

Road classifications, geometric designs and maintenance standards for low volume roads

George Giummarra



Research Report ARR354

Road classifications, geometric designs and maintenance standards for low volume roads

George Giummarra

Based on work carried out for the
Department of Natural Resources and Environment
and Parks Victoria

ARRB Transport Research Ltd
Research Report ARR 354
September 2001

Information Retrieval

GIUMMARRA, G. (2001) ROAD CLASSIFICATIONS, GEOMETRIC DESIGNS AND MAINTENANCE STANDARDS FOR LOW VOLUME ROADS. ARRB Transport Research Ltd, Vermont South, Victoria. Research Report ARR 354. 48 pages including 20 photographs, two figures and 13 tables.

ARRB Transport Research was engaged by the Department of Natural Resources and Environment (NRE) and Parks Victoria to: review the existing road classification systems used by NRE and Parks Victoria for low volume roads, confirm or modify the existing road classification, establish geometric design standards together with appropriate maintenance criteria for both sealed and unsealed roads, and establish procedures to monitor the performance of road conditions for the various road types.

This report provides notes on the development of guidelines for: a road classification system; geometric design guideline standards for each road classification; maintenance criteria and field assessment guidelines for sealed and unsealed roads; and maintenance intervention levels for each road classification and type.

The guidelines have been developed in close consultation with officers from NRE and Parks Victoria. They have been developed with the aim of obtaining consistency in their application across the road network throughout Victoria and to serve as a basis for any development of a common road asset management system.

A review of existing road classification systems in various road authorities, both in Australia and overseas, was undertaken. The classification systems adopted by various road authorities for unsealed roads together with assigned geometric design standards are summarised as appendices, as are detailed descriptions of the Austroads Functional Classifications, and details of the proposed road classification system.

ARR 354
SEPTEMBER 2001

ISBN 1 876592 21 4
ISSN 0158-0728

Any material may be reproduced without permission provided the source is acknowledged.

Although the Report is believed to be correct at the time of publication, ARRB Transport Research Limited, to the extent lawful, excludes all liability for loss (whether arising under contract, tort, statute or otherwise) arising from the contents of the Report or from its use. Where such liability cannot be excluded, it is reduced to the full extent lawful. Without limiting the foregoing, people should apply their own skill and judgement when using the information contained in the Report.

Wholly prepared and printed by ARRB Transport Research Ltd
500 Burwood Highway
Vermont South VIC 3133
AUSTRALIA

About the author

George Giummarra

George's work experience has extended across a wide range of engineering activities including transport planning, road design, construction, research and traffic engineering. Much of George's work, before beginning at ARRB TR, was associated with VicRoads and its predecessors, and on secondment to a Local Government planning authority.

At ARRB TR, George has been responsible for the establishment of research programs and technology transfer activities for Local Government and other agencies associated with local roads across Australia and overseas.

George was appointed ARRB TR's Local Roads Director in 1998, responsible for the establishment and delivery of a research program and technology transfer activities for Local Government and other agencies associated with local roads across Australia and overseas. This included successful marketing,

selling products and services and delivery of projects to agreed financial targets in often commercially competitive fields. George has been successful in providing a number of projects aimed directly at meeting the needs of authorities and agencies with responsibility for the maintenance of local roads.

Acknowledgement

The proposed road classifications have been developed in close consultation with various officers from NRE and Parks Victoria during the course of the review. The principle contacts were Mr Ross Potter, NRE, and Mr Andrew McCutcheon, Parks Victoria.

A CD version of this report is available with MS Word 97 and pdf files to facilitate use of the road classification tables.

Contact: Saleable Publications,
ARRB Transport Research Ltd,
phone 61 3 9881 1547,
fax 61 3 9887 8144.

ARR 354

Road classifications, geometric designs and maintenance standards for low volume roads

Contents

EXECUTIVE SUMMARY	v
1. Introduction	1
2. Proposed Road Classification System	1
3. Development of Guidelines to Geometric Design Standards	3
3.1 Terrain Considerations	3
3.2 Design Speed	3
3.3 Sight Distance Requirements	4
3.4 Vertical Grades	5
3.5 Vertical Curves	5
3.6 Cross Section Elements	6
4. Maintenance Criteria	7
5. Maintenance Intervention Levels	8
6. References & Bibliography	9
7. Glossary	10
Appendix A Comparison of Unsealed Road Classifications and Geometric Design Standards	11
Appendix B NAASRA Functional Road Classification*	13
Appendix C Proposed Road Classification System	14
Appendix D Guidelines to the Main Geometric Design Standards	15
Appendix E Road Maintenance Assessment Guide – Sealed Roads	17
Appendix F Road Maintenance Assessment Guide – Unsealed Roads	20
Appendix G Maintenance Intervention Levels for Unsealed & Sealed Rds	23
Appendix H1 Road Maintenance Work Sheet – Class: 5A Primary Road - Sealed Road	25
Appendix H2 Road Maintenance Work Sheet – Class: 5B Secondary Road - Sealed Road	27
Appendix H3 Road Maintenance Work Sheet – Class: 5A Primary Road - Unsealed Roads	29
Appendix H4 Road Maintenance Work Sheet – Class: 5B Secondary Road - Unsealed Road	31
Appendix H5 Road Maintenance Work Sheet – Class: 5C Minor Road - Unsealed Road	33
Appendix H6 Road Maintenance Work Sheet – Class: 5D Access Road/Track - Unsealed Road	35
Appendix I Typical Photographs of the Various Road Classes	37
Typical Road Defects (Source: Austroads 1987)	41

**ARRB Transport
Research Ltd**

ACN 004 620 651
ABN 68 004 620 651

HEAD OFFICE:

500 Burwood Highway
Vermont South
VIC 3133
AUSTRALIA
Tel: (03) 9881 1555
Fax: (03) 9887 8104
Email: info@arrb.org.au
Internet: www.arrb.com.au

PERTH OFFICE:

191 Carr Place
Leederville
WA 6007
PO Box 512
Leederville
WA 6903
AUSTRALIA
Tel: (08) 9227 3000
Fax: (08) 9227 3030
Email: arrbtr.wa@arrb.com.au

ARR 354

Road classifications, geometric designs and maintenance standards for low volume roads

Executive Summary

There is currently little information available to determine classification, geometric design and maintenance standards for low volume roads. The Department of Natural Resources and Environment (NRE) and Parks Victoria are responsible for significant lengths of low volume road and therefore commissioned ARRB Transport Research to:

- review the existing road classification systems used by NRE and Parks Victoria
- confirm or modify the existing road classification systems
- establish geometric design standards
- establish procedures to monitor the performance of road conditions.

This report provides notes on the development of guidelines for:

- a Road Classification System
- geometric Design Guideline Standards for each road classification
- maintenance criteria and field assessment guidelines for sealed and unsealed roads
- maintenance intervention levels for each road classification and type.

The guidelines have been developed in close consultation with officers from NRE and Parks Victoria. They have been developed with the aim of obtaining consistency in their application across the road network throughout Victoria and to serve as a basis for any development of a common road asset management system. While these guidelines were developed to NRE and Parks Victoria requirements, other authorities or agencies may elect to use the guidelines at their own discretion.

Guidelines for both the geometric standards and maintenance criteria are based on the main features that should be taken into account in the management of the road network. Additional items can be added to reflect local conditions, and details of these can be found in the various references listed.

In the development of the various guidelines care has been taken to adapt current roadway practices to the special requirements of low volume roads that predominate in NRE and Parks Victoria assets. The guidelines are based on appropriate experiences and reflect current practices.

It is desirable that the guidelines are trialed over a period to better evaluate their appropriateness and that they then be modified, if necessary, to better accord with desired outcomes. Although carried out for NRE and Parks Victoria the report will be of interest to other organisations concerned with managing low volume roads.

1. Introduction

There is currently little information available to determine classification, geometric design and maintenance standards for low volume roads. The Department of Natural Resources and Environment (NRE) and Parks Victoria are responsible for significant lengths of low volume road and therefore commissioned ARRB Transport Research Ltd to:

- Review the existing road classification systems used by NRE and Parks Victoria and compare them with systems used by State and Local Government and other road authorities, particularly in forested and rural areas.
- Confirm or modify the existing road classification systems to arrive at a more suitable system for NRE and Parks Victoria that will ensure consistency in the management of the road network across the range of roads on all crown land.
- Establish geometric design standards together with appropriate maintenance criteria for both sealed and unsealed roads.
- Establish procedures to monitor the performance of road conditions for the various road types and appropriate intervention levels to set priorities for scheduling road maintenance works.

This report establishes:

- A proposed Road Classification System;
- Guidelines for appropriate Geometric Design Standards for each road class;
- Maintenance criteria for sealed and unsealed roads; and
- Maintenance intervention levels for each road classification and type.

Although carried out for NRE and Parks Victoria the report will be of interest to other organisations concerned with managing low volume roads.

2. Proposed Road Classification System

A review of existing road classification systems in various road authorities, both in Australia and overseas, was undertaken. The classification systems adopted by various road authorities for unsealed roads together with assigned geometric design standards are summarised in Appendix A.

Roads in general fall into a hierarchy of functional classes ranging from major arterial to local access. Austroads (1989) defined a system of functional classifications for both urban and rural roads. In the case of roads found in NRE and Parks Victoria these are considered to fall predominantly into the Rural Class 5 category although there are some notable exceptions, eg Lakeside Drive in Albert Park (Class 6) and Black Mountain Road in the Alpine National Park (Class 4). For these unusual cases the classification description and geometric standard are readily found in Austroads (1989).

The vast majority of the roads fall into Rural Class 5 roads and are defined as 'Those roads, which provide almost exclusively for one activity or function which, cannot be assigned Classes 1 to 4'. Detailed descriptions of the Austroads Functional Classifications are given in Appendix B.

It is considered that a functional based classification system should be adopted based on the Austroads classification system to comply with classifications systems adopted by State and Local Government road authorities throughout Australia. Within the Austroads Class 5 the proposed road classifications, have been further subdivided into five categories as listed. The prefix 5 is added to link to the national road classification system, as roads are predominantly Class 5. The details of the proposed road classification system are shown in Appendix C.

