

TRANSFUND NEW ZEALAND

SAFETY AUDIT PROCEDURES FOR EXISTING ROADS

Review and Audit Division

Report No. RA97/623S



Safety Audit Procedures For Existing Roads

December 1998

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FOREWORD

Transfund New Zealand allocates funds to achieve a safe and efficient roading system. The safety audit procedures for existing roads described in this manual have been developed to assist Transfund achieve this objective.

This type of safety audit is applied to the existing network. It is different from the safety audit that is applied to new works (projects). The introduction to these procedures gives a brief history of their development.

Transfund is at the forefront of this type of safety audit. The majority of countries world-wide that have adopted safety audit apply the principles to new projects, not to the existing network.

While every effort has been made to ensure the accuracy, reliability and completeness of these procedures, Transfund makes this manual available strictly on the basis that anyone relying on it does so at his/her own risk without any liability to Transfund New Zealand.

If any reader has any ideas on how to improve the efficiency and effectiveness of safety audit, he/she is invited to write directly to:

Dr Ian Appleton, Safety Audit Manager, Transfund New Zealand, P O Box 2331, Wellington, New Zealand.

Similarly, comments on this document should be addressed to Transfund's Safety Audit Manager.

Transfund would like to thank all the individuals and organisations who have contributed to the development of the procedures in this manual.

P V WRIGHT

Review and Audit Manager

17 December 1998

IMPORTANT NOTE FOR THE READER

Document Status

This document “Safety Audit Procedures for Existing Roads” has status of a guideline as defined in Transfund New Zealand’s “Standards and Guidelines” Manual.

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SAFETY AUDIT PROCEDURES FOR EXISTING ROADS

1. Introduction

Safety Auditing of projects was introduced by Transit New Zealand (Transit NZ) in 1993 and is continuing to be used to ensure safety aspects of projects are addressed in the best possible way. Procedures were developed for Stage 1 *Feasibility* to Stage 4 *Pre opening of roading improvement projects*.

In February 1995 trials of two Australian methods for the safety auditing of existing roads were undertaken. Since that time 13 audits have been completed. The trial procedures used in the initial period were later modified as a result of the experience gained. In February 1996 Draft Procedures for Safety Auditing of Existing Roads were issued and have been used for nearly two years. This Final Draft of the revised procedures is the result of experience gained by all personnel involved in undertaking the audits to date. A series of workshops were held during November 1997 to review the draft procedures prior to the preparation of this document.

These procedures were initially developed by Transit NZ, but following the formation of Transfund New Zealand (Transfund), they have been developed by that organisation.

The procedures are designed to allow Transfund to review the provisions of traffic services, road maintenance and levels of safety primarily from a road user's view on the roading networks of the Road Controlling Authorities (RCAs). They can, however, be used by others to determine the 'status' of traffic services within a roading network, in which case they may be modified to suit the required outcome. In all cases users are encouraged to engage auditors who are independent of the regular network management.

2. Objectives and Outcomes

The objectives of a safety audit of existing roads are:

- To identify potential safety problems for road users and others.
- To ensure that measures to eliminate or reduce the identified problems are considered fully by the RCA.
- To seek consistency across the nation's total network and to influence policy weaknesses.

A safety audit will:

- Help minimise the risk and severity of crashes that may be attributed to the existing road conditions.
- Optimise whole-of-life maintenance and operation benefits for the road network.
- Improve awareness of safe maintenance practices.
- Help Transfund determine the effectiveness of its resource allocation for the provision of a safe and efficient roading network.
- Identify, primarily from a road user's perspective, those issues and features that give misleading or confusing messages.

3. Executive Summary of the Road Safety Audit Process

The road safety audit process includes three parts:

- Setting up the audit
- Audit procedures
- Audit reporting

Setting up the audit involves choosing the RCA to be audited, choosing and appointing a team leader, two team members and a representative of the RCA, agreeing on a time frame, specifying terms of reference and other details, gathering background information and ensuring that necessary equipment is available.

Audit procedures typically occupy three days. They start with an opening meeting, covering health and safety issues, background information, road selection, and the audit and reporting programme. This is followed by selection of the detailed audit programme, undertaking day and night inspections, preparing draft notes, and identifying key issues to be presented to the closing meeting. The audit procedures conclude with a closing meeting, an important event attended by representatives of the RCA or the local authority.

Audit reporting involves the sending of a letter, immediately following the audit, to the CEO of the RCA summarising the findings. A draft report is sent to the Asset Manager of the RCA. After comment from the Asset Manager, a final report is sent to the Asset Manager of the RCA.

A suggested timetable for the process is given in Appendix 1.

4. Setting Up the Audit

This section describes how an audit is initiated and set up. The differences with each individual audit may call for differences in how they are set up, but all should follow the principles in these guidelines, and there should be good reason for departing from what has come to be accepted as good practice. The steps in setting up an audit may be summarised thus:

1. Choose the RCA to be audited
2. Choose the team composition: Team leader, second, third and fourth team members.
3. Discuss with the RCA, the team leader, and other team members the time frame for the audit, ie, set indicative dates for the audit fieldwork.
4. Specify audit details: terms of reference, information to be supplied and logistical tasks.
5. Gather background information.
6. Ensure that the necessary equipment is available.

4.1 Choosing the RCA to be audited

Transfund follows a regular programme of initiating audits of Road Controlling Authorities (RCAs). RCAs may themselves initiate their own audits.

If RCA's choose to undertake an audit at their own initiative it is recommended that they use these procedures so that a later Transfund audit could be compared. Transfund is also interested in gaining comment as to how useful these procedures are in this situation.

4.2 Choosing the Team Leader and Team Members

The initiator of the audit chooses a Team Leader and two team members with the required skills and qualifications. The RCA chooses their own suitably qualified representative as the fourth team member.

4.2.1 Composition

Urban Audits should have a minimum of 4 persons, whilst Rural Audits should have a minimum of 3 persons. For the outcome of the Audit to be credible it is important that the Auditors (except the RCA's representatives) not be involved in the management of the particular network, nor should they be too familiar with the locality.

Audit Teams should comprise:

- Team Leader.
- Team Member 1.
- Team Member 2 (may not be necessary for a Rural Audit).
- Representative from the Road Controlling Authority (RCA).

4.2.2 Team Members' Tasks

The Team Leader's tasks are:

- Co-ordinate the Audit Programme.
- Lead team meetings.
- Ensure the necessary equipment and documentation are available.
- Ensure team members complete their tasks.
- Brief the Team regarding their safety whilst undertaking the audit and ensure that members sign the *Health and Safety Checksheet* (Appendix 2) and forward it to the client.
- Give guidance in the selection of roads for inspection.
- Prepare the report.

Team Members' tasks are:

- Fulfil the auditing inspection roles.
- Assist with reaching team conclusions.
- Review the Team Leader's draft report.

The tasks of the RCA's Representative are:

- Assist the Team by providing data.
- Accompany the Team on the inspections and take part in team meetings.
- Provide the Team with local knowledge of practices, policies and constraints.
- The RCA representative should **not** drive for any of the inspections.

