A Guide to Road Safety Auditing

Ministry of Infrastructure Development
Safety and Environment Unit
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Table of Contents

Acknowledgements

This Manual draws extensively on the recommendations contained in the report "Development of Road Safety Audit System for Tanzania" produced by M/S Design Partnership for the former Ministry of Works in 2003. Other sources are listed below, and the contribution made by the authors of these documents is acknowledged.

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Asian Development Bank, 2003, *Road Safety Audit for Road Projects, An Operational Toolkit,* Manila, Philippines
Ministry of Works, Housing and Communications, 2004, *Road Safety Audit Manual,* Republic of Uganda

FOREWORD

Road crashes are a growing menace. In 2006, road deaths reached an all-time high of 2,884, and behind this simple statistic is a huge amount of human pain and suffering. Economic losses are estimated to be at least Tshs 1,700 billion per year. The Government is committed to developing and maintaining a safer road transport system, and this is reflected in the National Transport Policy and the forthcoming National Road Safety Policy. In support of this, the Roads Act 2007 places a legal duty on all road authorities to ensure that their roads are designed, built, maintained and operated with proper regard for safety.

Road authorities must work to improve safety through a combination of crash reduction and crash prevention. Crash reduction programmes involve monitoring the location of crashes, identifying blackspots, and then treating them with remedial measures. Crash prevention work involves having specialists check the safety of road schemes before they are finalised and built – this is called ***road safety auditing,*** and is the subject of this Guide**.** Experience elsewhere has shown that safety audits are a simple and highly cost-effective way of reducing crashes on new and improved roads. The Guide explains the principles and practice of safety auditing, and gives technical advice on what can be a complex and demanding task. It has been written specifically for those involved in road safety audits, but it will also be of interest to highway designers, and supervisors of road construction projects.

Some safety audits have been done in recent years, but, because they were informal, the audit recommendations were not always taken seriously. From now on safety auditing will be a mandatory step in the planning and design process for major road projects, and my Ministry will monitor how well it is working. Training in safety audit will be provided, and road authorities should consider collaborating with each other when putting together safety audit teams. Some small schemes can cause big safety problems, and it will be for road authorities to decide which of these need to be audited.

Safety auditing involves one set of professionals checking the work of other professionals. It is important that those doing the auditing approach the task with sensitivity, and that those whose work is being audited accept that this is necessary and worthwhile. I challenge everyone to take road safety auditing seriously so that our new road infrastructure is as safe as possible.

Hon. Shukuru Kawambwa MP
Minister for Infrastructure Development

1. OVERVIEW OF ROAD SAFETY AUDIT

1.1. What are Road Safety Audits?

Road safety audit (RSA) is a systematic and formal safety performance examination of a road project. The objective is to identify potential safety problems, so that, where possible, the design can be improved to eliminate or reduce them. The audit is carried out by trained and experienced auditors who are independent of the scheme designers. The greatest benefits will come from auditing major road construction projects, but the safety of all road projects can be improved through auditing.

Road safety audits are a vital tool in a road authority's safety management system. They provide an opportunity for road safety professionals to ensure that all road users' safety needs are adequately addressed at various stages of road project development. They do not replace quality control and standards compliance, or make it any less necessary to be safety-conscious when planning, designing, constructing, maintaining, and operating road and traffic systems.

1.2. Key Elements

The National Transport Policy places clear emphasis on the provision of ***safe*** transport infrastructure. One of the tools that may be used to achieve safety is the auditing of road schemes. The National Road Safety Policy contains a commitment to "ensure that a formal, independent road safety audit is carried out on all road projects before they are finalised".

Road safety auditing follows the principle of ***"prevention is better than cure".*** An audit conducted at the planning or design stage allows a line on a plan to be changed, which is much cheaper than having to alter asphalt or concrete once the scheme has been built. The earlier a road project is audited within the design and development process the better.

The following stages (types) of audit are recognised:

- Stage 1 - Feasibility Study
- Stage 2 - Preliminary Design
- Stage 3 - Detailed Design
- Stage 4 - Roadworks
- Stage 5 - Pre-Opening
- Stage 6 - Post-Opening and Existing Roads
- Audit of Traffic Management Schemes
- Audit of Building Development (e.g., shopping malls, sports stadia)

Safety audits involve three parties, each with a defined role:

- ***the Audit Team*** is composed of safety specialists who are commissioned by the client to perform the audit and produce an audit report that identifies the potential safety problems and suggests what should be done about them;
- ***the Design Team*** is the party responsible for the design (an in-house team or a firm of consultants); they will be asked to comment on the audit report and, if necessary, will be instructed by the client to alter the design; these duties should be included in their terms of reference;
- ***the Client*** is the representative of the road authority (TANROADS and local government

authorities) who commissions the audit and decides whether the audit recommendations should be accepted or rejected.

It is important to recognise that:

- safety audits are not technical audits - they are only concerned with road safety and they do much more than check on compliance with standards
- safety audits are not informal checks or design reviews - these may still be useful
- safety auditors will not redesign aspects of the scheme that they consider to be unsafe - this is the responsibility of the designer
- safety audits are not just for big schemes - even small projects can give rise to serious safety problems
- safety auditing helps sensitise road engineers to safety issues, and feedback from audits will lead to improved design standards
- final responsibility for changing the design rests with the client - it is not necessary for the client to have the agreement of the auditor or the designer.

Road safety auditing can produce significant benefits at low cost if carried out in a formal and coordinated manner at all stages in the planning, design and implementation of a road project. The process requires strong management commitment, skilled auditors, cooperation from design teams, and an on-going training programme.

1.3. Why are Road Safety Audits necessary?

Why should audits be needed when the road agencies employ professional highway designers and insist on the use of good design standards? There are a number of answers to this question, including:

- **compliance with standards does not guarantee safety** – although conformity with standards and guidance is helpful for safety, there will be many situations that are not covered by the standards – and sometimes a number of individual elements, all designed to standard, may, when combined, be unsafe;
- **safety can be unduly compromised in the trade-off between conflicting requirements** - it can be difficult for highway designers to produce a design that meets all the project objectives, and sometimes safety is neglected;
- **lack of knowledge of crash causation -** highway designers may not have the necessary understanding of human-vehicle-road interactions to be able to detect potential safety problems.

Road safety audit is more concerned with "fitness for purpose" than compliance with technical standards. This means checking that the scheme meets the safety needs of everyone. Special attention is given to whether the needs of vulnerable road users have been met, because experience indicates that highway designers focus largely on the needs of motor vehicle traffic. The vulnerable road users include pedestrians, motorcyclists, pedal-cyclists, the passengers waiting for transport, and the roadside vendors. Another important part of safety auditing is checking that the design takes account of the realities of the operating environment, including road user indiscipline, the difficulty of law enforcement, the lack of access control, and the high proportion of vulnerable road users.

1.4. Audit Team

Ideally, road safety audits should be performed by a small team of people who have a variety of

experience and expertise, such as highway design, traffic engineering, road construction and maintenance, and road user behaviour. At least one member of the team, normally the team leader, must have expertise in road safety auditing. This means having attended a course in road safety auditing and having taken part in several audits (training exercises do not count). Competence in safety auditing comes through hands-on experience. Training is helpful at the start but is only a base on which to build experience.

The benefits of having a team are that they are more likely to spot safety problems that one person might miss. If the team members have different areas of expertise so much the better. Traffic policemen, urban planners, and knowledgeable local people may have a lot to contribute. Audits at different stages call for different skills. For example, at the Detailed Design stage it is helpful to have someone who has sufficient design experience to check the details of signs, safety barrier, street lighting, etc. And for a Pre-Opening audit it is usual to include a traffic police officer with local knowledge. It is always useful to have people on the team who have good knowledge of the local travel patterns, traffic problems, and crash history. Every audit can serve as a training exercise for novice auditors, and be an opportunity for all team members to gain more experience.

