PROVINCE OF KWAZULU-NATAL

Department of Transport

Gravel Road Management System

Manual for Visual Evaluation of Unsurfaced Provincial Roads

REPORT NO. AFRICON/M/1 EDITION 1.1 JANUARY 2004

TABLE OF CONTENTS

PAGE NO

1. INTRODUCTION 1

2. DEFINING SEGMENTS 1

3. INSPECTION PROCEDURE 2

4. GENERAL INFORMATION 2

5. WEARING COURSE ASSESSMENT 3
   - 5.1 Wearing Course Material Type 3
   - 5.2 Wearing Course Layer Thickness 3
   - 5.3 Gravel Quality 4
   - 5.4 Isolated Problems 5
   - 5.5 Dust 5

6. FUNCTIONAL ASSESSMENT 6
   - 6.1 Riding Quality 6
   - 6.2 Slipperiness 7
   - 6.3 Skid Resistance 8

7. DRAINAGE ASSESSMENT 9
   - 7.1 Prevailing Cross Section 9
   - 7.2 Drainage from the Road 10
   - 7.3 Side Drain Condition 11
   - 7.4 Mitre Drain Condition 12

8. SUMMARY ASSESSMENT 13
   - 8.1 Action Required 13

Appendix A: Inspection Form

1. INTRODUCTION

All gravel roads are evaluated annually to assess their general condition and the effectiveness of the maintenance applied. In addition, the evaluation should show up any severe problems that require attention of a more substantial nature than that which is accomplished with normal routine maintenance.

2. DEFINING SEGMENTS

In order to cost-effectively evaluate unsealed roads, it is necessary to segment them into manageable units. Each segment should be relatively uniform in terms of its material type and general performance with an average length of 5km long. The last segment of a link should not be less than 2.5km long in order to avoid the collection of excessive and repetitive data. For ease of use the start and end point of road links should be chosen as fixed datum points. The datum points currently defined for use in KwaZulu-Natal are listed below:

Access	- refers to a junction with an unproclaimed access road
Blacktop	- refers to a change in the surface type to blacktop
Bridge	- refers to a bridge type structure or drift
Concrete	- refers to a change in the surface type to concrete
Electricity powerline	- refers to powerline crossing over the road
End of road	- refers to the end of any road
Intersection leg	- refers to a junction with a proclaimed provincial road
Large box culvert	- refers to a large box type culvert that can be easily identified from the road
Railway line	- refers to a railway crossing
Start of road	- refers to the start of any road
Telephone line	- refers to a telephone line crossing over the road

3. INSPECTION PROCEDURE

The inspection is to be carried out by one or two people travelling in a vehicle at the end of the rainy season. Each road segment is assessed separately and the inspection should be carried out at a comfortable travelling speed to assess the riding quality of the visual assessment segment, but the evaluator must stop at least twice on each segment to assess the material type and the severity of the problems that occur. After travelling over the segment the evaluator/s must stop and fill in the form, which is contained in Appendix A.

The various items to be evaluated are described in more detail in the following sections of the manual.

4. GENERAL INFORMATION

The general information to be assessed and captured includes the details of the evaluator, date of evaluation, road numbers, start and end km's, region details, weather conditions and terrain type.

The rating of the region should be carried out as follows:

Rating	Description
D	Durban Region
P	Pietermaritzburg Region
L	Ladysmith Region
E	Empangeni Region

The rating of the weather conditions should be carried out as follows:

Rating	Description
W	Road surface is wet
D	Road surface is dry
M	Road surface is moist

The rating of the terrain should be carried out as follows:

Rating	Description
F	Flat terrain – the route follows level areas, few inclines and grades less than 3%
R	Rolling terrain – grades are approximately 5%
M	Mountainous terrain – grades are typically more than 7%

5. WEARING COURSE ASSESSMENT

5.1 Wearing Course Material Type

The geology of the material, which makes up the wearing course, must be shown. Where materials with more than one geological origin are present, the assessor must decide which is most prevalent and mark this on the form. Only **ONE** rating of material type will be accepted by the database.

5.2 Wearing Course Layer Thickness

The quantity of gravel forming the wearing course of the road must be indicated as described below.