4.2.3 Skills And Qualifications

The *Team Leader* shall have the following skills and qualifications:

- Shall be an experienced road safety engineer and have been involved in crash studies, in good design standards and practices, and in auditing.
- Shall have had experience with the type of network being audited (urban or rural).
- Shall generally have been involved with a minimum of two previous Existing Road Safety Audits.

Team Member 1 shall have the following skills and qualifications:

- Shall be experienced road safety engineers, particularly with the type of network being audited.
- Shall preferably have experience on at least one previous Existing Road Safety Audit.

Team member 1 should be a consultant with an interest in road safety and in being a team leader in a later audit. For Transit New Zealand audits this person is ideally from one of their network consultancies but from a different region, preferably one who has been involved in their highway inspection programme.

Team Member 2 shall have the following skills and qualifications:

- The same as for Team Member 1, except that:
- The second team member may be new to the process to enable new personnel to gain experience.
- For Transfund audits, the second team member should be from a similar RCA to that being audited, or could be from Transfund. For Local Authority audits it could be a local authority engineer from another similar Local Authority.

The RCA's Representative shall have the following skills and qualifications:

- May be either from the Asset Management of the RCA or its management consultant.
- Should be familiar with the policies and programmes for the network.

This team member is always the RCA's representative of their choice.

4.3 Setting the Audit Time Frame

Once the team membership is established, the Team Leader sorts out the dates for the fieldwork in consultation with the RCA, the other team members and the initiator.

4.4 Specifying Audit Details

Formal letters from the initiator to the RCA and team members specify the audit details. Consultants are sent formal contract documents.

The formal letters include *terms of reference* for the audits. The letter to the RCA stresses the importance of the *opening and closing (exit) meetings*, and requests that senior staff attend the closing meeting. Local Authorities might want to invite councillors to this meeting, so clearly it has to be on a day that they can attend.

The letter to the RCA requests that some *information be supplied in advance* to the team leader. These are a map of the RCA's roading hierarchy and another map showing traffic volumes. Other information should also be available. See 'Background Information' above.

The letter to the team leader specifies a number of *logistic tasks* to be done, like organising travel and accommodation, and requiring the team leader to ensure that the RCA has certain documents available for the team, should they require them.

4.5. Background Information

Prior to the audit, the RCA should provide the Team Leader with the following information:

- A plan of the network showing the road functional classifications.
- A schematic plan showing the AADTs across the network.
- If available, a plan showing the major traffic generators and land use zoning, eg, industrial/commercial centres, residential areas, etc.

The RCA should make available for the audit access to a copy of the latest LTSA crash database and the LTSA annual Road Safety Report. These may not be required by the Team, but should be available if needed so that the Team can assess any concerns they may have regarding the influence of standards etc. on the crash records.

A copy of any relevant local policy standards should also be available.

4.6 Audit and Reporting Programme

At the commencement of each audit, a programme which shows the timetable and response times for all parties should be prepared and agreed to by all parties. This will ensure that the final report is delivered within an acceptable timeframe.

A suggested programme is included in Appendix 1.

4.7 Equipment

4.7.1 Vehicle

The transport and safety arrangements for the Audit Team are important to ensure that the Audit can be undertaken effectively and safely.

It is important that the vehicle allows all team members a sufficient view of the road to enable them to make credible judgements regarding the features for which they are responsible. Most audits will involve at least four people, and a Toyota Previa vehicle has been very successfully utilised in such audits.

4.7.2 Warning Lights

A portable rotating light should be used in conjunction with the vehicle hazard lights when travelling slowly or stopped, particularly in a rural area. If possible, these rotating lights should be mounted with a “Road Survey” sign on the roof of the vehicle.

4.7.3 Trip Meter

This is not necessary in an urban area, but could be helpful, though not essential, in a rural area.

4.7.4 Other Equipment

In addition to the vehicle, the Team should have available:

- Camera
- Measuring wheel
- Tape measure
- Dictaphone.
- Copies of appropriate standards and guidelines, LTSA crash database and annual Road Safety Report.
- Safety vest for each team member.

5. Audit Procedure

A summary of the full audit and reporting programme, with suggested timetable, is given in Appendix 1. This section gives detail on the step *Undertake Audit—Week 0* in that appendix.

5.1 Opening Meeting

The audit team should commence with an opening meeting. This meeting is to describe the procedures and obtain background information. A programme showing the timetable and response times for all parties should be agreed to by all parties. This will ensure that the final report is delivered within an acceptable timeframe. The Road Controlling Authority shall decide who will represent them both at this meeting and during the audit.

The safety of the Audit Team is most important. The Team Leader shall, at the commencement of the Audit, complete a briefing of the Audit Team using the checklist in Appendix 2.

5.2 Inspection Programme

Audit inspections should be limited to a maximum of 3 days to ensure a good level of concentration is maintained. A proven format is summarised in the table below. More detail is given below the table.

Where audits are being completed for combined Urban/Rural RCA's, it is suggested that the first day be given to Rural Audits, the second day to Urban audits and the third day to any outstanding issues.

Day 1	<ul style="list-style-type: none"> • Opening meeting covering health and safety, background information, road selection, and the audit and reporting programme. • Pre-inspection: Select the first day's detailed audit inspection programme. • Undertake audit inspections both day and night.
Day 2	<ul style="list-style-type: none"> • Prepare notes for the first draft of first day's audit report. • Pre-inspection: Refine second day's audit inspection programme. • Undertake audit inspections both day and night.
Day 3	<ul style="list-style-type: none"> • Prepare notes for the first draft of second day's audit report. • Pre-inspection: Refine third day's audit inspection programme. Note: This will only cover a small sample and will not include a night inspection. • Undertake audit inspection.

	<ul style="list-style-type: none"> • Prepare notes for the first draft of third day's audit report. • Prepare key issues to be presented to the closing meeting. • Closing meeting: Discuss with Network Manager the general impressions and general audit findings.
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5.3 Road Selection

Selection of the roads to be audited is to be made by the Audit Team, who should not be influenced by the RCA representative. In making this selection, the Audit Team should take account of the roading network elements such as residential and employment centres, terrain and other factors which may influence traffic generation. The sample is to be representative of the roading network.

The auditing procedures are different for urban and rural roads.

5.3.1 Rural Roads

Dependent on the complexity and distance to travel between the audit sections, 70–110 km of road can be audited in one day including a night time inspection.

The total road section to be audited should be divided into smaller sub-sections, generally 10–15 km depending on network configuration. In the case of State highways these will be reference station lengths, whilst on local roads they will be between intersections and/or total road lengths. Changes in road function or traffic volumes may also be used as section breaks.

5.3.2 Urban Roads

Because of the greater traffic densities on the urban arterial and principal roads, it is recommended that a large percentage of the audit concentrate on these roads. It is recommended that samples of the arterial and principal collector roads be chosen, along with a small sample of the local road network. The sample of local roading network should include residential, industrial and commercial areas.