Road Class	Class Type
• 5A	Primary
• 5B	Secondary
• 5C	Minor
• 5D	Access
• 5E	Tracks

With each road classification a daily traffic volume has been included as a guide to the range of traffic likely to be carried by each road class. This volume is expressed as the Average Daily Traffic (ADT) and represents a guide to the traffic over the peak season. Also included is a description of the road type envisaged for each road class and a comparison with current NRE and Parks Victoria road classification systems.

A schematic diagram of the various road classifications is illustrated in Figure 1. The intent of the diagram is to depict the relative function of the road classifications in terms of the main road through an area and the various collector/distributor roads. This is a generic diagram and should be adapted to suit NRE and Parks Victoria requirements.

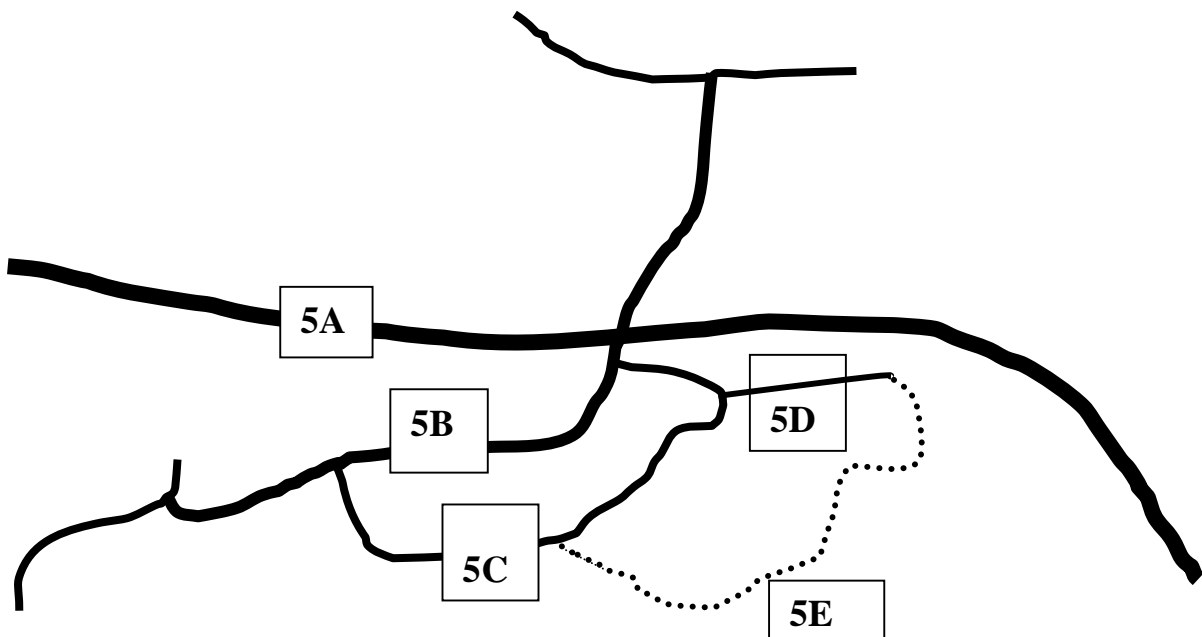


Figure 1. Schematic Diagram of Proposed Road Classification System

In the description of the road type the notion of a *quality of service* has been included to highlight the characteristic of the road class, which could be linked to the levels of service assigned by Parks Victoria to various visitor sites. The quality of service is a qualitative term based on the concept of providing varying levels of convenience, comfort and safety to a driver. Convenience can be associated with the travel time taken for a journey, (ie travel speed) comfort can be associate with ride quality (ie road profile), and safety related to the consistency of road standards (ie no surprises).

3. Development of Guidelines to Geometric Design Standards

The geometric design standards for a road are considered to be governed by the function of the road, traffic volumes and vehicle type, terrain, environmental issues and cost considerations. Ideally a compatible cross section, horizontal and vertical alignment is required which will provide users with an adequate quality of service in terms of ride comfort, convenience and a safe facility.

The geometric design of low volume roads presents special challenges requiring the application of common road engineering practices to a lower cost facility that serves only a small number of vehicles, often in sensitive environmental conditions and with constrained budgets. The design has to provide a road, which can cater for large vehicles, recognise the safety of all road users, and be accomplished at minimal cost. This requires a unique and flexible approach, without overturning the principles of roadway engineering.

Guidelines to the geometric design standards for each road class are given in Appendix D. The standards are based on the main design components for varying terrain types, namely, flat, rolling and mountainous. It should be noted that they are based on the roadway engineering principles with applied engineering judgement to arrive at practical and reasonable standards relating to a range of low volume roads. In determining a geometric design standard eg. horizontal radius, it has been necessary to select an appropriate value for coefficient of friction, response time etc from a range of values.

Details of the engineering principles applied are found in the references listed. The values given have also taken into consideration the views of various officers from NRE and Parks Victoria during the development of the guidelines.

The notes below outline the main geometric design considerations used in arriving at the various values given in Appendix D.

3.1 Terrain Considerations

A simple classification of 'flat', 'rolling' and 'mountainous' terrain descriptions has been adopted as a basis for specifying appropriate geometric standards. The definition of each can be described in general terms as follows:

- **Flat terrain** – based on 0 – 10 five-meter contours per kilometre. Roads generally follow the ground contours. Typical gradients being up to 1: 20 or 5% (3 degrees).
- **Rolling terrain** – based on 11 – 25 five-meter ground contours per kilometre. Roads can have substantial cuts and fills. Typical gradients being up to 1: 20 to 1:8 or 5-12.5% (3-7 degrees).
- **Mountainous terrain** – based on more than 25 five-meter contours per kilometre. Roads in rugged hilly or mountainous ground with substantial restrictions to both horizontal and vertical alignments. Typical gradients being > 1:8 or > 12.5% (7 degrees).

3.2 Design Speed

One of the most important features in arriving at design standards for roads is the selection of an appropriate design speed. Once selected the pertinent geometric features, including sight distance, horizontal and vertical alignments requirements are determined in order to obtain a balanced design.

The design speed ultimately determines the capital and maintenance costs of a road as well as the quality of the service provided in terms of user costs. To provide the most economical road design a detailed analysis is required which takes into account construction, maintenance and road user costs and benefits. This has not been undertaken in the establishment of the standards presented as it was

not included as part of the contract. The values used in this report are based on several Australian and overseas studies relating to low volume roads and practical experiences.

The design speed adopted should be commensurate with the topography, (the main factor) adjacent land use, function of the road and type. Every effort should be made to use as high a design speed as practicable to attain the desired degree of safety, comfort and convenience while under the constraints of economics, environmental and aesthetics requirements. In the Metropolitan area and in some parks the objective may be to set an appropriate speed, which may be well below the geometric design speed capability of the road, for environmental reasons, amenity of site users and safety. In such cases appropriate signs could be necessary to control speed to the desired level.

The design speed selected should be consistent with the speed a driver is likely to expect. In most cases the 85th percentile speed has been adopted. Lower design speeds are not always appropriate, as drivers do not adjust their speeds to the notional classification of the road but to its physical characteristics and traffic. Selecting lower design speeds where terrain is open and flat is likely to produce an accident prone and uneconomical road design. Where lower speeds are required to the design speed then this will need to be enforced by the use of signs and traffic slowing devices, such as road humps. However, under difficult terrain conditions, drivers will accept lower speeds.

Once the design speed has been selected all the pertinent features of the road alignment should be used to obtain a balanced design. Certain features, such as curves radius, super-elevation, and sight distances are directly related to the design speed adopted.

Lower design speeds are appropriate for rolling and mountainous terrain because of horizontal and vertical constraints. Higher design speeds are appropriate in flat terrain where horizontal and vertical geometry requirements may be attained without an appreciable increase in construction costs.

Ideally the design speed should be continuous throughout the length of the route. If this cannot be maintained because of physical or economic reasons, consideration should be given to actions that will alert a driver to a change in travel speeds, possibly with the use of transition zones and/or appropriate warning signs.

3.3 Sight Distance Requirements

A principal aim in road design is to ensure that a driver is able to see any possible hazards on the road in sufficient time to avoid a mishap. To help calculate this requirement the term *stopping sight distance* has been used.

Details on the basis of the sight calculations are given in Austroads (1989) and Giummarra (2000). The values provided in the Table in Appendix D are based on two of the main safety requirements. The designer should also take into account other possible requirements relating to passing, and lateral sight distances particularly at tight horizontal curves.

- **Minimum stopping sight distance (SSD)** – This is the distance required for a vehicle to stop in time to avoid hitting a fixed object on the road. This is applicable for two-lane and one-lane two-way roads.
- **Intermediate sight distance (ISD)** – This is applicable for one-lane two-way roads where enough sight distance is required for two vehicles approaching each other to stop before colliding. It is taken as twice the stopping sight distance required for a vehicle approaching a fixed object.

The values given in Appendix D are based on selected friction values appropriate for sealed and unsealed roads.

3.4 Vertical Grades

Greater maximum grades are suggested for lower class roads than for those with a higher classification. The benefits gained from reducing vehicle operating and time costs may not offset the additional construction costs of implementing minimal grades. Road user costs considerations are considered minimal in the case of recreational activities, but can become more significant for forestry operations. However, grades less than the maximum should be used wherever possible to increase the level of service and standard of operation.

Another factor to be considered in selecting grades is the resistance to soil erosion of the unsealed road surface material and that in the adjacent table drains.

3.5 Vertical Curves

Crest and sag vertical curves for low volume roads should be based on the minimum stopping sight distance. The calculations are based on a driver height of 1.15 m and a fixed object height of 0.2 m. This is considered to provide an appropriate basis for low volume roads where there may be an absence of continuous maintenance and a likelihood of a vehicle having to stop for a fixed object such as logs, washouts etc. The values in Appendix D allow for vertical curves on two-lane two-way roads based on providing minimum stopping sight distance.

On single-lane, two-way roads the values for stopping sight distance do not provide an adequate level of safety for the situation of two approaching vehicles travelling in the same lane. In this situation the stopping sight distance is required with a sight line from driver eye height to eye height. For such cases the 'K' values need to be doubled. Where this increased stopping sight distance is not available or is uneconomical to provide, an alternative is to widen the road (by about 3 m) to form a two-way road over the length of the vertical curve to allow oncoming vehicles greater manoeuvring space to take evasive action.

For sag curves, on low volume roads, the design is based on comfort control criterion.

