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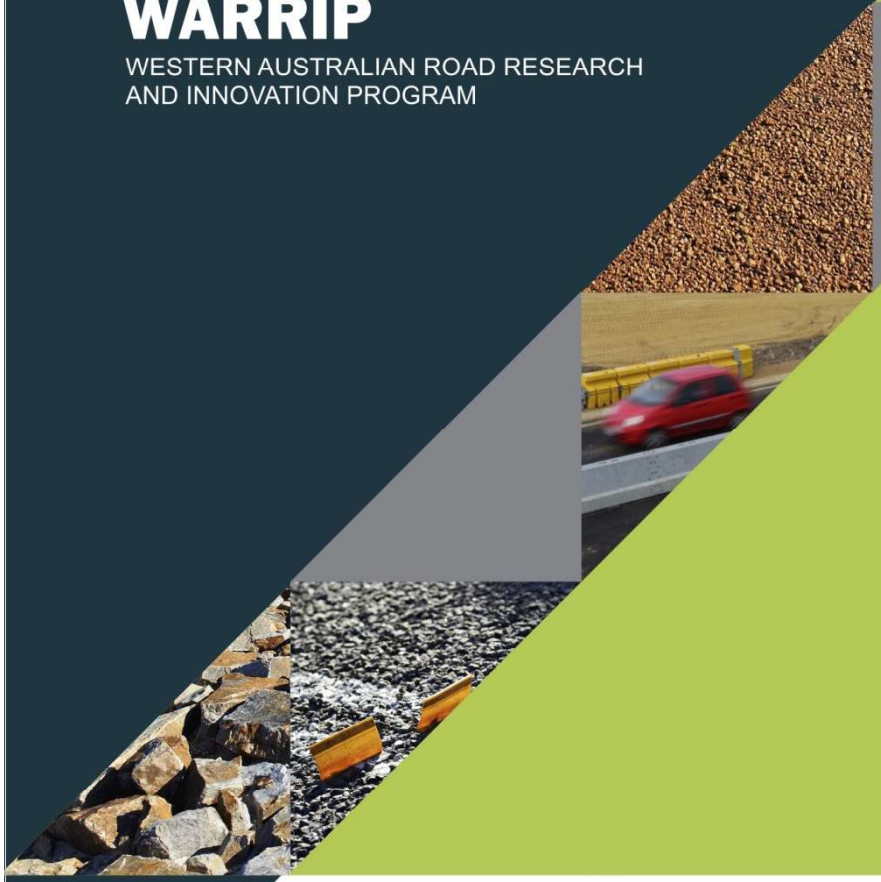

Development of a Rehabilitation Supplement for Main Roads WA (ERN16)

09 June 2020

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Rosemary Pattison

Webinar Moderator

Professional

- Knowledge Hub - ARRB Group

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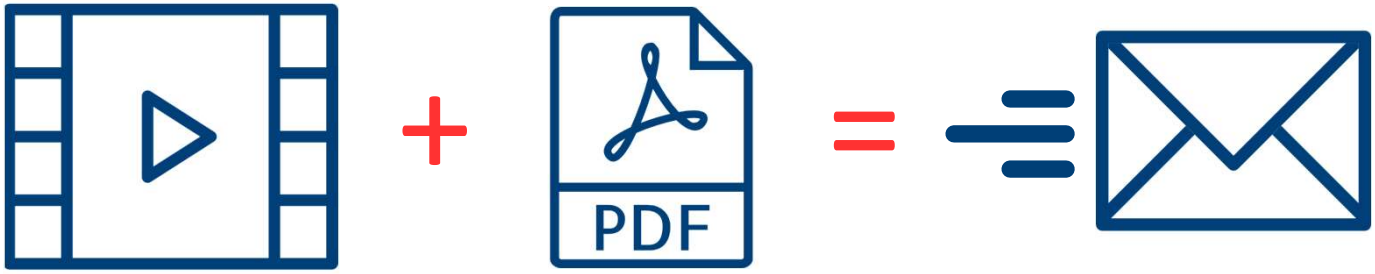
Housekeeping

- Webinar is 60 mins
- inc. question time of 15 mins



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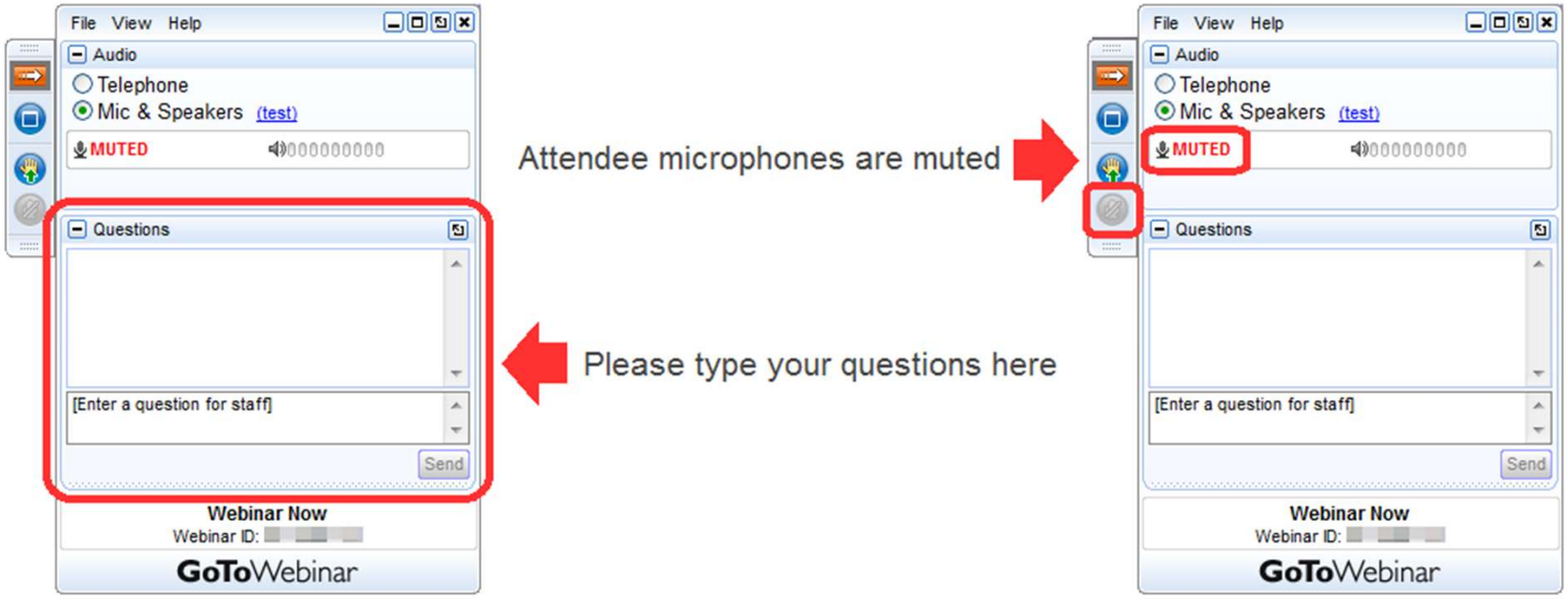

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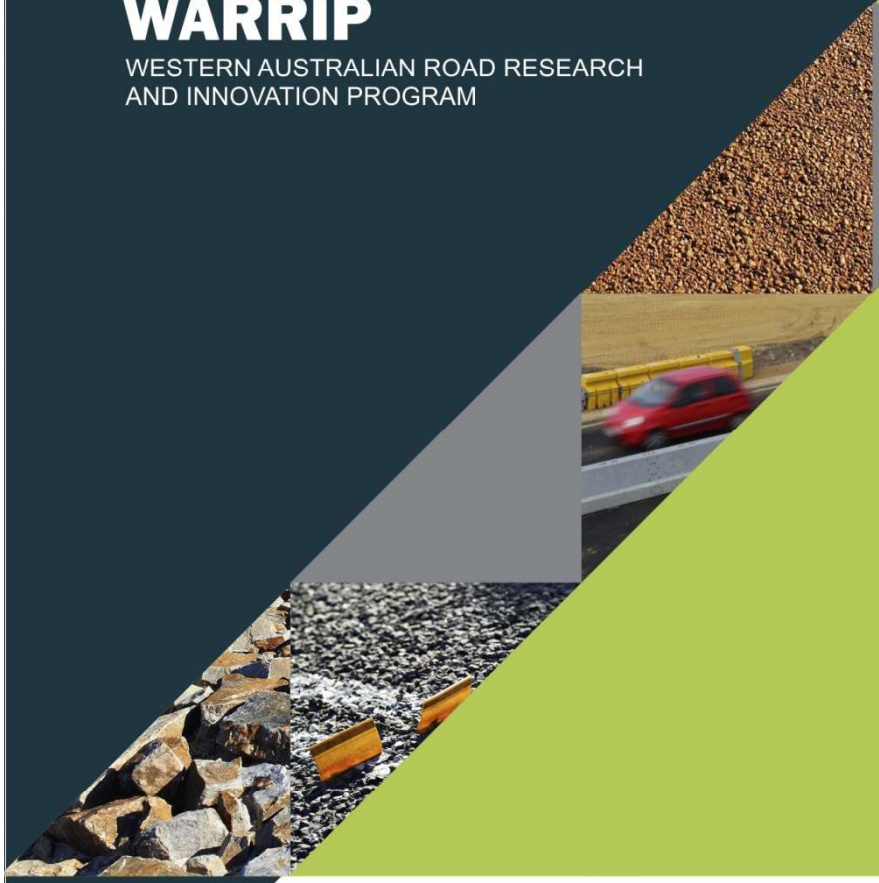

Today's Presenters

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Zia Rice has worked at ARRB for just over 4 years and leads the Perth Pavements team. Zia has undertaken several WARRIP projects with a focus on asphalt fatigue design, characterisation of materials and material performance. She has over 5 years previous experience as a Geotechnical Consultant. Zia was the ARRB Project Leader for this WARRIP project.

Geoff Jameson is the Chief Technology Leader, Pavements at ARRB. He has over 30 years of experience in research and development in a wide variety of areas dealing with the design and analysis of pavement structures and the characterisation of pavement materials. Geoff is the author of various parts of the Guide to Pavement Technology Part 5, and with this experience has developed the Main Roads rehabilitation supplement.