A good auditor is one who can read engineering drawings and visualise what the scheme will look like. They will be able to "put themselves in the shoes" of each road user and imagine what it will be like, for example, for a pedestrian to cross the road at night, or for a motorist to turn right in the junction.

Road authorities have three options for getting audits done:

- **In-house audit teams –** this option has the advantage that it is quick and easy to arrange for an audit to be done, and means that the auditors can see the scheme through till completion; if staff from outside the authority can be recruited to help, it will make the team more independent;
- **Instructing the design consultant to do the audit –** if this option is selected, the client must instruct the consultant to use auditors that have not been involved in the design work - nevertheless it may be difficult for the auditors to be completely objective because of the conflict of interest - it is recommended that someone from the client's engineering staff, or other independent party, be on the audit team;
- **Independent consultant -** this option ensures that the audit is independent, and over time may lead to a competitive market in providing audit services to road authorities.

1.5. Cost and Benefits

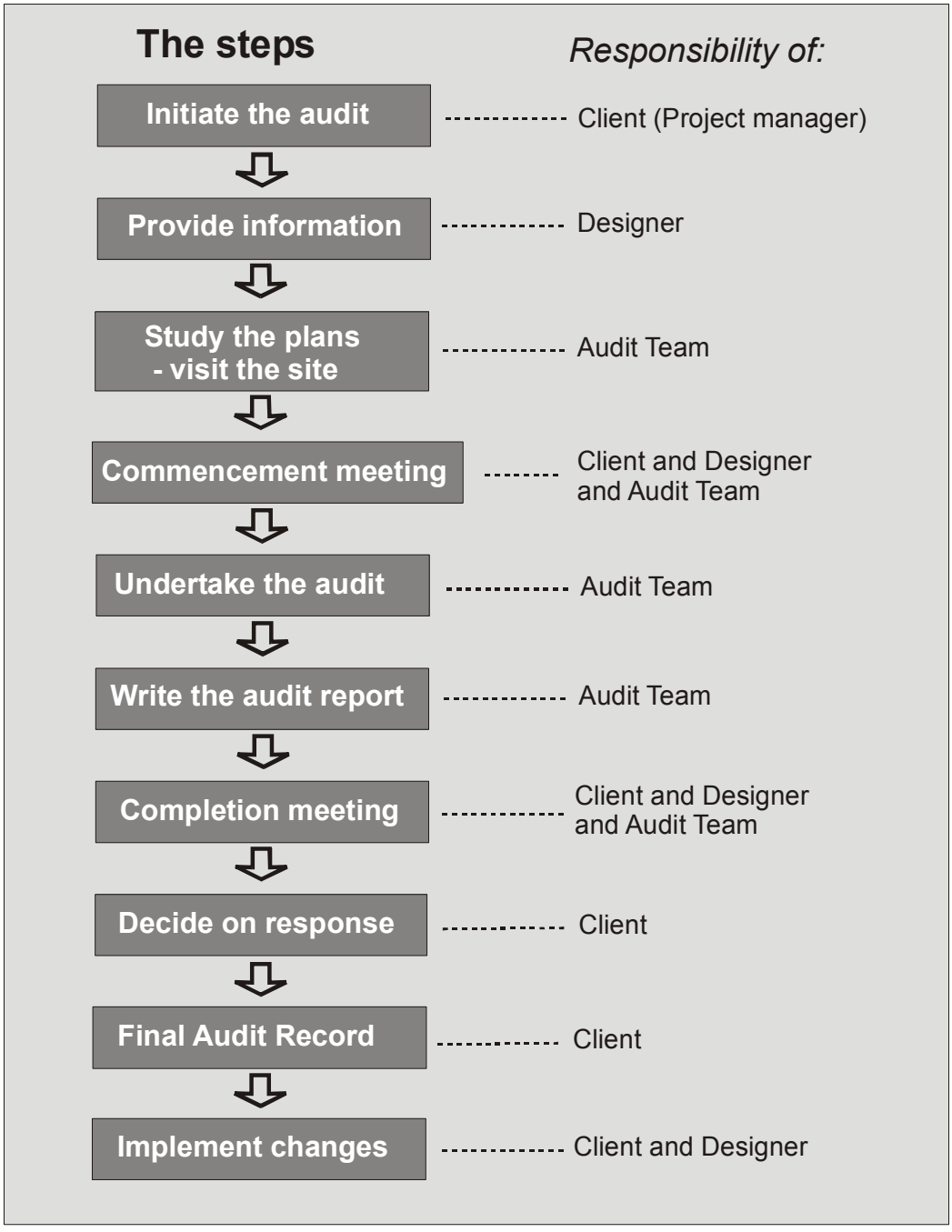
Audits do not cost very much, and a typical audit is likely to take no more than a few weeks to complete. Many audit recommendations will cost little or no extra money, and may even save money. The evidence from countries that have adopted safety auditing suggests that the costs of changes introduced as a result of a safety audit are significantly outweighed by the safety benefits, namely less crashes, less severe crashes, and less damage to road furniture. Direct benefits to road authorities include avoidance of expensive reconstruction to remedy safety deficiencies, and lower liability claims. Lifecycle costs may also drop, because safer designs often carry lower maintenance costs.

2. CONDUCTING ROAD SAFETY AUDITS

2.1. The Audit Process

The steps in the audit process are illustrated in the flow chart in Figure 1. It is important to broadly follow this process in order to ensure that the audit is done in a systematic way. The process is the same whatever the type and scale of project being audited, but the amount of work involved in each step will vary.

Figure 1 Steps in the Audit Process



Source: adapted from "Road Safety Audit", Austroads,2002

2.2. Initiating the Audit

The client will initiate the process by issuing written instructions that will typically state the terms of reference for the audit, the composition of the audit team, the format for presenting the results, and what the deadline is for submission of the audit report. These instructions should be copied to the designer. The process should be started immediately after the design has been submitted to the client. Road authorities should ensure that their design contracts require the designer to: a) respond to the findings of safety audits, and b) undertake any necessary re-design. If the project being audited is an old one the designer may no longer be available. In this case the client will have to rely on his own engineering judgement to assess the audit recommendations, and arrange for any necessary re-design.

2.3. Providing the Background Information

The client or designer will provide all relevant information to the audit team. Much of it can be found in the project reports. For a design audit the information should include:

- a project description
- an account of the design principles and standards that were used (e.g., design speed, standards for radii of horizontal curves, superelevation, standards for crest and sag curves, stopping sight distance, overtaking sight distance, percentage of route where safe overtaking sight distance is obtainable, etc.)
- a description of any departures from approved standards and the reasons for them
- traffic data and traffic forecasts
- data on pedestrian movement
- information on public transport services, including the location of stopping places
- crash history
- full set of drawings showing details of the horizontal and vertical alignment and other features
- signing and marking plans (essential for Detailed Design audits)
- a copy of the previous audit reports (if any) and an account of any changes since the previous audit (if any).

2.4. Studying the Plans and Inspecting the Site

The auditors will study the plans and other information, and try and understand what is proposed. It is essential for the audit team to visit the site in order to check for undocumented problems and visualise the future proposals and their effects. A night-time inspection is also highly desirable, as it will often show up extra problems. Based on their experience, and a check on whether design standards and general safety principles have been followed, the auditors will then make a provisional assessment of the safety problems.

2.5. Holding a Commencement Meeting with the Designer and Client

A Commencement Meeting is normally held between the audit team, client and the designers. The objectives of the meeting are:

- to familiarise the audit team with the project scope
- to clarify roles and responsibilities
- to set up lines of communication.

The client should inform the audit team of the project scope and highlight any problems and issues that are relevant for road safety. The terms of reference for the audit and the

roles/responsibilities during the audit should be clearly spelt out. Any special requirements should be identified and discussed. The meeting is also an opportunity for the auditors to clear up any doubts about what is proposed and what standards have been used. They may also want to get the designer's reactions to any problems that they have already identified.