5.4 Health And Safety

A Health and Safety Plan, with provision for Team members' signatures, is given as Appendix 2. All Team members shall sign the form provided in Appendix 2 to confirm that they have been briefed on the Health and Safety Plan. All Team members shall provide their own safety vests and wear them at all times when out on the road.

5.5 Background Information

The Team Leader should brief the team on the information that has been gathered from the RCA and other sources.

5.6 Pre-Inspection

Prior to commencing the physical inspection each day the audit team should meet and be briefed on:

- The day's programme
- Description of road being audited including:

Function in the Network.

Seasonal considerations.

AADTs.

Agreement on the roles to be fulfilled by each team member. Team members need to decide their positions in the vehicle to suit their inspection task.

Agreement on who will draft the report.

Agreement on who will take the photographs.

- Health and Safety requirements.

5.7 Day and Night Inspections

Because of the need to undertake night inspections, it is best if audits are scheduled over the winter months when there is no daylight saving. It also allows potential for some of the roads to be inspected in adverse conditions.

Each member, exclusive of the driver, should have one set of issues to note and record, eg, either delineation or features. Roles should preferably be alternated during the period of the audit.

The driver is not assigned any tasks to undertake, but can provide valuable feedback to the Team on the driver's views. These views, however, should not overly influence those of the other team members.

In some cases the Team may identify issues such as traffic signals which it may consider require a detailed level of inspection. In such cases they should recommend that specialists be engaged to undertake such detailed inspections.

5.7.1 Rural Inspections

Each sub-section of road should be driven in each direction at 'normal' road user speed with the team members completing the inspection check sheets. (See Appendix 3).

At the end of this run in both directions, the Team should discuss any inappropriate standards or safety problems, agree in principle and inspect in detail any issues if necessary on the trip to the beginning of the next sub-section. At this stage the team should also decide which intersections should be inspected and drive into and out of the selected side roads.

Night inspections should be undertaken at normal speed by drive-overs with a small sample being completed in both directions. The recording of items is best completed with the use of a dictaphone with the data transcribed before the post inspection meeting. (Refer *Post Inspection Meeting* below). This inspection should only record items not noted during the daytime inspection.

The recording is not designed to provide outputs detailing faults which can be passed directly to the maintenance contractor but should be used to prompt a more detailed inspection to schedule specific maintenance activities.

5.7.2 Urban Inspections

Because of the greater traffic densities on the urban arterial and principal roads, it is recommended that a large percentage of the audit concentrate on these roads.

For the sections of arterial and principal roads to be inspected it is recommended that these routes first be driven at (normal) speed in each direction. Following this inspection the team should agree upon the 'like' sections into which the route should be broken to complete the detailed inspection. This detailed inspection is then undertaken by checking for any items requiring detailed checking from the 'Prompt' list (see Appendix 4). The recording of these items will be made on a route progressive basis for summarisation by the team at the post inspection meeting.

Inspections of the sample local roading residential, commercial and industrial networks should be undertaken by a drive through of the area noting similar aspects to those listed on the Urban Prompt sheet.

Night-time inspections of some routes should be undertaken on the same day, only noting items not recorded during the day-time inspections. These items should be recorded on a dictaphone and preferably transcribed before the team post-inspection meeting.

The recording is not designed to provide outputs detailing faults which can be passed directly to the maintenance contractor but should be used to prompt a more detailed inspection to schedule specific maintenance activities.

5.8 Post Inspection Meeting and Report Drafting

Following the completion of the inspections (preferably the morning following the night audit) the team shall meet and agree in draft format the issues to be recorded. Because of the large volume of data involved it is important that this be completed for each day's inspections before commencing further inspections. Failure to do this could lead to confusion between the various sites inspected. The decisions made should reflect those of the Audit Team and not be influenced by the RCA representative whose role is to provide local knowledge and background data.

5.9 Closing Meeting

The aim of the exit meeting is to provide early feedback to the RCA and give opportunity for the clarification of local issues.

For this to be effective it is important that senior staff of the RCA attend. They may, if appropriate, invite a representative of their governing body to attend.

The Audit Team should prepare a summary of both positive and negative aspects of the audit to present to the exit meeting, be prepared to receive explanations regarding local practices, and acknowledge the assistance of the RCA.

This meeting should take between one and two hours.

6. Audit Reporting

6.1 Reporting Process

The completed report should be processed in a similar way to all Transfund Review and Audit Division Reports as shown below. This process may, however, be varied if the report is being undertaken directly for the Road Controlling Authority.

- Immediately following the Audit, a letter summarising the findings should be sent to the CEO of the RCA.
- Draft Report sent to Asset Manager of RCA.
- Asset Manager to comment on:

- Factual errors.
- Omissions.
- Disagreement with any opinions expressed.
- Final report to Asset Manager of RCA.
- Implementation Report

Any items regarding policy/standards should be separately reported via the appropriate channels, i.e. to Transfund to pass on to LTSA.