3.6 Cross Section Elements

The main elements of a road cross section, for both a sealed and unsealed road, are shown in Figure 2.

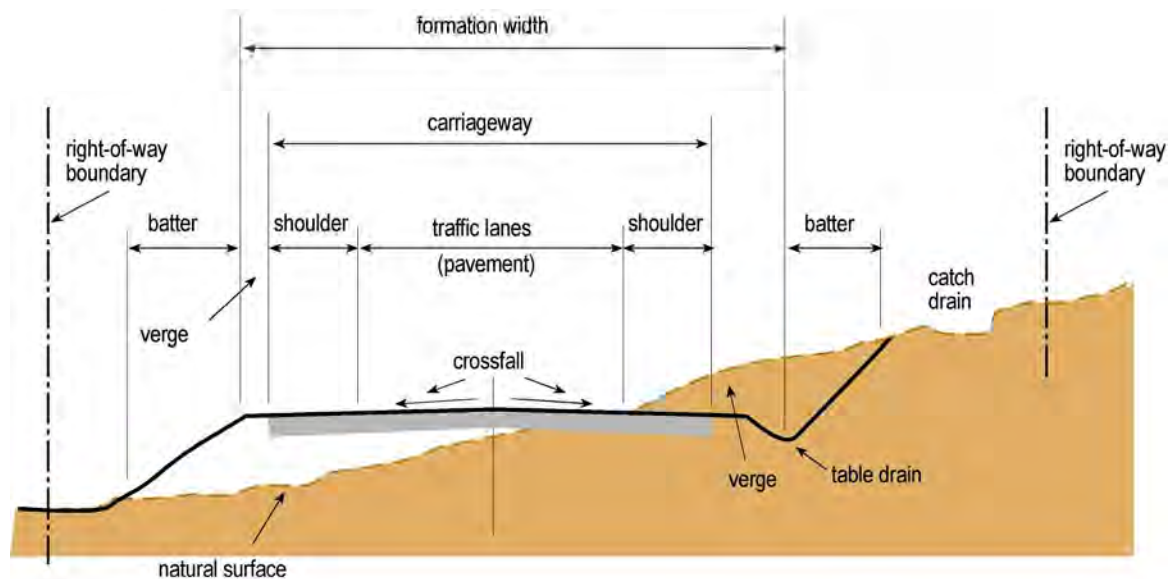


Figure 2. Road Cross Section Elements (Source Austroads 1989)

Roadway widths are normally based on the function of a road, traffic volume, traffic mix, design speed and surface type. The widths shown in Appendix D for each road class satisfy the safety requirements of opposing vehicles. They do not provide for emergency and leisure stops because the frequency of traffic conflicts on low volume roads associated with stopped vehicles does not justify additional width for sheltering. Locations where there is such a requirement will need to be considered separately.

High truck volumes can influence roadway widths on two-lane two way unsealed roads. On these roads, vehicles tend to travel along the centre line of the roadway as drivers shy away from the edge. To allow for the safe passage of opposing vehicles, the overall roadway width given in Appendix D could be increased by 0.5 m for roads carrying truck traffic over 20% of ADT.

In some cases provision for curve widening on tight curves will be necessary to allow for the tracking of large vehicles. These requirements can be found in the Unsealed Roads Manual (Giummarra 2000).

Due to economic considerations and very low traffic volumes one-lane two-way roads can be provided with roadway widths of 4 m. This limits the road to a one-lane facility and turnouts, or layover areas may be necessary for opposing vehicles to pass. Layover lanes should desirably be intervisible and a maximum distance between layovers should be in the order of 300 m. This spacing may be increased for eg. forest roads if the vehicles using the road are equipped with two-way radio communications.

In the case of a sealed single lane, two-way road it is desirable that the road shoulders are constructed from material suitable for carrying vehicles both in dry and wet weather. A traffic lane width of less than 3.5 m can result in excessive shoulder wear. A width greater than 4.5 m but less than 6.0 m may lead to vehicles trying to pass with each remaining on the lane. A width of 3.5 m ensures that one or both vehicles must have the outer wheels on the shoulder when passing.

For unsealed roads the traffic lanes and shoulders are all considered as part of the traveled way or carriageway as there is no distinction to the driver. Carriageway widths should be selected for either a

two or single lane operation as in between widths will result in the ‘three wheel’ effect causing extra wear on the road crown.

4. Maintenance Criteria

The main maintenance criteria for both sealed and unsealed road pavements are given in Table 1 below. These are based on three key performance criteria of safety, serviceability and structural requirements and a priority listing for data collection requirements. Table 2 lists the other main roadside factors outside of the pavement that require maintenance attention.

Table 1. Maintenance Criteria for Pavements

<i>Sealed Road</i>			<i>Unsealed Roads</i>		
Type of Issue	Road Condition Key Defect	Priority Group	Type of Issue	Road Condition Key Defect	Priority Group
Safety	Edge Defect	1	Safety	Rutting	1
Safety	Edge break	2	Safety	Loose material	1
Safety	Rutting	2	Serviceability	Corrugations	2
Structural Capacity	Cracking	1	Serviceability	Channels or scouring	2
Serviceability	Roughness	2	Serviceability	Course texture or roughness	2
Serviceability	Potholes & patches	2	Serviceability	Potholes	3
Structural Capacity	Shoving	3	Structural Capacity	Gravel depth (wearing and base course)	1

Table 2. Maintenance Criteria on Road Sides

<i>Sealed and Unsealed Roads</i>		
Type of Issue	Road Condition Key Defect	Priority
Serviceability	Table drains	2
Serviceability	Batters	2
Serviceability	Roadside vegetation	3
Structural	Culverts	1

The criteria listed in Table 1 are based on a recent review of local road conditions in Australia (Austroads 2001) and experiences as applied to low volume roads. They are included as a guide only and should be modified to best suit local conditions and the extent of resources available to collect condition data.

Road Maintenance Assessment Guide forms for sealed and unsealed roads are included in Appendices E and F respectively to guide field staff in the assessment and recording of road conditions on particular road sections.

Their purpose is help to rate and rank, in a consistent manner, the numerous road sections that make up a road network to enable the overall road conditions to be assessed. The forms can be adapted to suit each road classification to facilitate easier entry by field staff. The forms are based on both the extent and severity of a road defect. The product of each providing an overall score for that defect. For a given road section a total score of all the defects can be obtained as a basis of rating each road section and assisting in prioritising road maintenance works and preparing maintenance schedules. A different weighting factor can be applied to the total score for each road classification to reflect the relative importance of each road type.

The road defect items selected are based on those considered essential in monitoring existing road conditions and can be collected readily by visual means while driving along a road. The selected road defect and rating system suggested is an attempt to arrive at a workable set of criteria that depicts the condition of a road section without the need to collect too much data and requiring a higher use of staff resources. Further details on the various defects for both sealed and unsealed road can be found in (Austroads 1987).

These forms should be trialed over time and adjusted to ensure they suit local requirements. It is important to establish consistency in monitoring, evaluating and reporting road conditions for a central road asset management system. To obtain a 'stock take' of the overall condition of the road asset for annual budgeting purposes, an assessment should be made at least once a year.

5. Maintenance Intervention Levels

Appendix G provides, as a guide, a summary of the key maintenance intervention levels for each road class. These are based on the selection of the key defect elements for sealed and unsealed roads, mentioned in Table 1, taking into account minimal life cycle cost considerations. The intervention levels provided indicate the level of severity and extent of road (by % length) when routine maintenance should be taken and the typical actions necessary. Also given is the level of severity at which urgent or immediate maintenance action should be taken at isolated road locations.

The forms given in Appendix H1 to H6 provide suggested Road Maintenance Work Sheets and intervention levels for each road class. It is intended that these be used for the more routine day to day assessment of roads and the development of a maintenance program.

The intervention values given are based on current experiences and need to be further reviewed by NRE and Parks Victoria field staff based on user expectations and the impact on existing budget considerations.

The suggested maintenance intervention levels should be trialed for a period to establish their appropriateness and adjusted to best reflect actual field conditions. Again, consistency across the NRE and Parks Victoria field operations is most desirable in the better management of resources across the State.

To assist in the identification of defect type, Appendix I provides photographs giving examples of each Road Classification and most of the typical road defects.

6. References & Bibliography

- AUSTROADS (1987). A guide to the visual assessment of pavement condition. Austroads: Sydney.
- _____ (1989). Rural Road Design: Guide to the Geometric Design of Rural Roads. 7th edition. Austroads: Sydney
- _____ (1998). Responsibilities for Local Roads. AP 129. Austroads: Sydney
- _____ (2001) Local Road Conditions in Australia BS. A. 68 Austroads: Sydney (in progress)
- DEPARTMENT OF TRANSPORT (1989). The design, construction and maintenance of low volume rural roads and bridges in developing areas. Report No. S89.2. Prepared on behalf of South African Roads Board, CSIR, Pretoria, South Africa
- CONSERVATION and LAND MANAGEMENT (1980 ?). Extract of Policy document on roading operations and management. CALM Perth, Western Australia
- FOREST PRACTICES CODE (1993). Forestry Commission Tasmania, Hobart, Tasmania
- GIUMMARRA, G. J. (Ed) (2001). Unsealed Roads Manual: Guidelines to good practice, Revised Edition. ARRB Transport Research: Vermont South, Victoria
- _____ (1980). Development of a Road Hierarchy. Upper Yarra and Dandenong Ranges Authority. Lilydale, Victoria.
- LAY, M.G. (1981). Source Book for Australian Roads. Australian Roads Research Board: Vermont South, Victoria
- LOREN, D. E. (1998). Low-Volume Road Geometric Design Practices in the National Forests of the United States. International Symposium on Highway Geometric Design Practices pp 42 –1. TRB, Washington, D. C. USA
- LARCOMBE, C. (1999). Forest Roding Manual. Liro Forestry Solutions. Rotorua, New Zealand
- McDONALD, M., ROBINSON, R. (1995). Geometric Design of Low-Cost Roads in Developing Countries. TRB 6th International Conference on Low Volume Roads. Washington D.C., USA
- NYASULU, D. T.G. (1989). Geometric Guidelines for Developing Areas. Research Report DPVT 17. CSIR, Pretoria, South Africa.
- ROADS AND TRANSPORT ASSOCIATION OF CANADA (1986). Geometric Design Guide for Canadian Roads. Chapter H Low volume Roads. Ottawa, Canada.
- TRANSPORT RESEARCH BOARD (1999). Minimum Impact Low-Volume Roads Manual. Short Course. TRB Washington, D. C., USA.

