PRINGLE BAY RATEPAYERS

PRINGLE BAY GRAVEL STREET CONDITION SURVEY
A PRACTICAL MANUAL

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PRINGLE BAY GRAVEL STREET CONDITION SURVEY: Field Evaluation Sheet

1. INTRODUCTION

This document provides guidelines for the visual assessment of the condition and performance of unsealed roads (gravel roads/streets) for use in gravel road management systems, maintenance programming. This document is based on *Draft TMH12: Pavement Management Systems: Standard Visual Assessment: Manual for Unsealed Roads Version 1*

The appearance of distress is varied and often extremely complex. The task of describing this is achieved by recording its main characteristics – the so-called attributes of distress. The attributes referred to in this manual are the:

* Type
* Degree
* Extent (not covered in this document)

These attributes are defined below in general terms. In some cases, information is also provided on the mechanisms and causes of distress.

The type of distress evaluated will depend on the purpose of carrying out the assessment. The modes of distress needing assessment for strategic network level decisions may differ from those needed for detailed network level decisions. A number of assessment parameters are considered essential for any type of evaluation, while detailed descriptions of distress are often desirable, particularly for detailed network level investigations, project level investigations and research investigations. Typical types of distress encountered on unsealed roads include:

* Loss of gravel
* Potholes
* Rutting
* Erosion
* Corrugations
* Loose material
* Stoniness
* Dust
* Cracking

These can be assessed individually or in terms of their interactive effect on the functional performance of the road together with material properties, road profile, drainage etc. An example of this is the development of corrugations or potholes, which result in deterioration of overall functionality, particularly riding quality. For more detailed investigations, aspects such as cracking or rutting, although not directly related to riding quality for instance, are indicative of material quality or a potentially problematic situation such as periodic slipperiness or water ponding respectively.

2. **Degree**

The degree of a particular type of distress is a measure of its severity. Since the degree of distress can vary over the pavement section, the degree to be recorded should give the predominant severity of a particular type of distress. The degree is described by a number where:

- Degree 1 indicates the first evidence of a particular type of distress ("slight").
- Degree 3 indicates a warning condition. This would normally indicate that intervention might be required in order to avoid the distress deteriorating to a severe condition.
- Degree 5 indicates the worst degree ("severe"). Urgent attention is required.

The general descriptions of degree of each type of distress are presented in Table 1. These descriptions relate to the possible consequences of each type of distress and therefore also to the urgency of maintenance or rehabilitation. Degree 0 is recorded if the defect does not occur. Degree 1 generally indicates that no attention is required; degree 3 indicates that maintenance/improvement might be required in the near future, whereas degree 5 indicates that immediate maintenance/improvement is required. Specific classifications for the various types of distress have been compiled, based on these general descriptions.

TABLE 1: General description of degree classification

DEGREE	SEVERITY	DESCRIPTION
0	None	No distress visible
1	Slight	Distress difficult to discern. Only the first signs of distress are visible.
2	Between slight and warning	
3	Warning	Distress is distinct. Start of secondary defects. (Distress notable with respect to possible consequences. Maintenance might be required in near future eg. potholes can be removed by blading)
4	Between warning and severe	
5	Severe	Distress is extreme. Secondary defects are well-developed (high degree of secondary defects) and/or extreme severity of primary defect. (Urgent attention required e.g. potholes require manual repair).

A flow diagram illustrating the use of the five-point classification system is shown in Figure 1. The most important categories of degree are 1, 3 and 5. If there is any uncertainty regarding the condition between degrees 1 and 3 or 3 and 5, the defect may be marked as 2 or 4, respectively.

