AUS-SPEC

Infrastructure Specifications

0054 Rural pavement design - unsealed

0054 RURAL PAVEMENT DESIGN - UNSEALED

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- See ANNEXURE M at the end of this document which contains (where practical) Cessnock City Council customisations (also known as 'office master' text). References to the Annexure are to also be inserted at relevant clauses in the main body of the document.
- Where content is added to the main body of the document, it is to be shown in brown text like this.
- Where content is deleted or excluded from the main body of the document, it is to be shown ~~struck through like this~~. Such clauses are to have no effect.

Where there is a conflict between main body text and Cessnock City Council specific clauses, Council's specific clauses shall prevail.

1 GENERAL

1.1 INTRODUCTION

Worksection application

Description: This worksection is applicable to the design and documentation for new road pavements and rehabilitation of existing unsealed pavements. It includes procedures for designing the following type of pavements:

- Unsealed flexible pavements comprised of unbound granular materials.
- Unsealed pavements.

1.2 RESPONSIBILITIES

General

Requirement: Provide design and documentation for pavement and surfacing materials; including types, layer thicknesses and configurations; so that the pavement performs to its designed expectations and requires minimal maintenance under the ~~anticipated~~ design traffic loading for the required design life.

1.3 STANDARDS

General

Road design: To Austroads AGRD01 (2021), Austroads AGRD07, ARRB Best Practice Guide 1 (2020) and ARRB Best Practice Guide 2 (2020).

Design considerations: To Austroads AGRD01 (2021) Table 4.5.

Pavement structural design: To Austroads AGPT02 (2017) and AGPT06..

1.4 INTERPRETATION

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- ARRB: Australian Road Research Board.
- CBR: California bearing ratio.
- DCP: Dynamic Cone Penetrometer.
- ESA: Equivalent standard axle.
- HV: Heavy vehicle.
- HVAG: Heavy vehicle axle group.
- MDD: Maximum Dry Density.

- ODD: Optimum Dry Density.
- PI: Plasticity Index.
- PSD: Particle size distribution.
- RAP: Reclaimed asphalt pavement.
- UCS: Unconfined compressive strength.

1.5 DEFINITIONS

Pavement specific definitions

For the purposes of this worksection the definitions in Austroads AP-C87 (2015) and ARRB Best Practice Guide 2 ~~following~~ definitions apply:

- Base course: ~~Directly onto the subgrade or subbase if applicable.~~ One or more layers of material usually constituting the uppermost structural element of a pavement and on which the surfacing may be placed. For unsealed roads, the base course may also be designed to perform as a wearing course. It may be composed of fine crushed rock, natural gravel, broken stone, or stabilised material.
- Blended granular material: Joining of two or more gravel materials in various designed % mix blends using ARRB spreadsheet model to achieve improved structural strength and improved plasticity whether smaller or larger as required.
- Flexible pavement: A pavement which obtains its load-spreading properties from intergranular pressure, mechanical interlock and cohesion between the particles of the pavement material.
- Formed road: This road is designed to the geometric design standards with the required drainage. These are earth roads made up of local materials with no imported gravel requiring periodic resheeting maintenance. Will require patrol grading maintenance including heavy patching from time to time
- Formed and gravel: This road is designed to the appropriate geometric design standards with the required drainage. A layer of imported granular material is compacted to the required thickness to support estimated traffic. Resheeting and patrol grading maintenance is required on a regular basis.
- Modified granular material: Granular materials to which small amounts of stabilising agent have been added to improve their performance without causing a significant increase in structural stiffness.
- Recycled materials: Materials manufactured from recycled material such as crushed concrete, bricks, terracotta tiles or glass or reclaimed asphalt pavement (RAP).
- Reconstruction: Treatments requiring full removal and replacement and/or improvement of the existing pavement structure including subbase, base course, and surface course.
- Rehabilitation: Resurfacing, reconstruction heavy patching and stabilisation work undertaken to restore serviceability and to extend the service life of an existing road.
- Subbase: Course granular ~~preferably impervious~~ material such as material meeting ~~usually~~ DGS40 specification.
  . Provides structural strength.
  . Prevents intrusion of parent material into wearing course or base course layer, if applicable.
- Subgrade: Natural parent material ~~with CBR% greater than 5. If less than 5 excavate as unsuitable material.~~ on which the pavement is constructed.
- Unformed road: These are non-engineered roads that simply consists of a track that is cleared of vegetation. These are often not all weather roads and carry very low traffic volumes.
- Wearing course: That part of the pavement specifically designed to resist abrasion from traffic and to minimise the entry of water. Also referred as the ‘sheeting layer’; it is maintained with patrol grading and replenished after some years as its thickness is reduced and/or when a large amount of fine material has been lost as dust.