7. Glossary

Austroads - is the association of Australian and New Zealand road transport and traffic authorities whose mission is to contribute to the development and delivery of the Australasian transport vision.

Intervention level – is a specified level of maintenance (ie depth of rutting) when reached. Work should be undertaken to rectify the defect.

‘K’ values – for vertical curves it is the length of vertical curve in metres for 1% change in grade (refer to Austroads 1989 Chapter 7 for details).

Layover – is an area set aside along a road edge to enable a vehicle to stand for an oncoming vehicle to pass. Applied on very narrow roadways.

NRM - NAASRA Roughness Measurement (counts/km) is a measure of the road profile

Road User Costs - represents the cost to the commercial road user based on the wear and tear on a vehicle, travel time costs and accident costs.

Superelevation – the banking of a road around a curve to enable vehicles to maintain speed in a safe and comfortable manner.

85th percentile desired speed - is referred to as the speed environment of a road section.

APPENDIX A

Comparison of Unsealed Road Classifications and Geometric Design Standards

Road Class	Road Name	AADT	Terrain	Minimum Design Speed kph	Lanes	Grade %	Cross fall %	Max Super %	Pav. m	Shldr- m	C'way m	Table Drain m	Verge m	Frmn- m	Curve Radius m
STATE FORESTS OF NSW															
					2				6.8	1.2	9.2	0.5	0.0	10.2	
III	Primary				2				5.5	0.9	7.3	0.5	0.0	8.3	
IV & V	Secondary				1				3.7	0.9	5.5	0.5	0.0	6.5	
IV & V	Feeder				1				3.0	0.6	4.2	0.5	0.0	5.2	
V	Harvesting				1						3.7+				
FORESTRY VIC															
		Log Trucks													
	Class 1	>24		50	2	7	5	5	6.2	1.2	8.6	0.6	0.6	9.8	60
	Class 2	8 to 24		30	1	8	5	5	3.7	1.8	7.3	0.6	0.6	8.5	30
	Class 3	<8		20	1	12.5	5	5	3.7	0.9	5.5	0.6	0.6	6.7	15
	Class 4	<8		<20	1	15	5	5	3.0	0.6	4.2	0.6	0.6	5.4	15
DEPARTMENT OF FORESTRY QLD															
	Hoop Pine Plantation Roads														
	Class A			80	2	8			7.4	1.2	9.8	1.2	0.0	11.0	350[240]
	Class B			60	1	12.5			5.5	1.2	7.9	1.2	0.0	9.1	200[120]
	Class C			40	1	14			3.7	1.0	5.7	0.0	0.0	5.7	100[50]
	Class D			----	1	25			3.0	0.6	4.2	0.0	0.0	4.2	----
ARRB TR Proposal (Unsealed Roads)															
5A	Primary	>100	Flat	80	2	6	5	6	7	1.0	9	1	1	11	320
			Rolling	70	2	8	5	7	6	1.0	8	1	1	10	220
			M'tain	50	2	12	5	8	6	0.5	7	1	1	9	140
5B	Secondary	100-30	Flat	70	2	6	5	6	6	0.5	7	1	1	9	250
			Rolling	50	2	8	5	8	6	0.5	7	1	1	9	100
			M'tain	30	2	12	5	10	6	0.5	7	1	1	9	35
5C	Minor	50-20	Flat	60	1	6	5	6	3	1.5	6	1	1	8	170
			Rolling	40	1	8	5	8	3	1.0	5	1	1	7	60
			M'tain	20	1	12	5	10	3	0.5	4	1	1	7	15
5D	Access	<20	Flat	40	1	6	5	6	3	1.0	5	1	1	7	70
			Rolling	30	1	8	5	8	3	0.5	4	1	1	6	35
			M'tain	< 20	1	15	5	10	3	0.5	4	1	1	5	15
5E	Tracks	<10		NA	1	NA	4	NA	3	0.0	3	NA	NA	3	NA

AUSTROADS 1989															
		>150			2	4		7.0	1.0				0.5 to 1		
		<150			2	4		6.0					0.5 to 1		
		<150			1	4		3.5		5 to 6			0.5 to 1		
DEPARTMENT OF MAIN ROADS NSW 1929															
	Feeder		Hilly		2	4	6	3.7	0.3	4.3	0.6	0.6	5.5	15.3	
	Feeder		Hilly		1	4	6	3.1	0.0	3.1	0.6	0.6	4.3	15.3	
FOREST PRACTICE CODE TASMANIA															
Class 1	Main Road	<100 vpd			2	8		6	1	8					
Class 2	Semi Main	<50			2	10		5.5	0.6	6.7					
Class 3	Spur	<20			1	15		4	1	6					
Class 4	Track	<10			1	15		3.7	0.6	4.9					
CONSERVATION AND LAND MANAGEMENT (CALM) WA															
1st Class	Major				80	2	10	5	4	1	10	1	1	14	350
2nd Class	Secondary				60	1	12	5	5	0.5	6	1	1	10	150
3rd Class	Minor				30	1	15	5	4	0	4	1	1	7	80
	Forest Track				15	1	25	0	4	0	4	0	0	6	30
CSIR SOUTH AFRICA															
Class IV	Secondary	>100						6	1.5	9					
Class V	District	100 - 20						6	1.5	9					
Class VI	District	<20						3	1.5	6					
UNITED KINGDOM															
Class D	Collector	>100			70		10	5	1+	7+					
Class E	Access	100 - 20			60		15	3	1.5	6					
Class F	Access	<20			N/A		15/20	2.5/3.0	N/A						
USA FORESTRY MANUAL															
	two-lane	250 - 50	rolling	40 -65	2	8		3	1.5	9				61 -140	
			hilly	30 -50	2	8		3	1.5	9				33- 76	
	single lane	<100	rolling	30 -65	1	6		4.2	N/A	4.2				21-140	
			hilly	20 - 50	1	8		4.2	N/A	4.2				15 - 77	

APPENDIX B**NAASRA Functional Road Classification *****Rural Areas – Arterial Roads**

Class 1 - Those roads, which form the principal avenue for communications between, major regions of Australia, including direct connections between capital cities.

Class 2 - Those roads, not being Class 1 whose main function is to form the principal avenue of communication for movements between:

- A capital city and adjoining states and their capital cities; or
- A capital city and key towns; or
- Key towns.

Class 3 - Those roads, not being Class 1 or 2 whose main function is to form an avenue of communication for movements:

- Between important centres and Class 1 and Class 2 roads and/or key towns; or
- Between important centres; or
- Of an arterial nature within a rural area.

Rural Areas - Local Roads

Class 4 - Those roads, not being Class 1, 2 or 3 whose main function is to provide access to abutting property (including property within a town in a rural area).

Class 5 - Those roads, which provide almost exclusively for one activity or function which, cannot be assigned to Classes 1 to 4.

Urban Areas – Arterial Roads

Class 6 - Those roads whose main function is to perform the principal avenue of communication for massive traffic movements.

Class 7 - Those roads, not being Class 6, whose main function is to supplement the Class 6 roads in providing for traffic movements or which distribute traffic to local street systems.

Urban Areas – Local Road

Class 8 - Those roads not being Class 6 or 7, whose main function is to provide access to abutting property.

Class 9 - Those roads, which provide almost exclusively for one activity or function and which cannot be assigned to Classes 6, 7 or 8.

* (Source Austroads 1989)

APPENDIX C

Proposed Road Classification System

Road Class ^φ	Class Type	Service Function Description	Road Type Description	Parks Victoria Equiv.	NRE Equiv.	NRE Royalty Classes
5A	Primary Road > 100 ADT #	<ul style="list-style-type: none"> Provides primarily for the main traffic movements into and through a region. This includes access to high use visitor sites and forest areas. Caters generally for higher travel speed, all vehicle types including large vehicles (ie buses and trucks). 	<ul style="list-style-type: none"> All weather road predominantly two-lane and mainly sealed. A high quality* of service road Design speed standard of 80 - 50 km/h according to terrain Minimum carriageway width is 7 m 	Class S1 Class U1		Class A
5B	Secondary Road 100 - 30 ADT	<ul style="list-style-type: none"> Provides access to moderate use visitor sites and forest areas. Serves the purpose of collecting and distributing traffic from local areas, moderate use visitor sites and forest areas to or from primary or minor roads. Caters for moderate travel speed a full range of vehicles including large vehicles 	<ul style="list-style-type: none"> All weather two lane road formed and gravelled or single lane sealed road with gravel shoulders A good quality of service road Design speed standards of at 70 30 km/h according to terrain Minimum carriageway width is 5.5m 	Class S2 Class U2	Class 1 & 2	Class B (i)
5C	Minor Road 50 – 20 ADT	<ul style="list-style-type: none"> Provides a link to low and moderate use visitor sites and forest areas, and forms a feeder link to a logging coupe access track/road or fire track. Purpose is to link areas, which are traffic generators to secondary or primary roads. Caters for lower travel speed and full range of vehicles 	<ul style="list-style-type: none"> Generally all weather single lane two-way unsealed formed road usually lightly gravelled A fair quality of service road Design speed standards of 60 - 20 km/h according to terrain Minimum carriageway width is 4m 	Class U3	Class 3	Class B (ii) Class C (i)
5D	Access Track/ Road < 20 ADT	<ul style="list-style-type: none"> Provides access to low use visitor sites and forest areas Can be short term, temporary or feeder roads to access individual timber harvesting coupes. Provides for fire protection and management access (sometimes exclusively for management vehicles only) Caters for low travel speed and a range of vehicles in dry weather May be seasonally closed 	<ul style="list-style-type: none"> Substantially a single lane two-way generally dry-weather, formed (natural materials) track/road A low quality of service track/road Design speeds of 40 - <20 km/h according to terrain Minimum carriageway width is 4m May be restricted to four wheel-drive vehicles 	Class U4	Class 4	Class C (ii) & D (ii)
5E	Rough Tracks < 10 ADT	<ul style="list-style-type: none"> Provides primarily for four wheel-drive vehicles Mainly used for fire protection purposes, management access and limited recreational activities. Caters for very low travel speed May be seasonally closed. May be restricted to management vehicles only 	<ul style="list-style-type: none"> Predominantly a single lane two-way earth tracks (unformed) at or near the natural surface level A very low quality of service track Predominantly not conforming to any geometric design standards Minimum cleared width is 3m 	Class U5	Class 5	Class D (i) & (ii)

^φ The prefix 5 is related to the Austroads National Functional Road Classification categories

Average Daily Traffic (ADT) represents the average daily traffic over the peak season.