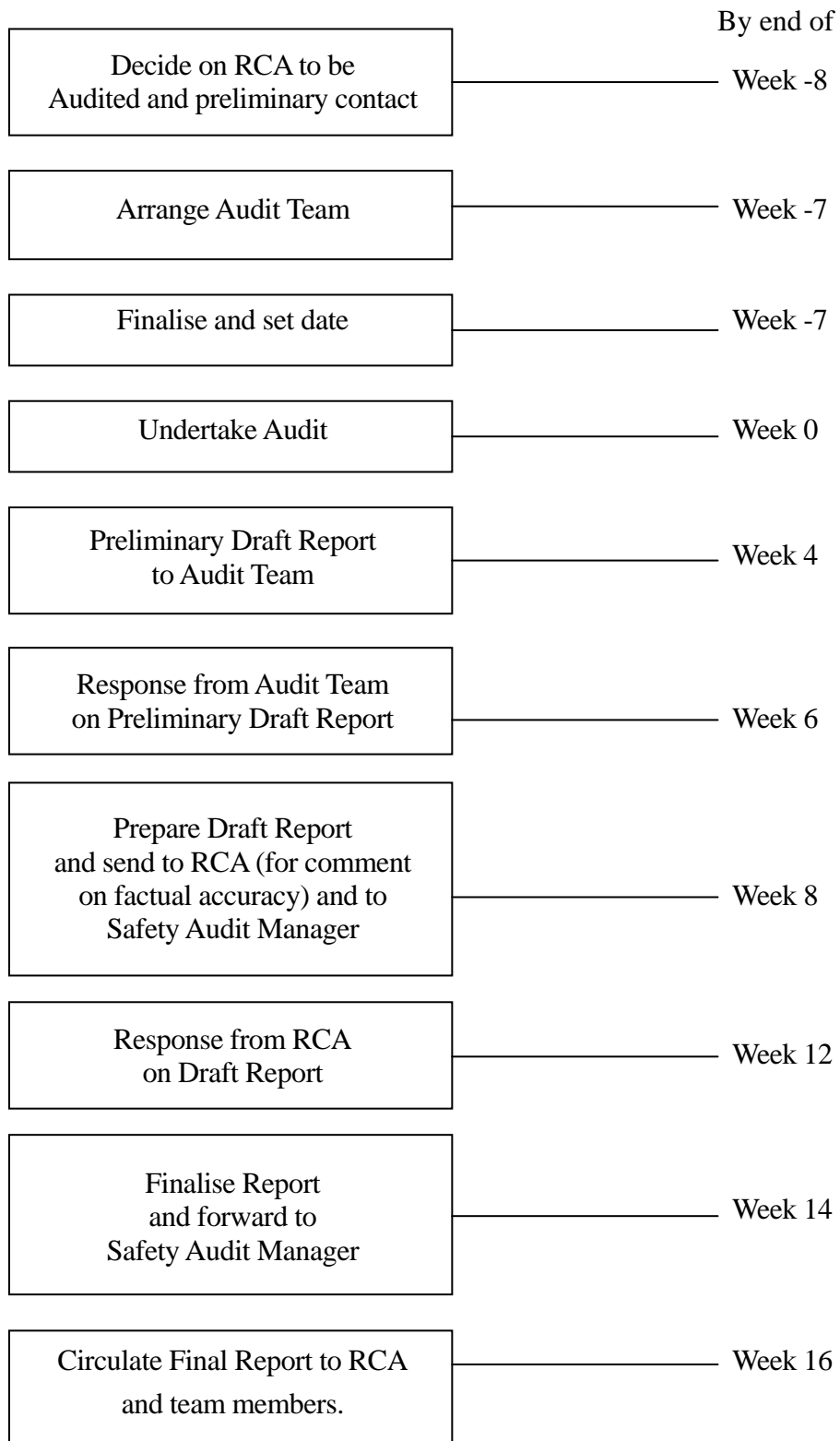
6.2 Report Format

Shall generally follow the format set out in Appendix 7 and should include the following:

1. Executive Summary: Briefly summarise the extent of the audit, general observations, good points and aspects that could be improved in the RCA.
2. Introduction, Objectives and Methodology: Standard introduction as to why a safety audit of existing roads was undertaken for the RCA.
3. Methodology: Introduce Audit Team, audit dates and discuss procedures of the audit.
4. Route Descriptions: Briefly discuss selected routes, provide a map of the RCA with selected routes.
5. Safety Audit Findings: General
 - a) Use the prompt sheets (Appendix 6) as a guide for general headings (be careful not to double count problems).
 - b) General observations across the district should be included in this section with examples of where these observations occur.
 - c) Include comments on good general observations.
 - d) Recommendations should relate to general RCA policy or standards improvements, not to specific sites.
 - e) Recommendations should be allocated a risk weighting as determined in Appendix 5. (Note, if the team consider that an “Urgent” risk level requires early remedial action, a separate letter should be forwarded to inform the RCA as well as raising it at the exit meeting.
6. Recommendations: Recommendations should result from general safety audit findings.
7. A report on the implementation is to be completed by the RCA within 1 year and forwarded to Transfund (the format for this is to be developed).
8. Audit Team Statement: All members of the Audit Team shall sign the final report.
9. Appendices: The appendices provide comments and notes on each individual route. The appendices are written in a similar manner to the general section, but provide more specific information on observations. The specific information is used to support and enhance general observations as well as providing the RCA with examples of specific findings along particular routes. Photos may also be included in the appendices.

APPENDIX 1
Audit and Reporting Programme: Suggested Timetable

Appendix 1: Audit and Reporting Programme: Suggested Timetable



APPENDIX 2
Health and Safety Plan

Appendix 2: Health and Safety Plan

Team Leader to file with Client when completed

Road Controlling Authority:

Date:/...../.....

Audit Team	Name	Confirmation of Safety Briefing
Team Leader		
Team Member		
Team Member		
Team Member		
RCA Representative		

TEAM LEADER'S BRIEFING TOPICS

Safety Hazards Summary

- Inspection vehicle: crashes.
- Team member (pedestrian): vehicle crashes.
- Team member health hazards: sun, rain, cold etc.

Preventative Measures

Vehicle:

- Comply at all times with the road rules (Reg, WOF, licensed driver).
- Drive defensively.
- Ensure the driver is not required to undertake tasks which would cause distraction when driving.
- Use warning lights when close to or obstructing the carriageway, particularly in a rural area.

Team Members must:

- Always wear high visibility safety vests when outside of the vehicle.
- Comply with Transit's G1 and high capacity working on the road requirements.
- Ensure that another team member 'watches the backs' for members undertaking detailed on-carriageway inspections.
- Ensure they have suitable clothing (coat, hat etc) and use them when appropriate.
- In the event of a crash either involving or witnessed by the Team:
 - Provide immediate assistance where possible.
 - Notify emergency services.
 - When the Team is involved, affected members must notify their own organisations and follow their internal Health and Safety procedures.

APPENDIX 3
Inspection Check Sheets for Rural Roads

Appendix 3: Inspection Check Sheets for Rural Roads

1. Maintenance Deficiencies: Sheet 1

The various maintenance faults are noted in the box correlating with the running distance and fault. More can be added on the reverse-direction drive-over. The spare columns can be used for any other maintenance items.

The recording is not designed to provide outputs detailing faults which can be passed directly to the maintenance contractor, but should be used to prompt a more detailed inspection to schedule specific maintenance activities.

These sheets should be completed during the ‘normal road user speed’ drive-over.

2. Inappropriate Standards or Safety Problems: Sheet 2

Before commencing the inspection, particularly for an audit (3–5 yearly), the Team should familiarise itself with the desirable standards for the section. During the ‘normal road user speed’ drive-over in each direction, each item and any comment should be noted against the running distance. These items can be examined if necessary by the team on the second outward trip and the comments expanded to a separate sheet.

Whilst these sheets may be partially completed during the ‘normal road user speed’ drive-over they should be completed more fully during the return detailed inspection.

SAFETY AUDIT OF EXISTING ROADS

INSPECTION CHECK SHEET 1: MAINTENANCE ITEMS

Road Name
or description.....

Start Position
(RS or side road).....

Finish Position
(RS or side road).....

AADT.....

Weather.....

Date / /

Completed By.....

		0.00	1.00	2.00	3.00	4.00	5.00	6.00
Pavement	Running Distance kms (Outgoing)							
	Surface Condition/Ride							
	Shoulder Condition/Edge Break							
	Side Slopes/Roadside Hazards/Water Table							
	Drainage Features (culverts etc)							
	Guardrails (exist) (requiring maintenance)							
Delineation/ Markings	Vegetation (obstructing visibility & signs)							
	Centreline							
	RRPMs							
	Edge Lines							
	Marker Posts							
	Curve Warning/Chevrons							
Intersections	Other Warning/Advisory							
	Intersection Marking & Signs							
	Destination Signs							
	Regulatory/Side Road Control							
	Lighting							
Running Distance kms (Return)								

(Note: Fill in before return trip)

SAFETY AUDIT OF EXISTING ROADS

INSPECTION CHECK SHEET 1: MAINTENANCE ITEMS

Road Name
or description.....