2 PRE-DESIGN PLANNING

2.1 EXISTING PAVEMENT CONDITION EVALUATION

Data collection

Requirement: Collect the following information for pavements requiring rehabilitation, to assess the existing pavement condition and the rehabilitation actions required:

- Layer material and subgrade soil CBR% ~~testing with cone penetrometer.~~ in situ testing with Dynamic Cone Penetrometer (DCP) or, more reliably if time and budget permits, 4- or 7-day soaked CBR laboratory testing.
- ESA traffic loadings.
- Climatic conditions.

Condition assessment

Assess pavement condition as appropriate for the development, including the following methods:

- Pavement condition/distress survey: Identify the following through detailed visual inspection(s):
  . Distress type: For example ravelling, corrugating, erodible, slippery, dusty, gouging and potholes.
- In-depth field investigation:
  . Testing of the source gravel pits and apply to the ARRB Best Practice Guide ~~1~~ 2 (2020) Figure A 4 and ARRB Grading Assessment Spreadsheet Model.

Council and other Authorities

Requirements: Consult with the other adjoining Councils and other relevant authorities during the preparation of design. In addition to the requirements of this worksection, identify the specific design requirements of these authorities.

Authorities: As required by relevant DA consent conditions

Public consultation

Requirements: Undertake public consultation on design in conformance with Council policy.

Utilities services plans

Existing services: Obtain service plans from all relevant utilities and other organisations whose services exist within the area of the proposed development. Plot these services on the relevant drawings including the plan and cross-sectional views.

Location of subsurface utilities: To AS 5488.1 (2022). Contact BEFORE YOU DIG AUSTRALIA to identify the locations of underground utility services pipes and cables.

3 ROAD ASSESSMENT

3.1 DESIGN INPUTS

Design life

Wearing ~~coarse~~ course: 3 to 12 years dependent on weather conditions.(Typically for tropical conditions the design life ~~is~~ may be around 3 years and 12 years for dry areas.)

Base course and subgrade: 10 to 50 years subject to proper maintenance, good selection of materials and timely replacement of wearing course.

Project scope and base design factors

Project design: Consider the following factors:

- Soil type.
- Type and volume of traffic including traffic loading, future trends and climate.
- Availability of materials.
- Maintenance costs.
- Risk.

Stages of pavement construction

Pavement type: Select from any of the following types:

- For existing tracks or new intermittent access tracks: Unformed or Formed in accordance with the road classification provided in Austroads AGPT06.
- For traffic-generating development applications (DAs): Formed and gravelled in accordance wih Council's *0041 Geometric sealed road design* worksection, Annexure M Road classification table M5.2.

Classification

Functional rural road classification: To Austroads AGRD01 (2021) Table 4.1.

Unsealed road classification: To Austroads AGPT06 (2009) Table 2.1 or
ARRB Best Practice Guide 2 (2020) Table 3.9.

Council design classification: To *0041 Geometric sealed road design* worksection Appendix M5 Table 2 Rural and Rural-Residential Roads.