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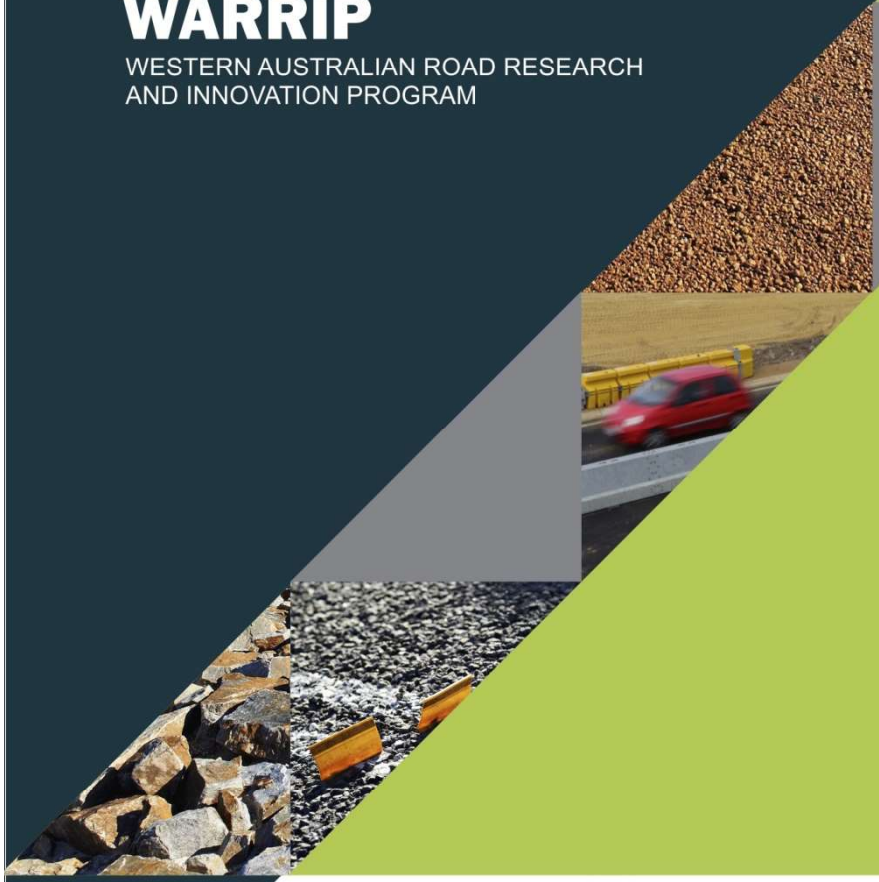

Presentation outline

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1

Project Introduction
WARRIP
Project objectives

2

Project method and development
Methodology
MRWA feedback

3

Supplement contents
Overview of Supplement
Design of granular overlays
Design of asphalt overlays and inlays
Mechanistic-empirical procedure

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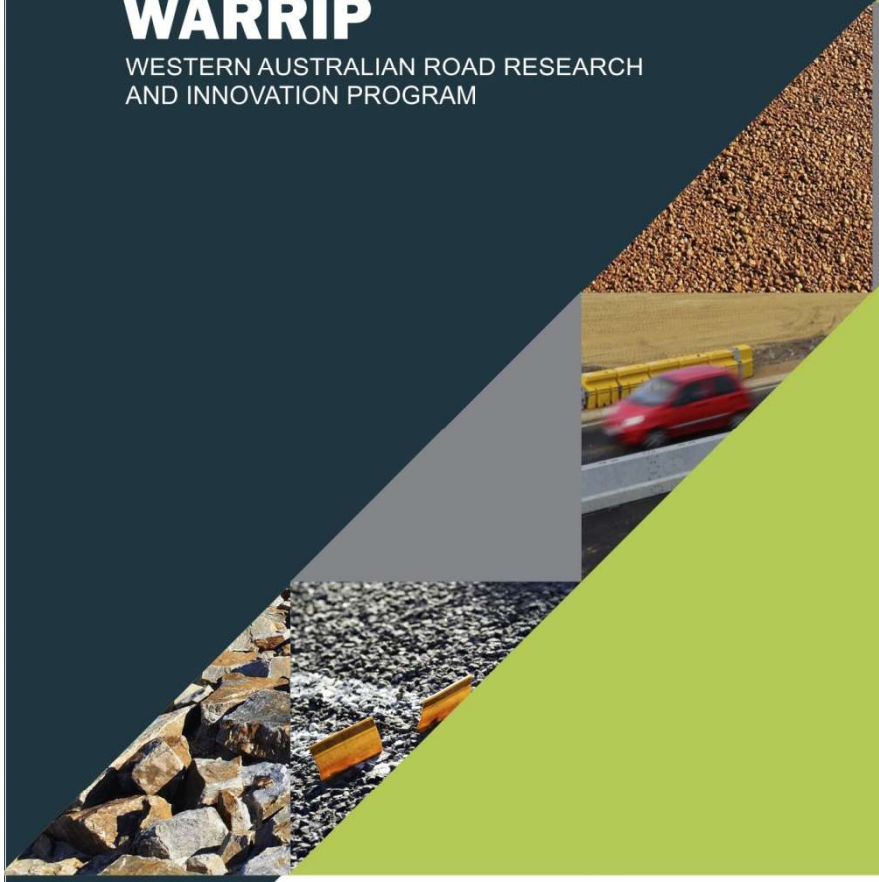

Project Introduction

Zia Rice

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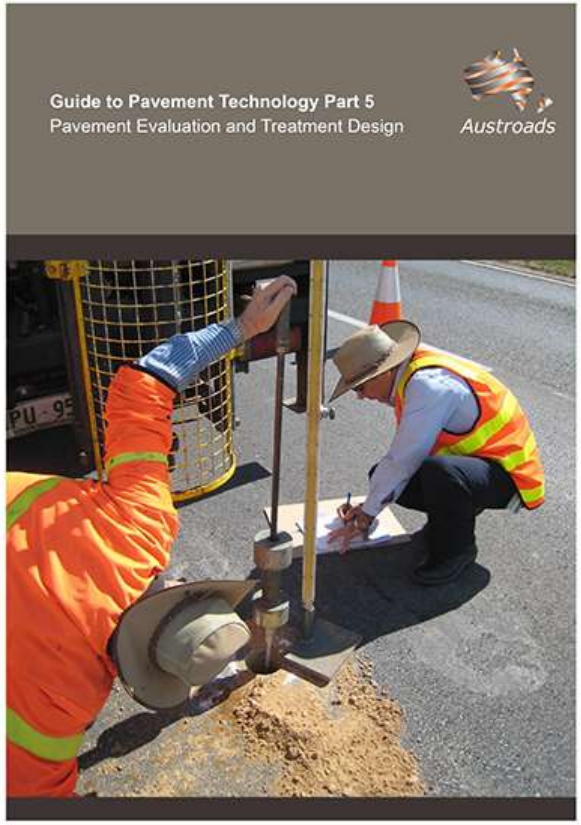
A collaborative research agreement between MRWA ARRB

Identify innovative practices and guide implementation to deliver superior technology and cost savings in road infrastructure

Project Background

- Capture state specific learnings and practices for rehabilitation works
- Provide guidance and methodology to achieve uniform/best practice
- Direction in the form of a rehabilitation supplement
  - Alignment with AGPT05-19 structure
  - State specific information and practices
  - Collection of all MRWA relevant information in one document
- A live document
  - Continuous amendment and revisions as more information, new techniques are adopted



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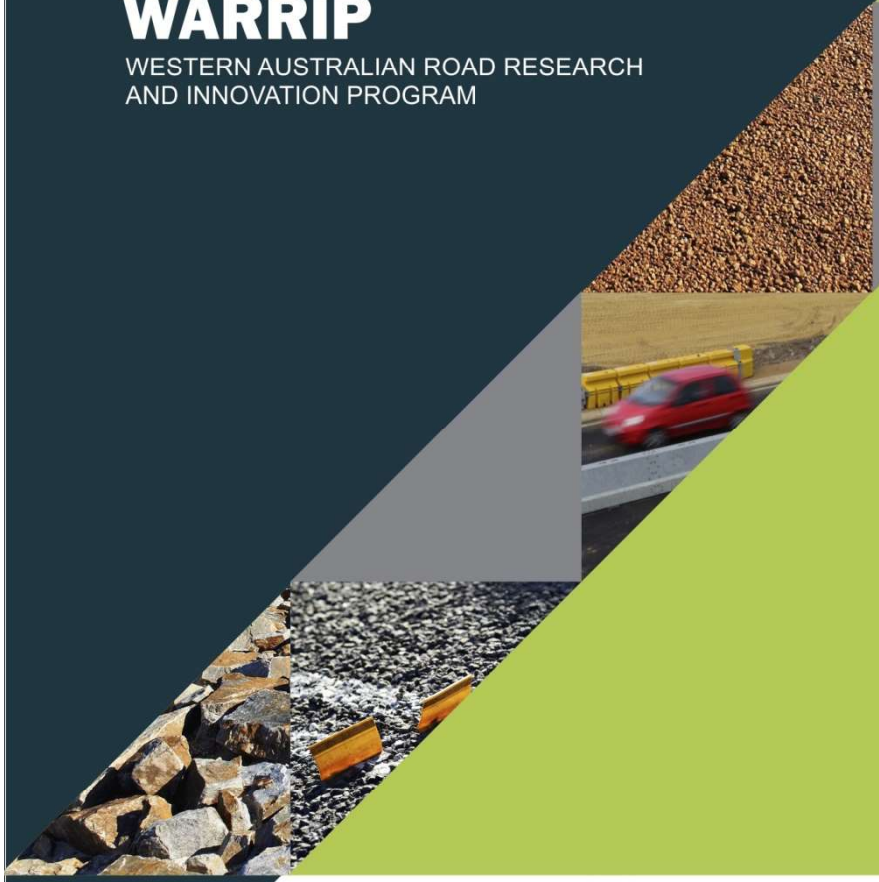

Method and development

Zia Rice

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Project plan

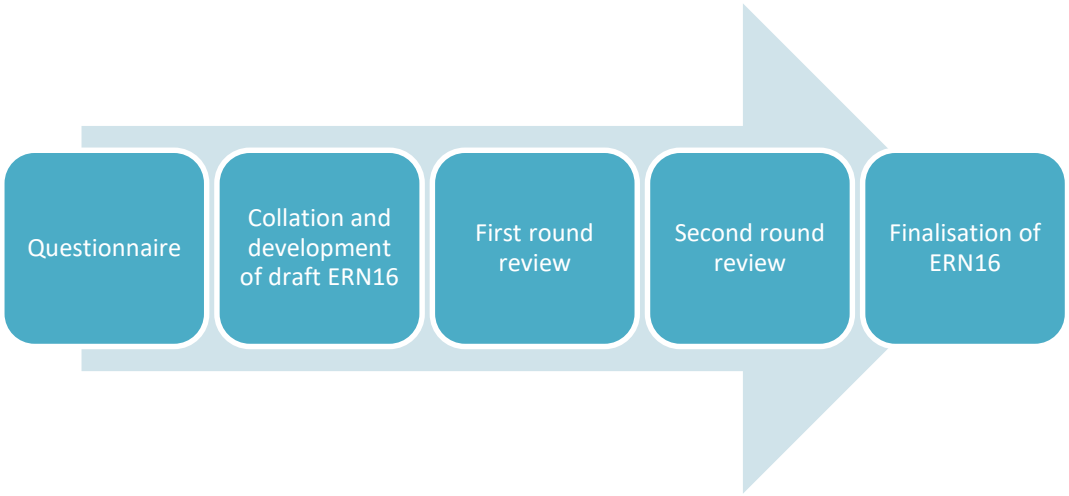
1. Review of rehabilitation practices both nationally and internationally (outside of WA)
2. Review and collate all current MRWA documentation related to rehabilitation
   - PAMP
   - RAMP
   - Skid resistance management plan
   - Road maintenance planning documents
   - Road maintenance instructions documents
   - Road maintenance procedure documents
   - Other internal documentation
3. Interview MRWA staff
   - Current practice
   - Gaps in knowledge
   - Needs