For a small project that requires one auditor, a telephone call following delivery of background information may suffice. A bigger project would require a formal meeting with representatives of the client and designers and the entire audit team.

2.6. Undertake the Audit

There are various ways of organising the work, and this is a matter for the audit team leader and the team members. However, one method that is usually effective is for the team members to study the project reports and drawings independently, and then come together for the site visit. They meet later to discuss their findings, and draft the audit report.

Auditors should bear in mind the following key principles for achieving a safe road environment:

- PROVIDE safety for all road users (including pedestrians (especially children), cyclists, and motorcyclists) in all weathers and lighting conditions
- MANAGE speeds by careful design of the road environment
- ENSURE that there are no nasty surprises
- GUIDE, INFORM and WARN the driver about the road ahead
- BE CONSISTENT in the way roads and junctions are designed and signed
- CONTROL the driver's passage through conflict points and other difficult sections
- FORGIVE the driver's mistakes or inappropriate behaviour.

Auditors should remember to:

- be thorough and comprehensive
- be realistic and practical (though they should not be too concerned about costs, as it is for the client to decide whether the cost can be justified)
- keep to road safety aspects
- check compliance with approved standards and guidelines whilst remembering that compliance with standards does not guarantee that the road will be safe.

It has been found that the use of checklists or memory prompts is a valuable tool in ensuring that nothing is forgotten during the audit. A provisional set of checklists is given in Section 4 – one for each audit type / stage. These will need to be refined as more audit experience is gained. Note however that they do not cover every possible safety problem, and they are not a substitute for knowledge and experience. Novice auditors may wish to record their findings against every item in the checklist. More experienced auditors may prefer to just read through the checklist before they start auditing – and perhaps afterwards as well.

2.7. Writing the Audit Report

The audit report must set out clearly what the problems are and make outline recommendations on corrective action. It will usually refer first to general problems - for example, inadequate cross-section, or lack of signing plans - and then move on to problems at specific points along the road, presented in sequence from one end of the project to the other. For each problem there will be *findings* and *recommendations*:

Findings – refer briefly to the problem, and, if it is a specific feature, locate it precisely (give the chainage, or mark it on a copy of the scheme drawing); explain briefly but clearly why the feature increases the crash risk;
Recommendations – give a clear indication of what needs to be done, but do not be too specific or provide a detailed design; that is the job of the designer.

The findings and recommendations should be presented in tabular form (see Table 1) with a column for the client's response. This helps keep the findings and recommendations short and makes it is easier for the client to respond.

In some cases there may be no obvious solution to the problem, but the problem should still be identified in the report.

Table 1 Example of an Audit Findings Table

Ref:	Findings	Recommendations	Client's Response	
			✓×	Comment
A1	Very many pedestrians will be walking along the road on the section from ch. 0+000 to 1+050 (Chogwe centre) yet there is no provision for them other than a wide shoulder. There will be a high degree of conflict between pedestrian movement and vehicles parking / unparking and crossing the shoulder to access the roadside commercial development.	Segregate the pedestrians from the vehicles and control access	✓	**designer to produce a detailed design for a footway with limited openings for vehicular access to roadside development**
A2	There is no provision for street lighting on the section through Chogwe centre (ch. 0+000 to 1+050) yet this area is busy at night and darkness will increase the risk of collisions, especially between pedestrians and vehicles	Provide street lighting	×	**insufficient funds for street lighting - road will be illuminated by lights of roadside commercial buildings**
A3	At ch. 1+020 the existing pipe culvert carrying the Misooga stream is to be replaced by a 3m wide box culvert. The specific design is not indicated but, if it is constructed to the typical design shown on Dwg. TRF-DT-029c, it will have no parapet. Without a parapet there is a risk that pedestrians (including children from the nearby school) may fall into the stream.	Provide a pedestrian parapet on both sides of the culvert	✓	
A4	From ch. 1+800 to 2+050 (Tiyenga village) there is an open side drain (1.4m wide and 1m deep) along both sides of the road - this will be a dangerous trap at night for the many pedestrians and cyclists that will use this road - and could also be a hazard for stopping vehicles.	Cover the drain	✓	
A5	The bend at ch. 2+600 has a radius (70m) that is well below standard, and the view of the bend for traffic coming from Chogwe will be obscured by the crest at ch. 2+550. Drivers will not see the bend in time to slow down sufficiently to be able to negotiate the bend safely. There are no signs or delineators shown on the drawings	Re-align this section to remove the crest and bend, or, if this cannot be done, provide a high standard of signing and delineation	×	**realigning the road would not be cost-effective but warning signs and delineators will be installed**

The audit report should be thorough and comprehensive, but also concise. There is no need to describe the safety situation in Tanzania, nor discuss general safety and highway design issues. There is also no need to refer to the good points of the design, because the audit report is not giving an overall assessment. The report should detail the specific safety concerns about the scheme, nothing else. Once the report is ready it should be signed by the audit team leader and submitted to the client.

Checklist for audit reports

Introduction – details of:
- who requested the audit
- names of persons in the audit team
- drawings and documents submitted
- constraints, e.g., no signing plans available
- when the audit was done – date and time of site visits
- dates of meetings
- the technical terms used in the report

Safety concerns regarding general aspects of the design such as design speed, cross-section, superelevation, speed management, signing, etc.

Safety concerns regarding features at specific locations, such as an awkward bend, or a dangerous junction.

Concluding section
The audit team leader should sign and date the report.

2.8. Holding a Completion Meeting

Prior to the Completion Meeting the client will send a copy of the audit report to the designer with a request for a response on each of the report's recommendations. Once the designer's responses have been received the client will request the audit team leader and the designer to attend the Completion Meeting.

The objective of the Completion Meeting is to foster a constructive dialogue centred on the audit report findings. The meeting provides an opportunity to:
- formally present the audit findings and clarify or elaborate their meaning
- discuss possible remedial measures for problems identified.

Essential elements of a successful Completion Meeting include the following:
- A positive, constructive and co-operative attitude on the part of all participants;
- Designers must appreciate that the audit is not a critique of their individual or team performance;
- Auditors and designers must respect the fact that the client alone will make the decision on whether and what action is to be taken to correct the safety problems identified in the audit; it is not necessary for all three parties to be in agreement.

The client will usually make a decision on each audit point at the meeting, but he may prefer to wait for further consultation or investigation. The designer may be asked to research the feasibility and cost of remedial measures and report back to the client.

2.9. Final Audit Record

The Final Audit Record is a copy of the Audit Report in which the audit findings table (Table 1) contains the client's response. The client can:

Accept the audit recommendation, or
Reject the audit recommendation - in which case he must give his reasons.

The client should try to be as objective as possible when considering his decision. A refusal to accept an audit recommendation may be because he doubts whether there is a safety problem or it could be that he does not like the proposed remedy. In the latter case the client must indicate what alternative remedy he prefers. The client is responsible for preparing the Final Audit Record.

The client must sign a statement in the Final Audit Record committing himself to follow up the decisions recorded in the response column of the audit findings table. The designer should also sign a statement to the effect that he accepts the client's decisions and will amend the design accordingly. Copies of the Final Audit Record will be sent to the audit team leader and the designer.

2.10. Follow-up

The client will instruct the designer to make the necessary amendments to the design. It is important that these instructions be clearly recorded to avoid confusion.

Usually what happens then is that the audit team disbands and has no further involvement with the project. However, where the audit is of a Detailed Design, it is desirable for the audit team leader to continue to provide advice and technical support to the designers and those responsible for supervising the construction. It is quite likely that the design will be changed during implementation, because of site difficulties or other unforeseen problems. If possible, the audit team leader should try and monitor construction progress, and, if he feels that changes are being made that compromise safety, he should alert the client of the need to audit these changes.