Pavement materials

Selection of pavement materials: Consider the following factors affecting the performance of materials:

- For all pavement layers:
  - Stability: To resist deformation both vertically and laterally.
  - Impermeability: To protect the underlying material from the entry of water and subsequent loss of bearing strength or stability.
  - Workability and compaction: Ease with which the material is compacted to a desired density, finished surface and uniformity.
- For wearing course: Resistance to wear to provide a tight surface where the aggregate is held in place strongly by the fine soil matrix when exposed to weather and traffic.

Tests

Testing required for unsealed wearing course pavement: Perform tests for Particle Size Distribution (sieve gradings), Atterberg limits, soaked and unsoaked CBR , linear shrinkage% and Optimum Dry Density before and after multiple material blending if required. Targeting grading to achieve a MDD over 2.2 t/m^3 ~~to achieve~~ may improve impermeability of gravel.

Suggested 4 day soaked CBR values for pavement materials for unsealed roads

Pavement layer	**Minimum typical CBR (soaked)**
Wearing course (gravel materials)	40
Base	50
Subbase	30
Source: Austroads AGPT06 (2009) Table 3.1.	

3.2 REHABILITATION OF UNSEALED ROADS

Project design

Design factors: Address all factors causing the defects in addition to the surface indicators in the final design. Consider factors such as structural capacity of the pavement, subgrade support strength, surface and subsurface drainage characteristics in the final design.

3.3 DESIGN OF NEW UNSEALED PAVEMENTS

Pavement design procedure

Design variables: Select pavement types based on the design variables and subgrade evaluation:

- Pavement thickness: Determine the thicknesses of subbase, base and wearing course for the traffic loadings performance required.

Safety in design

Requirement: Provide a design that allows for safe construction, operation and maintenance, and demolition in conformance with statutory requirements.

3.4 DESIGN TRAFFIC

Traffic loading

Standards: To Austroads AGPT02 (2017) Section 12 and Austroads AGPT06 (2009).

Vehicle classification system: To Austroads AGPT02 (2017) Table 7.1.

Requirement: Design road pavement so that the pavement width and geometry allows vehicles to operate safely at an acceptable speed. For example, the pavement design within the shoulders or table drains may need to cater for or consider occasional vehicular loadings for one-way roads, or shoulders may need to perform structurally the same as the pavement on widened heavy haulage routes. Make sure the pavement strength is suitable for the heaviest of the design vehicles and is able to withstand the cumulative effects of the passage of all vehicles. A pavement built without sufficient strength is prone to rutting defect.

Minimum pavement design life (period)

General method: Determine the design life to suit the design traffic conditions, as appropriate for the road pavement, to function without major rehabilitation or reconstruction, based on the following minimum design life for the pavement type:

- Flexible, unbound granular: ~~25 years minimum.~~ To the DA consent conditions, or if not specified, to *0041 Geometric sealed road design* worksection Appendix M5 Table 2 Rural and Rural-residential Roads.

Equivalent standard axles (ESA)
Requirement: Calculate design traffic in equivalent standard axles (ESA's) for the design life of the pavement. Take into account the present and predicted heavy vehicle traffic volumes.

Design traffic volumes
ESA for non-urban streets: ~~To **Design ESA's 25-year design life table.**~~ To the DA consent conditions, or if not specified, to *0041 Geometric sealed road design* worksection Appendix M5 Table 2 Rural and Rural-residential Roads.

~~**Design ESA's 25-year design life table**~~

~~**Road type**~~	~~**Design ESA's – 25-year design life**~~
~~Rural local~~	~~3 x 10^5~~

4 SUBGRADE PAVEMENT MATERIAL DESIGN CRITERIA

4.1 SUBGRADE EVALUATION

Design considerations
Subgrade support design: Consider the following factors:

- The compaction moisture content and field density required for construction.
- Subgrade variability.
- Stabilisation requirements both granular and chemical.
- Carry out subgrade evaluation to determine CBR using a ~~Proctor~~ Dynamic Cone Penetrometer or laboratory testing..