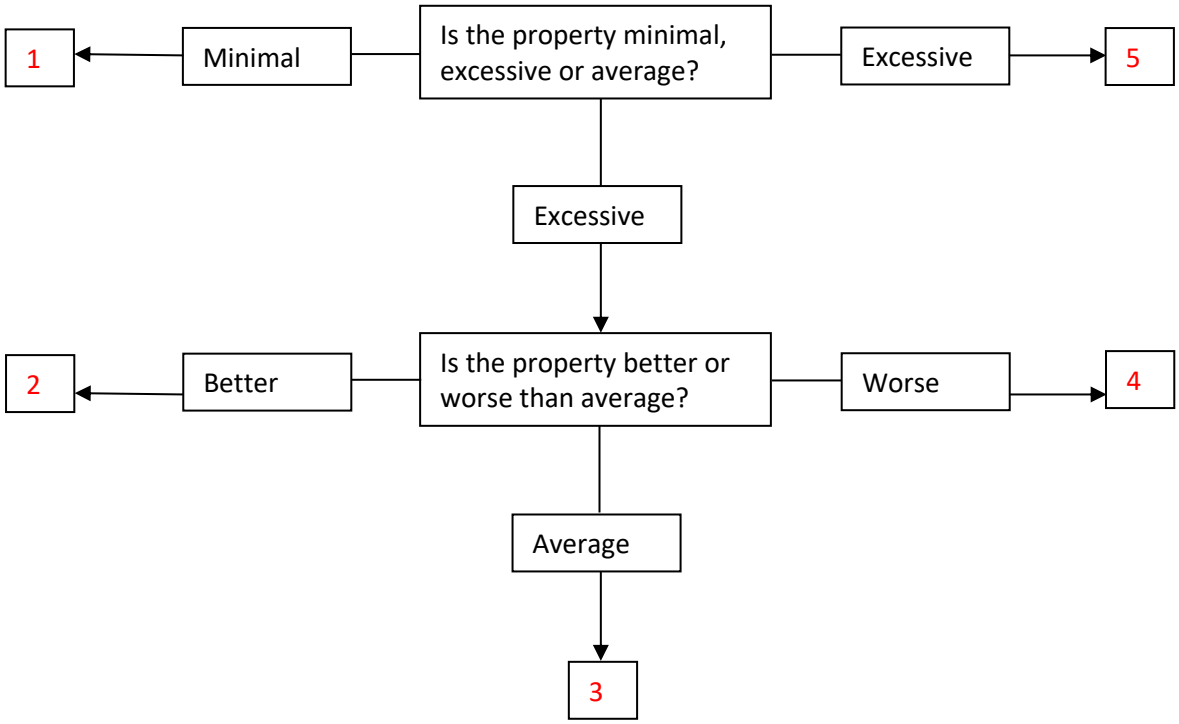


FIGURE 1: Flow diagram – five point classification system

3. Parameters to be Assessed

The following road characteristics should be assessed as a minimum in a Gravel Road Maintenance System (GRMS) assessment:

- General performance
- Moisture condition
- Gravel quantity/layer thickness
- Road profile/shape as an assessment of water shedding capacity
- Road drainage in terms of removal of water from the road surface
- Road drainage in terms of accepting water from elsewhere and drained along the road
- Riding quality and influencing factors
- Dust
- Trafficability
- Isolated problems

4. General Performance

An estimate of the general performance should be made. This should be representative of how the travelling public would view the condition and performance of the road. This parameter is recorded for possible use as a crosscheck with any visual condition index calculated from the full assessment (e.g. if general condition is rated as good, but corrugations are rated as severe over most of the road, a misjudgement has been recorded). It can also be used as a first indication of the overall performance of the road network.

General performance is assessed on a scale of **one** to **five** (where one is very good and five is very poor) primarily in terms of driver and passenger comfort and the drivers perception of safety. It should be estimated after driving the segment before the detailed assessment is carried out in order to eliminate any bias that may result after completing the detailed assessment.

5. Moisture Condition

The moisture condition affects the visual assessment of properties such as dust, corrugations, loose material and skid resistance. It is therefore necessary to estimate the moisture condition for later use if there are queries regarding the influence of any of these properties.

Assessment of the condition is limited to a subjective rating of "**wet**" (damp) or "**dry**" taking the consequences into account (e.g. the road will not be wet if dustiness is significant). Disturbance of windrows or loose material will usually indicate whether the material is wet.

6. Gravel Quantity/Layer Thickness

Most unsealed roads are constructed with a wearing course of about 150 mm of compacted selected gravel. Under traffic and environmental influences, this gradually wears away and requires periodic replacement. If it is not replaced, the subgrade is exposed to traffic. This material is usually unsuitable as a wearing course and results in trafficability problems and shear failures. In flat areas, drainage of water away from the road will be retarded or even impeded.