Start Position
(RS or side road).....

Finish Position
(RS or side road).....

AADT.....

Weather.....

Date / /

Completed By.....

	Running Distance kms (Outgoing)	7.00	8.00	9.00	10.00	11.00	12.00
Pavement	Surface Condition/Ride						
	Shoulder Condition/Edge Break						
	Side Slopes/Roadside Hazards/Water Table						
	Drainage Features (culverts etc)						
	Guardrails (exist) (requiring maintenance)						
	Vegetation (obstructing visibility & signs)						
Delineation/ Markings	Centreline						
	RRPMs						
	Edge Lines						
	Marker Posts						
	Curve Warning/Chevrons						
	Other Warning/Advisory						
Intersections	Intersection Marking & Signs						
	Destination Signs						
	Regulatory/Side Road Control						
	Lighting						
	Running Distance kms (Return)						

(Note: Fill in before return trip)

SAFETY AUDIT OF EXISTING ROADS

INSPECTION CHECK SHEET 1: MAINTENANCE ITEMS

Road Name
or description.....

Start Position
(RS or side road).....

Finish Position
(RS or side road).....

AADT.....

Weather.....

Date / /

Completed By.....

	Running Distance kms (Outgoing)	13.00	14.00	15.00	16.00	17.00	18.00
Pavement	Surface Condition/Ride						
	Shoulder Condition/Edge Break						
	Side Slopes/Roadside Hazards/Water Table						
	Drainage Features (culverts etc)						
	Guardrails (exist) (requiring maintenance)						
	Vegetation (obstructing visibility & signs)						
Delineation/ Markings	Centreline						
	RRPMs						
	Edge Lines						
	Marker Posts						
	Curve Warning/Chevrons						
	Other Warning/Advisory						
Intersections	Intersection Marking & Signs						
	Destination Signs						
	Regulatory/Side Road Control						
	Lighting						
	Running Distance kms (Return)						

(Note: Fill in before return trip)

SAFETY AUDIT OF EXISTING ROADS

INSPECTION CHECK SHEET 1: MAINTENANCE ITEMS

Road Name
or description.....

Start Position
(RS or side road).....

Finish Position
(RS or side road).....

AADT.....

Weather.....

Date / /

Completed By.....

Pavement	Running Distance kms (Outgoing)	19.00	20.00				
	Surface Condition/Ride						
	Shoulder Condition/Edge Break						
	Side Slopes/Roadside Hazards/Water Table						
	Drainage Features (culverts etc)						
	Guardrails (exist) (requiring maintenance)						
Delineation/ Markings	Vegetation (obstructing visibility & signs)						
	Centreline						
	RRPMs						
	Edge Lines						
	Marker Posts						
	Curve Warning/Chevrons						
Intersections	Other Warning/Advisory						
	Intersection Marking & Signs						
	Destination Signs						
	Regulatory/Side Road Control						
	Lighting						
	Running Distance kms (Return)						

(Note: Fill in before return trip)

SAFETY AUDIT PROCEDURES FOR EXISTING ROADS
INSPECTION CHECK SHEET 2 STANDARDS AND PROBLEMS

Road Name Start Position Finish Position AADT
 or description..... RS or side road).....(RS or side road).....

Weather Date Completed by

Alignment Consistency
Consistency of Pavement Width (Lane and Shoulders)
Delineation (Warning, Information & Destination Signs, Edge Marker Posts etc)
Level of Service (Overtaking Opportunities, Passing Lanes and Access Control)
Road Side Hazards (Clear Zones, Drains, Poles, Advertising Signs etc) (Guard Railing required)
Intersections (Form, Conspicuity, Control, Markings, Sight Distance)
Drivability (Inspection Team Driver's comments on general 'readability' of the section)

APPENDIX 4
Inspection Check Sheets for Urban Roads

Appendix 4: Inspection Check Sheets for Urban Roads

As described in Section 7.8 of the procedures, the total section of urban road to be audited should first be driven in both directions at normal speed.

This is then followed by a detailed block by block inspection using the attached prompt sheet. It will probably be necessary for the team to stop in each 'block' and complete the detailed inspection on foot—wearing safety vests.

At all times in the 'urban' sector remember that there are many road users (through vehicles, parking vehicles, parked vehicles, turning vehicles, vehicles entering or exiting properties, cyclists, pedestrians both elderly and young), and give thought to their needs and safety. For example, don't congregate in a group so that drivers visibility is restricted.

Safety Audit Procedures for Existing Roads: Urban Prompt List

Road Controlling Authority..... Road Name..... From..... To..... Classification

or description

Weather..... Completed by..... Date . / /

Features	Standards	Comments
Roadmarkings (along route)	Condition	
	Lane markings	
	Edgelines	
	Transverse Lines	
	Flush Medians	
	RRPMs	
Road Surface Condition	Maintenance	
	Drainage - Channels / Catchpits	
Intersections (Side Roads)	Conspicuity/Visibility	
	Appropriate controls	
	Islands	
	Signs and Markings	
	Vehicles Movements	
	Traffic Signals	
Signs (along route)	Regulatory Signs	
	Warning Signs	
	Street Names	
	Directional/Info Signs	
	Advertising	

Features	Standards	Comments
Vegetation Control	Intersections	
	Signs and Signals	
Pedestrian Facilities	Crossings	
	Refuges	
	Footpaths	
Cyclists	General	
	Cyclist Facilities	
Parking	Manoeuvring	
	Controls	
Property Accesses	Adequacy of Design	
	Visibility (entry and exit)	
	Turning Traffic Issues	
Speed Control	Appropriateness	
Lighting	Adequate	
	Placement	
	Intersections	
	Pedestrian Facilities	
Hazards	Poles	
	Roadside Structures <ul style="list-style-type: none"> - Transformers - Bus Shelters etc. 	

APPENDIX 5
Risk Level Assessment for Inappropriate Standards or Safety Problems

Appendix 5: Risk Level Assessment for Inappropriate Standards or Safety Problems

The following definitions and matrix are to be agreed to and assigned by the Team. This provides some initial guidance for prioritising feasibility investigations into each item identified.

It is intended that a database be prepared and provided to all auditors for guidance in assessing the risk of various issues. This is not a scientific system but simply a ‘judgement call’ by the auditors and may be amended by detailed analysis using benefit/cost ratio’s at a later stage of investigation. In complex situations consideration should be given by RCAs to using a more detailed analysis of hazard probability and severity. This may involve comparative analysis of other like situations.

The audit team should use the following process to determine the risk of issues identified as inappropriate standards or safety problems as well as outstanding maintenance requirements.

Step I : Determine the level of ‘Hazard Probability’ from Table 1.

Step II : Determine the category of the ‘Hazard Severity’ from Table 2.

Step III : Determine Risk Level from Table 3.