Design CBR
Design CBR value: For the design, determine a subgrade CBR value at the density and moisture conditions which are expected to prevail in-service for each identifiable unit, defined by topography, drainage and soil type. A collection of in situ correlated CBR% or lab soaked CBR% or a values intermediate between soaked and unsoaked may be ~~used.~~ appropriate for unsealed roads ~~due to~~ considering exposure to rain and in particular for roads subject to flooding inundation.

Calculation of design CBR
Methods of calculating CBR: Determine the CBR value based on ~~either~~ one or a combination of the following methods:

- Testing by a NATA-accredited laboratory: 4- or 7-day soaked CBR.
- Clegg Impact Hammer test: ~~Field testing:~~ To Austroads AGPT06 (2009) clause 3.1.1 using Clegg Impact Hammer test.
- Dynamic Cone Penetrometer (DCP): Determine CBR using DCP testing to AS 1289.6.3.2 (1997) and Austroads AGPT02 (2017) Figure 5.3 gives a correlation between DCP and CBR values.

Note: ARRB Best Practice Guide 1 (2020) clause 3.7.5 gives detailed information how to carry out DCP test and Figure 3.23 gives a correlation between DCP and CBR.

Presumptive subgrade design CBR (not to be used for roads that will cater for traffic generating developments):: If no information is available, adopt the presumptive values for lightly trafficked roads to Austroads AGPT02 (2017) Table 5.4.

Summary of results
Pavement design: Include a summary of all laboratory and field test results and assumptions and/or calculations made in the assessment of design soaked and unsoaked CBR%.

MDD: Target for blending gravels to MDD over 2.2 t/m^3 to ~~create impervious~~ increase the impermeability of the wearing course, base and subbase course to prevent water penetration into the weaker subgrade layer. Subgrade failure will result in pothole defects.

5 BASE AND SUBBASE UNSEALED PAVEMENT INVESTIGATION AND DESIGN

5.1 GENERAL

Factors affecting pavement design

Subgrade factors: Determine the granular base and subbase thickness for subgrade cover by considering the following factors:

- CBR measured in winter when the parent soil is wet.
- ESA equivalent standard axles for design life ~~of 25 years.~~ specified at Section 3.4 above.
- Cost effective: It is more cost effective to provide the required thickness initially rather than multiple follow up constructions.
- Thickness for granular pavement design unsealed (80% confidence): Need to determine the granular base and subbase thickness for subgrade cover.
- Where pavement course thicknesses are not specified by DA consent conditions or Section 3.4 above, use the ARRB Best Practice Guide 2 (2020) Figure 3.17 for a correlation between Traffic ESA's to subgrade CBR's to design thickness of pavement.

Other factors affecting pavement design:

- 4 to 6% cross fall on wearing course.
- Tightly bound dense ~~impervious~~ impermeable wearing surface is preferred by blending if required.
- Good table drains preventing moisture intrusion into the pavement.
- Use a 4-day soaked CBR with lab testing (if not using Dynamic Cone ~~Proctor~~ Penetrometer testing).
- Spacing of test CBR's at 300 m for rural roads.
- Not less than 3 tests per project.
- Use 10th percentile low value of the CBR's.

6 WEARING COURSE PAVEMENT MATERIALS

6.1 SELECTION OF WEARING COURSE

General

Design parameters: Use ARRB Best Practice Guide 2 (2020) Figure A 4 Relationship between shrinkage product, grading coefficient and performance of base and wearing course.

Defect Factors: Selection of appropriate material is required to avoid the surface being characterised as ~~defective surface like~~ slippery, erodible, ravels, potholing, corrugates and ravels, rutting and surface gouging ~~or good without blending.~~

Design requirements: Select wearing course material such that:

- It binds material to prevent ravelling and corrugations.
- Using material blending it creates a wearing course pavement with sufficient CBR strength to minimise rutting and surface gouging.
- Using blending it creates a dense ~~impervious~~ impermeable gravel material with a MDD over 2.2 and preferably 2.3 to prevent water intrusion through the wearing course and into the low strength subgrade and prevents pothole defects.
- It provides smooth running surface with minimal dust and is non-slippery after rain. Evaluate using the ARRB Grading Assessment Spreadsheet model.