3. TYPES OF SAFETY AUDIT

3.1. Introduction

One road project can have up to six road safety audit stages, but most projects will have less. Audit stages 1 to 3 focus on the pre-construction phase - the feasibility study and the preliminary and detailed designs. It needs to be stressed that **the earlier a road project is audited the better**. A Stage 4 audit checks the safety of the contractor's plans for the roadworks. A Stage 5 audit is done as a final check just before the road is opened to traffic. After the road has been open for a year a Stage 6 audit can be done to assess what, if any, safety problems have arisen.

Safety audits can also be useful for checking traffic management schemes and major building developments.

3.2. Stage 1 Audits - Feasibility Studies

Audits at this stage can influence fundamental issues such as design standards, cross-section, route choice, impact on surrounding road network, and the number, location and layout of junctions. If a wrong or inappropriate decision is made, it will probably be impossible to correct the problem at a later stage in the design process.

Feasibility studies sometimes recommend phased construction – for example, designing a road as a dual carriageway but with only one carriageway being built in the first stage. Auditors should be aware that this often involves design compromises that adversely affect safety. Interim designs need more attention, not less.

3.3. Stage 2 Audits - Preliminary Design

The preliminary or draft design will determine the standards, the cross-section, the alignment, and the junction type. The audit will check all these elements. Particular attention will be paid to any departures from standards, and the interaction between project elements that have been designed to minimum standards. The audit will also look at the wider issues, such as:

- Have the needs of all likely road users been considered?
- Is property access catered for?
- Are local traffic movements catered for safely?
- Are the connections to the existing road network adequate and safe?
- Will the project staging, if any, affect safety?

It often happens that the auditors will identify problems that stem from decisions made during the feasibility stage, such as the cross-section, the route and the junction type. If there was an audit at the feasibility stage and these concerns were raised but rejected by the client, it will not be appropriate to raise them again. However, if there was no audit at the feasibility stage, the auditors must include these concerns in the audit findings, even though it may be too late to change things.

3.4. Stage 3 Audits – Detailed Design

This audit occurs on completion of the detailed road design but before the construction contract documents are prepared and the land acquisition fixed. Auditors should look for anything that has been missed during previous audits, and see how any issues identified in previous audits have

been dealt with. It is a chance to check all the details, including signs and markings, safety barrier, roadside obstacles, lighting, landscaping, pedestrian facilities, and connections to existing roads. Check also the interaction of the detailed elements – for example, check that the lighting columns are behind the safety barrier not in front. Attention to detail at this stage can help reduce the cost and nuisance of last-minute changes during construction. However, it is often difficult to get sufficiently detailed information, because many minor decisions will be left for the supervising engineer to make during the construction phase. This is why Stage 5 (Pre-Opening) audits are so important.

3.5. Stage 4 Audits - Roadworks

Roadworks tend to have an above-average number of crashes. The Ministry's Standard Specifications for Roadworks, 2000 (Clause 1503) state that before starting work the Contractor must submit a detailed "Programme for the Passing of Traffic" that includes details of all signing, protection measures and arrangements for traffic control. Contractors are reminded to follow the provisions of the Ministry's "Guide to Traffic Signing". The Engineer supervising the construction on behalf of the road authority has to approve the Programme before the Contractor is allowed to proceed. There is also a requirement for the Contractor not to revise the Programme without the prior written permission of the Engineer. If all parties follow this procedure carefully the number of crashes can be minimised. In most cases the Engineer should be capable of making his own assessment of the Programme, but with big projects or complex situations (such as major roadworks in towns) it will be advisable to arrange for a safety audit.

The focus of roadworks audits should be:

- advance warning
- guidance by means of signs and devices
- speed control
- clear and efficient traffic control
- protection of workers
- safe access for construction vehicles.

3.6. Stage 5 Audits – Pre-Opening

This audit takes place immediately before the road is opened to traffic, and involves a detailed inspection of the road and all the signs, and other road furniture. The objective is to check for any hazardous feature that was not apparent at previous stages, that all the design details have been correctly implemented, and that the signing is quite clear. Check too that the roadway is free of construction equipment, building materials, etc., and that any temporary signage is ready to be removed when the road is opened to traffic. It is useful to have a local traffic police officer take part in the inspection, as they are likely to have a good understanding of how the local people will cope with the new road. They can also be asked to arrange for an increased police presence in the first few days after opening.

An ‘immediate post-opening’ audit can also be done after the road has been open for a few days. This will show how the road is actually being used, and, if there are any problems, they will probably be apparent already. It may be possible to make minor changes before the contractor demobilises.

3.7. Stage 6 Audits - Post-Opening and Existing Roads

Safety audits of existing roads help identify unsafe, inconsistent, outworn, and outdated elements in the road environment. They are an opportunity to review how the various design elements interact, how road users are actually using the road facility, and what problems, if any, they are experiencing. This makes Stage 6 audits especially useful when planning major maintenance or rehabilitation projects.

The audit team should inspect the road together, from the viewpoint of all road users. It is not sufficient to just drive along the road - wherever pedestrians are found the team must get down from the vehicle and check what it is like to walk along the road and to cross it. The inspection should be done without first checking the crash data, so as not to bias the findings. The aim is to identify safety deficiencies of design, layout and road furniture. A two-stage inspection process is recommended for long road sections of about 100-km or more. The first stage should focus on identifying the main problems of the route and where they are located. This is followed by the detailed stage during which a close examination of the selected problem areas is done.

Once the preliminary assessment has been completed the results should be checked against the crash history. Sometimes a site that looks unsafe may be found to have had no crashes. The auditor should be cautious about recommending corrective action, because of the risk of making things worse, but note that:

- crash history is not necessarily a good indicator of *future* crashes, especially on lightly-trafficked rural roads
- Police crash records are not very reliable - and crash locations may have been mis-recorded
- pedestrians and cyclists may be making long detours to avoid the site because of its perceived danger
- if it is a known and obvious safety problem (e.g. an unprotected bridge parapet end on a high-speed trunk road) it is probably worth treating it.

Stage 6 audits are not a substitute for blackspot studies. The most economic way of treating the safety engineering problems of the busier sections of the trunk road network is probably by doing blackspot studies. Stage 6 audits are more appropriate for the less trafficked parts of the network where there is not much crash data.

3.8. Audit of Traffic Management Schemes

It is advisable to do safety audits of major traffic management schemes. When the existing circulation patterns are altered by means of one-way systems, road closures, parking restrictions, etc., there is always a risk that the number of conflicts / collisions will increase. Audits of traffic management schemes should focus on:

- potential problems with one-way systems, especially the increased speeds and the connections with two-way streets
- whether there is clear signing – for both drivers and pedestrians
- potential problems with drivers and pedestrians not noticing and understanding unusual layouts, such as contra-flow bus lanes, even when they are well signed
- whether the streets that will receive additional traffic can handle the increase safely.

3.9. Audit of Building Development

Large building and land use developments usually generate considerable vehicular and pedestrian

traffic, so they have a major impact on the surrounding road network. The layout of the site, and the design of the car parks, access roads, footpaths, etc., is critical for the safety of both visitors and the passing traffic on the surrounding network. Those responsible for planning control must consult the road authority when considering whether to grant development permission. The road authority may decide that a traffic impact assessment and safety audit is needed. Sometimes the developer is asked to provide or pay for this, but such reports can lack objectivity because of the conflict of interest. Audits of building development will typically focus on:

- the vehicular and pedestrian access
- the safe provision of public transport services
- the safety impact of any congestion caused by the vehicles entering or leaving the development
- the generation of pedestrian movements across surrounding roads
- the adequacy of the parking provision (to avoid parking overflow onto surrounding roads)
- speeds within the site and at access points
- pedestrian / vehicle conflicts within the site and at access points