The assessment is very often subjective, depending upon the quality of the gravel which forms the riding surface as the distinction between the subgrade and wearing course may often be problematic. Should the wearing course material rate from fair to very poor as indicated above, then the evaluator's decision regarding the quantity of material available may be influenced by the evaluator's assessment of the need for regravelling.

The rating of the layer thickness should be carried out as follows:

Rating	Descriptor	Description	mm
1	Plenty	There appears to be a substantial wearing course.	> 125
2	Sufficient	The gravel appears to be adequate and no immediate needs are apparent.	100 - 125
3	Isolated Exposures	In this instance the gravel is worn away in places and may require some patch regravelling or complete regravelling in the medium term future.	50 - 100
4	Extensive Exposures	The gravel has worn away over large parts of the road and requires regravelling in the short term.	25 - 50
5	None	There is no gravel of any significance left on the road and regravelling should be carried out immediately.	0 - 25

5.3 Gravel Quality

If all of the gravel has been worn away and the evaluator assesses that users are riding on the subgrade (natural insitu material) of the road, then the quality of the subgrade must be evaluated and noted as though it is a wearing course and the quantity of gravel must be shown as “none”.

The quality of the gravel, which forms the wearing course, should be rated on a scale of 1 to 5 as indicated below:

Rating	Descriptor	Description
1	Very Good	This wearing course material will form a firm, well-compacted layer that does not loosen nor rut under traffic. The material has an adequate quantity of fine, clayey material to bind the particles together and is also not too stony.
2	Good	This material is similar to that described above but some ravelling, clayiness in the wet, or stoniness occurs. However, the material has adequate shear strength to carry the traffic loads and only minor problems are experienced.
3	Average	This material represents a reasonable quality wearing course material, but some problems do occur which must be indicated on the form.
4	Poor	This material provides a relatively maintenance intensive wearing course due to one or more of the problems indicated below.
5	Very Poor	This material is not at all suitable to act as a gravel wearing course and requires continual maintenance, or provides a very poor riding quality due to one of the problems indicated below.

Should the material be evaluated as average to very poor the reason for the substandard rating must be provided as follows:

Rating	Description
C	This material will have an excessive quantity of clay and/or silt that looses strength in the wet season resulting in unacceptable rutting or slipperiness.
S	This material is sandy and does not have a sufficient quantity of clay binder and forms windrows of loose material next to the wheel paths.
O	This material has oversize stones (>40mm), which provide a rough ride, obstruct maintenance, or can readily be plucked out to form potholes.

5.4 Isolated Problems (with the wearing course)

The evaluator is given the opportunity to record the occurrence of isolated problems that occur on the wearing course. The word isolated implies that the problems are not general and therefore will not influence the overall rating of the segment. Such problems can usually be addressed by a "spot repair" treatment and no major plant will be required.

The problems which should be noted for this item are as follows:

Rating	Description
E	Should severe erosion gulleys occur across the wearing course, they can be noted here (transverse or longitudinal)
S	Isolated areas where the entire wearing course has been eroded away and exposures of poorer quality subgrade material occur can be noted.
T	A localised problem exists with transverse drainage
L	A localised problem exists with longitudinal drainage
R	A localised area of rough or stony gravel occurs and significantly affects the riding quality for a short distance.

5.5 Dust

It is difficult to rate the degree of dustiness on a gravel road with any accuracy or consistency. However, where dust is a danger to traffic due to severely impaired visibility it should be noted. The following cases should be described as unacceptable:

- Where dust behind a vehicle travelling ahead completely obscures the vehicle so that it cannot be seen.
- Where dust from a vehicle travelling in the opposite direction causes a temporary complete loss of visibility.
- Where dust in the rear-view mirror is such that following vehicles cannot be seen.

The rating should be as follows:

Rating	Descriptor	Description
1	Acceptable	No loss of visibility
5	Unacceptable	Dangerous loss of visibility - significant discomfort

6. FUNCTIONAL ASSESSMENT

6.1 Riding Quality

This item is used to rate the comfort of the ride provided to the road user. The comfortable travelling speed at which the vehicle is stable with minimal road noise and rattling is used to assist in this assessment.