The rate of gravel loss is a function of the material properties and the traffic. However, as the traffic increases, or the material quality deteriorates, this annual loss increases significantly. The rate also increases if profile and drainage are poor

During the visual assessment, it is necessary to estimate whether sufficient gravel remains to provide adequate service until the next assessment period. This requires actual measurements of the layer thickness, or judgement by the evaluator taking into account the material quality, traffic and any evidence of subgrade exposure.

Gravel quantity is either rated on a five-point scale as described in Table 2, or physically measured on the road by excavating small holes in the wheel tracks. This should be done at a sufficient frequency (e.g. 5 holes on a 5 km segment) to determine a representative average for the segment. Output from the assessment will be millimetres of material remaining. It should be noted that the direct measurement of layer thickness is essentially a measure of the severity of gravel loss, while estimation of the subgrade exposure represents an extent. Although the former is the optimum solution, the latter is a more readily obtained proxy for the severity.

TABLE 2: Visual assessment of gravel quantity

RATING	DESCRIPTOR	DESCRIPTION	mm
1	Plenty	Good shape, and no stone protrusion	>125
2	Sufficient	No exposures of subgrade, but some stone protrusion	100 – 125
3	Isolated exposures	Less than 25 per cent exposure of the subgrade	50 – 100
4	Extensive exposures	Up to 75 per cent exposure of the subgrade	25 – 50
5	None	75 to 100 per cent exposure*	0 – 25
* Total exposure of subgrade should not be confused with plenty of gravel			

When visually assessing gravel thickness, adequate cover of material over pipe drains and culverts can be a good indicator, bearing in mind that all culverts/pipes should have sufficient cover to protect the structures from traffic loads. Exposure of pipe drains, culverts and bedrock indicates neglect of the road and inadequate gravel cover. The same applies to stone exposure. If it is assumed that the surface of the road was level after compaction, the height of stones above the surrounding road surface will give an indication of the amount of gravel that has been lost.

When less than 25 per cent of the imported gravel wearing course material remains, but the exposed subgrade material appears to be performing adequately, the gravel quantity should still be rated as “none” to ensure that the road is prioritised for regravelling by the GRMS.

GRAVEL QUANTITY

Degree 1

X	**2**	**3**	**4**	**5**

Plenty

Degree 3

1	**2**	**X**	**4**	**5**

Isolated exposures

Degree 5

1	**2**	**3**	**4**	**X**

None

7. Road Profile/Shape

The profile (shape) of a road has a major impact on the performance of that road. Roads with good profile tend to shed water rapidly avoiding the development of potholes and potentially impassable conditions. Where the profile is flat, water tends to pond in localised depressions resulting in softening of the wearing course and the development of potholes and other deterioration. Failure to timeously repair a flat road will usually result in the development of ruts under traffic. These may become preferential water paths resulting in erosion, accelerated gravel loss and significant deterioration in riding quality.

It should be noted that rutting in unsealed roads is generally the result of loosening and whip-off of material and is only seldom the result of subgrade deformation/settlement. Routine grader blading usually reduces rutting.

The road profile is rated on a five-point scale where one is very good and the trafficked surface will shed water easily, and five is very uneven resulting in potential localised ponding and/or surface drainage occurring in a longitudinal direction. These are defined in Table 3 and illustrated in Figure 1. It should be noted that on grades, the impact of the gravel profile becomes less dominant than the actual grade.

TABLE 3: Visual assessment of gravel profile

Rating	Descriptor	Description
1	Very good shape	Well formed camber (about 3 - 4 per cent)
2	Good shape	Good camber (about 2 per cent)
3	Flat	Some unevenness with camber mostly less than 2 per cent
4	Uneven	Obvious development of irregularities that will impede drainage and form depressions
5	Very uneven	Development of severe irregularities impeding drainage and likely to cause extensive localised ponding. Water tends to flow to the centre of the road or individual lanes

