yr)	**Possible** (Once every 1-3 yrs)	**Remote** (once every 3-7 yrs)	**Improbable** (once every 7-20 yrs)
Severity of Outcome	**Extreme** (multiple fatal)	**16**	**12**	**8**	**4**
	Severe (fatal/serious)	**12**	**9**	**6**	**3**
	Minor (minor injury)	**8**	**6**	**4**	**2**
	Negligible (damage only)	**4**	**3**	**2**	**1**

Auditing Development Schemes

4.9 The auditing of any changes to the road layout that are development-led within the local authority planning process is another area that needs clarification.

4.10 A road safety audit is a requirement for any development scheme that results in a permanent change to the road layout on a National Road, whether inside or outside urban areas.

4.11 If a new access is required for the development, or the Traffic and Transport Assessment indicates that an existing access or junction needs improvements, or that pedestrian or cycle facilities need improvement, then a road safety audit will be required.

4.12 Many Roads and Planning Authorities request a road safety audit too late in the planning process to address fundamental safety issues. Once planning approval has been given it is difficult to require developers to make significant changes to schemes, especially if they are costly or reduce the amount of land available for development. It is important therefore that the road safety audit process is built into the planning procedure of each authority so that audit reports and their responses can be given due consideration by the Planning Authority.

4.13 The five stages of road safety audit are summarised in Table 4/2. Whether all these stages are necessary depends on the size and impact of the development concerned.

Table 4/2: Road Safety Audit Stages

Stage F:	Preplanning, concept stage
Stage 1:	Completion of preliminary design
Stage 2:	Completion of detailed design
Stage 3:	Completion of construction.
Stage 4:	Early operation.

4.14 In the case of large developments a Stage F audit should be submitted during preplanning talks, and Stage 1 and 2 audits as part of the planning application. In the case of small developments a combined Stage 1/2 road safety audit should be submitted as part of the planning application. In all cases the planning application should contain the report from at least one stage of road safety audit. Any relevant Audit Report and Audit Response can then be considered by the Local Authority before planning permission is granted.

4.15 Where a Road Safety Audit has been carried out on a development this does not imply that all the road safety issues associated with that development have been addressed. It is essential that the road safety audit process is completed, and all final recommendations of the road safety audit report are implemented, in order to ensure mitigation of any safety problems identified in the audit. Discussions in preplanning and the use of planning conditions provide methods of ensuring that the development complies fully with the DMRB and Government objectives to maintain road safety.

4.16 Conditions on a planning permission may be used to ensure implementation of the recommendations of a Road Safety Audit. Note that deferring the requirement for an Audit to a post decision planning condition is highly inappropriate and does not allow for the full road safety implications of a development to be addressed.

4.17 The following are examples of requirements that can be included as conditions to a planning approval:

a) The agreed recommendations from the road safety audit process must be completed by the developer to the satisfaction of ..... County Council, as the Roads Authority, before the public road hereby permitted is taken into charge by ..... County Council.

b) The development shall not open for the approved use intended by the developer until the road safety audit process has been complied with by the developer in accordance with NRA DMRB HD 19 and the agreed recommendations from the road safety audit report have been completed by the developer to the satisfaction of ..... County Council, as the Roads Authority.

c) Note; all costs associated with the implementation of the road safety audit recommendations shall be borne by the developer/scheme promoter.

4.18 The following is an example of a statement of grounds for refusal of planning approval:

a) The development is not permitted because following the road safety audit process, fundamental road safety issues remain. These issues have not been resolved, and it is therefore considered that were the development to go ahead in its proposed form it would pose a significant traffic hazard to road users

4.19 If a developer refuses to implement a certain recommendation in the road safety audit report then an Exception Report would be required. The final decision to reject or accept the Exception Report, i.e. to either implement the disputed recommendation or not, rests with the Planning Authority and Roads Authority.

4.20 Once the change in road layout is completed, a subsequent Stage 3 road safety audit should be carried out. The requirement for this can either be enforced through planning condition or reached by agreement between the Planning and Roads Authority and the developer.

4.21 It must be stressed that in order to facilitate the road safety audit procedure within the planning process it is necessary for senior roads and planning staff to review in-house planning application processes, so that the requirement for road safety audit is included within each county development plan and becomes part of the planning application process.