Selection of wearing course: Formulae for use of chart indicators to
ARRB Best Practice Guide 2 (2020) Figure A 4:

- Shrinkage product = linear shrinkage x % passing 0.425 mm sieve (maximum 240 preferred).
- Grading coefficient = (% passing 26.5 mm - % passing 2.0 mm) x (% passing 4.75 mm)/100.
- Soaked CBR% greater than ~~20~~ the value provided in the **4 day soaked CBR values for pavement materials for unsealed roads table** above (95% modified and 4 days soaking).
- If the pit gravel is not "good" with reference to the model parameters (e.g. ARRB spreadsheet) then use blending of 2 or 3 local materials with different properties to get the best fit in line with the ARRB Best Practice Guide 2 (2020) Section 4.2.1.

- Use the ARRB Grading Assessment Spreadsheet model or model in the IPWEAQ Supervisors Handbook.
- Blend of granular and plastic binder to a designed mix formulae. A plasticity Index between 9 and 13 is an ideal binder plasticity. Test the grading and Shrinkage limits.
- Use the ARRB Grading Assessment Spreadsheet model to achieve the best mix combination.
- Wearing course is exposed to rain therefore it should be an impermeable pavement material with high MDD to prevent wetting of weaker low CBR subgrade.

Recommended PI, CBR and MDD for natural gravel wearing course cover when mixed table

Plasticity Index	Not greater than 12 for > 500 mm rain annually Not greater than 15 for < 500 mm rain annually
Soaked and unsoaked CBR	In excess of ~~40% for soaked and 50% for unsoaked CBR~~ the value given in the **4 day soaked CBR values for pavement materials for unsealed roads table** above.
Maximum Dry Density (MDD) for mixed gravels	Target greater than 2.2 t/m^3 MDD for ~~impervious~~ impermeable rating

7 BASE COURSE GRADINGS SELECTION

7.1 BASE COURSE REQUIREMENTS

General

Requirements: Base course requirements for unsealed roads are generally broader than for sealed roads although the principles are the same.

Material properties

Particle size distribution (PSD): Controls permeability with emphasis on % of material finer than 0.5 mm.

Shape of the stone: Select shape considering the following factors:

- To achieve good compaction.
- Prefer cubic shape with rugged edges for interlocking.
- Do not select flat pieces or round river gravel pieces because of compaction difficulty.
- Do not select with sharp stone edges that risk causing tyre damage.

Plasticity: Select fine material below 0.425 mm.

Aggregate hardness: As indicated by the geologist, consider reduced risk of breakdown under construction compaction and vehicle trafficking and is an important property for wearing course.

Atterberg and shrinkage limits:

- Fine grained cohesive soils properties vary in different states (solid if dry and semi-solid, plastic and liquid states) based on the interaction between the soil particles and water.
- Water contents at the boundaries between the soil states are termed, linear shrinkage, plastic limit and liquid limit and give an indication of the amount of clay present in the soil.

Recommended sieve size gradings for natural gravel base under an unsealed wearing course unsealed table

Sieve size passing (mm)	40mm nominal screened gravel % passing	20mm nominal screened gravel % passing
53	100	
37.5	95 - 100	
26.5		100
19.0	60 - 81	95 - 100
9.5	45 - 70	70 - 92
4.75	34 - 58	50 - 76
2.36	26 - 48	35 - 63

Sieve size passing (mm)	**40mm nominal screened gravel % passing**	**20mm nominal screened gravel % passing**
0.425	10 - 32	15 - 40
0.075	4 - 26	4 - 25
Plasticity Index[a]	Not greater than 8 for > 500 mm rain annually, not greater than 13 for < 500 mm rain annually	
Soaked CBR%	In excess of ~~40 soaked or 50 unsoaked for rural construction~~ the value given in the **4 day soaked CBR values for pavement materials for unsealed roads table** above	
a. Plasticity Index is the difference between plastic limit and the liquid limit.		