4. CHECKLISTS

Road Safety Audit Checklists - Stage 1 – Feasibility Studies

	Issue
1.1	**Project function and scope:** Is the scheme consistent with the development plans for the area? Is the scheme consistent with the planned road hierarchy for the area? Will the scheme adequately cater for: - cars?- motorcyclists?- pedal cyclists?- pedestrians?- heavy vehicles?- buses?
1.2	**Major generators of traffic** Does the scheme serve major generators of traffic safely? Are there any developments, planned or committed, that may affect the new road?
1.3	**Network effects:** Will the scheme alter the volume and speed of traffic on the surrounding road network? - if so, will these effects result in safety problems? Can any safety problems be adequately dealt with? Will local vehicle and pedestrian movements be cut by the scheme? - if so, will this result in safety problems? Does the scheme relieve crash-prone routes or sites?
1.4	**General design issues:** Is the design appropriate for the road's function, category, traffic mix, design year traffic volume, etc? Is the design speed appropriate? Has a clear zone been defined and, if so, is it adequate? Can any sudden change in the speed environment be safely accommodated? Are there likely to be safety problems where the new / improved road connects with the existing road network? Will the route permit the achievement of alignment standards (horizontal and vertical)? Does the route fit in with the physical constraints of the landscape? Will the road be affected by adverse weather - high winds, mist, etc.? Does the road cross areas where wild animals are present (e.g. parks and game reserves)? Are standards (e.g., cross-sections) consistently applied?
1.5	**Junctions and access control:** Is the frequency of junctions and their type appropriate for the road function, design speed, traffic volumes and turning movements? Are the proposed junctions at locations where sight distances and other design requirements can be met? Are there any properties with direct access? If so, are they necessary, and in safe locations?
1.6	**Staging:** Will the scheme be carried out in stages? Will junctions be built in interim or final form? Have design compromises been made which might affect the safety of the interim stages?
1.7	**Evaluation of alternatives:** Is the road safety performance one of the evaluation criteria?

Road Safety Audit Checklists - Stage 2 – Preliminary Design

	Issue
2.1	**General topics:** Have the circumstances changed since the last audit (e.g. traffic volume, traffic mix, development plans, etc.)? Has the general form of the project design remained unchanged?
2.2	**General design issues:** Is the design appropriate for the road's function, category, traffic mix, design year traffic volume, etc? Is the design speed and speed limit for each section of the road appropriate to the function of the road, the traffic mix, and the road environment?
2.3	**Cross-sections** Are the widths of the lanes, shoulders, medians (if any) in accordance with standards and adequate for the function of the road and the mix of traffic likely to use it? Does the cross-section help to reinforce the speed limit? Are the needs of pedestrians and cyclists adequately catered for? Is there a need to separate through traffic from access traffic in towns? Are there narrow sections (e.g. at bridges, culverts)? Are these avoidable? If they are unavoidable, are they handled as safely as possible? Are overtaking / climbing lanes provided if needed? Are changes in cross-section (e.g. at terminal points) handled safely? Will the carriageway drain adequately?
2.4	**Shoulders and roadside areas** Are the shoulders of appropriate width and construction? Has a clear zone been defined and, if so, is it adequate? Check embankment heights and steepness of foreslopes - if they are too high / steep, will they be protected by safety barrier? Has adequate provision been made for bus lay-bys, rest areas, etc.?
2.5	**Alignment** Does the horizontal and vertical alignment give sufficient forward visibility for the selected design speed? Are there any substandard (inconsistent) elements? Does the horizontal and vertical alignment fit well together? Does the alignment provide regular, safe overtaking opportunities? Does the alignment avoid creating situations where the forward visibility is marginal for safe overtaking (dilemma zones)? Does the alignment help to reinforce the speed limit?
2.6	**Junctions:** Can the number of junctions be reduced to improve safety? Are junctions so close together that there may be a "see-through" problem? Is the junction in a safe location (especially regarding visibility requirements)? Is the type of junction (priority, control, etc.) suitable for the function of the two roads, the traffic volume, the traffic movements (vehicular and pedestrian), the approach speeds and the site constraints? Is it the safest alternative – for all road users? Are the junctions all of the same type? If not, will this be confusing for drivers? Will the layout and function of the junction be understood by drivers as they approach? Does the layout conform to established Tanzanian practice? Is the route through the junction as simple, clear and logical as possible? Is there adequate provision for channelling (and protecting) where necessary the different streams of traffic? Is there proper "lane balance", and "through lane continuity"? Are there any "trap lanes" (i.e. a turning lane that is not clearly signed and so may be

	mistaken for a through lane)? Is the layout of the junction adequate for all permitted vehicular movements and for all types of vehicle? Does the layout encourage slow, controlled speeds at and on the approach to STOP and GIVE WAY signs / lines? Is there adequate provision for pedestrians and cyclists? Does the junction design permit adequate signing?
2.7	**Pedestrians and other special road users** Have pedestrian needs been satisfactorily considered (check whether there is evidence of a survey having been done)? Have the needs of cyclists and motorcyclists been considered, especially at junctions (check whether these vehicles were covered by the traffic surveys)? Have the needs of bus users been considered?
2.8	**Major traffic generators / access control** Does the route serve major generators of traffic safely? Are accesses to major traffic generators located near to hazards (e.g. junctions, sharp bends, sections with restricted visibility)? Risk of queues? Can accesses to existing properties be used safely? Are there any properties with direct access? Is there an alternative to direct access?
2.9	**Bridges** Is the outline design satisfactory from a safety viewpoint (continuation of full carriageway and shoulder width, provision for pedestrians, cyclists, etc)?
2.10	**Railway crossings** If the road crosses a railway, is an at-grade crossing acceptable given the road function, speed, traffic volume, etc? If an at-grade crossing is acceptable, is it located where visibility is adequate? Will there be adequate visibility to queue tails? Does the crossing need to be equipped with barriers and signals?
2.11	**Staged development** Will the scheme be carried out in stages? Will junctions be built in interim or final form? Have design compromises been made which might affect the safety of the interim stages?

Road Safety Audit Checklists - Stage 3 – Detailed Design

	Issue
3.1	**General topics:** Check for major changes since the last audit. Are there any safety implications? Check that the circumstances for the proposals still apply. Have there been any significant changes to the network or area to be served? Is the proposed function of the road still as intended? Are future improvements planned that will affect the safe use of the road?
3.2	**Detail of geometric design:** Are the design details (e.g. lane and shoulder widths, crossfall, superelevation, footway design, etc.) consistent?
3.3	**Cross-sections** Have there been changes to the cross-sections that affect safety? Is the design still free of undesirable changes in cross-section design? Are the clearances in accordance with standards? Have overtaking / climbing lanes been designed in a safe manner (particularly the lane gain and lane drop)? If there are narrowings for speed management purposes, are they safe (check whether cyclists might get squeezed)?
3.4	**Drainage** Will the new road drain adequately (particularly at sag curves)? Are the road grades and crossfall adequate for satisfactory drainage? Are flat spots avoided (check at start/end of superelevation)? Are roadside drains of a safe design (can they be traversed safely by out-of-control vehicles; are they a hazard to pedestrians)? Will pedestrian areas, cycleways, lay-bys and other paved areas drain adequately?
3.5	**Shoulders, edge treatment and roadside areas** Are the shoulders of appropriate design (width, crossfall, construction, avoidance of edge drop)? Have the clear zone standards been met? If not, can the hazards be removed? If not, have adequate arrangements been made to protect vehicles from the hazards? Are there any "open windows" through which out-of-control vehicles could fall? If so, can they be closed, or shielded by safety barrier? If there is a median, is it free of hazardous objects? If not, can they be removed, or protected? Has adequate provision been made for bus lay-bys, rest areas, etc.? Are any lay-bys, rest areas, etc. located and designed to safe standards? Are culvert ends (headwalls) located outside the clear zone, or have they been designed not to be a hazard, or has adequate protection been provided? Is the design of kerbs appropriate for the speed of traffic and the road environment?
3.6	**Alignment** Does the horizontal and vertical alignment give sufficient forward visibility for the selected design speed? Are there any substandard (inconsistent) sections? Are substandard sections adequately signed? Are changes in speed handled safely? Does the horizontal and vertical alignment fit well together? Does the alignment provide regular, safe overtaking opportunities? Does the alignment avoid creating situations where the forward visibility is marginal for safe overtaking (dilemma zones)? Does the proposed treatment at bends make appropriate and safe provision for: transition curves, superelevation and carriageway widening?