Table 1 : Hazard Probability

Probability	Description
Frequent	Likely to occur frequently (at least once per year)
Occasional	Likely to occur at some time (once every 1–5 years)
Improbable	Unlikely that the occurrence may ever be experienced

Table 2 : Hazard Severity

Category
Fatal
Serious
Minor

Table 3 : Risk Level

Severity	Probability		
	Frequent	Occasional	Improbable
Fatal	URGENT	HIGH	MEDIUM
Serious	HIGH	MEDIUM	LOW
Minor	MEDIUM	LOW	LOW

APPENDIX 6
General Findings Prompt List

Appendix 6: General Findings Prompt List

- | | |
|--|--|
| <p>1 Alignment & Environment</p> <ul style="list-style-type: none"> • Horizontal • Vertical • Urban / Rural interface <p>2. Pavement Width</p> <ul style="list-style-type: none"> • Lanes • Shoulders <p>3. Delineation</p> <ul style="list-style-type: none"> • Warning signs • Information signs • Regulatory signs • Destination signs • Road name signs • Edge marker posts • RRPMS • Pavement Marking <p>4. Level of Service</p> <ul style="list-style-type: none"> • Overtaking opportunities • Passing lanes • Property access • Speed Limits • Parking <p>5. Roadside Hazards</p> <ul style="list-style-type: none"> • Advertising • Clear zones (recoverable areas) • Drains • Poles / objects • Banks / cliffs • Culverts • Bridges <p>6. Intersections</p> <ul style="list-style-type: none"> • Form • Conspicuity/Visibility • Control • Traffic Signs • Markings • Sight distance • Vehicle Manoeuvres • Traffic Islands | <p>6. Intersections (<i>continued</i>)</p> <ul style="list-style-type: none"> • Traffic Signals • Roundabouts • Accessways <p>7. Road Users</p> <ul style="list-style-type: none"> • Pedestrians • Pedestrian Facilities • Cyclists • Cyclist Facilities • Other <p>8. Lighting</p> <ul style="list-style-type: none"> • Intersection • Non Intersection <p>9. Maintenance / General Works</p> <ul style="list-style-type: none"> • Surface condition (flushing etc) • Shoulder condition (edgebreak etc) • Side slopes • Clear Zones (maintenance of hazards) • Vegetation • Guard railing • Drainage • Pavement Marking • Traffic Signs <p>10. Maintenance / signs and markings</p> <ul style="list-style-type: none"> • Pavement markings • RRPMS • Edge marker posts • Signs <p>11. Road works</p> <ul style="list-style-type: none"> • Sign condition/suitability • Sign layout • Overall standard of temporary traffic control • Pavement surface condition <p>12. Others: special</p> |
|--|--|

APPENDIX 7
Report Format Proforma

Report No. RA 97/597S

File No.

TRANSFUND NEW ZEALAND
SAFETY AUDIT OF EXISTING ROADS
PROFORMA REPORT
(BLACK STUMP DISTRICT COUNCIL)

Prepared By:
T. Leader, Opus International Consultants, Limited

Reviewed By:
Safety Audit Manager

Approved By:
Review and Audit Manager

Date

DISCLAIMER FOR DRAFT REPORTS

Disclaimer

This is a draft report and it is subject to change. It has been prepared in the discharge of Transfund New Zealand's legal responsibility to audit the performance of *[local authorities against regional programmes and district roading programmes/Transit New Zealand against its state highways programme].

The findings, opinions and recommendations in the report are based on an examination of a sample only, and may not address all issues existing at the time of the audit. The report may also deal with technical matters. So readers are urged to seek specific advice on particular matters and not to rely solely on the report.

While every effort has been made to ensure the accuracy of the report, it is made available strictly on the basis that anyone relying on it does so at their own risk without any liability to Transfund New Zealand.

DISCLAIMER FOR FINAL REPORTS

Disclaimer

This is a final report. It has been prepared in the discharge of Transfund New Zealand's legal responsibility to audit the performance of *[local authorities against regional programmes and district roading programmes/Transit New Zealand against its state highways programme]. A draft of the report was referred to *[*name of District/City Council being audited*] for comment.

The findings, opinions and recommendations in the report are based on an examination of a sample only, and may not address all issues existing at the time of the audit. The report may also deal with technical matters. So readers are urged to seek specific advice on particular matters and not to rely solely on the report.

While every effort has been made to ensure the accuracy of the report, it is made available strictly on the basis that anyone relying on it does so at their own risk without any liability to Transfund New Zealand.

EXECUTIVE SUMMARY

This report presents the findings of an audit of a selection of roads in (Black Stump District) undertaken by a Transfund New Zealand Safety Audit Team. The purpose of the audit is to identify issues and suggest recommendations that will contribute to increasing road safety in the district.

The audit of the network was undertaken between (Monday, 1 September 1997 and Wednesday, 3 September 1997). It followed the procedure described in the Transfund New Zealand 'Safety Audits on Existing Roads' January 1998.

It was agreed that the team should audit selected lengths of various roads as typical examples of road hierarchy, condition and environment in the district. Approximately (120 km, 10.0% of the 1,200 km) of sealed roads in the district were surveyed.

Safety problems highlighted by the audit team should enable a remedial treatment programme to be prepared. It will also enable further safety studies and strategies to be implemented over wider areas of the roading network than those inspected during the Audit.

The Safety Audit identified (***) urgent crash risks, (***) high crash risks, (***) medium crash risks and (***) low crash risks.

General: *(A single paragraph summary of the districts safety).* Overall the team felt that the roads in (Black Stump) District were generally in *(poor to excellent)* condition. The observations made are further improvements that may be considered to maximise safety in the District and to provide target areas for improvement.

Good points: The team listed the following good points.

(List good points and examples identified in the District)

Aspects which could be improved: The team listed the following points that they felt would improve road safety:

- (1. List items that could be improved in the district.)*
- (2. List items that could be improved for national consistency and national policy.)*

General observations identified throughout the district are discussed in section 5. These are intended as a general measure of safety and maintenance throughout the district and are to be reported to the Transfund New Zealand Board as part of its review and audit function.

Specific observations identified along each route are discussed in the Appendices of this report. These are intended for the specific use of the Council to review findings of the Audit team. Re-occurring observations listed in the appendices are used to justify general recommendations in Section 5. However there are also isolated observations listed in the appendices that have not been included in Section 5. A district safety management strategy would be useful to prioritise work and monitor progress of the implementation of improvements.