Recycled materials for road construction: To Austroads AGPT04E (2022), IPWEA PN 13 (2023) for the use of recycled materials in infrastructure assets, LGNSW (2020) *Guide to recycled materials in roads and pavements*, ARRB Best Practice Guide 1 (2020)~~ and *1140 Wearing course, base and subbase - unsealed*.~~

Reference: Due regard should be taken of the opportunity to use recycled materials for the subbase and base course of pavement. Austroads AP-T85 (2007) discusses optimum use of material for granular bases. Refer to
ARRB Best Practice Expert Advice on the Use of Recycled Materials in Road and Rail Infrastructure: Part A Technical Review and Assessment (2022),
ARRB Best Practice Expert Advice on the Use of Recycled Materials in Road and Rail Infrastructure: Part B Sustainability Impacts Report (2022) and factsheets available from www.arrb.com.au.

Plasticity index for non-standard materials table

Material use	**Annual rainfall (mm)**			
	< 500 mm		> 500 mm	
	Liquid Limit	Plasticity Index	Liquid Limit	Plasticity Index
Unsealed base/shoulder	35 (max)	7-15	35 (max)	4-9
Subbase for unsealed pavements	35 (max)	18 (max)	35 (max)	15 (max)

8 COST AND PERFORMANCE EVALUATION

8.1 METHODS TO IMPROVE PAVEMENT PERFORMANCE

Strengthening of unsealed roads

Base gravel: Strengthen with DGS 20 hard rock gravel or crusher dust by product or crushed and screened waste material from local mines or crushed and blended on the job site with local pit gravels.

Locally available materials: Fit-for-purpose locally available materials to Austroads AP-T352 (2020).

Cost evaluation: To Austroads AP-T353 (2020).

Blending of natural local pit gravels

Blending for wearing course: Consider a combination of two local pit gravels plus/or adding a ~~stabilent~~ stabilising binder at the pugmill and using a roadside cleared area to mix two local pit gravels, ~~stabilent~~ stabilising binder and water with a pugmill. Pre-construction assess the design blend with computer.

ARRB Best Practice Guide 2 (2020) - Grading Assessment Spreadsheet ~~for~~ to determine the best % mix to provide the ~~best~~ optimal wearing surface performance and longer whole of life costs and conform to the following:

- Establish the relationship between shrinkage, grading coefficient and performance using the ARRB Best Practice Guide 1 (2020) Figure A 4.
- NATSPEC TECHnote DES 035 *Improvement and Stabilisation of Unsealed Roads*.
- *IPWEAQ Supervisor's Handbook (2016)* for the *Construction and Maintenance of Infrastructure,* Figure 12.1.
- To the *ARRB Road Base Test kit*.

Use of stationary mixing pugmill

Mixing using pugmill: Blend materials with the use of a pugmill on the road side cleared areas incorporating water and ~~stabilents~~ stabilising binder with a 2-gravel mix. Operate pugmills up to 400 tonnes per hour. Target water addition 2% below optimum moisture content from the pugmill.

Mixed gravel

Moisture test: Sample test the moisture % in the mixed gravel as it exits the pugmill. Use a Speedy Moisture Tester or equivalent ((Monitoring accuracy to achieve 0.5% for a range 0 to 20% moisture). Use laboratory testing to ~~gain~~ determine OMC. This ready to use pavement gravel triples daily production and achieves better compaction with the controlled moisture.

Stabilisation

For unsealed roads: To NATSPEC TECHnote DES 034 for different types of stabilisation materials, typical strengths achieved after stabilisation, common binders adopted, to achieve anticipated performance.

Cost evaluation

General: Extra handling on the roadside site will apply with stationary pugmill mixing and transport from the stationary mixing to the grader on site:

- Using a side tipping truck improved site spreading along the edge of the road can reduce the work of the grader by up to 30%.
- The prime cost of materials is higher due to the extra handling, pugmill mixing of gravels, water and ~~stabilents~~ stabilising binder plus short haul transport costs from the pugmill to the road site.
- The extra handling cost is offset by reduced grader gang site construction costs. With no further mixing required, the site grader only has to spread and trim. Construction is continuous with spreading and rolling and thus daily productivity per tonne ~~is~~ may be more than 400% ~~more~~ higher compared with the conventional less productive on the job, grading, water mixing and blending of different gravels.