5. REFERENCES

5.1 AA Foundation for Road Safety Research, Urban Accidents: Why do they happen?

5.2 Austroads, Guide to Road Safety Part 6, Road Safety Audit

5.3 Department of the Environment, A Guide to Road Safety Engineering in Ireland

5.4 Highways Agency UK, Design Manual for Roads and Bridges, Volume 5: HD 19/03, Road Safety Audits

5.5 The Chartered Institution of Highways and Transportation, Road Safety Audit Guidelines

5.6 National Roads Authority, Design Manual for Roads and Bridges, Volume 5: HD 19 Road Safety Audit

5.7 Roads Act, 1993

5.8 Road Traffic Act, 1961

5.9 Road Traffic Act, 1994

6. ENQUIRIES

6.1 All technical enquiries or comments on this document or any of the documents listed as forming part of the NRA DMRB should be sent by e-mail to infoDMRB@nra.ie, addressed to the following:

"Head of Network Management, Engineering Standards & Research
National Roads Authority
St Martin's House
Waterloo Road
Dublin 4"

……...
Pat Maher
Head of Network Management,
Engineering Standards & Research

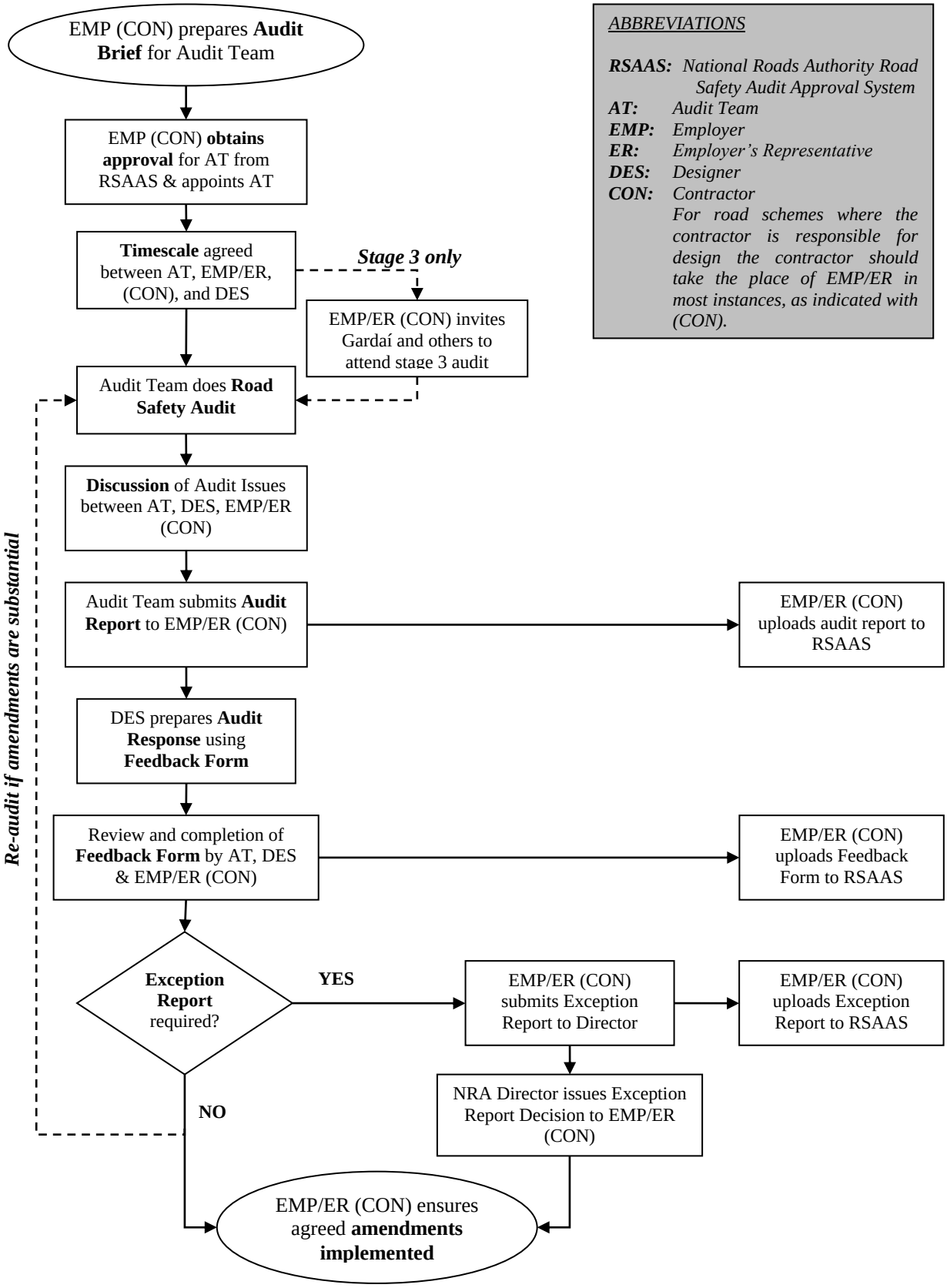
APPENDIX A: SCHEME TYPE AND AUDIT STAGES