	Does the alignment help to reinforce the speed limit? Is the design free of sight line obstructions (fences, street furniture, safety barrier, signs, landscaping, bridge abutments, parked vehicles)? Is visibility adequate at any pedestrian crossings? Is there sufficient visibility on the approach to junctions? Check that drivers will be able to read the road ahead. Are there any awkward surprises or visual illusions that could confuse drivers? If so, can they be avoided? If not, are they handled safely? Does the vertical alignment put excessive demands on the power of heavy vehicles? Has it been designed so that maximum grades are interspersed with recovery grades?
3.7	**Junctions:** Will the layout and function of the junction be understood by drivers as they approach? Does the layout conform to established Tanzanian practice? Is there proper "lane balance", and "through lane continuity"? Are there sufficient lanes for the volume of traffic? Is the route through the junction as simple, clear and logical as possible? Is there adequate provision for channelling (and protecting) where necessary the different streams of traffic? Is the layout of the junction adequate for all permitted vehicular movements and for all types of vehicle? Are the lane widths adequate (check need for widening on curves)? Are the traffic islands sufficiently large to avoid being a hazard (especially at night)? Does the shape guide vehicles into the correct travel path? Are there any "trap lanes"? Can they be avoided? If not, are they signed adequately? Does the layout encourage slow, controlled speeds at and on the approach to STOP and GIVE WAY signs / lines? Are the sight lines at and on the approach to STOP and GIVE WAY lines and other critical decision points adequate and unobstructed? Are there are awkward differences in level on the approach to and within the junction? If there is likely to be queuing, will approaching vehicles be able to see the queue tails in time to stop safely? Are there any 'local' features that may affect the safe use of the junction? Is there a need to provide for U-turns? If so, does the layout permit safe U-turns? Is there adequate provision for pedestrians (clear, convenient crossing points, refuge islands, dropped kerbs, etc.)? Is there a need to use pedestrian barrier to channel pedestrians to safe crossing points? Is the junction safe for cyclists? Are there acceleration and deceleration lanes? If so, are they long enough for traffic to use them safely? Is the junction adequately and correctly signed in accordance with the Traffic Signs Manual? Does the junction need to be lit? If lighting is to be provided, are the lighting columns in a safe place? **Additional checklists where junctions include:** **Traffic Signals** Can the signals be clearly seen on the approach to the junction? Do measures need to be taken to reduce speeds on approach to the junction? Is there any confusion when groups of signals are placed close together (see-through effect)? Is there a need to fit signal hoods to prevent drivers seeing signals that do not apply to them? Will the signals be hidden in bright sunshine? Are the signal heads fitted with backing boards?

	Are the signal lamps the correct size? Are there at least two signal heads (primary and secondary) controlling each traffic movement? If there are two or more lanes on the approach, is there a need to provide a second primary signal - on a traffic island? Is there likely to be any confusion over which signal controls each movement? Is there sufficient lateral clearance between signal heads and the carriageway? Do the signal colours, arrangement, signal sequence, and signal timings conform to accepted practice? Are they in accordance with the Traffic Signs Regulations and the advice in the Traffic Signs Manual? Does the signal phasing prevent any unexpected conflict situations? Is it necessary to have protected right turns? Is the "intergreen time" between conflicting phases sufficient for safe operation? Can the junction be used safely if the signals are not working or are switched to flashing amber? Is there a phase to accommodate pedestrians? Are the settings and timings adequate for safe use? Can pedestrians get confused about which signal applies to them? Is the junction properly marked in accordance with the advice in the Traffic Signs Manual? Is the stop line perpendicular to the centre line? Is the control equipment located in a safe place where it will not interfere with visibility and is unlikely to be hit by errant vehicles? Is there safe parking for the maintenance vehicle? **Roundabouts** Is the geometry simple and easily understood by drivers on the approach to the roundabout? Is the size of the roundabout sufficient for the volume and mix of traffic and the number of entries? Is the central island sufficiently conspicuous? Are there too many entries for safe, efficient operation? Are the entries and exits spaced far enough apart? Does the design deflect entering traffic sufficiently to ensure that entry speeds are no greater than 50 km/h? Is the visibility for entering traffic and circulating traffic adequate? Has the centre island been designed to be forgiving to errant vehicles? Has adequate provision been made for pedestrians to cross the arms of the roundabout? Have the needs of cyclists been considered? Is the signing and marking in conformity with the guidance given in the Traffic Signs Manual? Are the markings adequate? Is there a need for dedicated lanes? **Grade separated** Is the vertical alignment adequate? Can the drivers see the junction? If there are merge situations, are they arranged so that the traffic joins the mainline from the nearside, i.e. from the left? Is the merge/diverge point clearly identifiable for drivers on the mainline? Are the acceleration lanes of adequate length and design? Are the deceleration tapers of adequate length and design? Is joining traffic inter-visible with the mainline? Is the design speed for the ramps adequate? Does the design of the ramp provide adequate forward visibility? Are there sharp bends on the ramps? (consider use of chevron signs and safety barrier) Are there any accesses on the ramps? Can they be relocated? Are the off-ramps long enough to accommodate peak traffic flows without queues

	extending back onto the mainline? Check whether safety barrier is needed on embanked ramps and other road sections.
3.8	**Traffic Signs:** Is the level of signing appropriate for the road? Is there an over-reliance on signs (instead of better geometric design)? Do the signs (incl. road markings) conform to the Traffic Signs Regulations and the advice given in the Traffic Signs Manual? Can the signs be seen and are they of sufficient size? Do the signs convey the correct message? Are signs located in appropriate and safe places? Do signs give adequate information to drivers? Do the signs need to be protected with safety barrier? Are gantry signs needed? If gantry signs are used can they be seen at night? Do they need to be externally illuminated? Does the scheme make provision for removing unnecessary, wrong or outworn signs? Are the road markings correct? Are the criteria for the use of no overtaking centre lines specified, and, if they are, are they correct for the traffic speed on each section? Will traffic island markings need to be reinforced by rumble strips or flexible traffic cylinders? Will reflective pavement markers (road studs) be needed? Should roadside marker posts (delineators) be provided in order to improve the "readability" of the road?
3.9	**Bridges** Is the design satisfactory from a safety viewpoint (continuation of full carriageway and shoulder width, provision for pedestrians, cyclists, etc.)? Will pedestrians have a clear and safe path onto and off the bridge? Does the parapet need to function as a safety barrier? If so, will it perform satisfactorily? Has the parapet been designed for safety (height, level of containment, limit on size of openings, etc.)? Are the parapet ends properly shielded?
3.10	**Safety barrier** Are safety barriers provided where necessary? Are they long enough to prevent an out-of-control vehicle from reaching the hazard? Are the terminal arrangements (upstream and downstream ends) safe? Do safety barriers restrict visibility? Do safety barriers block pedestrian desire lines? Has steel beam guardrail been designed correctly (check beam height, post spacing, lateral clearance, spacer blocks, nuts and bolts, reflectors, terminal pieces, and whether the beams are overlapped correctly)? Check that transitions between barrier types (e.g. steel beam guardrail to concrete bridge parapet) are safe. Are there any features that could create a safety problem?
3.11	**Provision for Pedestrians** Are footways provided where needed? Is there a network of footways and safe crossing points serving the main pedestrian movements? Is there a need for special provision outside schools, hospitals and other major generators of pedestrian movement? Does the footway network enable pedestrians to avoid major conflicts with vehicular traffic? Are the main crossing points in safe locations? Is there good intervisibility between