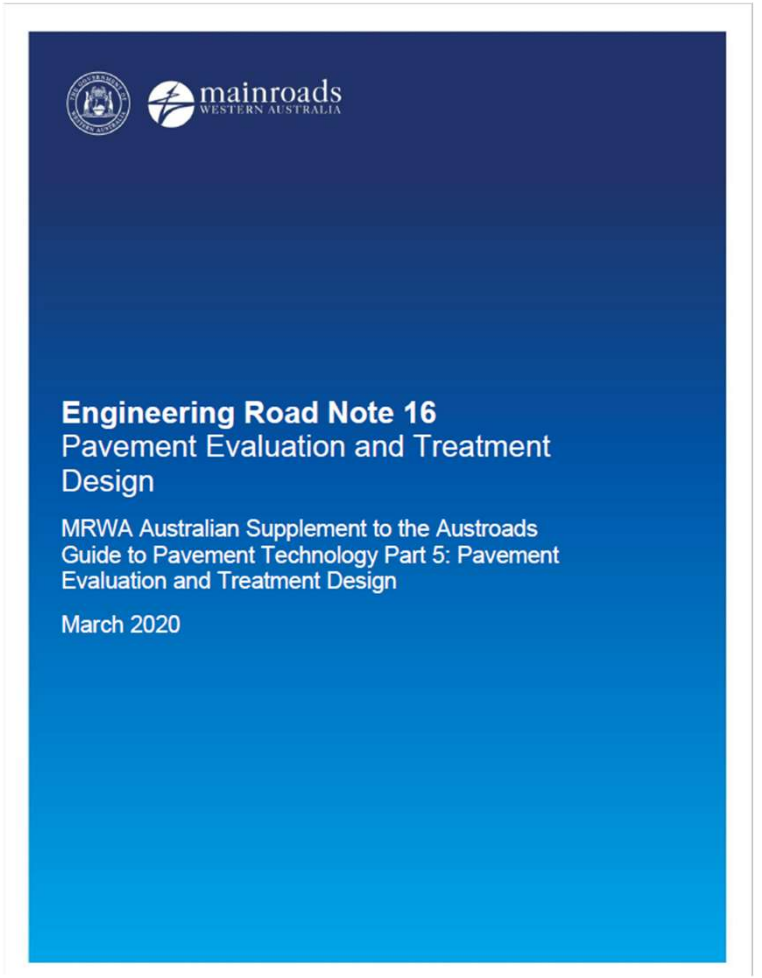
Project plan

4. Develop a draft supplement
   - Collation of MRWA documentation
   - Interview feedback
   - Other input and feedback
5. Feedback on Draft from MRWA
   - Provide feedback on contents and applicability of draft
6. Amend and publish




Development process





MRWA Feedback

General items

Areas for improvement

- Construction
- Industry knowledge
- Improvement on the use of UCS
- Improved MMIS use

Gaps in current knowledge

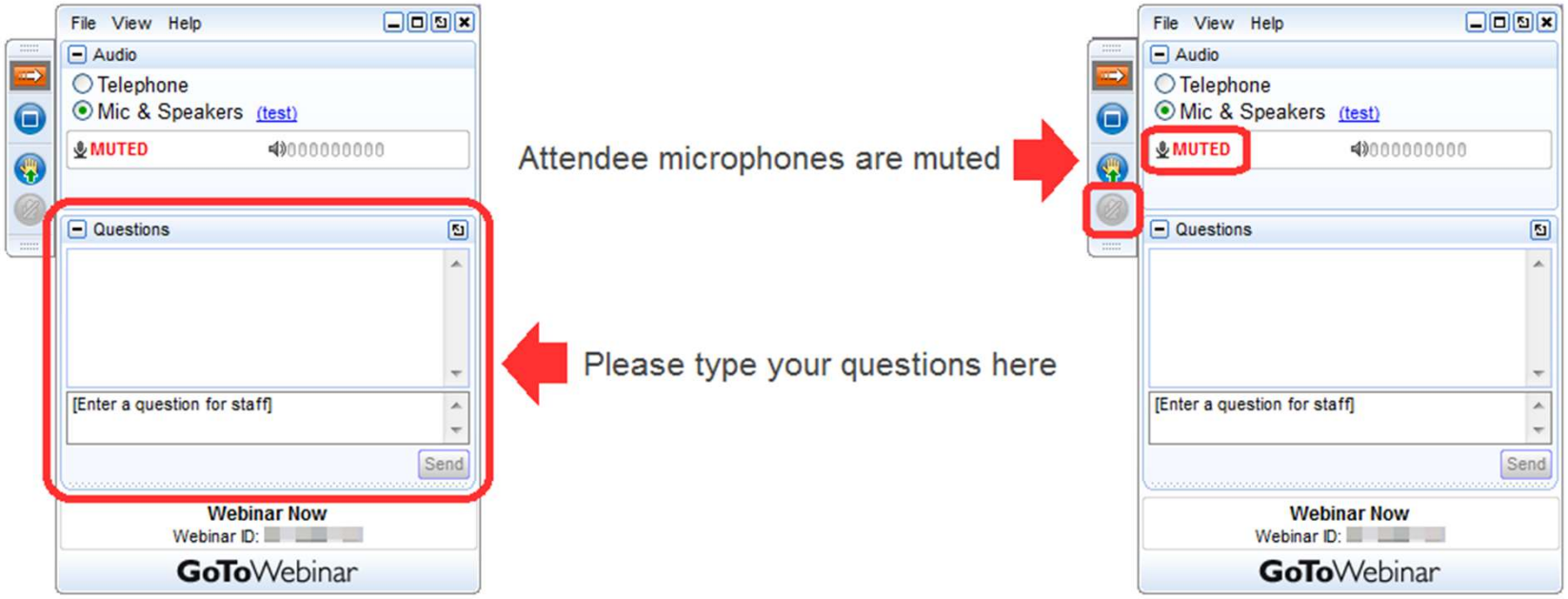
- Guidance on performance measures
- Selection of treatments
- Considerations when choosing treatment

MRWA Feedback

Common treatment breakdown

General shape loss	Cracking	Rutting in wheel path	Proposed increased traffic
• Overlay • Microsurfacing • Stabilisation	• Patching • GRS • Reseal • Stabilisation	• Overlay • Microsurfacing • Stabilisation • Reconstruction	• Overlay • Resurface • Review maintenance cycle

Please send your questions with slide number



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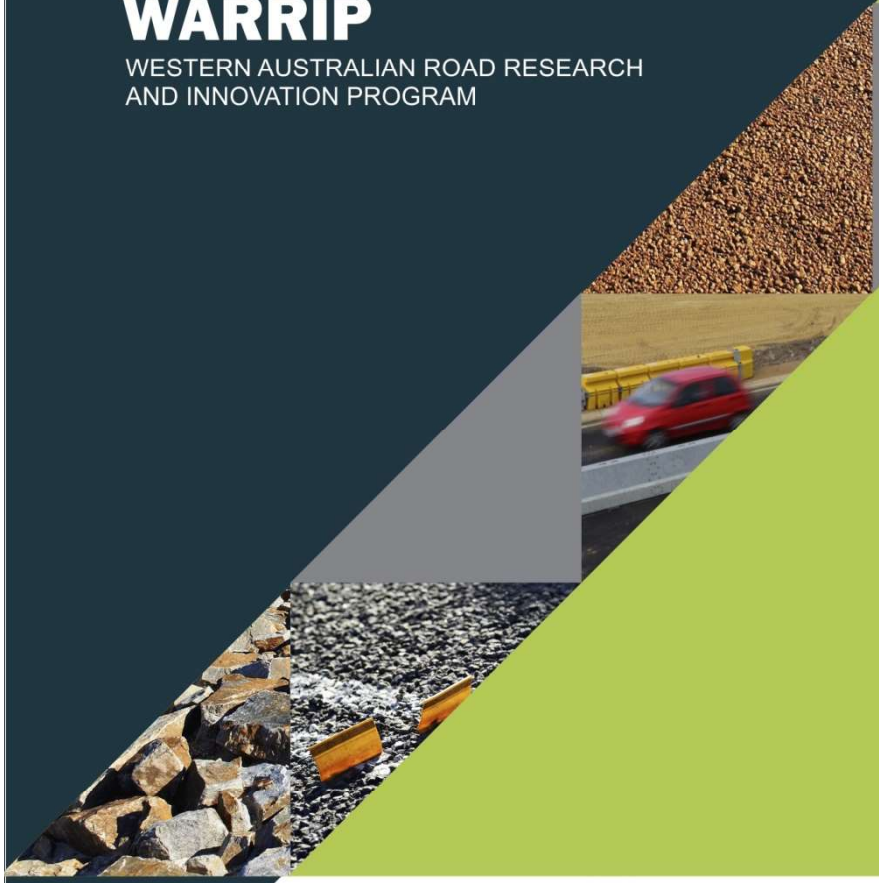

Supplement Overview

Geoff Jameson

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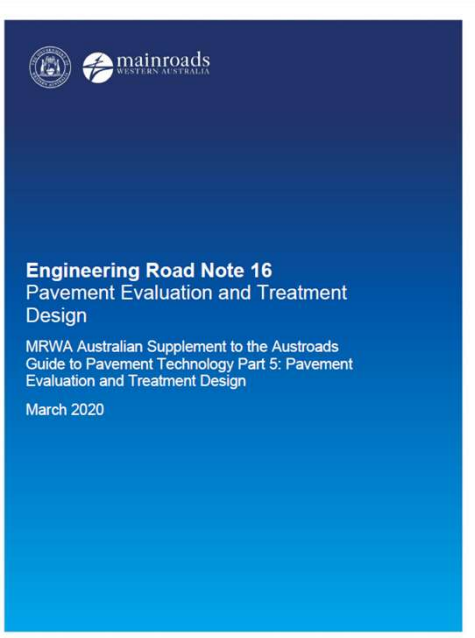
Format of Supplement follows Guide

- Supplement provides MRWA guidance additional to the Guide
- Supplement not a standard alone document
- Supplement needs to be read in conjunction with the Guide