No Audit is required on like-for-like repair or replacement of existing road infrastructure		
	Example Scheme Description	
	Pavement repair such as patching, edge strengthening which does not result in widening the carriageway, inlay works with similar materials etc.	No Audit Required
	Pavement overlay which does not change the cross section, vertical alignment, camber or superelevation	No Audit Required
	Surface rejuvenation such as mechanical abrasion etc.	No Audit Required
	Surface dressing of an existing carriageway	No Audit Required
	Replacement of a worn road sign with a new road sign of the same type	No Audit Required
	Replacement of a damaged road sign with a new road sign of the same type	No Audit Required
	Refreshment of existing worn road markings	No Audit Required
	Replacement of worn or missing road studs	No Audit Required
	Replacement of a length of damaged safety barrier with barrier of the same or similar type.	No Audit Required

Audit is required on any piece of road infrastructure which requires a design							
	Example Scheme Description	**Audit stages required**					
		F	**1**	**2**	**1/2**	**3**	**4**
New Alignment	Off-line road scheme with multiple options.	X	X	X		X	X
	On-line road scheme – Minor land take required		X	X		X	
	On-line road scheme – No land take required				X	X	
	New junction or access onto the road		X	X	(X)	X	
Realignment	Realignment of bend				X	X	
	Realignment of junction				X	X	
	Alteration of type of junction control, such as traffic signals, mini				X	X	

	roundabout etc.						
	Junction Sight Line Improvement				X	X	
	Example Scheme Description	**Audit stages required**					
Pavement Improvement	Change to the existing cross section, widening or narrowing the pavement				X	X	
	Change to the existing vertical alignment				X	X	
	Change to the existing pavement which affects the horizontal or vertical alignment of public or private entrances				X	X	
	Change to existing camber or superelevation				X	X	
Signing & Roadmarkings	Installation of road signs: Single installation, multiple installations, or addition or amendment to sign on existing supports				X	X	
	Installation of road markings which results in a change to the existing road marking layout and/or its meaning				X	X	
Safety Barrier	Installation of new safety barrier				X	X	
	Upgrade to an existing safety barrier				X	X	
	Upgrade of an existing terminal				X	X	
	Replacement of an entire safety barrier installation				X	X	
Kerbing & Footpath	Installation of kerbs in the verge and/or hard shoulder				X	X	
	Installation of kerbs in the centre of the pavement		X	X	(X)	X	
	Installation of kerbs and footpaths				X	X	
	Installation of pedestrian crossing, both informal and formal crossing points		X	X	(X)	X	
Lighting	Installation of traffic route lighting				X	X	
	Change to the lighting level and type of existing lighting				X	X	
Development	Major development, meeting the criteria in NRA Traffic and Transportation Assessment Guidelines Table 2.2	X	X	X		X	X
	Any development that is not a major development				X	X	

APPENDIX B: ROAD SAFETY AUDIT PROCESS FLOW CHART



APPENDIX C: ROAD SAFETY AUDIT FEEDBACK FORM

Road Safety Audit Feedback Form

Scheme: _____ **Route No.** _____

Audit Stage: _____

Date Audit Completed: _____

	To Be Completed By Designer			To Be Completed by Audit Team Leader
Paragraph No. in Safety Audit Report	Problem accepted (yes/no)	Recommended measure accepted (yes/no)	Describe alternative measure(s). Give reasons for not accepting recommended measure. Only complete if recommended measure is not accepted.	Alternative measures or reasons accepted by auditors (yes/no)