	pedestrians and drivers? Do the main crossing points have features / facilities to help pedestrians (e.g. "dropped kerbs", refuges, "build-outs", zebra crossings, signal-controlled crossings, etc.) Is there likely to be any confusion about who has right of way at crossing facilities? Does the signing and marking conform to the Traffic Signs Regulations and the advice in the Traffic Signs Manual? Are there any obstructions (signs, lighting columns, safety barrier, etc) in the footways? If so, can they be removed or moved? Is it necessary to channel pedestrians to safe crossing points using pedestrian barrier? If pedestrian barrier is used is it of a safe design (not dangerous when hit by vehicles)?
3.12	**Access to Properties:** Can accesses to existing properties be used safely? Are there any special measures that need to be incorporated into the design to ensure safety (i.e. near schools, public areas, or commercial centres)
3.13	**Utilities:** Is there adequate clearance for overhead power lines? Can utility apparatus be accessed safely? Can maintenance vehicles be parked safely? Are power boxes and access chambers located in a safe place (e.g. away from traffic lanes)
3.14	**Vegetation and landscaping:** Are there any trees/vegetation/landscaping located where they may interfere with visibility and affect the safety of road users?
3.15	**Lighting:** Is lighting required and, if so, has it been adequately provided? Does the lighting adequately illuminate critical points, such as pedestrian crossings, refuges, merge and diverge areas, STOP and GIVE WAY lines, etc.)? Will the lighting scheme mislead drivers in any way (e.g. regarding priorities at junctions, or alignment)? If there are sites with night-time accident problems, are these covered by the lighting scheme? Are the lighting columns located where they are less likely to be hit by out-of-control vehicles (as far as the need for even illumination allows)? Are the lighting columns of a design that makes them as little a hazard as possible? Is there adequate clearance between the lighting column and the edge of the carriageway? Do lighting columns on a median need to be protected by safety barrier?
3.16	**Railway crossings:** Is the crossing located where visibility is adequate? Will there be adequate visibility to queue tails? Is there a need for speed management measures on the approaches to the crossing? Is there a need for barriers and signals? If so, have these been correctly designed? Has the Tanzania Railways Corporation given its approval?
3.17	**Maintenance:** Can access to structures be carried out safely? Can maintenance vehicles stop in a safe place?
3.18	**Publicity and training:** If the project will bring big changes to the traffic environment (e.g. more traffic, faster traffic) is it necessary to undertake a road safety awareness campaign amongst roadside communities?

Road Safety Audit Checklists - Stage 4 – Roadworks

	Issue
4.1	**Providing safely for everyone:** Do the roadworks proposals cater safely for the passage of all types of traffic and road users? Check that pedestrians and cyclists will be safe when crossing the site? Can local people access their properties on foot and by vehicle?
4.2	**Signing** Does the signing provide sufficient advance warning of the roadworks? Is all the signing in accordance with the provisions of the Traffic Signs Manual?
4.3	**Safe traffic movement through the site:** Do the arrangements for the passage of traffic encourage smooth flow of traffic at safe speeds? Will speed humps, speed limit signs, or other speed control measures be required? Does the signing and channelisation provide clear guidance to drivers on which way they should go? Are traffic lanes of sufficient width, taking account of vehicle mix, likelihood of wide vehicles, etc.? Are the barricades, markers and other channelisation devices adequate (check size, robustness, colour, visibility, spacing, etc.)?
4.4	**Diversion roads** Are any diversion roads designed to safe standards (check width, alignment, drainage, edge markers, side slopes, junctions, signing, surfacing, etc.)? Will there be a need for speed humps, speed limit signs, no overtaking signs, or other speed control measures?
4.5	**Work areas** Are all work areas, excavations, stockpiles of materials, etc., adequately fenced off and protected from moving traffic? Has sufficient space been left for workers and plant to operate without coming into conflict with moving traffic?
4.6	**One-way working** Is one-way working acceptable, given the road's traffic function, traffic volume and speed? Is the advance signing adequate (check visibility to queue tails)? Will the traffic queues obstruct junctions and accesses, or cause other problems? How will traffic be controlled ? (traffic signals or STOP/GO boards are much safer than flagmen) If one-way working will operate at night, what will be the traffic control arrangements? - is there likely to be abuse by impatient drivers? Will the STOP/GO signs or traffic signals be clearly visible to approaching traffic? Is the shuttle lane excessively long? Will the traffic control lead to unacceptably long delays to traffic?
4.7	**Access for works traffic** Are the accesses for works vehicles safe (check location, signing, need for control, etc.)?
4.8	**Safety at night** Will the site operate safely at night? Will lighting be needed?

Road Safety Audit Checklists - Stage 5 – Pre-Opening

	Issue
5.1	**General topics:** Have any changes been made during construction that may lead to safety problems? Has the design been correctly translated into physical form? Check that no roadside hazards have been installed or overlooked. Is safety adequate for: pedestrians of all ages, bicycles, truck and bus movements, motorcycles, cars?
5.2	**Drainage:** Is the drainage of the road and its surroundings adequate? Will the discharge from the drains cause problems (e.g. washaways of rail track or roads)?
5.3	**Environmental:** Is planting located to avoid obstruction to visibility and sight lines? Will planting cause problems when mature (i.e. size of trunk or canopy spread)? Does planting obscure pedestrian movements near the edge of the road? Check that no natural feature creates a danger by its presence or loss of visibility.
5.4	**Roadside:** Are there any obstructions or other hazards remaining in the clear zone? Are there any "open windows" through which out-of-control vehicles could fall? Have the appropriate types of kerbs (if any) been used?
5.5	**Safety barriers:** Are safety barriers provided everywhere they are needed? Are they long enough to prevent an out-of-control vehicle from reaching the hazard? Are the terminal arrangements (upstream and downstream ends) safe? Do safety barriers restrict visibility? Do safety barriers block pedestrian desire lines? Has steel beam guardrail been designed and installed correctly (check beam height, post spacing, lateral clearance, spacer blocks, nuts and bolts, reflectors, terminal pieces, and whether the beams have been overlapped correctly)? Check that transitions between barrier types (e.g. steel beam guardrail to concrete bridge parapet) are safe. Are there any features that could create a safety problem?
5.6	**Access to property and developments:** Are all accesses safe for their intended use? Are all accesses adequate, in terms of design, location and visibility?
5.7	**Services:** Are access chambers, lines, boxes, lighting columns etc. located in a safe place? (i.e. clear of traffic lanes and behind any safety barrier). Is there a safe place for maintenance vehicles to stop?
5.8	**Alignment:** Check that the route has no safety problems in each direction. Are there any problems at night that are not apparent during the day? Is there adequate visibility/stopping sight distance? Check that the form of road and its traffic management are easily recognised under likely traffic conditions. Check the need for more signs and markings. Check that the edge delineation of the edge of the carriageway is clear. Are drivers misled by any visual illusion? Could the alignment of the old road mislead drivers? Is the transition from the old, unimproved road to the new road satisfactory (good

	delineation, no awkward manoeuvres)?
5.9	**Junctions:** Is the junction clearly visible to approaching drivers? Is the form and function of the junction clear to drivers on all approaches? Are the STOP and GIVE WAY lines visible at a safe stopping distance? Are there any problems at night that are not apparent during the day? **Additional items to consider for specific types of junction:** **Traffic signals:** Can the signals be seen clearly on all approaches? Is the alignment of the signal heads correct? Are the signal lamps bright enough? or too bright (glare)? Can the signals be seen by only those who need to see them? Is the sequence of operation correctly set? (include pedestrian phases if appropriate). Are lane markings for dedicated turns adequate? Are all pedestrian signals functioning correctly and safely? **Roundabouts:** Check that the roundabout is fully visible and recognisable from all approaches. Check that all signs and markings are correctly placed.
5.10	**Traffic signs:** Are the correct signs used and are they correctly placed? Check the visibility, legend and legibility in both daylight and in darkness. Are there spelling or design errors? Do they give the correct message to drivers? Are they readable? Are they located in a safe place? Are they interfering with visibility at junctions? Are clearance standards met? Do the signs obstruct footways? Are safety barriers needed to protect posts from vehicle impact? Are any more signs required? Are all the road markings placed correctly and fully visible? Are reflective pavement markers correct and visible? Check that all redundant signs (including markings) from the old alignment and temporary signs used during construction have been removed.
5.11	**Surface treatment** Does the surface appear to have adequate skid-resistance? Are there any areas where there is excessive bleeding of bitumen?
5.12	**Pedestrian/Non Motorised Users:** Is there an adequate network of footways and safe crossing points? Are there any obstructions that may affect safe passage of pedestrians? Are there “dropped kerbs” at crossing points? Are there any gaps in the network of footways? Is there sufficient pedestrian guardrailing? Has it been installed correctly? Does it obstruct visibility? Are there any places where cyclists may be particularly at risk?