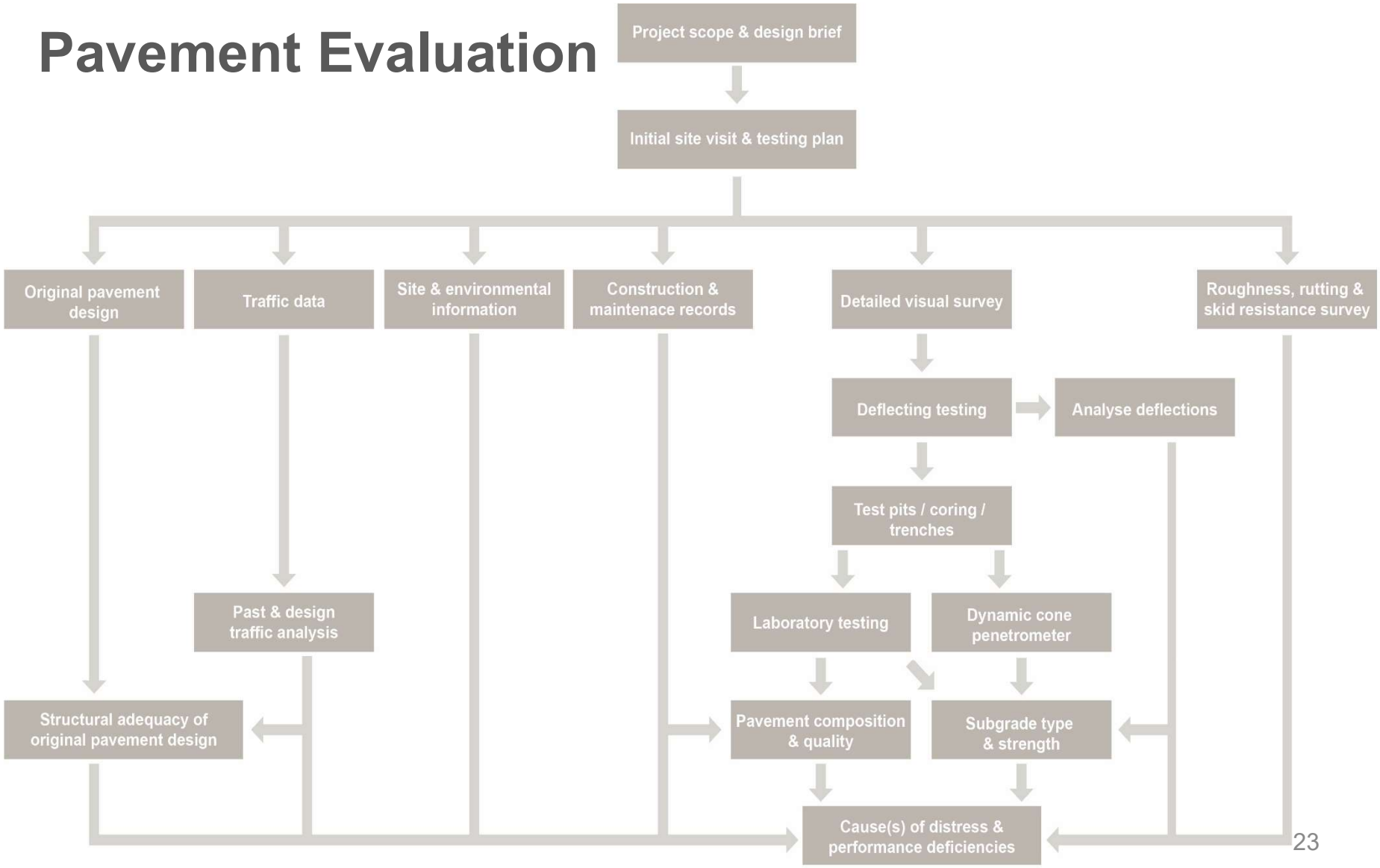
Section Headings

1. Introduction
2. Project definition
3. Pavement data and inspection
4. Investigative testing on pavement surface
5. Pavement composition and subgrade characterisation
6. Causes and modes of distress
7. Selection of treatments for flexible pavements
8. Treatments for rigid pavements

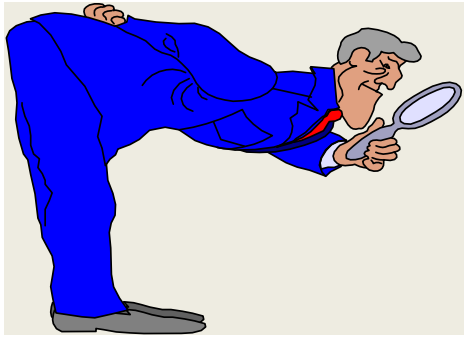
Section Headings

9. Empirical design of granular overlays for flexible pavements
10. Mechanistic-empirical method of designing strengthening treatments for flexible pavements
11. Concrete overlays on flexible pavements
12. Thickness design of structural treatments for rigid pavements
13. Economic comparison of alternative treatments
14. [MRWA] Chart based thickness design of asphalt overlays and inlays

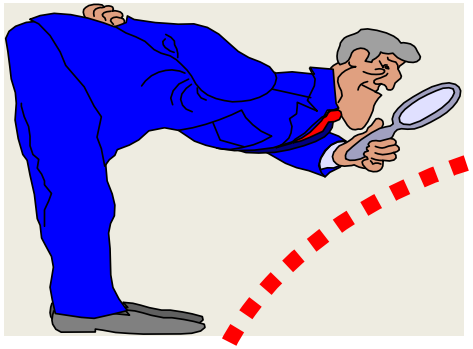
Pavement Evaluation



Inspection and testing



Causes of distress



Appendix A of Guide may assist

Rutting

Description:

Longitudinal deformation in a wheelpath.

Result of densification of pavement layers, including subgrade or plastic shear deformation of upper layers. Bound lower layers may not be affected.

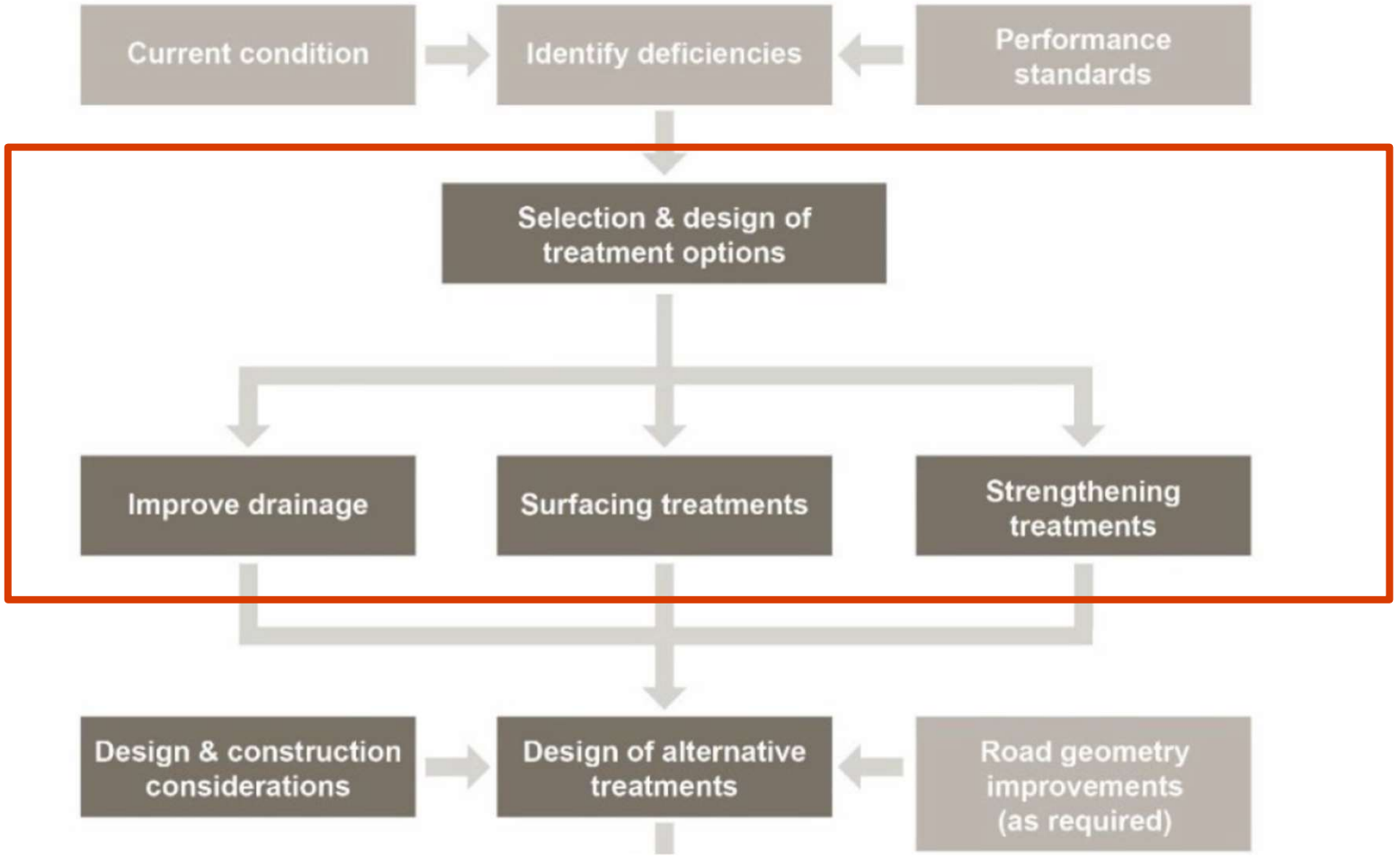
Length-to-width ratio – determined using a straightedge laid on the high points – normally greater than 4 to 1.

May occur in one or both wheelpaths of a lane but mostly in the outer wheelpath nearest to the pavement edge.