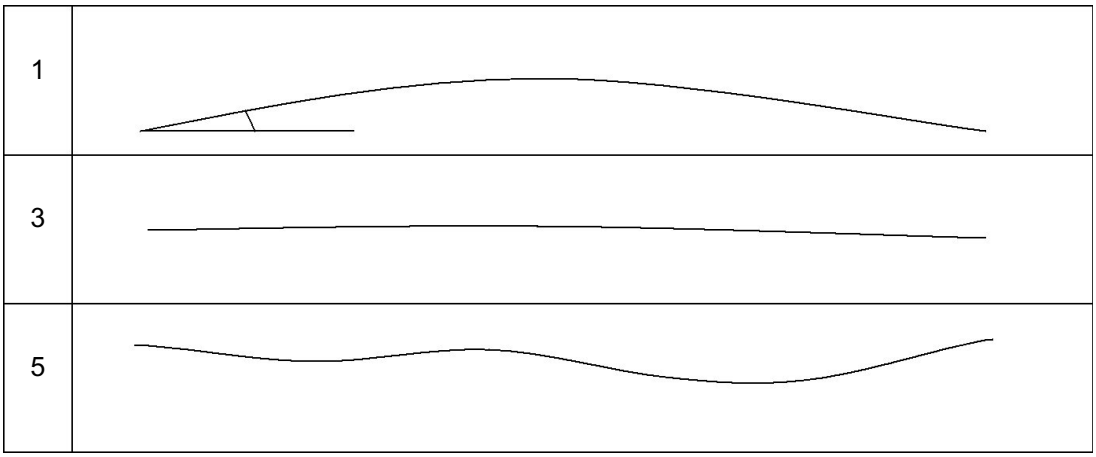
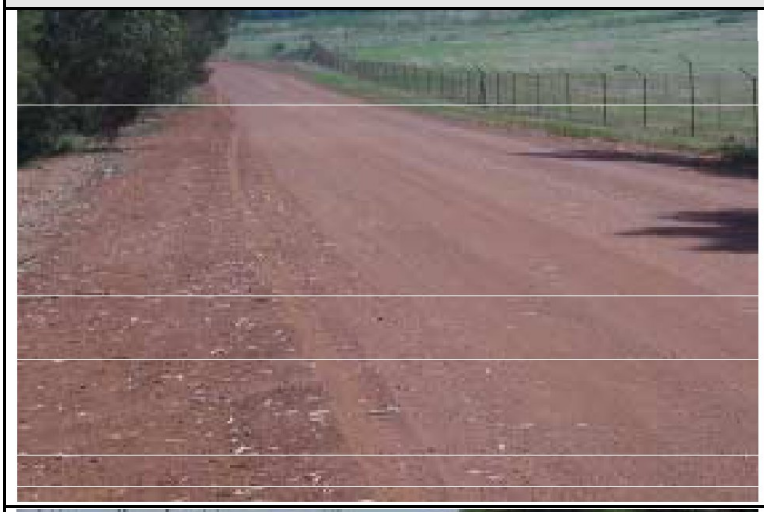


FIGURE 1 Gravel profile schematics

GRAVEL PROFILE



Degree 1

X	**2**	**3**	**4**	**5**

Very good

Degree 3

1	**2**	**X**	**4**	**5**

Flat

Degree 5

1	**2**	**3**	**4**	**X**

Very uneven

8. Drainage from and along the road

There is obviously a strong interrelationship between the road profile discussed previously (drainage off the road) and drainage from the road. However, the profile 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. These are defined in Table 4 and illustrated in Figure 2. 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.

TABLE 4: Visual assessment of drainage/road formation

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.
* If pipes are laid under the road for drainage, then the formation should be at least 500 mm above natural ground level		