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1. INTRODUCTION
2. OBJECTIVE
3. METHODOLOGY
4. ROUTE DESCRIPTIONS
5. SAFETY AUDIT FINDINGS: GENERAL
6. RECOMMENDATIONS
7. AUDIT TEAM STATEMENT

APPENDICES: SAFETY AUDIT FINDINGS: SPECIFIC ROUTES

APPENDIX A:	First Road, from <i>(A to B)</i>
APPENDIX B:	Second Road, from <i>(A to B)</i>
APPENDIX C:	Third Road, from <i>(A to B)</i>
APPENDIX D:	Fourth Road, from <i>(A to B)</i>
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APPENDIX F:	Beta Road, from <i>(A to B)</i>
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APPENDIX I:	Tua Road, from <i>(A to B)</i>

ABBREVIATIONS

RCA	Road Controlling Authority
SH	State highway

1. INTRODUCTION

This safety audit of (Black Stump District Council) was undertaken using the ‘Safety Audit Procedures for Existing Roads’ (February 1998). The procedures, developed for Transfund New Zealand Review and Audit Division, provide a method of undertaking a peer review of safety features on an existing road network. It is recommended that the findings of the report be used to assess the remainder of the (Black Stump District) Network.

2. OBJECTIVE

The objectives of a safety audit of existing roads are :

- to identify potential safety problems for road users and others
- to ensure that measures to eliminate or reduce the identified problems are considered fully by the RCA
- to seek consistency across the nations total network and influence policy weaknesses.

A safety audit will :

- help minimise the risk and severity of crashes that may be attributed to the existing road conditions
- optimise whole of life maintenance and operation benefits for road network
- improve the awareness of safe maintenance practices
- help Transfund determine the effectiveness of its resource allocation for the provision of a safe and efficient roading network
- identify, primarily from a road users perspective, those issues and features which give misleading or confusing messages.

A safety audit is not a technical or financial audit. It highlights safety concerns identified by the team.

The audit will provide general recommendations on overall safety problems. However, in some cases the team may identify and comment on specific problems and also on positive aspects of the network audited.

3. METHODOLOGY

This audit was undertaken in terms of Transfund New Zealand 'Safety Audit Procedures for Existing Roads', December 1998.

The team members for the audit were:

- (T. Leader)
(Opus International Consultants)
(Team Leader)
- (S Member)
(Beca Carter Hollings & Ferner Ltd)
(Second Team Member)
- (A Manager) Roothing Manager
Similar District Council
(independent RCA team member)

(A. Person) (Black Stump District Council), accompanied and assisted the team for the duration of the audit.

(List other personnel involved with the audit).

The audit of the network was undertaken between (Monday 1 September 1997 and Wednesday 3 September 1997).

The Audit Team held an exit meeting with the following representatives from the (Black Stump District Council) on (Wednesday 3 September 1997):

- A Bluff, Councillor
- D Pipe, Civil Division Manager
- P Hole, Roothing Manager

Because of the extent of road network in the district, it was agreed by the team to audit selected lengths of various road types and hierarchies as typical samples of road condition and environment in the district. Recommendations identified for the sample sections of road types and hierarchies may be developed and applied across the district.

Approximately (120 km 10% of the 1,200 km) of sealed roads in the district were audited.

Refer to routes selected in Section 4.

As per the safety audit procedures, each road section was driven in each direction at normal speed to identify possible safety concerns. A third drive-over was used to investigate identified concerns in detail. Each road inspected on days 1 and 2 was driven in at least on direction at night (Routes studies on Day 3 were not inspected at night).

Non-local drivers were used to driver over each section to provide a fresh pair of eyes on unfamiliar roads.

General observations were also made by the team when driving over sections of the roading network that were not included in the sample to confirm that recommendations identified for the selected routes may benefit when applied to the whole District.

It is important to note that the process is not used to identify every deficiency on a section of road, but to identify patterns that may require improvement through changes to local or national policy or additional priority for funding towards areas of concern. Specific problems at some locations have also been identified and discussed.

Section 6.0 of this report will provide an overview of the team's opinion on general traffic safety problems in the district. This section may be used by (Black Stump District Council) to consider appropriate plans and solutions for the problems. The Appendices discuss specific items identified on a route by route basis.

Recommendations for identified problems have been annotated with risk and priority codes as defined below:

Recommendations for identified problems have been annotated with risk¹ as defined below:

Table 1: Risk Level			
	Hazard Probability		
Likely Crash Severity	Frequent	Occasional	Improbable
Fatal	Urgent	High	Medium
Serious	High	Medium	Low
Minor	Medium	Low	Low

Table 2: Hazard Probability	
Probability	Description
Frequent	Likely to occur frequently (less than once per year)
Occasional	Likely to occur at some time (once every 1 - 5 years)
Improbable	Unlikely that the occurrence may ever be experienced

The Safety Audit identified:

- xxx general items that rated urgent crash risk
- xxx items that rated high crash risk
- xxx general items that rated medium crash risk
- xxx general items that rated low crash risk

¹ Risk codes are determined as in Appendix 5 of the Safety Audit Procedures.

(Insert map of District showing routes inspected)

Figure 1: Inspection Routes

4. ROUTE DESCRIPTIONS

The following selected routes were investigated during the three day safety audit.

Appendix	Route Name	Hierarchy	AADT	Seal Width (m)	Length (km)	Notes
Day 1						
A	First Road (A to B)	Collector	895	6.0	15.37	Tourist route
B	Second Road (A to B)	Collector	931	6.0	17.0	
C	Third Road (A to B)	Local	485	6.00	9.53	
D	Fourth Road (A to B)	CBD Arterial		7.5 - 12.0	2.00	Heavy transport route
Day 2						
E	Alpha Road (A to B)	Arterial	5603 2976	7.0 - 9.5	16.8	High traffic growth
F	Betta Road (A to B)	Collector	1068	6.5	21.06	Revoked SH
G	Gamma Road (A to B)	Collector	294	6.0	10.77	Tourist route
Day 3						
H	Rua Road (A to B)	Collector	5711	8.0	12.6	Day inspection only
I	Tua Road (A to B)	Collector	1740	9.3 - 6.0	11.7	Day inspection only

5. SAFETY AUDIT FINDINGS: GENERAL

Based on the Routes that were audited, the following generalised observations are made. More detailed discussion on these observations is provided in the Appendices.

(General comments on audit based on the Transfund Safety Audit Manager's letter to the Road Controlling Authority following the exit meeting).

(Overall the roads were in a safe condition. The audit team generally identified features that could be further improved to maximise safety in the district. It is recommended that the findings identified will assist the district council in prioritising future improvements).

The team noted the following safety features during the inspections:

(Use the *General Findings Prompt List* in Appendix 6 of the Procedures, for paragraph headings. The headings have been adopted directly from the rural and urban safety audit checklist. Some items may be identified additional to the attached sheets. These should be included either in Section 12 'other' or in a closely related topic. The appendices containing the specific route findings will duplicate these issues, and dependent on the audience for the report these items could be deleted from the appendices.)

Examples of report format are provided below:-

5.2 DELINEATION STANDARDS

5.2.1 CURVE WARNING SIGNS

Poor application and location of curve warning signs and chevrons were identified on every route inspected. Common features included:

- Incorrect or no advisory speeds.
- Incorrect location of warning signs.
- Variable sizes of warning signs and chevrons.
- Chevron boards mounted too high.
- Old black and white warning signs.
- Incorrect application of chevron signs.