Causes:

- Ingress of water through the pavement surfacing or road edges into base, subbase and subgrade
- Structural overloading of the pavement and/or inadequate pavement thickness (exacerbated, in asphalt pavements, by high pavement temperatures)
- Inadequate quality of pavement materials
- Poor quality construction control, particularly compaction and drainage
- Pavement at terminal condition

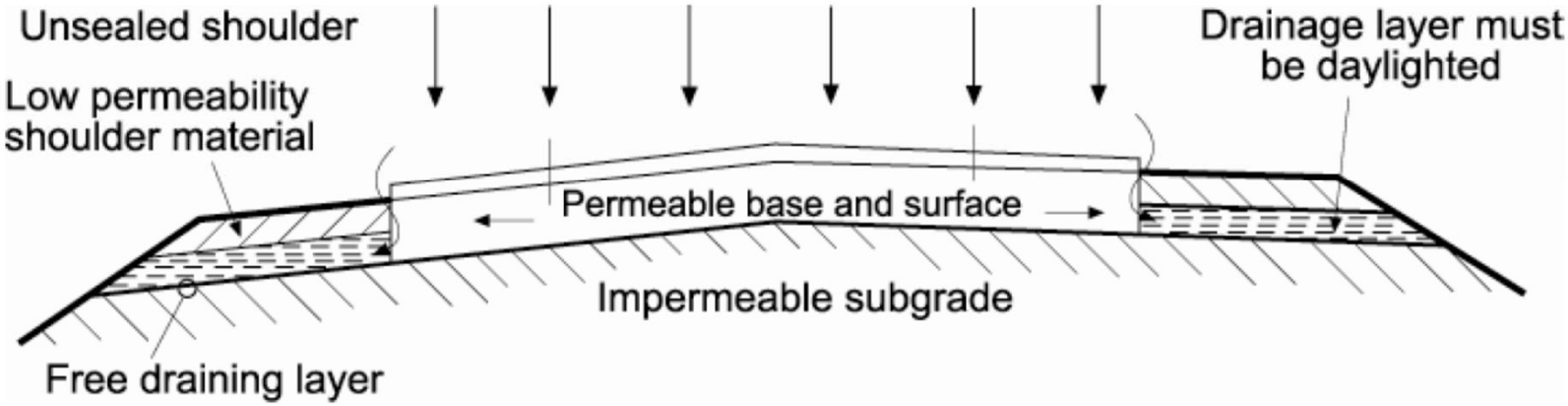
Selection and design of treatments



Treatment to improve drainage

Align treatment with the cause of high moisture contents

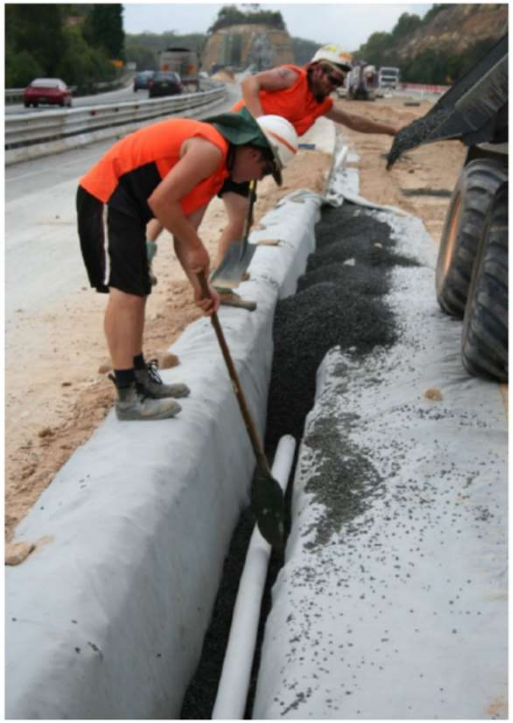
Figure 7.3: Drainage for surface infiltration unsealed shoulder



Treatment to improve drainage

Figure 4.10: Geotextile as separation layer above and below drainage layer

Figure 5.4: Placement of granular material



Treatments for surface distress

Resealing

Figure 7.8: Single/single seal

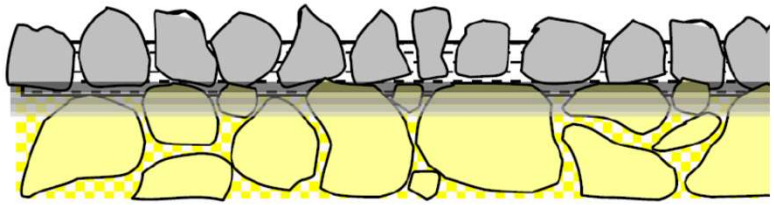
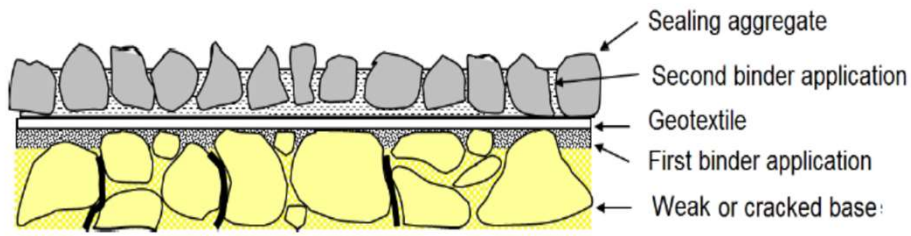
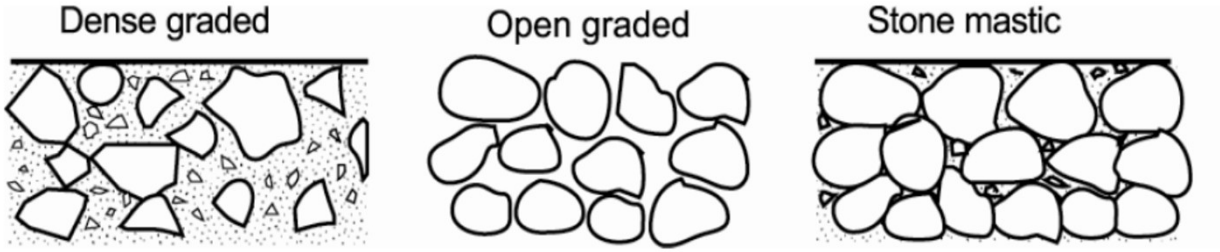