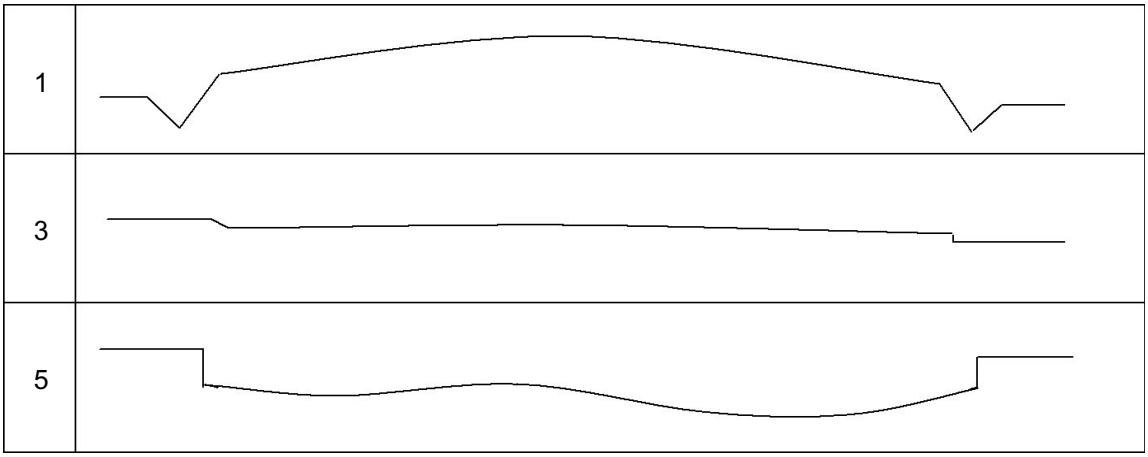


FIGURE 2: Schematics of road drainage

NOTE: Additional information may be required on the presence, condition and effectiveness/adequacy of culverts and mitre drains.

DRAINAGE

Degree 1

X	**2**	**3**	**4**	**5**

Well above ground

Degree 3

1	**2**	**X**	**4**	**5**

Level with ground

Degree 5

1	**2**	**3**	**4**	**X**

Canal

9. Riding Quality and Influencing Factors

The riding quality of the road is probably the major performance parameter affecting driver and passenger comfort and safety. It also has a significant impact on the overall vehicle operating cost associated with the road. Road roughness is best quantified using one of the many items of equipment dedicated to roughness evaluation. However, for the purposes of network assessment, it is usually acceptable to rate the riding quality subjectively.

Road roughness is influenced primarily by maintenance frequency, quality of grader maintenance and material properties. Other factors such as intensive rainfall and heavy seasonal traffic will also have an influence. Certain pavement defects are the direct result of deficiencies in the material properties. These defects influencing riding quality are:

- Corrugation
- Loose material
- Stoniness
- Potholes
- Ruts
- Erosion

More detail is given on these defects in later sections.

Riding quality is most easily rated as a function of the “estimated” comfortable and safe driving speed (unaffected by geometric constraints or road width) that could be driven in a privately-owned passenger/saloon car. This is estimated while travelling at the speed recommended for visual assessment (40 km/h) and is interpreted as follows (Table 5):

TABLE 5: Assessment of riding quality

Rating	Descriptor	Description
1	Very good	Estimated comfortable/safe speed in excess of 35-40 km/h
2	Good	Estimated comfortable/safe speed between 30and 35km/h
3	Average	Estimated comfortable/safe speed between 25 and 30 km/h
4	Poor	Estimated comfortable/safe speed between 20 and 25 km/h
5	Very poor	Estimated comfortable/safe speed less than 20 km/h

Riding quality is usually measured in conjunction with an assessment of the parameters that influence it.

RIDING QUALITY

Degree 1

X	**2**	**3**	**4**	**5**

Very good

Degree 3

1	**2**	**X**	**4**	**5**

Average

Degree 5

1	**2**	**3**	**4**	**X**

Very poor

RIDING QUALITY – INFLUENCING FACTORS

Corrugation

Loose material

Stoniness

RIDING QUALITY – INFLUENCING FACTORS

Potholes

Rutting

Erosion

10. Dust

Definition and cause

Road dust is the dry solid matter consisting of clay and silt-sized particles that is entrained by wind, the wind shear forces created by vehicles and the interaction of vehicle tyres with the road and which disperses and remains in suspension for a period before eventually falling back to the earth's surface. The aerodynamic shape, tyre size and number of wheels on trucks imply that dust generation by heavy vehicles is more severe than light vehicles.

Problem

Dust is undesirable from a number of points of view including safety (loss of visibility), economic (accelerated gravel loss as a result of the loss of fines), comfort of vehicle occupants, health (respiratory diseases), vehicle damage (filters and exposed moving parts), damage to road side vegetation (Fynbos) and environmental impact (air pollution). Dust is generally considered unacceptable by the travelling public when the vehicle generating the dust cannot be seen by a following vehicle.