Overall comparison

Whole of life costs: Better mixing and improved compaction control will increase the pavement CBR% which leads to longer pavement life and lower whole of life costs per annum.

9 MAINTENANCE MANAGEMENT OF UNSEALED ROADS

9.1 SELECTION OF UNSEALED ROADS WEARING COURSES

Whole of life maintenance management

Life cycle cost evaluation: To Austroads AP-T353 (2020).

Resheeting

Wearing course gravel loss: Subsequent replacement by resheeting is the most significant factor for life cycle operating cost for unsealed roads. A well selected wearing course of 150 mm solid thickness ~~is~~ can be lost in a time period 8 to 13 years after which a new wearing course is required. This estimated time period depends on:

- Traffic ESA.
- Climatic conditions, wind and rain.
- Material selection for wearing course, blending to “good” in the gravel charts ARRB modelling spreadsheet.
- Inappropriate patrol grading by overcutting the surface and grading loose material to edge of road windrows.

Stabilisation of unsealed roads

Stabilisation: Includes granular blending of different gravels. Modification with lime and chemical binders enhances surface wear characteristics, slows down the rate of deterioration, reduces dust, potholes, ravelling and corrugations and extends time between resheeting, resulting in delayed patrol grading and improved resheeting intervention times.

Types of chemical binders: Synthetic polymers (commonly termed dry powdered polymers) and natural polymers, ionic compounds and salts. Select chemical binders for an unsealed road based on the plasticity index, climatic conditions, traffic volumes and cost of transportation to the site.

9.2 MAINTENANCE FOR WEARING COURSE LOSS

Maintenance

General: Maintain unsealed roads on an ongoing basis.

Maintenance of wearing course: Do not wait for the base gravel or subgrade to show through the wearing course. It is then too late in time for the maintenance resheeting of an unsealed road to prevent damage to the lower courses.

Road surfacing defects: Identify the following road surfacing defects:

- Measure gravel loss by spot coring.
- Use ground penetrating radar for measuring gravel loss and gravel depth.
- Differentiate between the materials used in wearing and base courses.
- Measure rutting and roughness for asset management allowing calculated interventions with maintenance using a Roughometer and a laser profilometer mounted to a vehicle.
- Loss of fine materials finer than 0.425 mm will cause dust due to traffic wear and climatic conditions. The loss of fines will lead to an increase in permeability of the surface leading to early pavement deterioration.
- With particle sizes greater than 5 mm, ~~and~~ low plasticity and limited fines or materials that lose fines due to traffic corrugations can occur in pavement materials.
- Roads with insufficient cross-fall and permeable wearing ~~coarse~~ course and/or base course will allow water to percolate down to the weaker subgrade causing subgrade failure under traffic and thus create potholes.
- Dry rutting in wheel paths is caused mostly in dry conditions by trafficking, and due to insufficient pavement support strength in the wheelpaths.
- Surface gouging is caused in wearing courses with high clay or silt content. In rain events the surfaces become instantly slippery and results in surface gouging. This is the greatest cause of road closures.
- Surface scour is caused by water flow along the road referred to as longitudinal scour and where the water exits is called a transverse scour.

Note: For more details on defects refer to Austroads AGPT06 (2009) Section 9.2.2.

9.3 COST – BENEFIT CONSIDERATIONS

Life cycle analysis

General: Evaluate cost benefits gained from processes which increase the gravel sheeting life and reduce grading intervention by life cycle analysis based on Net Present Worth (NPW) and Equivalent Annual Cash Flow (EACF).