Examples:

- First road 200m south of SH 1
- First road 400m south of SH 1
- Second road 1 km west of Harbour Road

Recommendation

- *Review curve warning, advisory speed and chevron board application throughout the district.*
- *Upgrade curve warning signs as appropriate.*

Risk: Medium.

5.2.2 DESTINATION SIGNS

The consistent level of designation signs and road name signs throughout the district was very sound. All signs appeared to be appropriate, well sited, with consistent quality and excellent reflectivity.

The audit team notes and commends the recent programme undertaken by the Council to improve destination and road name signs throughout the district.

5.2.3 HAZARD MARKINGS

On a number of the routes inspected, power poles were located within 9m trafficable distance of the traffic zone. The audit team estimates approximately 5-10% of power poles on road reserve have a reasonable probability of being hit by a loss of control vehicle.

Examples were observed on:

- First Road;
- Gamma Road; and
- Rua Road.

Recommendation

Install appropriate hazard marking delineators on power poles within 9m trafficable distance of the roadway.

Risk: Medium.

5.2.4 BRIDGE END MARKERS

Throughout the region, bridges with guardrails do not generally have bridge end markers.

The Transit New Zealand Manual states that it is optional for bridges with guardrails to have bridge end markers.

Generally, levels of edge delineation on the State highway are very high. However, throughout the region, bridge end markers are not provided on bridges with guardrails. It was noted during the night inspections that the bridges without bridge end markers or delineation posts were very dark and poorly delineated in comparison with the approaches.

It is the Audit Team's view that bridge end markers should be used to delineate the extent of the road narrowing, regardless of whether a bridge is guardrailed or not.

It is also the Team's observation that as guard rail ages, it oxidises and loses its reflective properties.

The Team also noted a number of bridges without guardrails that had either no bridge end markers, or inadequate bridge end markers.

Examples:

- First Road Traceys Bridge
- Fourth Road Williams Bridge
- Alpha Road Whangae Bridge

Recommendation

Consider preparing a policy and a programme to install bridge end markers on all bridges in the region, particularly those with seal widths that are less than that of the approaches.

Consider upgrading delineation of longer bridges by installing reflective strips or edge marker posts along their length.

Transfund New Zealand Safety Audit Manager to approach Transit New Zealand Head Office regarding clarification of the existing policy on bridge end markers, particularly in light of delineation on the rest of the State Highway Network.

Risk: Medium.

5.2.5 EDGE MARKER POSTS

Although roadside edge marker posts have been installed on a number of the roads inspected, some of the earlier installations failed to fully delineate the curvature of the road. It was observed that edge marker posts along some routes were poorly maintained and had not been replaced when knocked over.

It is noted that the council has commenced an upgrading programme for edge marker posts throughout the region. Routes with recently installed edge marker posts were very good.

Examples:

- First Road;
- Third Road; and
- Alpha Road

Recommendations

- A. *Continue an upgrading programme for installing edge marker posts on priority routes.*
- B. *Install edge marker posts as per the correct standards.*
- C. *Maintain edge marker posts to the correct standard.*

Risk: Medium.

6. RECOMMENDATIONS

Based on observations made in the Audit Report, the Safety Audit Team recommends the following safety improvements.

Local Authority (Local Improvements):

1. (Develop and apply consistent standards along road routes based on its hierarchy and predicted level of service).
2. (Review the district's strategy for implementing guide and tourism signs, upgrade the signs to comply with the Transit New Zealand Manual of Traffic Signs and Markings and match into Transit New Zealand Strategy for Guide Signs).
3. (Review the application of curve warning signs within the district to comply with Transit New Zealand Manual of Traffic Signs and Markings).
4. (Ensure that a consistent level of delineation is achieved along a route (depending on its hierarchy) and that new projects provide a level of delineation that at last matches that of the approach road).

Transfund New Zealand (National Improvements):

1. (Review a national policy of road side clear zones).
2. (Review a national policy for delineation on bridges with guardrails).

7. AUDIT TEAM STATEMENT

The Safety Audit was undertaken to provide an overview of safety issues within the (Black Stump District). The team does not guarantee to have identified all of the safety issues relating to the sections of road surveyed.

The Audit Team has surveyed only a sample of roads within the District, but anticipates that the findings and recommendations may be appropriate throughout the whole District.

The Safety Audit Team has endeavoured to identify features of the (Black Stump) District Council Roads that could be removed or modified in order to improve safety. The problems identified have been noted in this report, together with the recommendations which should be studied for implementation.

Signed: Date:.....
T. Leader, Senior Traffic Engineer, Opus International Consultants

Signed: Date:.....
T. Member, Senior Roading Engineer, Beca Carter Hollings & Ferner Ltd

Signed: Date:.....
A. Manager, Similar District Council

APPENDICES A - I
Safety Audit Findings: Specific Routes

APPENDIX A
Specific Route First Road (from A to B)

APPENDIX A

SPECIFIC ROUTE: First Road (From A to B)

Refer to Photographs A1 and A2.

First Road is a collector road surveyed from A Road to B, a total length of 15.37 km. Distances in brackets () are measured from A Road.

Traffic volumes along the route were 895 vehicles per day.

The road carries a high number of non local motorist during the summer months as it provides access to a popular estuary and the beach.

Seal width along the route averaged 6.0m.

Delineation

Delineation along the route was generally good for the road function and use. However from South of Dyke Road where the road follows the estuary (10.6) to (14.3) the outside curves adjacent to the estuary have little background definition.

Refer to Photographs A1 and A2.

Recommendation:

Upgrade edge marker posts along this section of road to State Highway standard. Consider installing an edge line on the Estuary side of the road.

Risk: Medium.

Isolated curves requiring additional delineation include:

- Port Hill lookout (14.5)
- Nth of Dyke Road (5.8)
- Curve at 3.64 km west of Brown Road (3.64)

Recommendation:

Upgrade as necessary

Risk: Medium.

Road Side Hazards: Bridges & Culverts

Refer to Photograph A2.

A number of bridges and culverts along the route were poorly delineated. Examples include:

- Bridge markers too high at (2.25)
- Low culvert head walls at (4.4), (8.26), (9.68), (10.49)
- Bridge end markers required at (12.9) and (11.96).

Recommendation

Delineate bridges and culverts with bridge end markers.

Risk: Medium.

Curve Warning Signs

There is no inconsistent application of curve warning signs and chevrons along the route.

Examples include:

- a) Speed advisory required
(1.37)
- b) Speed advisory sign incorrectly placed could require full chevron board
(3.64)
- c) Signs conflict with alignment, advisory speeds required, full chevrons required.
(5.8)

Recommendation:

Review application of curve warning signs and chevrons along route and upgrade as necessary.

Risk: Low.

Metal and Debris on Road Surface

A number of sites along the route were observed with loose material on the road surface.

Examples include:

- a) Brown Store Road (0.0)
- b) Dyke Road
- c) Debris in water table (12.5)

Recommendation

Ensure regular maintenance of sites where metal migration or debris occurs. Consider sealing side roads to prevent migration.

Risk: Medium.

PHOTO

PHOTO