The following values are used:

Rating	Descriptor	Description
1	Very Good	The wearing course has a smooth surface and speeds in excess of 100km/h are possible without discomfort.
2	Good	The riding quality is fairly good and speeds of 100km/h are possible.
3	Average	Some roughness occurs and speeds of only 80km/h, on average, are comfortable.
4	Poor	The road is rough and uncomfortable with speeds of only 60km/h being achieved with reasonable comfort and safety.
5	Very Poor	The riding quality is very poor and it is both uncomfortable and dangerous to exceed a speed of 40km/h.

Should the evaluator rate the riding quality in the range of average to very poor then the factors that influence the riding quality should be noted. As many factors as are present can be noted. These are as follows:

Rating	Description
C	Where corrugations influence the riding quality these should be noted.
P	Potholes which involve any depression in which water can stand should be noted.
S	Stony gravel in which the size of the stones exceeds 37 mm should be noted.
E	Erosion gulleys often occur in a transverse or longitudinal direction and these should be noted.
R	Ruts often occur between windrows of loose material. This influences the safe speed on the road.

6.2 Slipperiness

Slipperiness is the loss of traction caused by an accumulation of excessively fine or plastic material on the surface of the wearing course in wet conditions. This can result in unsafe road conditions.

Slipperiness is difficult to assess unless the rater actually experiences the condition. However it can often be evaluated by observing wheel tracks formed during wet weather that are retained in the road.

The rating of slipperiness is as follows:

Rating	Descriptor	Description
1	Acceptable	Exposed and protruding gravel on road surface. No significant shrinkage cracks. No evidence of tyre impressions remain on the road surface.
5	Unacceptable	Smooth clayey surface with few protruding gravel particles. Significant shrinkage cracks. Evidence of tyre impressions remain on the road surface. Evidence of compaction and shearing under traffic. Loss of control when driving on a wet surface.

6.3 Skid Resistance

Skid resistance problems are caused by an excess of loose, fine gravel (between 2 and 7mm in diameter) that accumulate on the road surface through ravelling under traffic or poor blading practices during dry conditions. This material behaves like a layer of ball bearings and skid resistance is reduced.

Skid resistance is rated as either acceptable or unacceptable in terms of the effect of loose material on vehicle stability and the general impression gained while driving and braking on the dry road.

The rating of skid resistance is as follows:

Rating	Descriptor	Description
1	Acceptable	No excessive fine gravel (2 - 7mm) in the wheel tracks. Exposed and protruding gravel on road surface. Good directional control when braking.
5	Unacceptable	Presence of layer of fine gravel (2 - 7mm) in the wheel tracks. Loss of directional control when braking.

7. DRAINAGE ASSESSMENT

7.1 Prevailing Cross Section

This item is used to rate the shape of the wearing course surface with a view to water draining off the surface, any influence it may have on user comfort and directional stability, and the extent of maintenance required to rectify the problem. It is rated as follows:

Rating	Descriptor	Description
1	Very Good	The road has a well shaped crown with crossfalls of roughly 4%, and surface water will be shed readily.
2	Good	The wearing course still has a crown with crossfalls of the order of 2%. Although the crown is slightly flattened, it can easily be reinstated during the next routine blading.
3	Flat	The surface of the road is fairly flat and some ponding of water in potholes and ruts may occur. The profile can be improved with normal routine maintenance although it may require more than a single pass of a grader for it to be corrected to the required standard.
4	Rutted/ Eroded	In this case the gravel wearing course is severely rutted and/or eroded, particularly where it is super elevated. The profile of the road cannot be reinstated by blading alone and some ripping, reshaping and recompaction is required to achieve the correct profile.
5	Severely eroded	In this case the wearing course has been severely eroded by traffic and extensive rutting and/or erosion gulleys occur. Extensive reconstruction and possible importation of new gravel will be required to reinstate the profile.

7.2 Drainage from the Road

There is obviously a strong interrelationship between the road cross section discussed previously (drainage off the road) and drainage from the road. However, the cross section relates more directly to the capacity of the road to shed water without causing erosion, while drainage from the road relates more closely to the impact of standing water on both the wearing course and underlying road structure. Effective operation of adequate side drains is the predominant aspect to be considered during this rating. This includes removal of water from the zone of influence adjacent to the road as well as erosion effects associated with shoulders and undercutting of the road.