* Quality of service is defined in terms of the level of convenience, (travel speed), comfort (ride qualities) and safety (travel consistency) provided.

APPENDIX D

Guidelines to the Main Geometric Design Standards

Road Classification	5A Primary			5B Secondary			5C Minor			5D Access			5E Tracks			Comments
	Flat	Rolling	M'tain	Flat	Rolling	M'tain	Flat	Rolling	M'tain	Flat	Rolling	M'tain	Flat	Rolling	M'tain	
Terrain Type (1)																
Main Geometric Characteristic																
Speed value km/hr	80	70	50	70	50	30	60	40	20	40	30	< 20	N/A	N/A	N/A	based on safety, costs and environmental considerations based on 85th percentile speed
Cross section elements																
number of traffic lanes	2	2	2	1 / 2	1 / 2	1 / 2	1	1	1	1	1	1	1	1	1	single lane sealed / two lane unsealed
minimum cross fall/camber %																
sealed road	3	3	3	3	3	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
unsealed road	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	min of 4 % to drain rain fall off tracks
maximum superelevation % (2)																
sealed road	7-10	7-10	7-10	6-8	6-10	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	actual value based on curve
unsealed road	6	7	8	6	8	10	6	8	10	6	8	10	N/A	N/A	N/A	radius adopted
minimum traffic lane width m (3)	3.5	3	3	3.5 / 3	3.5 / 3	3.5 / 3	3	3	3	3	3	3	3	3	3	sealed / unsealed values
minimum shoulder widths m	1	1	0.5	2 / 0.5	1.5 / 0.5	1 / 0.5	1.5	1	0.5	1	0.5	0.5	0	0	0	sealed / unsealed values
minimum carriageway width (lanes + shoulder) m	9	8	7	7.5 / 7	6.5 / 7	5.5 / 7	6	5	4	5	4	4	3	3	3	sealed / unsealed values
minimum formation width (including verges) (4)	11	10	9	9.5 / 9	8.5 / 9	7.5 / 9	8	7	7	7	6	5	3	3	3	sealed / unsealed values
Horizontal Geometry																
minimum radius curve m (5)																
sealed road	160	100	45	110	45	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
unsealed road	320	220	140	250	100	35	170	60	15	70	35	15	N/A	N/A	N/A	
minimum stopping sight distance m (6)																
sealed road	110	90	50	90	50	25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	at tight curves check for lateral obstructions to provide the stopping sight distance required
unsealed road	150	120	70	120	70	30	90	50	30	50	30	20	N/A	N/A	N/A	
minimum meeting sight distance m (7)																
sealed road	210	170	100	170	100	45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	for high volume roads may need to check for overtaking provisions
unsealed road	290	230	130	230	130	60	180	100	60	100	60	40	N/A	N/A	N/A	
Vertical Geometry																
maximum vertical grade % (8)	6	8	12	6	8	12	6	8	12	6	8	15	N/A	N/A	N/A	for tracks avoid steep grades to reduce soil erosion
minimum crest vertical curve K values (9)	23 / 46	14 / 28	5 / 9	14 / 28	5 / 9	2 / 5	9	4	2	4	2	1	N/A	N/A	N/A	sealed / unsealed values
minimum sag vertical curve K values (10)	10	8	4	8	4	3	6	3	2	3	2	1	N/A	N/A	N/A	sealed / unsealed values

Notes (Appendix D)

- (1) Flat, rolling or mountainous terrain.
- (2) The maximum superelevation value will need to take into account the use of the road by high loaded heavy vehicles, speed and curve radii.
- (3) In cases where there is a high percentage of heavy vehicles (> 20 %) minimum lane widths can be increased by 0.5 m.
- (4) Allows for 1m verge/table drain width. This must be reviewed based on actual locations where for drainage reasons greater widths may be required.
- (5) This is based on Austroads (1989) and Giummarra G. (2001). Lower values of surface coefficients on unsealed roads result in radii being greater. Values rounded up. For minimum radius curves widening on the inside of a curve may be necessary to accommodate longer vehicles.
- (6) Based on a reaction time of 2 seconds and surface coefficients relating to sealed and unsealed surfaces and values round up. Values based on flat grades and allowances will need to be made for up and down grades.
- (7) This is a requirement for single lane two-way roads. Values rounded up.
- (8) In some cases higher grades of up to 20 % can be allowed for short sections (about 150 m). Keep grades on unsealed roads lower due to ravelling and scouring of surface.
- (9) Calculation of these values are to be based on information contained in Austroads (1989) for sealed roads and Giummarra G. (2000) for unsealed roads. The length of the vertical curve (L) is based on the product of K multiplied by the algebraic difference in grades percentage A. (ie $L = K \times A$).
- (10) Sag values are based on comfort control criteria.

APPENDIX E

Road Maintenance Assessment Guide – Sealed Roads

Road Name _____ Class _____ Date of Survey _____

Section Start _____ (_____ km) Section End _____ (_____ km)

Note: Field staff to fill in only blank sections

Safety

Edge Effects - EB Edge Drop		Condition Assessment						Severity		Comments on work requirements	
Cond Ass - Length %		Rating →	good	fair	poor	high	medium	low			
Severity		Score →	2	6	10	5	3	1			
Total		drop	0 – 20%	20 – 50 %	> 50 %	>100 mm	50 – 100mm	< 50 mm			

Edge Effects – EB Edge Break		Condition Assessment						Severity		Comments on work requirements	
Cond Ass - Length %		Rating →	good	fair	poor	high	medium	low			
Severity		Score →	2	6	10	5	3	1			
Total		break	0 – 20%	20 – 50 %	> 50 %	>100mm	100 – 50mm	<50mm			

Deformations DR-Rutting		Condition Assessment						Severity		Comments on work requirements	
Cond Ass - Length %		Rating →	good	fair	poor	high	medium	low			
Severity		Score →	2	6	10	5	3	1			
Total		rutting	0 – 20%	20 – 50 %	> 50 %	>100 mm	50 – 100mm	< 50 mm			

Serviceability

Deformation CR Cracking	
Cond Ass - Length %	
Severity	
Total	

		Condition Assessment			Severity		Comments on work requirements
Rating →		good	fair	poor	high	medium	
Score →		2	6	10	3	2	1
cracking		0 – 20%	20 – 50 %	> 50 %	>100 mm	50 – 100mm	< 50 mm

Surface Texture -ST Coarse Texture	
Cond Ass - Length %	
Severity	
Total	

		Condition Assessment			Severity		Comments on work requirements
Rating →		good	fair	poor	high	medium	
Score →		2	6	10	3	2	1
Coarse		0 – 20%	20 – 50 %	> 50 %	>75mm	30 – 75mm	<30mm

Potholes - HO Potholes	
Cond Ass – No per km	
Severity	
Total	

		Condition Assessment			Severity		Comments on work requirements
Rating →		good	fair	poor	High	medium	
Score →		2	6	10	3	2	1
Potholes/km		1 – 4	5 – 10	< 10	>100mm	100 -50mm	<50mm

TableDrains TD Ponding* Conditions	
Cond Ass – % per km	
Severity	
Total	

		Condition Assessment			Severity		Comments on work requirements
Rating →		good	fair	poor	High	medium	
Score →		2	6	10	3	2	1
Ponding/km		0 – 20 %	20 – 50 %	< 50 %	>300mm	100 -300mm	<100mm

Batters BA Vegetation Clearing	
Cond Ass – % per km	
Severity	
Total	

		Condition Assessment			Severity		Comments on work requirements
Rating →		good	fair	poor	High	medium	
Score →		2	6	10	3	2	1
Clearing/km		0 - 20 %	20 – 10	< 10	>500mm	500 -100mm	<100mm

*Ponding conditions occur when drains are blocked by vegetation, batter slips or scouring

Structural Capacity

Deformation DS Shoving		Condition Assessment						Severity		Comments on work requirements
Cond Ass - Length %		Rating →	good	fair	poor	high	medium	low		
Severity		Score →	2	6	10	4	3	1		
Total		Shoving	0 – 20%	20 – 50 %	> 50 %	>75mm	50 -75mm	<25mm		

Culvert CU Cleaning Deposits		Condition Assessment						Severity		Comments on work requirements
Cond Ass - Length %*		Rating →	good	fair	poor	high	medium	low		
Severity		Score →	2	6	10	4	3	1		
Total		Siltation depth	0 – 20%	20 – 50 %	> 50 %	> 100mm	50 -100mm	<50mm		

Total Score	
-------------	--

Note: Scores for ‘Safety’ and ‘Structural Capacity’ categories above are treated as a higher priority than those for ‘Serviceability’ categories.

*length of pipe (%) needing clearing

Overall comments

.....

.....

.....

.....

.....

.....