Typical ~~uses~~ considerations for life cycle analysis over say 30 years time cycle include:

- Determine the operating costs of existing pavements and forward planning.
- Blending other gravel pit materials to improve wearing course performance by increasing sheeting life and reducing patrol grading to NATSPEC TECHreport TR 08. This considers any additional costs of mixing and transporting additional materials to the mixing site compared with single gravel delivery from pit to work site and mixing and watering onsite.
- Using ~~stabilents as binder~~ stabilising binders as improvements in the cost benefit analysis.
- Comparison for AADT of more than 150 vehicles per day and the cost of unsealed maintenance versus sealed pavement especially in areas where quality gravel is in limited supply.

10 DOCUMENTATION

10.1 SUPPORTING DESIGN DOCUMENTS

Specifications

Construction documentation: Prepare technical specifications using the AUS-SPEC Construction worksection *Templates* from the National Classification System workgroups 02, 03, 11, 13 part of the package.

Design certification

Certificate: Provide a signed and dated design certificate in accordance with *0010 Quality requirements for design* worksection as evidence that a suitably qualified professional has reviewed all the design documents, verifying that the designed road pavement for the development site meets the Council requirements.

10.2 WORK-AS-EXECUTED

Work-as-executed (WAE) documents

WAE drawings: Provide an additional set of final construction drawings for the purpose of recording the work completed by the Contractor. Provide WAE plans in digital dgf format to Council's requirements (e.g. DXF, DWG and PDF) formats. Provide pavement compaction density testing and sample laboratory test results for sieve gradings, linear shrinkage % every 5000 tonnes.

11 ANNEXURE A - REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

AS 1289		Methods of testing soils for engineering purposes
AS 1289.6.3.2	1997	Soil strength and consolidation tests - Determination of the penetration resistance of a soil - 9kg dynamic cone penetrometer test
AS 5488		Classification of Subsurface Utility Information (SUI)
AS 5488.1	2022	Subsurface utility information
ARRB Best Practice Guide1	2020	Road materials
ARRB Best Practice Guide2	2020	Unsealed Roads
ARRB Best Practice Guide3	2020	Sealed roads
Austroads AGPT		Guide to pavement technology
Austroads AGPT02	2017	Pavement structural design
Austroads AGPT04E	2022	Recycled materials
Austroads AGPT06	2009	Unsealed pavements
Austroads AGRD		Guide to road design
Austroads AGRD01	2015	Introduction to road design
Austroads AGRD02	2019	Design Considerations
Austroads AP-C87	2015	Austroads glossary of terms
Austroads AP-T352	2020	Sustainable Roads through fit-for-purpose use of available materials: Technical basis
Austroads AP-T353	2020	Sustainable Roads through fit-for-purpose use of available materials: Evaluation tool and users guide
IPWEA NSW Greenspec	2018	Specification for the supply of recycled materials for pavements, earthworks (Roads and Transport Directorate)
IPWEA PN 13	2023	Practice Note 13: The circular economy and use of recycled materials for infrastructure assets
LGNSW Guide	2020	Recycled materials in roads and pavements - A Guide for local councils
NATSPEC DES 034		Pavement stabilisation for unsealed roads
NATSPEC DES 035		Improvement and stabilisation of unsealed roads
NATSPEC TR 08		Management of council gravel pits - A case study
Cessnock City Council		Development Engineering Handbook

12 ANNEXURE M – CESSNOCK CITY COUNCIL SPECIFIC CLAUSES

M1.	Variations to or non-conformances with Council's AUS-SPEC are to be evaluated with reference to the procedure in Council's *Development Engineering Handbook*. Acceptance is to be obtained in writing from: a) an authorised representative of Council's Director of Infrastructure and Engineering Services.	**Variation procedure**
M2.	This specification applies in addition to any development consent (DA) conditions. If there is any inconsistency, the conditions of consent shall prevail.	**DA Conditions**

M3.	Refer to the Cessnock City Council Development Engineering Handbook for final inspection, works-as-executed and handover requirements.	**Completion**

13 AMENDMENT HISTORY

0	15/01/2024	First Published