Drainage from the road is rated on a five-point scale where one indicates that the road is well above ground level and has effective side drains leading water away from the road formation. Five is classified as a canal where the road acts as the drainage path in the area.

Rating	Descriptor	Description
1	Well above ground level	Edges of road are at least 300 mm above natural ground level with effective side drains.
2	Slightly above ground level	Road is between 50 and 300 mm above natural ground level. Side drains are present. Stormwater could cross in isolated places.
3	Level with ground	Road is generally at ground level with ineffective side drains. Stormwater could cross in most places.
4	Slightly beneath ground level	Isolated areas of the road are below natural ground level. No side drains are present and localised ponding of water will occur.
5	Canal	Road is the lowest point and serves to drain the entire area.

The descriptors are essentially applicable to roads in flat or slightly sloping terrain. Where grades are steeper, roads assessed as degrees 4 and 5 will act as drainage courses during periods of intensive rainfall leading to severe erosion.

7.3 Side Drain Condition

The condition of the drains running alongside the road are to be rated as follows:

Rating	Descriptor	Description
1	Very Good	Side drains are well shaped with no evidence of erosion, siltation or vegetation. Fully functional and no maintenance is required.
2	Good	Between 1 and 3.
3	Fair	Side drains have slight erosion, siltation or vegetation growth. Functional, however maintenance is recommended.
4	Poor	Between 3 and 5.
5	Very Poor/None	Side drains are badly eroded, silted up or overgrown with vegetation. They either are not functional at all or don't exist.

Should the evaluator rate the side drainage condition in the range of fair to very poor then the predominant problem should be noted. Only one problem can be noted. These are as follows:

Rating	Description
N	No side drain exists.
E	Erosion problem exists in the side drain.
S	Siltation problem exists in the side drain.
V	The side drain is overgrown with vegetation.

7.4 Mitre Drain Condition

The condition of the mitre drains along the road are to be rated as follows:

Rating	Descriptor	Description
1	Very Good	Mitre drains are well shaped with no evidence of erosion, siltation or vegetation. Fully functional and no maintenance is required.
2	Good	Between 1 and 3.
3	Fair	Mitre drains have slight erosion, siltation or vegetation growth. Functional, however maintenance is recommended.
4	Poor	Between 3 and 5.
5	Very Poor/None	Mitre drains are badly eroded, silted up or overgrown with vegetation. They either are not functional at all or don't exist.

Should the evaluator rate the mitre drainage condition in the range of fair to very poor then the predominant problem should be noted. Only one problem can be noted. These are as follows:

Rating	Description
N	No mitre drain exist.
E	Erosion problem exists in the mitre drains.
S	Siltation problem exists in the mitre drains.
V	The mitre drains are overgrown with vegetation.

8. SUMMARY ASSESSMENT

8.1 Action Required

The evaluator is required to give his opinion of the appropriate maintenance action to be taken on the specific segment. The following possible actions exist:

Rating		Description
N	None	No action required. Road in good condition.
LB	Light Blading	Identify the need for continuation of light routine blading, or adjustment of the blading programme to be more appropriate to that specific segment.
HB	Heavy Blading	Where the road profile is incorrect resulting from insufficient or poor maintenance, this option can be marked. Depending on the severity of the problem, reshaping will entail heavy blading with watering and compaction, but could require limited ripping and recompaction in exceptional circumstances.
PG	Patch Gravelling	Labour intensive spot gravelling often associated with impassability, drainage/erosion problems or removal of excessive oversize material.
RG	Regravelling	Where there is insufficient material to provide the required level of service until the next assessment, this option should be selected.
RC	Reconstruct	Rip and rebuild to correct width, add additional material and reshape with watering and compaction. Breaking down or removal of oversize material may also be necessary.
B	Betterment	The same as Reconstruction (above) with the option of realigning sections of road.
DI	Drainage Improvement	Where drainage maintenance has been ineffective or insufficient drainage exists, corrective action needs to be taken. This could involve labour intensive clearing and reshaping of side drains and mitre drains, or the installation of new pipes.
UB	Upgrade to Blacktop	The traffic is adequate to warrant upgrading.

APPENDIX A

INSPECTION FORM