APPENDIX F

Road Maintenance Assessment Guide – Unsealed Roads

Road Name _____ Class ____ Date of Survey _____ Section Start _____ (___km) Section End _____ (___km)

Note: Field staff to fill in only blank sections

Safety

Deformations - DR Rutting		Condition Assessment						Severity		Comments on work requirements	
Cond Ass - Length %		Rating →	good	fair	poor	high	medium	low			
Severity		Score →	2	6	10	5	3	1			
Total		rutting	0 – 20%	20 – 50 %	> 50 %	>100 mm	50 – 100mm	< 50 mm			

Surface – SL Loose Material		Condition Assessment						Severity		Comments on work requirements	
Cond Ass - Length %		Rating →	good	fair	poor	high	medium	low			
Severity		Score →	2	6	10	5	3	1			
Total		Loose	0 – 20%	20 – 50 %	> 50 %	>100mm	100 – 50mm	<50mm			

Serviceability

Deformations - DC Corrugations		Condition Assessment						Severity		Comments on work requirements	
Cond Ass - Length %		Rating →	good	fair	poor	high	medium	low			
Severity		Score →	2	6	10	3	2	1			
Total		corrugations	0 – 20%	20 – 50 %	> 50 %	>100 mm	50 – 100mm	< 50 mm			

Drainage - DN Channels/Scouring		Condition Assessment						Severity		Comments on work requirements	
Cond Ass - Length %		Rating →	good	fair	poor	high	medium	low			
Severity		Score →	2	6	10	3	2	1			
Total		scouring	0 – 20%	20 – 50 %	> 50 %	>100 mm	50 – 100mm	< 50 mm			

Surface -ST Coarse Texture		Condition Assessment						Severity			Comments on work requirements		
Cond Ass - Length %		Rating →	good	fair	poor	high	medium	low					
Severity		Score →	2	6	10	3	2	1					
Total		Coarse	0 – 20%	20 – 50 %	> 50 %	>75mm	30 – 75mm	<30mm					

Potholes - HO Potholes		Condition Assessment						Severity			Comments on work requirements		
Cond Ass – No per km		Rating →	good	fair	poor	high	medium	low					
Severity		Score →	2	6	10	3	2	1					
Total		Potholes/km	1 – 4	5 – 10	< 10	>100mm	100 -50mm	<50mm					

Table - TD Ponding Conditions		Condition Assessment						Severity			Comments on work requirements		
Cond Ass – % per km		Rating →	good	fair	poor	High	medium	Low					
Severity		Score →	2	6	10	3	2	1					
Total		Ponding/km	0 – 20 %	20 – 50 %	< 50 %	>300mm	100 -300mm	<100mm					

Batters - BA Vegetation Clearing		Condition Assessment						Severity			Comments on work requirements		
Cond Ass – % per km		Rating →	good	fair	poor	High	medium	Low					
Severity		Score →	2	6	10	3	2	1					
Total		Clearing/km	0 - 20 %	20 – 10	< 10	>100mm	100 -50mm	<50mm					

Structural Capacity

Gravel Depth GD	
Cond Ass - Length %	
Severity	
Total	

	Condition Assessment			Severity			Comments on work requirements
Rating →	good	fair	poor	low	medium	high	
Score →	2	6	10	4	3	1	
Gravel depth	> 50 %	20 – 50 %	0 – 20%	<25mm	50 -75mm	>75mm	

Culvert CU Cleaning*	
Cond Ass - Length %	
Severity	
Total	

	Condition Assessment			Severity			Comments on work requirements
Rating →	good	fair	poor	high	medium	low	
Score →	2	6	10	4	3	1	
Siltation depth	0 – 20%	20 – 50 %	> 50 %	> 100mm	50 -100mm	<50mm	

Total Score	
--------------------	--

Note: Scores for ‘Safety’ and ‘Structural Capacity’ categories above are treated as a higher priority than those for ‘Serviceability’ categories.

(* length of culvert % needing cleaning)

Overall comments

.....

.....

.....

.....

APPENDIX G**Maintenance Intervention Levels for Unsealed & Sealed Roads****5A Primary Roads - unsealed**

DEFECT	INTERVENTION LEVELS		URGENT MAINTENANCE (at isolated locations)	TYPICAL ACTION
	SEVERITY	EXTENT (% / km)		
Rutting	depth > 50 mm	> 20	depth > 80 mm	medium/heavy grading
Loose material	depth > 30 mm	> 20	depth > 50 mm	reshape and compaction
Corrugations	> 50 mm	> 20	depth > 70 mm	heavy grading and re shape
Drainage scours	> 50 mm depth	> 20	depth > 70 mm	reshape of cross falls 4 - 6 %
Course texture/ride quality	NRM* > 180 (envn. speed < 80%)	> 30	NRM > 210 (envn. speed < 70%)	heavy grading and shaping
Potholes	depth > 50 mm	> 25	depth > 70 mm	restoration of crown and cross falls
Gravel depth	< 70 mm	> 25	< 50 mm	re gravelling
Table drain	Ponding > 100 mm	> 20	>200 mm	regrade
Batter clearing	Veg. > 400 mm	>20	> 600 mm	slashing
Roadside vegetation	Veg. > 300 mm	> 20		
Culvert cleaning	Siltation > 150 mm	> 25	> 250 mm	clear out deposits

5B Secondary Roads - unsealed

DEFECT	INTERVENTION LEVELS		URGENT MAINTENANCE (at isolated locations)	TYPICAL ACTION
	SEVERITY	EXTENT (% / km)		
Rutting	depth > 70 mm	> 25	depth > 90 mm	medium/heavy grading
Loose material	depth > 50 mm	> 40	depth > 80 mm	reshape and compact
Corrugations	depth > 70 mm	> 35	depth > 90 mm	heavy grading and re shape
Drainage scours	depth > 70 mm	> 25	depth > 90 mm	reshape of cross falls 4 - 6 %
Course texture/ride quality	NRM > 200 (envn. speeds < 70%)	> 45	NRM > 240 (envn. speed < 60%)	heavy grading and shaping
Potholes	potholes > 70 mm depth	> 40	potholes > 90 mm depth	restoration of crown and cross falls
Gravel depth	< 50 mm	> 25	< 30 mm	re gravelling
Table drain	Ponding > 150 mm	> 25	>250 mm	regrade
Batter clearing	Veg. > 500 mm	>20	> 800 mm	slashing
Roadside vegetation	Veg. > 400 mm	> 20		
Culvert cleaning	Siltation > 200 mm	> 25	> 300 mm	clear out deposits

5C Minor Road - unsealed

DEFECT	INTERVENTION LEVELS		URGENT MAINTENANCE (at isolated locations)	TYPICAL ACTION
	SEVERITY	EXTENT (% / km)		
Rutting	depth > 90 mm	> 35	depth > 110 mm	medium/heavy grading
Loose material	depth > 70 mm	> 45	depth > 100 mm	reshape and compact
Corrugations	depth > 90 mm	> 45	depth > 120 mm	heavy grading and re shape
Drainage scours	depth > 90 mm	> 35	depth > 120 mm	reshape of cross falls 4 - 6 %
Course texture/ride quality	NRM > 220(envn. speeds < 60%)	> 55	NRM > 270 (envn. speed < 50%)	heavy grading and shaping
Potholes	potholes > 90 mm depth	> 35	potholes > 140 mm depth	restoration of crown and cross falls
Gravel depth	< 30 mm	> 30	< 20 mm	re gravelling
Table drain	Ponding > 200 mm	> 30	> 300 mm	regrade
Batter clearing	Veg. > 600 mm	>30	> 900 mm	slashing
Roadside vegetation	Veg. > 500 mm	> 20		
Culvert cleaning	Siltation > 250 mm	> 30	> 350 mm	clear out deposits

5D Access Roads - unsealed

DEFECT	INTERVENTION	LEVELS	URGENT MAINTENANCE (at isolated locations)	TYPICAL ACTION
	SEVERITY	EXTENT (% / km)		
Rutting	depth > 100 mm	> 40	depth >160 mm	medium/heavy grading
Loose material	depth > 80 mm	> 50	depth > 140 mm	reshape and compact
Corrugations	depth > 100 mm	> 50	depth > 160 mm	heavy grading and re shape
Drainage scours	depth > 100 mm	> 40	depth > 160 mm	reshape of cross falls 4 - 6 %
Course texture/ride quality	NRM > 240 (envn. speed < 50%)	> 60	NRM > 300 (envn. Speed <40%)	heavy grading and shaping
Potholes	potholes > 100 mm depth	> 40	potholes > 160 mm depth	restoration of crown and cross falls
Gravel depth	NA	NA	NA	
Table drain	Ponding > 300 mm	> 40	> 400mm	regrade
Batter clearing	Veg. > 700 mm	>40	> 1000 mm	slashing
Roadside vegetation	Veg. > 600 mm	> 40		
Culvert cleaning	Siltation > 300 mm	> 40	> 400 mm	clear out deposits

5A Primary Road - sealed

DEFECT	INTERVENTION	LEVELS	URGENT MAINTENANCE (at isolated locations)	TYPICAL ACTION
	SEVERITY	EXTENT (% / km)		
Edge Drop	depth > 50 mm	> 20	depth > 100 mm	shoulder re gravelling and grading
Edge Break	> 100 mm	> 30	length > 150 mm	reshaping and sealing of edges
Rutting	> 20 mm	> 20	depth > 50 mm	road reconstruction
Cracking	> 5 mm width	> 20	width > 10 mm	road reseals
Ride quality	NRM > 130	> 20	NRM > 180	reconstruction
Potholes	potholes > 70 mm depth	> 20	potholes > 100 mm depth	patch repairs
Shoving	> 70 mm	> 20	>150 mm depth	reconstruction of effected parts
Table drain	Ponding > 70 mm	> 20	150 mm	regrade
Batter clearing	Veg. > 300 mm	>20	> 500 mm	slashing
Roadside vegetation	Veg. > 200 mm	> 20		
Culvert cleaning	Siltation > 100 mm	> 20	> 200 mm	clear out deposits

5B Secondary Road - sealed

DEFECT	INTERVENTION	LEVELS	URGENT MAINTENANCE (at isolated locations)	TYPICAL ACTION
	SEVERITY	EXTENT (% / km)		
Edge Drop	depth > 70 mm	> 25	depth > 120 mm	shoulder re-gravelling and grading
Edge Break	> 150 mm	> 35	length > 200 mm	reshaping and sealing of edges
Rutting	> 40 mm	> 25	depth > 100 mm	road reconstruction
Cracking	> 10 mm width	> 25	> 15 mm width	road reseals
Ride quality	NRM > 150	> 25	NRM > 210	reconstruction
Potholes	potholes > 90 mm depth	> 30	potholes > 120 mm	patch repairs
Shoving	> 100 mm	> 25	> 200 mm	reconstruction of effected parts
Table drain	Ponding > 90 mm	> 25	180 mm	regrade
Batter clearing	Veg. > 400 mm	>25	> 600 mm	slashing
Roadside vegetation	Veg. > 300 mm	> 20		
Culvert cleaning	Siltation > 150 mm	> 25	> 300 mm	clear out deposits

Notes

* NRM : NAASRA Roughness Measurement (counts/km)

APPENDIX H 1**Road Maintenance Work Sheet – Class: 5A Primary Road - Sealed Road**

Road Name _____ Section Start _____ (____ km) Section End _____ (____ km) Date of Survey _____

(tick appropriate box)

Defect	Intervention level		Work Requirements	Routine	Urgent	Work Done
	Routine	Urgent				
Edge Drop	<input type="checkbox"/> >50mm & > 20%/km	<input type="checkbox"/> > 100 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Edge Break	<input type="checkbox"/> >100mm & > 30%/km	<input type="checkbox"/> > 150 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Rutting	<input type="checkbox"/> >20mm & > 20%/km	<input type="checkbox"/> > 50 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Cracking	<input type="checkbox"/> >5mm & > 20%/km	<input type="checkbox"/> > 10 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Ride Quality	<input type="checkbox"/> > 130 NRM & > 20%/km	<input type="checkbox"/> > 180 NRM	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Potholes	<input type="checkbox"/> >70mm & > 20%/km	<input type="checkbox"/> > 100 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

APPENDIX H 1 (cont)

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Shoving	<input type="checkbox"/> >70mm & > 20%/km	<input type="checkbox"/> > 150 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Table Drain Ponding	<input type="checkbox"/> >70mm & > 20%/km	<input type="checkbox"/> > 150 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Batter Clearing	<input type="checkbox"/> >300mm & > 20%/km	<input type="checkbox"/> > 500 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Roadside Vegetation	<input type="checkbox"/> >200mm & > 20%/km	<input type="checkbox"/> > 400 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Culverts	<input type="checkbox"/> >100mm & > 20%/km	<input type="checkbox"/> > 200 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Overall comments

.....