Signed: _____ **Designer** **Date** _____

Signed: _____ **Audit Team Leader** **Date**_____

Signed: _____ **Employer** **Date** _____

APPENDIX D: EXCEPTION REPORT DECISION FORM

Road Safety Audit Exception Report Decision Form

Scheme: _____ **Route No.** _____

(If NRA scheme) NRA Project Ref No.: _____

Audit Stage: _____ **Date Audit Completed:** _____

Exception Report Item	Paragraph No. in Road Safety Audit Report	Decision by Director (Accept / Reject Exception Report)

Signed: _____ **Director of Overseeing Organisation** **Date** _____

APPENDIX E: SAMPLE AUDITOR'S CHECKLIST

(Source: CIHT Road Safety Audit Guidelines)

Checklist for Stage F - Feasibility

General
Consistency of standards with adjacent road network, especially at tie-ins;
Secondary effects on surrounding road network;
Where a preferred scheme is being chosen, relative safety performance of options.

Routes
Impact of standard of route, related to design flows and speed, on safety;
Overtaking opportunities;
Consistency of junction arrangements, access control;
Frequency of junctions (public and private) related to safe access;
Location of junctions in relation to horizontal and vertical alignments;
Horizontal and vertical alignments consistent with visibility requirements, both along the road and at junctions;
Facilities for pedestrians, cyclists and equestrians;
Provision for unusual aspects of traffic composition (heavy concentrations of particular types of road user), or environment (e.g. sunrise / sunset glare, fog, or wind).

Area Schemes
Designation of functions for different elements of the road hierarchy;
Scheme consistent with overall safety plan.

Checklist for Stage 1 - Preliminary Design

General
Review any previous Road Safety Audit in order to allow for subsequent design changes;
For major schemes, determine need for land take for safety requirements.

Alignments and Sight lines
Any elements of horizontal and vertical alignments which may produce hazards due to reduced sight lines, especially where these are combined and / or there are departures from standards;
Sight lines obstructed by bridge abutments, parapets, landscaping, structures or street furniture.

Junctions
Minimising potential conflict points at junctions (including numbers of private accesses);
Conspicuity of junctions on approach, and sight lines from minor road approaches and private accesses;
Control of approach speed, and layout of approach roads;
Provision for turning traffic;
Location and access of lay-bys.

Other
Impact of landscaping on visibility and road user perception;
Concept of road marking / signing for road user perception;
Provision for safety aids on steep hills;
Facilities for pedestrians, cyclists and equestrians;
Potential for flooding due to inadequate drainage;
Compatibility with adjacent network at tie-ins;
Servicing access and maintenance arrangements.

Checklist for Stage 2 - Detailed Design

General

Review any previous Road Safety Audit in order to allow for subsequent design changes;
Note: Scope for altering alignments or junction design is less extensive at this stage, so the Road Safety Audit will focus mainly on details of signing, marking, lighting, etc., and issues which affect visibility and drivers' perception of the road scene, and provide aids to safety.

Junctions

Appropriateness of corner radii or curvature in relation to approach speed;
Road users' perception of road layout.

Road signs and markings

Locations of signs and markings to aid, inform, and warn of hazards, without obscuring visibility or misleading drivers;
Consistency of signing and marking information.

Lighting and signals

Consistency of lighting within the scheme and with the adjacent network;
Safe positioning of lighting columns, signals and operational equipment;
Confusion or conflict between lighting and traffic signals;
Positioning of heads for traffic and pedestrian signals to ensure clarity to appropriate road user, and avoid confusion to others to whom they do not apply;
Safe access and servicing arrangements.

Facilities for vulnerable road users

Location and type of crossing facilities;
Visibility;
Dedicated cycle or pedestrian facilities;
Provision of facilities for people with mobility impairments.

Landscaping

Potential obstruction to visibility from landscaping, taking account of future growth;
Potential for trees to become collision objects: choice of appropriate species;
Ability to maintain planted areas safely.

Protective aids

Positioning of safety fences, and guard rails to protect against vehicle conflicts or roadside objects (poles, columns, statutory undertakers' apparatus), without obscuring visibility;
Use of arrester beds.

Surface characteristics

Appropriate surfacing for high speed roads, or locations (e.g. bends) which are potentially hazardous when wet;
Appropriate surfacing for approaches to junctions, and thresholds to villages or residential areas in towns, to encourage lower vehicle speeds.