Measurement

At network level, assessment of dust is necessary as input for prioritising a potential dust problem and determining the costs of applying a dust palliative. In assessing the dustiness of a road, the moisture condition at the time of assessment plays a major role. Dust generation is influenced by many factors and some subjectivity during assessment is inevitable. The following procedure has been developed in an attempt to bring some uniformity to dust assessment.

For the purposes of strategic network level assessments, dust is usually rated as either **acceptable** or **unacceptable** with safety being the major factor taken into account. If the dust generated by a vehicle is perceived to be dangerous, it should be rated as unacceptable. Dustiness should be rated in the rear view mirror while travelling at 40 km/h. This may require that short distances within the segment are monitored at this higher speed. Wind speed and lighting conditions (position of the sun) can influence rating in this way and should be taken into consideration.

The description of degrees of dustiness is given in Table 6. The extent of dust is not normally estimated.

TABLE 6: Degrees of dustiness

Degree	Description
1	No loss of visibility
3	Some loss of visibility – no discomfort
5	Dangerous loss of visibility – significant discomfort

DUST	
	Degree 1 Acceptable
	Degree 5 Unacceptable

11. Trafficability

Definition and cause

Trafficability (or passability) is the capacity of a normal saloon car to negotiate the road without losing traction or without excessive use of low gears. The terms trafficability and impassability are used interchangeably throughout this document (however, impassability should not be confused with the inability to overtake in dusty conditions). The mechanism affecting trafficability is the loss of traction between the tyres and the road resulting from the low shear strength of the material. This results in churning of the material and sinking of the vehicle into the weak layer. Sandy materials are more prone to impassability when dry, while clayey materials are strong when dry, but often become impassable when wet. Impassable conditions may result from continued trafficking of slippery roads.

Problem

The primary objective of importing wearing course gravel during the construction of an unsealed road is to provide an all-weather surface. This objective is not met if the material becomes impassable in wet weather. This is often a particular problem with earth roads where in situ materials are used.

Assessment

Impassability is difficult to assess unless the Evaluator actually experiences the condition at its worst. However, evidence of earlier impassable conditions often remains after the event. This includes:

- Deep depressions and evidence of potholes
- Detouring on the shoulders and verges to avoid wet areas
- Spurious material used to fill depressions and to provide temporary traction (often includes vegetation)

For assessment purposes, trafficability is rated as either **acceptable** or **unacceptable**, the latter only being used when definite evidence is observed over a major portion of the segment.

TRAFFICABILITY

Degree 1

Acceptable

Degree 5

Unacceptable

PRINGLE BAY GRAVEL STREET CONDITION SURVEY

EVALUATOR						**DATE**	dd:		mm:		yy:	
STREET NAME					**SECTION**							
GENERAL PERFORMANCE	1	2	3	4	5	**MOISTURE CONTENT**	Wet		Dry			

GRAVEL QUANTITY	Plenty	1	Sufficient	2	Isolated Exposure	3	Extensive Exposure	4	None	5
ROAD PROFILE/SHAPE	Very Good (4%)	1	Good (2%)	2	Flat	3	Uneven	4	Very Uneven	5
DRAINAGE FROM THE ROAD	Well Above Ground	1	Slightly Above	2	Level with Ground	3	Slightly Below	4	Canal	5
DRAINAGE ALONG THE ROAD	Well defined shaped canal	1	Natural canal	2	Visible signs of Erosion	3	Severe Erosion on side of road	4	Dangerous Erosion / Donga on side of road	5
RIDING QUALITY / SAFETY	Very Good (35-40km/h)	1	Good (30-35km/h)	2	Average (25-30km/h)	3	Poor (20-25km/h)	4	Very Poor (<20km/h)	5

INFLUENCING FACTORS	Corrugation	Loose Material	Stoniness	Potholes	Ruts	Erosion
ISOLATED PROBLEMS	Potholes	Corrugation	Transverse Erosion	Longitudinal Erosion	Rough patches	Slipperiness

DUST	Acceptable		Unacceptable		
TRAFFICABILITY	Acceptable		Unacceptable		

COMMENTS