.....

.....

.....

APPENDIX H 2

Road Maintenance Work Sheet – Class: 5B Secondary Road - Sealed Road

Road Name _____ Section Start _____ (____ km) Section End _____ (____ km) Date of Survey _____

(tick appropriate box)

Defect	Intervention level		Work Requirements	Routine	Urgent	Work Done
	Routine	Urgent				
Edge Drop	<input type="checkbox"/> >70mm & > 25%/km	<input type="checkbox"/> > 120 mm	Materials & Plant Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Edge Break	<input type="checkbox"/> >150mm & > 35%/km	<input type="checkbox"/> > 200 mm	Materials & Plant Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Rutting	<input type="checkbox"/> >40mm & > 25%/km	<input type="checkbox"/> > 100 mm	Materials & Plant Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Cracking	<input type="checkbox"/> >10mm & > 25%/km	<input type="checkbox"/> > 15 mm	Materials & Plant Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Ride Quality	<input type="checkbox"/> > 150 NRM & > 25%/km	<input type="checkbox"/> > 210 NRM	Materials & Plant Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Potholes	<input type="checkbox"/> >90mm & > 30%/km	<input type="checkbox"/> > 120 mm	Materials & Plant Location			<input type="checkbox"/> date_____

APPENDIX H 2 (cont)

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Shoving	<input type="checkbox"/> >100mm & > 25%/km	<input type="checkbox"/> > 200 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Table Drain Ponding	<input type="checkbox"/> >90mm & > 25%/km	<input type="checkbox"/> > 180 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Batter Clearing	<input type="checkbox"/> >400mm & > 25%/km	<input type="checkbox"/> > 600 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Roadside Vegetation	<input type="checkbox"/> >300mm & > 25%/km	<input type="checkbox"/> > 500 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Culverts	<input type="checkbox"/> >150mm & > 30%/km	<input type="checkbox"/> > 300 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Overall comments

.....

.....

.....

.....

APPENDIX H 3

Road Maintenance Work Sheet – Class: 5A Primary Road - Unsealed Road

Road Name _____ Section Start _____ (____ km) Section End _____ (____ km) Date of Survey _____

(tick appropriate box)

Defect	Intervention level		Work Requirements	Routine	Urgent	Work Done
	Routine	Urgent				
Rutting	<input type="checkbox"/> >50mm & > 20%/km	<input type="checkbox"/> > 80 mm	Location			date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Loose Material	<input type="checkbox"/> >30mm & > 20%/km	<input type="checkbox"/> > 50 mm	Location			date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Corrugations	<input type="checkbox"/> >50mm & > 20%/km	<input type="checkbox"/> > 70 mm	Location			date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Drainage Scours	<input type="checkbox"/> >50mm & > 20%/km	<input type="checkbox"/> > 70 mm	Location			date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Course Texture/ Ridge Quality	<input type="checkbox"/> >180 NRM & > 30%/km	<input type="checkbox"/> > 210 NRM	Location			date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Potholes	<input type="checkbox"/> >50mm & > 25%/km	<input type="checkbox"/> > 70 mm	Location			date_____

APPENDIX H 3 (cont)

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Gravel Depth	<input type="checkbox"/> <70 & > 20%/km	<input type="checkbox"/> < 50 mm	Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Table Ponding	Drain <input type="checkbox"/> >100mm & > 25%/km	<input type="checkbox"/> > 200 mm	Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Batter Clearing	<input type="checkbox"/> >400mm & > 20%/km	<input type="checkbox"/> > 600 mm	Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Roadside Vegetation	<input type="checkbox"/> >300mm & > 20%/km	<input type="checkbox"/> > 500 mm	Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Culverts	<input type="checkbox"/> >150mm & > 25%/km	<input type="checkbox"/> > 250 mm	Location			<input type="checkbox"/> date_ _ _ _

Overall comments

.....

.....

.....

.....

APPENDIX H 4

Road Maintenance Work Sheet – Class: 5B Secondary Road - Unsealed Road

Road Name _____ Section Start _____ (____ km) Section End _____ (____ km) Date of Survey _____

(tick appropriate box)

Defect	Intervention level		Work Requirements	Routine	Urgent	Work Done
	Routine	Urgent				
Rutting	<input type="checkbox"/> >70mm & > 25%/km	<input type="checkbox"/> > 90 mm	Materials & Plant Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Loose Material	<input type="checkbox"/> >50mm & > 40%/km	<input type="checkbox"/> > 80 mm	Materials & Plant Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Corrugations	<input type="checkbox"/> >70mm & > 35%/km	<input type="checkbox"/> > 90 mm	Materials & Plant Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Drainage Scours	<input type="checkbox"/> >70mm & > 25%/km	<input type="checkbox"/> > 90 mm	Materials & Plant Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Course Texture/ Ridge Quality	<input type="checkbox"/> >200 NRM & > 45%/km	<input type="checkbox"/> > 240 NRM	Materials & Plant Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Potholes	<input type="checkbox"/> >70mm & > 30%/km	<input type="checkbox"/> > 90 mm	Materials & Plant Location			<input type="checkbox"/> date_____

APPENDIX H 4 (cont)

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Gravel Depth	<input type="checkbox"/> <50 & > 25%/km	<input type="checkbox"/> < 30 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Table Drain Ponding	<input type="checkbox"/> >150mm & > 25%/km	<input type="checkbox"/> > 250 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Batter Clearing	<input type="checkbox"/> >500mm & > 20%/km	<input type="checkbox"/> > 800 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Roadside Vegetation	<input type="checkbox"/> >400mm & > 20%/km	<input type="checkbox"/> > 600 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Culverts	<input type="checkbox"/> >200mm & > 25%/km	<input type="checkbox"/> > 300 mm	Materials & Plant Location			<input type="checkbox"/> date_ _ _ _

Overall comments

.....

.....

.....

.....

APPENDIX H 5**Road Maintenance Work Sheet – Class: 5C Minor Road - Unsealed Road**

Road Name _____ Section Start _____ (____ km) Section End _____ (____ km) Date of Survey _____

(tick appropriate box)

Defect	Intervention level		Work Requirements	Routine	Urgent	Work Done
	Routine	Urgent				
Rutting	<input type="checkbox"/> >90mm & > 35%/km	<input type="checkbox"/> > 110 mm	Location			date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Loose Material	<input type="checkbox"/> >70mm & > 45%/km	<input type="checkbox"/> > 100 mm	Location			date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Corrugations	<input type="checkbox"/> >90mm & > 45%/km	<input type="checkbox"/> > 120 mm	Location			date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Drainage Scours	<input type="checkbox"/> >90mm & > 35%/km	<input type="checkbox"/> > 120 mm	Location			date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Course Texture/ Ridge Quality	<input type="checkbox"/> >220 NRM & > 55%/km	<input type="checkbox"/> > 270 NRM	Location			date_____

APPENDIX H 5 (cont)

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Potholes	<input type="checkbox"/> >90mm & > 35%/km	<input type="checkbox"/> > 140 mm	Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Gravel Depth	<input type="checkbox"/> <30 & > 30%/km	<input type="checkbox"/> < 20 mm	Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Table Drain Ponding	<input type="checkbox"/> >200mm & > 30%/km	<input type="checkbox"/> > 300 mm	Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Batter Clearing	<input type="checkbox"/> >600mm & > 30%/km	<input type="checkbox"/> > 900 mm	Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Roadside Vegetation	<input type="checkbox"/> >500mm & > 30%/km	<input type="checkbox"/> > 700 mm	Location			<input type="checkbox"/> date_ _ _ _

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Culverts	<input type="checkbox"/> >250mm & > 30%/km	<input type="checkbox"/> > 350 mm	Location			<input type="checkbox"/> date_ _ _ _

Overall comments

.....

.....

.....

APPENDIX H 6**Road Maintenance Work Sheet – Class: 5D Access Road/Track - Unsealed Road**

Road Name _____ Section Start _____ (____ km) Section End _____ (____ km) Date of Survey _____

(tick appropriate box)

Defect	Intervention level		Work Requirements	Routine	Urgent	Work Done
	Routine	Urgent				
Rutting	<input type="checkbox"/> >100mm & > 40%/km	<input type="checkbox"/> > 160 mm	Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Loose Material	<input type="checkbox"/> >80mm & > 50%/km	<input type="checkbox"/> > 140 mm	Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Corrugations	<input type="checkbox"/> >100mm & > 50%/km	<input type="checkbox"/> > 160 mm	Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Drainage Scours	<input type="checkbox"/> >100mm & > 40%/km	<input type="checkbox"/> > 160 mm	Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Course Texture/ Ridge Quality	<input type="checkbox"/> >240 NRM & > 60%/km	<input type="checkbox"/> > 300 NRM	Location			<input type="checkbox"/> date_____

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Potholes	<input type="checkbox"/> >100mm & > 40%/km	<input type="checkbox"/> > 160 mm	Location			<input type="checkbox"/> date_____

APPENDIX H 6 (cont)

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Gravel Depth	NA	NA	Materials & Plant			<input type="checkbox"/> date_____
			Location			

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Table Drain	<input type="checkbox"/> >300mm & > 40%/km	<input type="checkbox"/> > 400 mm	Materials & Plant			<input type="checkbox"/> date_____
Ponding			Location			

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Batter Clearing	<input type="checkbox"/> >700mm & > 40%/km	<input type="checkbox"/> > 1000 mm	Materials & Plant			<input type="checkbox"/> date_____
			Location			

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Roadside Vegetation	<input type="checkbox"/> >600mm & > 40%/km	<input type="checkbox"/> > 800 mm	Materials & Plant			<input type="checkbox"/> date_____
			Location			

Defect	Intervention level		Work Requirements	Routine	Urgent	Done
	Routine	Urgent				
Culverts	<input type="checkbox"/> >300mm & > 40%/km	<input type="checkbox"/> > 400 mm	Materials & Plant			<input type="checkbox"/> date_____
			Location			

Overall comments

.....