Figure 3.12: Geotextile reinforced seal



Treatments for surface distress

Asphalt overlays



Strengthening treatments

Granular overlays

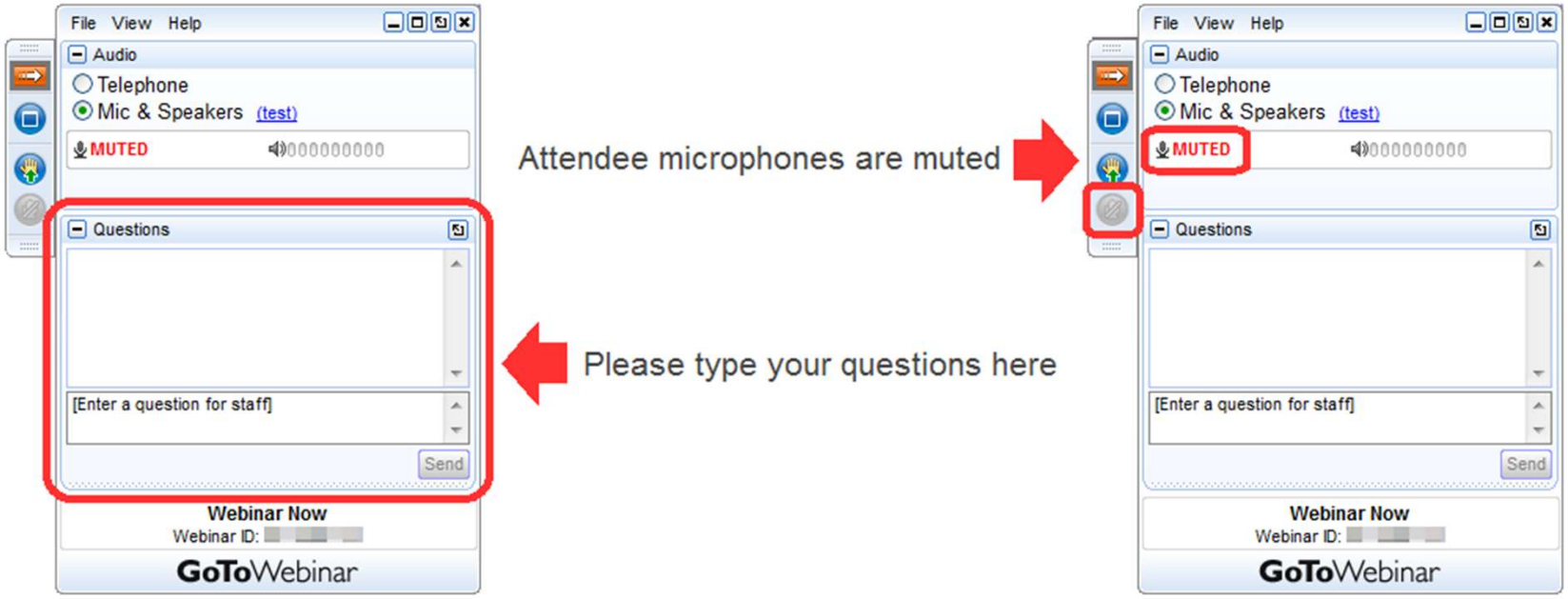
Asphalt overlays

Strengthening treatments

In situ stabilisation

Figure B 4: Kewdale Road FBS site during stabilisation

Please send your questions with slide number



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Design of granular overlays

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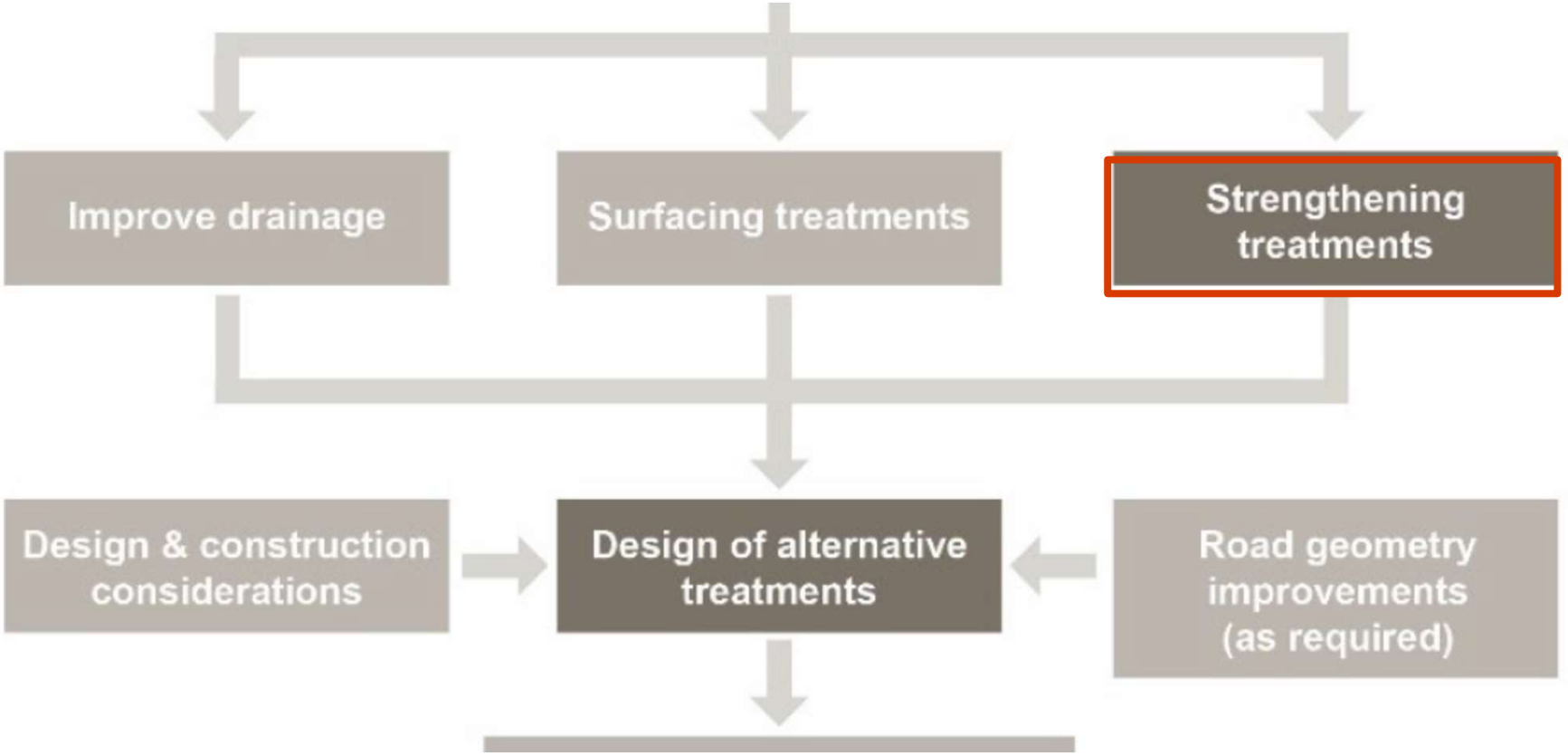
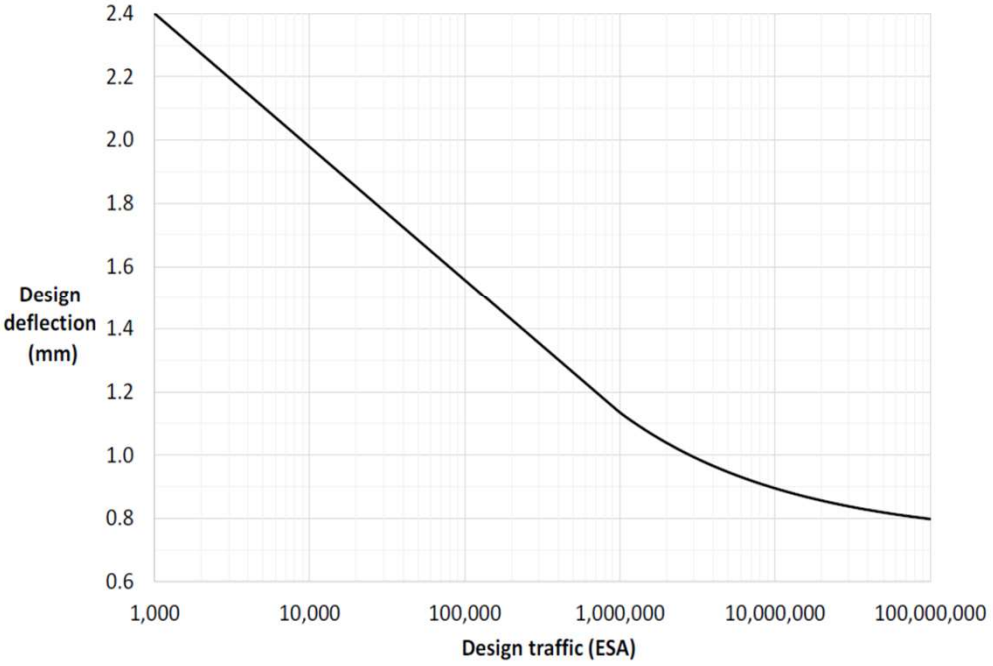
Thickness design of granular overlays



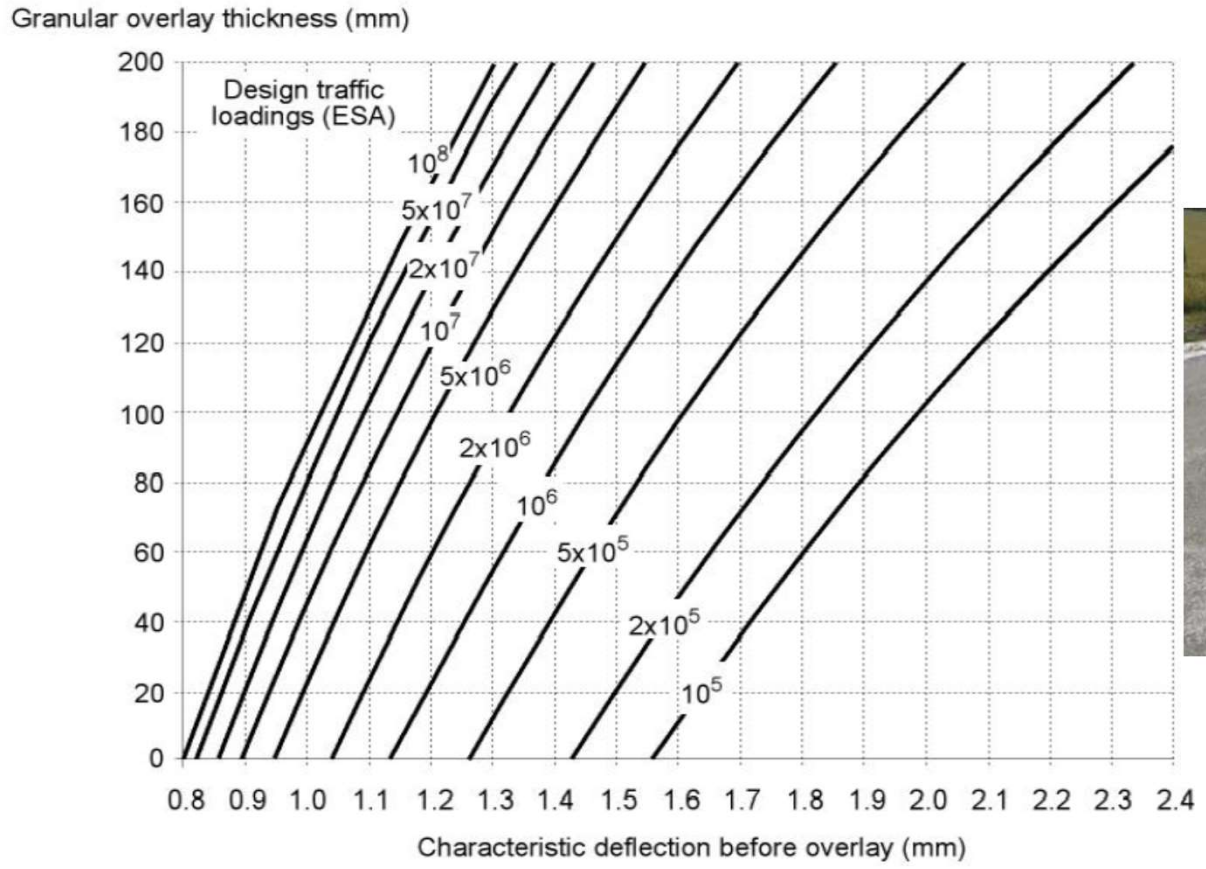
Select thickness to reduce measured deflections to design deflection

Figure 9.2: Design deflections to limit permanent deformation



Empirical method of granular overlay design based on Benkelman Beam maximum deflections D_0

Figure 9.3: Granular overlay design charts



Deflection testing devices

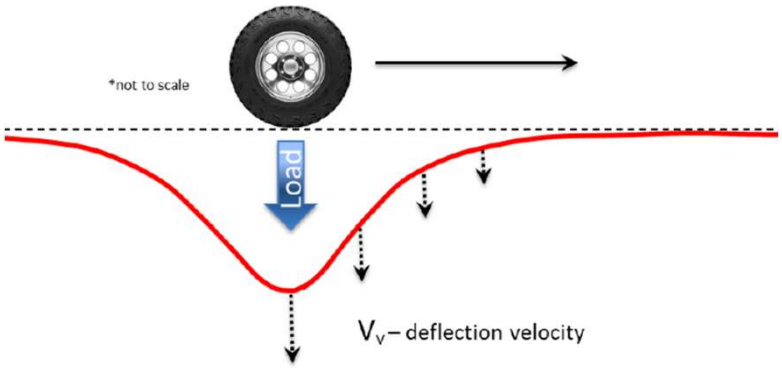
Benkelman Beam

Deflectograph

Falling weight deflectometer (FWD)

Traffic speed deflectometer (TSD)

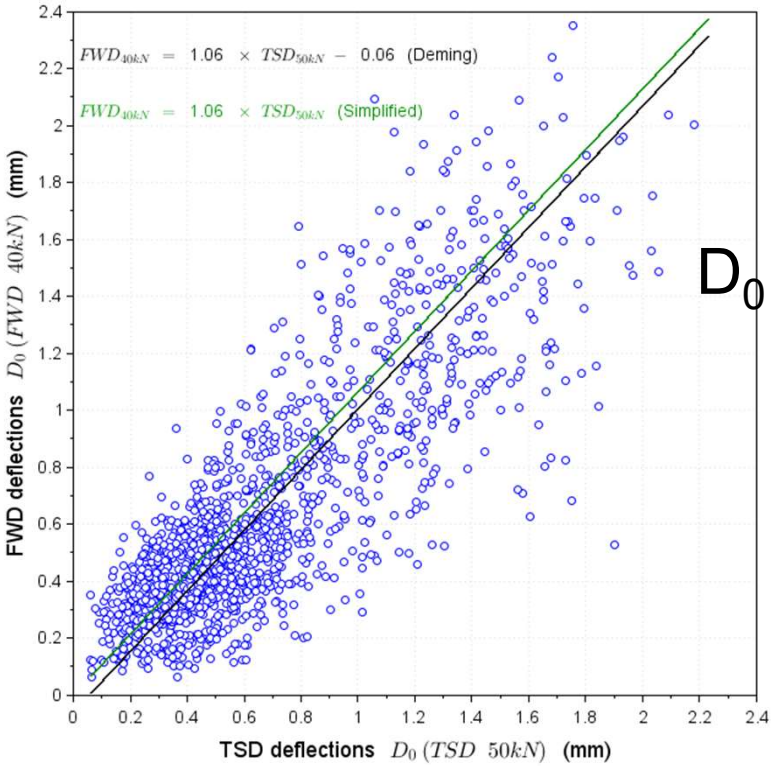
- 7 laser sensors measure deflection velocities
- Deflections are estimated from the vertical and horizontal velocities
- Use area under the velocity curve as described in test method



AUSTROADS TEST METHOD AG:AM/T017

Pavement Data Collection with a Traffic Speed Deflectometer (TSD) Device

TSD maximum deflections correlated with FWD values



D_0 (FWD 40 kN) = 1.06 D_0 (TSD 50 kN)

Estimation of Benkelman Beam D_0 from TSD values

D_0 (BB) = 1.06 x 1.1 D_0 (TSD 50 kN)

Table 9.2: Deflection standardisation factors

Deflection measurement device	Deflection standardisation factor
Deflectograph, 80 kN single axle with dual tyres	1.2
TSD, 50 kN dual tyres	1.2
Falling Weight Deflectometer, 40 kN load	1.1

D_0 (BB) = 1.2 D_0 (TSD)

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Design of Asphalt Overlays and Inlays