Checklist for Stage 3 - Pre-opening

General

Review any previous Road Safety Audit in order to allow for subsequent design changes.
The main emphasis is to inspect the scheme from the viewpoint of the different road users, considering where appropriate the needs of pedestrians, cyclists, equestrians, public transport operators, and HGV drivers as well as car drivers.
Inspection at appropriate times of day, in particular in daylight and darkness.
Checklist for Stage 2 provides an appropriate aide memoire

Checklist for Stage 4 - Post-opening

General

The main emphasis is to view the scheme in operation and to inspect particularly all tie-ins and cut off roads from the viewpoint of all road users.
Inspection at appropriate times of day, in particular in daylight and darkness.
Checklist for Stage 2 provides an appropriate aide memoire.

APPENDIX F: SAMPLE ROAD SAFETY AUDIT REPORT

N99 BALLYMACK BYPASS

ROAD SAFETY AUDIT STAGE 2

1. INTRODUCTION

1.1. This report describes a Stage 2 Road Safety Audit carried out on a proposed bypass at Ballymack on N99 in Co Skellig, on behalf of Cullen and Dempsey Partnership. The audit was carried out between 12 and 18 October 2013 in the offices of ABC Consultancy.

1.2. The Audit Team members were as follows:-

Helen Doyle, MSc, MIEI, MIHT, Director, ABC Consultancy, Team Leader;

Daniel McLoughlin, MIEI, Engineer, ABC Consultancy, Team Member.

1.3. The audit comprised an examination of the drawings relating to the scheme supplied by the design office and a visit to the site by the team on 12 October 2013.

1.4. The Audit Team had previously done a stage 1 audit of this bypass scheme in February 2012.

1.5. The Ballymack Bypass road scheme is a single carriageway realignment of N99 for approximately 4km. It runs in an approximate north-south direction between Kilmacsouth and Ballynanorth. It is entirely off line and bypasses the town of Ballymack and 5km of existing N99. There are two roundabouts, each at the tie-ins to the existing line of N99. Two overbridges carry local roads over the new alignment.

1.6. This Stage 2 audit has been carried out in accordance with the relevant sections of NRA HD 19. The team has examined only those issues within the design relating to the road safety implications of the scheme, and has therefore not examined or verified the compliance of the design to any other criteria.

1.7. Appendix 1 describes the drawings examined by the Audit Team.

1.8. All of the problems described in this report are considered by the Audit Team to require action in order to improve the safety of the scheme and minimise collision occurrence.

2. ITEMS RESULTING FROM THIS STAGE 2 AUDIT

2.1. General problems / problems at multiple locations

2.1.1. Problem –Crash barrier end treatments

It is proposed that terminals of the crash barriers will be ramped down to ground level but not flared away from the road. This can cause problems if errant vehicles leaving the carriageway collide with the terminals. They can be launched from the ramped ends, which can result in severe injury for the occupants

Recommendation

Leading ramped ends should be removed or amended to remove the hazard of launching. Particular attention should be paid to the leading ramped ends of crash barriers at:

- N99 northbound approach to Muckross roundabout;
- Carrigstown Road west approach to Muckross roundabout;
- N99 northbound (3 locations);
- N99 southbound (5 locations).

2.1.2. Problem – Drainage ditches and headwalls

A number of drainage ditches and head walls at culverts appear to be within the clear zone of the road and unprotected. These are hazards and vehicle occupants could be injured if vehicles overturn in ditches or strike head walls.

Recommendation

In the first instance all effort should be made to remove these hazards from the clear zone adjacent to the road. Drainage ditches can be piped and filled in, removing the hazard completely. Culverts can be extended so that the headwall is not within the clear zone.

If this is not possible, then crash carrier should be provided to protect each hazard. As each barrier terminal is a hazard in itself care should be taken in placing the barriers. Separate lengths of barrier with gaps shorter than 100m between them should be joined.

The following locations should be reviewed:

- West side of N99 between chainages 400 and 700 approximately (drainage ditch and culverts);
- East side of N99 between chainages 500 and 1200 approximately (drainage ditches and culverts);
- Bog Lane east approach to Bog Lane roundabout (drainage ditch).

2.2. Problems at specific locations

2.2.1. Problem – Attenuation Pond (Carryover from stage 1 audit)

The attenuation pond at the northwest corner of Muckross roundabout appears to be within the clear zone of the road and unprotected. Vehicle occupants could drown if errant vehicles land in the pond. This hazard was identified in the stage 1 audit report, the recommended measure being to relocate the pond so that is not within the clear zone of the road. This has not been done.