.....

.....

.....

APPENDIX I

Typical Photographs of the Various Road Classes

5A Primary Road



Two lane sealed road



Two lane unsealed road

5B Secondary Road

Single lane two way sealed road



Two lane two way unsealed road

5C Minor Road

Single lane unsealed road lightly gravelled

5D Access Road/Track

Single lane unsealed road formed but not gravelled

5E 4 Wheel Drive Tracks

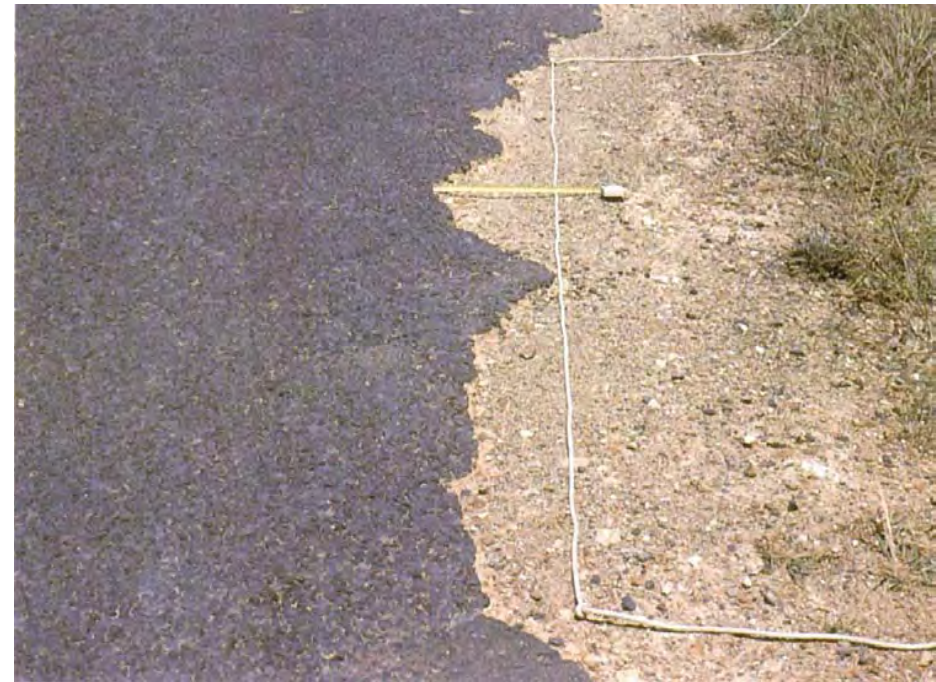
One lane earth road unformed on natural surface

Typical Road Defects (Source: Austroads 1987)

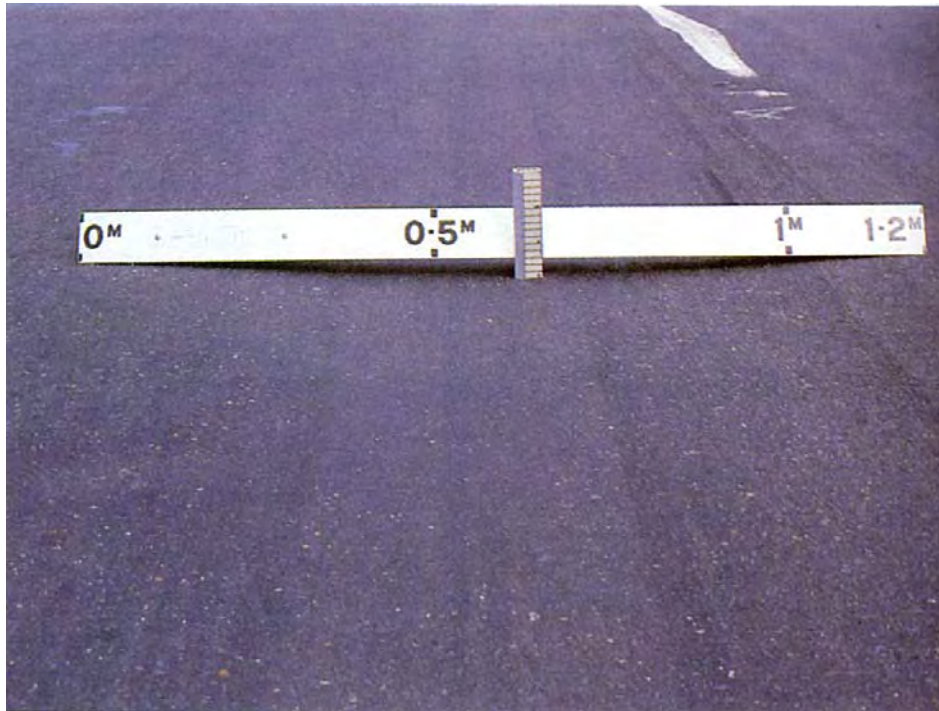
Sealed Road



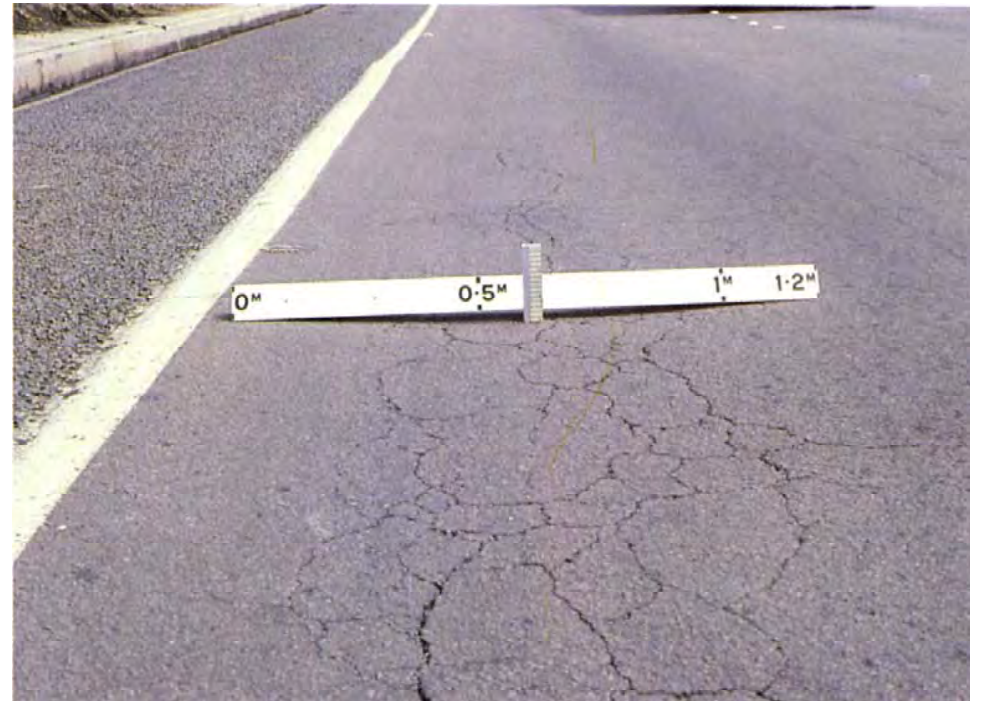
Edge Drop - Off



Edge Break



Rutting



Cracking



Pothole



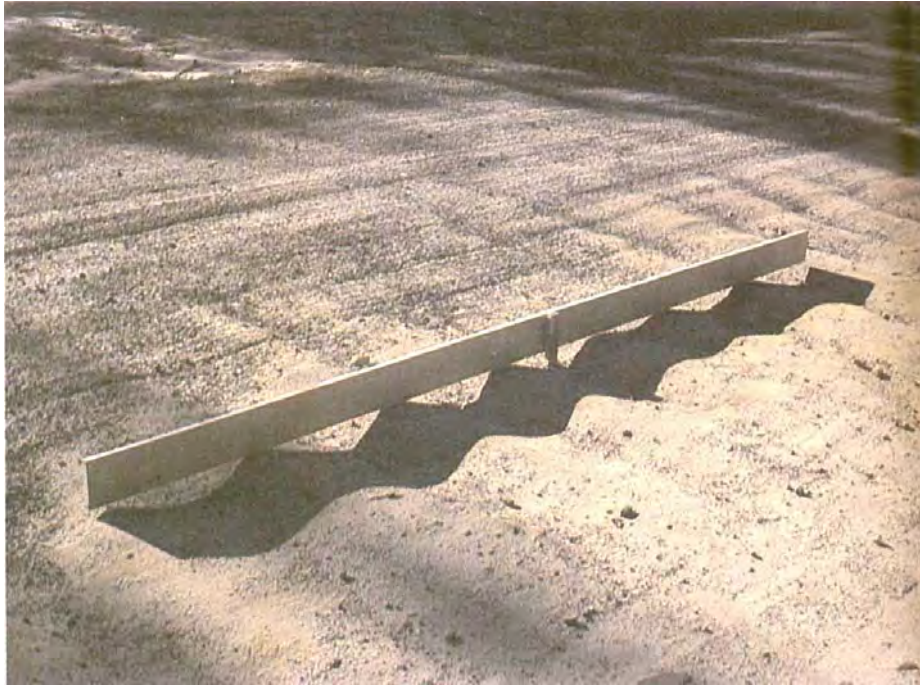
Shoving

Unsealed Roads

Rutting



Loose gravel



Corrugations



Drainage channels



Course texture



Potholes



Shoving