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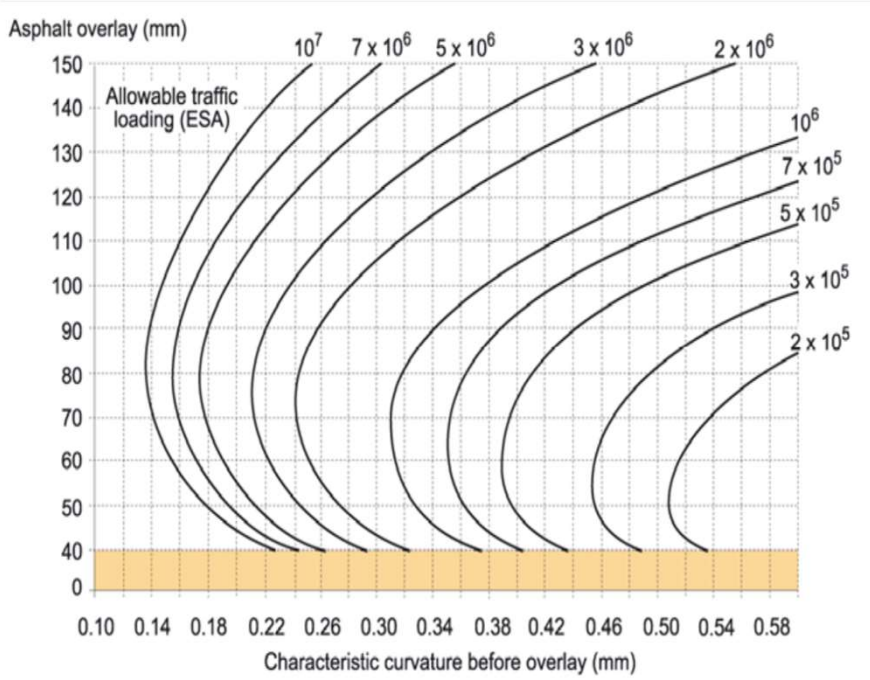
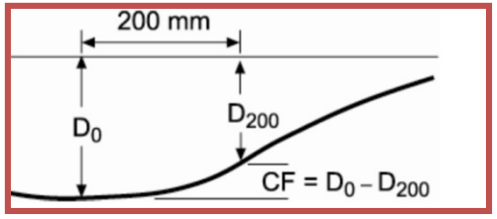
Thickness design of asphalt overlays and inlays

2011 Austroads Guide thickness design methods for asphalt overlays

Existing pavement type	Section
Flexible pavements without cemented materials	6.2 (using Design Charts)
All flexible pavements	6.3 (using General Mechanistic Procedure)





2019 Guide asphalt overlay charts considerations

- The charts needed to be revised to reflect recent changes in asphalt fatigue life prediction in Part 2
- Since original development 30 years ago, design traffic values have increased significantly
- Now common for arterials and highways to have design traffic > 10^7 ESA
- Over the last 10 years the use of general mechanistic procedure (GMP) has increased and use of simplified approach using charts has reduced
- Assumed asphalt moduli in charts do not cater for wide range of possible mixes

Austroads decided:

- Delete simplified design charts for thickness design asphalt overlays
- general mechanistic procedure (GMP) used to determine the required thickness of all flexible treatments

MRWA decided to develop new asphalt overlay and inlay charts

MRWA asphalt overlay and inlay design charts

Alternative to the mechanistic-empirical procedures (MEP)

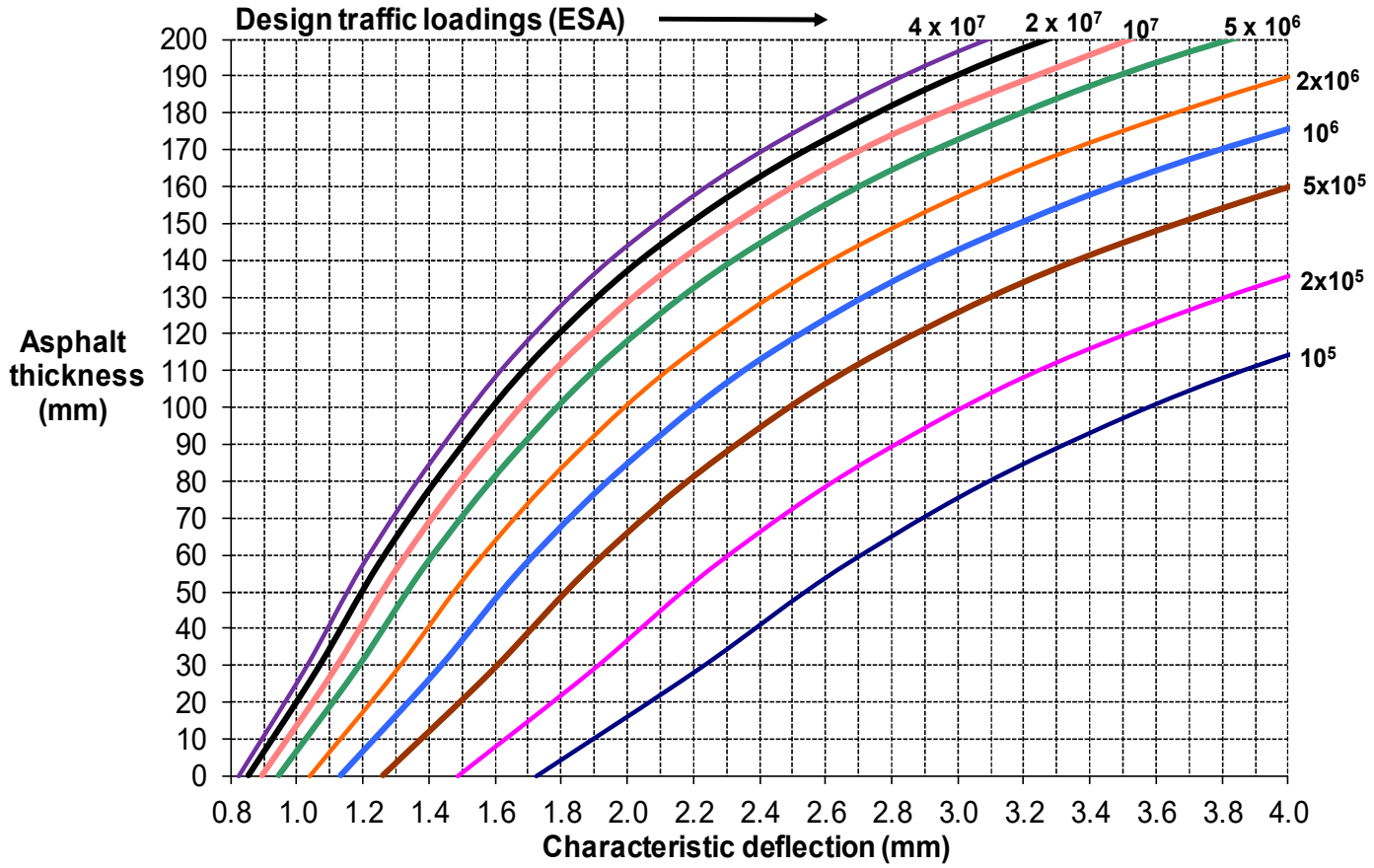
Applicable to:

- flexible pavements without cemented materials
- have a maximum design traffic loading of 4 x 10^7 ESA
- have a WMAPT of 29 °C such as the metropolitan region of Perth
- asphalt overlays and inlays

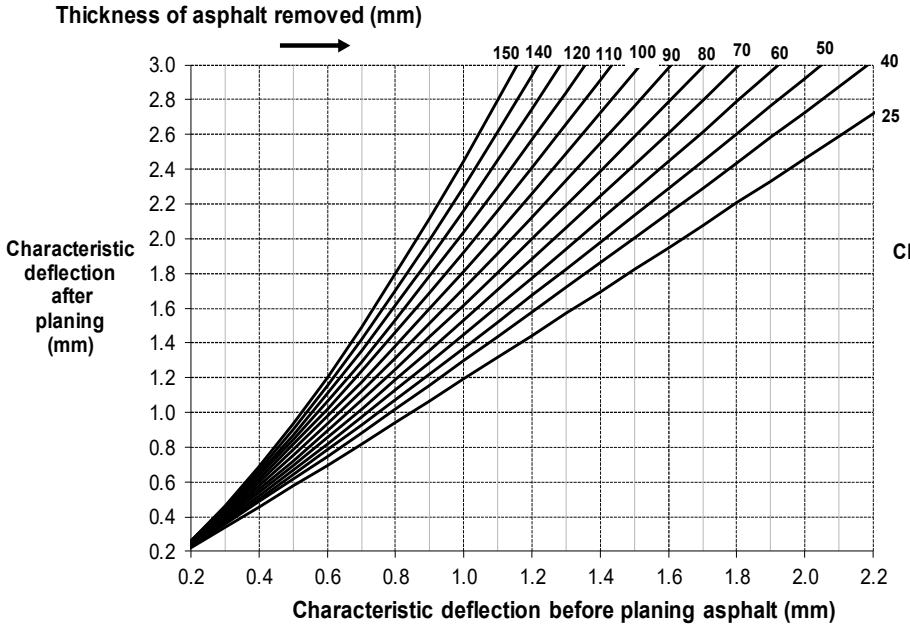
MRWA decided to develop new asphalt overlay and inlay charts