Road Safety Audit Checklists - Stage 6 - Post-Opening and Existing roads

	Issue
6.1	**General topics:** Review previous road safety audit (if carried out). Are there any issues still causing concern? Do the Police have any concerns over accidents that may have occurred since opening (is there a predominant accident type that could indicate a particular problem)? Is there any confusion between the road and the adjacent network? If a service road is present does the service road operate safely? Is there any problem with headlight glare? Has there been any change of use of existing developments on or near the road that has affected traffic safety? Is the surface of the road free from defects that may result in safety problems (i.e. loss of control or skidding)?
6.2	**Cross-section:** Are the lanes, shoulders, medians etc., of adequate width? Is there a pavement edge drop (i.e. shoulder is lower than carriageway)? Does the cross-section change with different speed limits?
6.3	**Drainage:** Is the drainage of the road and its surroundings adequate? Have the side drains been designed to a safe standard for vehicles and pedestrians? Are culverts and headwalls outside the clear zone, or are they protected by safety barriers?
6.4	**Roadside:** Are the shoulders of an appropriate design (width, profile, surfacing, etc)? Are there any obstructions or other hazards in the clear zone? - if so, can they be removed? - if they cannot be removed do they need to be protected by safety barrier? Are the kerbs (if any) of the appropriate type for the speed environment?
6.5	**Safety barriers:** Are safety barriers provided where necessary? Are they long enough to prevent an out-of-control vehicle from reaching the hazard? Are the terminal arrangements (upstream and downstream ends) safe? Do safety barriers restrict visibility? Do safety barriers block pedestrian desire lines? Has steel beam guardrail been designed and installed correctly (check beam height, post spacing, lateral clearance, spacer blocks, nuts and bolts, reflectors, terminal pieces, and whether the beams have been overlapped correctly)? Check that transitions between barrier types (e.g. steel beam guardrail to concrete bridge parapet) are safe. Are there any features that could create a safety problem?
6.6	**Alignment:** Is sight distance adequate for the speed of traffic using the route? Is the horizontal and vertical alignment suitable for the 85th percentile speed of traffic? If not:- • Are there sufficient warning signs? • Have speed limits been imposed? - are they correctly signed? Are there any sections of road that may cause concerns? Consider: • Is the alignment clearly defined? • Have all old road markings been removed? Are there sufficient clear overtaking sections?

	Are there sections with marginal visibility for overtaking (dilemma zones)? Are there sections where the alignment is dangerous (e.g. sharp curves after long straight sections, sharp curves after crests, long downgrades)? Is the design of curves adequate (check superelevation, transitions, carriageway widening)? Are there long / steep hills where climbing lanes would help prevent unsafe overtaking?
6.7	**Speed management** Does the geometric design (cross-section, alignment, etc.) reinforce the speed limit? Is the traffic exceeding the speed limit? Is there a need for speed management measures? Are speed humps and other speed control devices of a safe design and are they adequately signed?
6.8	**Junctions:** Are junctions located in safe places? (Check in relation to horizontal and vertical alignments) Is the layout of junctions obvious on each approach? Does the layout accommodate all types of vehicle? Is the visibility from the side road adequate? Is the method of control appropriate? (Priority/signalled) Are dedicated turning lanes adequate (i.e. lengths and widths) to accommodate volume and mix of traffic? Is the signing on the approach to an junction adequate? Is there adequate provision for pedestrians and cyclists? If the junction is a roundabout is it designed to control speeds to 50km/h? **Where there are signals:** Do they operate correctly? Are they clearly visible (in all conditions)? Can signals only be seen by those who should see them? Are control boxes located in a safe place?
6.9	**Pedestrian and cyclists** Are there adequate, safe facilities for pedestrian movement? Are pedestrian facilities used as intended? Are there any places where cyclists are particularly at risk?
6.10	**Bus and parking facilities** Are there sufficient roadside bus stop and parking facilities? Are stopping areas located and designed to safe standards? Are bus stops and parking facilities used in a safe manner?
6.11	**Access to properties** Is there any roadside activity that may cause road safety problems? Is the number of roadside accesses compatible with the function of the road and the volume and speed of traffic? Are all accesses adequate in terms of design, location and visibility?
6.12	**Bridges** Is the cross-section of the approach road maintained across the bridge? Are there many pedestrians and cyclists crossing the bridge? Can they cross safely? Is the bridge parapet safe (height, design, level of containment, limit on size of openings, etc.)? Are the ends of the bridge parapet adequately protected?
6.13	**Traffic signs** Are all the necessary signs in place? Are they readable? (consider in all conditions). Are they located in a safe place? Do they give the correct message? Is there any confusion in the message they give?

	Do posts need protection? Is edge delineation adequate? Are road markings correct and in good condition? Are reflective pavement markers (road studs) correct and in good condition?
6.14	**Environmental:** Does vegetation obstruct: • Traffic signs; • Visibility at junctions; • Stopping sight distances on the mainline; • Footways / crossing points?

5. APPENDIX 1 - OUTLINE TERMS OF REFERENCE FOR A ROAD SAFETY AUDIT

Introduction

The objective of this assignment is to carry out a Stage [X] Road Safety Audit (RSA) of the proposed *[insert name of project]* so that potential road safety problems can be minimised. The conduct of the audit shall broadly follow the procedure set out in the latest edition of the Ministry of Infrastructure Development's document, "Guide to Road Safety Auditing".

The following information will be made available for the audit:
[list reports, drawings, data, etc.]

Scope of Services

The scope of services include, but are not necessarily limited to, the following tasks:

1) Review the reports, drawings, etc., provided by the road authority
2) Hold a Commencement Meeting with the design team in order to obtain further information and understand the background to the design
3) Visit the site (entire length) so as to get a better understanding of the existing situation and how the project will look
4) Produce a concise Road Safety Audit Report identifying safety concerns, and in each case recommending how the design should be changed to eliminate or minimise the potential problem. The auditors should consult the appropriate checklist in the "Guide to Road Safety Auditing" but not limit their audit to the concerns listed therein. They must look at the needs of all road users, especially vulnerable road users. The audit findings should be presented in tabular form, as per Table 1 of the "Guide to Road Safety Auditing".
5) Attend the project manager's Completion Meeting in order to answer questions on the Audit Report and discuss the recommended changes.

Qualifications and Experience

The services will be provided by a team comprising two or more road safety specialists, at least one of whom (the team leader) must have experience of undertaking road safety audits. Knowledge and experience of highway design will be an advantage.

Required Inputs

The assignment is expected to take about 15 days, as follows:

- 5 days reviewing the reports and drawings, etc., and holding the Commencement Meeting
- 5 days visiting the site
- 5 days preparing the Road Safety Audit Report.

In addition, it will be necessary for the audit team leader to attend the Completion Meeting. This will normally be held within one month of the Audit Report being submitted.
[Adjust these requirements to suit the scale and complexity of the project]

Reporting

The auditors will submit (x) copies of the Road Safety Audit Report to the road authority, together with an electronic copy in MS Word.