Recommendation

If land is available to relocate the pond then do so.

Otherwise provide crash barrier to protect this hazard.

2.2.2. Problem – Bog Lane roundabout

The N99 northbound and the Bog Lane east approaches to the roundabout will be relatively high speed in low flow conditions. These straight approaches could lead to a situation in which drivers lose control and overrun the central island, resulting in injury to vehicle occupants.

Recommendation

Increase roundabout conspicuity.

Ensure optimum sign face conspicuity for traffic approaching from all entries, reviewing the length, height, position and angle of signs. Chevrons should be directly within the sight of the driver when positioned at stopping sight distance on approach to the roundabout

2.2.3. Problem – Bog Lane / Curragh Road junction

On approach to Bog Lane the left hand bend on the realigned Curragh Road obscures advance sight of the junction. There is a possibility that drivers on Curragh Road will not be aware that they are approaching a junction and that they are required to stop. This may result in overshoot type collisions at the junction.

Recommendation

Provide a junction warning sign in advance of the Bog Lane / Curragh road junction. Provide an additional STOP sign at the junction at the right hand side of Curragh Road approach.

2.2.4. Problem – Gully at Muckross Roundabout

A gully is located in the pedestrian route at the pedestrian crossing of Carrigstown Road on the east side of the roundabout. This could be a trip hazard for pedestrians. If the gully becomes blocked the resultant flooding could force pedestrians to cross at another, less safe, location, which may lead to pedestrian injuries.

Recommendation

Site the gully away from the pedestrian crossing.

2.2.5. Problem – Gradient at Bog Lane / Curragh Road junction

The gradient of Curragh Road leading to this junction is approximately 4%, with no level platform at the junction. This can lead to “hill-start” problems, when a driver can have difficulty in emerging quickly from the junction, resulting in junction type collisions when the driver has not allowed for the required amount of time to emerge safely.

Recommendation

Regrade the approach to this junction so that there is a level approach to the junction for at least a length of 15m.

3. AUDIT TEAM STATEMENT

We certify that we have examined the drawings and other information listed in Appendix 1. 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 which we recommend should be studied for implementation. The road safety audit has been conducted by the persons named below who have had no involvement in the design of the scheme.

Signed.....Helen Doyle, ABC Consultancy

Date.....

Signed.....Daniel McLoughlin, ABC Consultancy

Date.....

APPENDIX 1:

LIST OF DRAWINGS EXAMINED

N99 Ballymack Bypass	Horizontal Layout 01300/D11 Rev A	June 2013
N99 Ballymack Bypass	Vertical Layout 01300/D12 Rev B	June 2013
N99 Ballymack Bypass	Side roads 01300/D13 Rev C	October 2013
N99 Ballymack Bypass	Sign Layout 01300/D14 Rev C	October 2013
N99 Ballymack Bypass	Road Marking Layout 01300/D15 Rev C	October 2013

ROAD SAFETY AUDIT FEEDBACK FORM

Scheme: Ballymack ByPass Route: N99

Audit Stage: 2

Date Audit Completed: 12th- 18th October 2013

Paragraph No. in Audit Report	Problem accepted (yes/no)	Recommended measure accepted (yes/no)	Describe alternative measure(s). Give reasons for not accepting recommended measure Only complete if recommended measure is not accepted.	Alternative measures or reasons accepted by auditors (yes/no)
2.1.1	Yes	Yes		n/a
2.1.2	Yes	Yes		n/a
2.2.1	Yes	No	Will have difficulty installing barrier that provides adequate protection in available space.	No
2.2.2	Yes	Yes		n/a
2.2.3	Yes	Yes		n/a
2.2.4	Yes	No	The gully is located at the lowest point on the road. It is proposed to move the pedestrian crossing alongside the gully	Yes
2.2.5	Yes	Yes		n/a

Signed: ..... Designer Date.....

Signed: ..... Audit Team Leader Date.....

Signed: ..... Employer Date.....

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Ionad Ghnó Gheata na Páirce,
Stráid Gheata na Páirce,
Baile Átha Cliath 8, Éire

Parkgate Business Centre,
Parkgate Street,
Dublin 8, Ireland

www.tii.ie

info@tii.ie

+353 (01) 646 3600

+353 (01) 646 3601