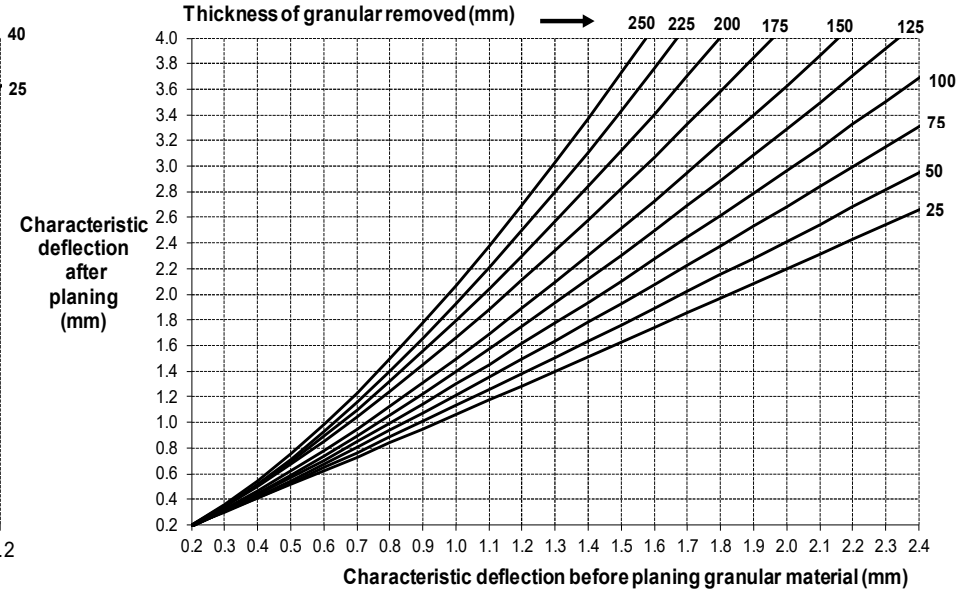
based on 50 kN FWD deflections

Asphalt overlays and inlays required to inhibit rutting

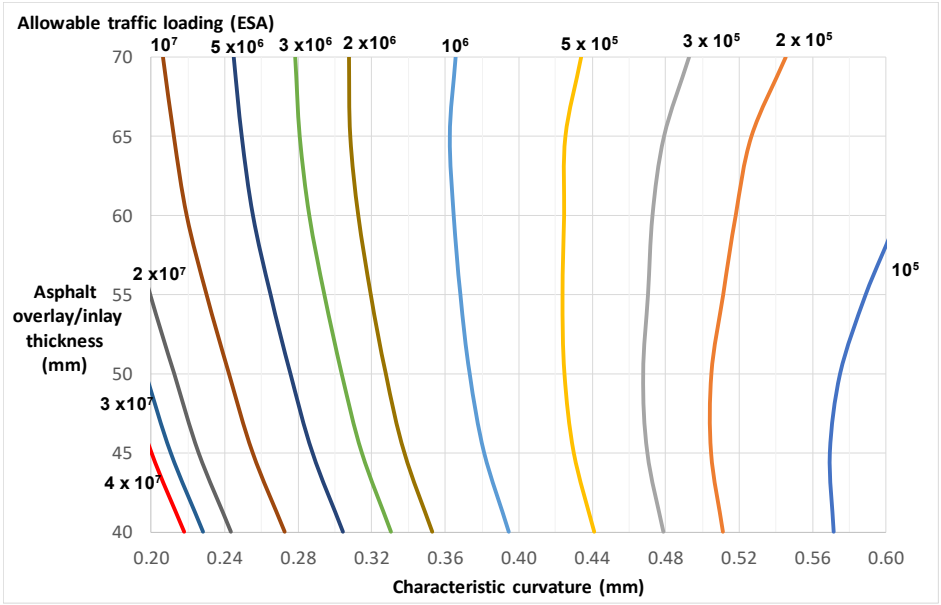


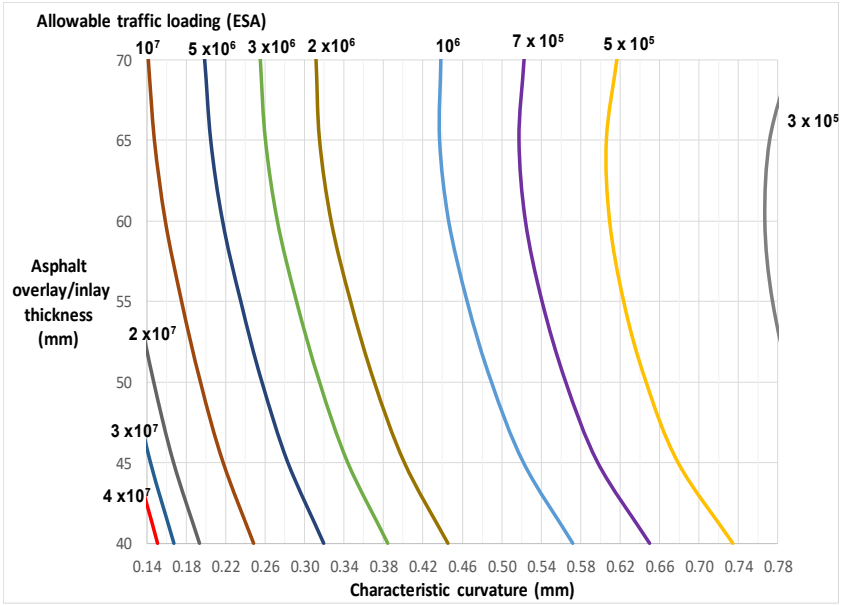
If designing an inlay, allowance for increase in CD due to removal of asphalt and granular





Asphalt overlays and inlays required to inhibit fatigue of new asphalt

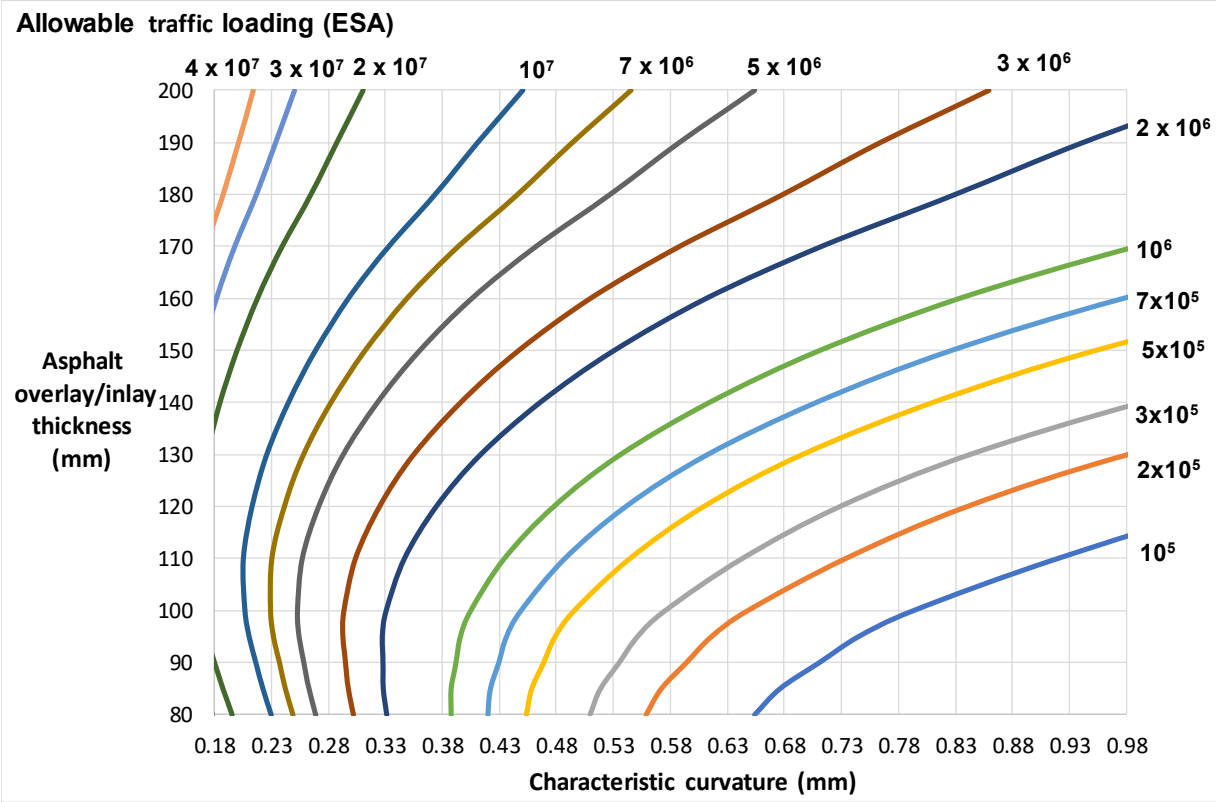




40-70 mm thick overlay/inlays
On surfaces without existing asphalt

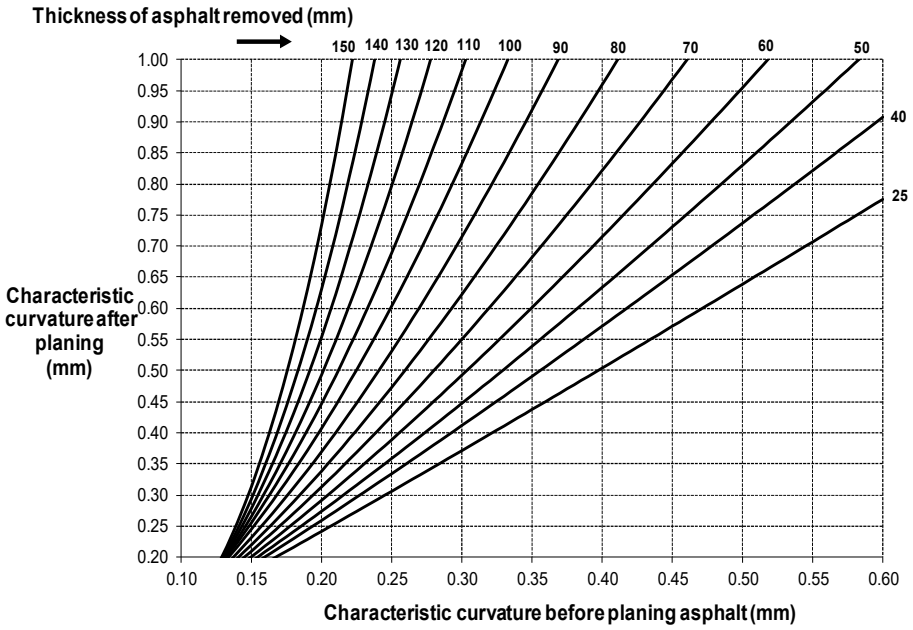
40-70 mm thick overlay/inlays
surfaces with existing asphalt

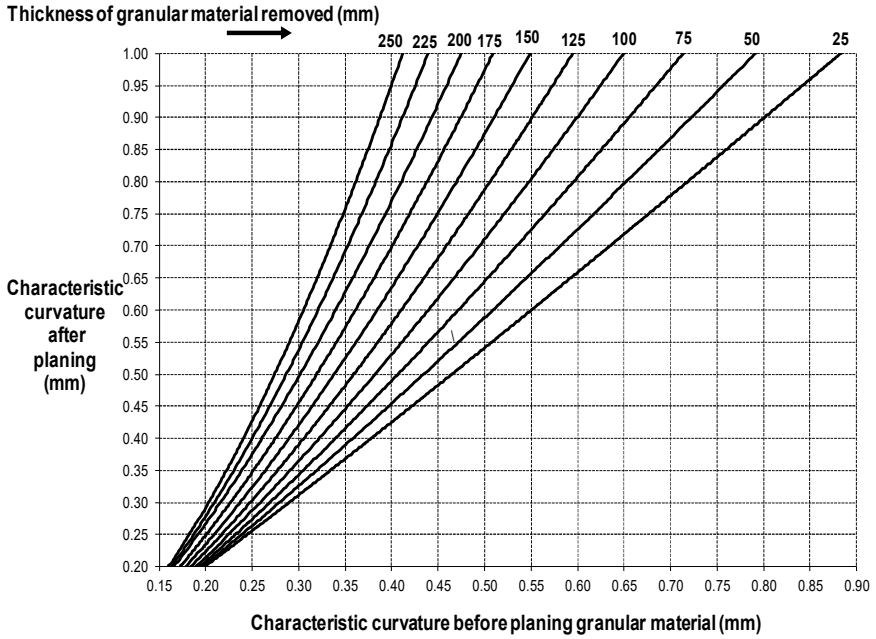
Asphalt overlays and inlays required to inhibit fatigue of new asphalt



overlay / inlay thicknesses of 80 – 200 mm

If designing an inlay, allowance for increase in curvature due to removal of asphalt and granular





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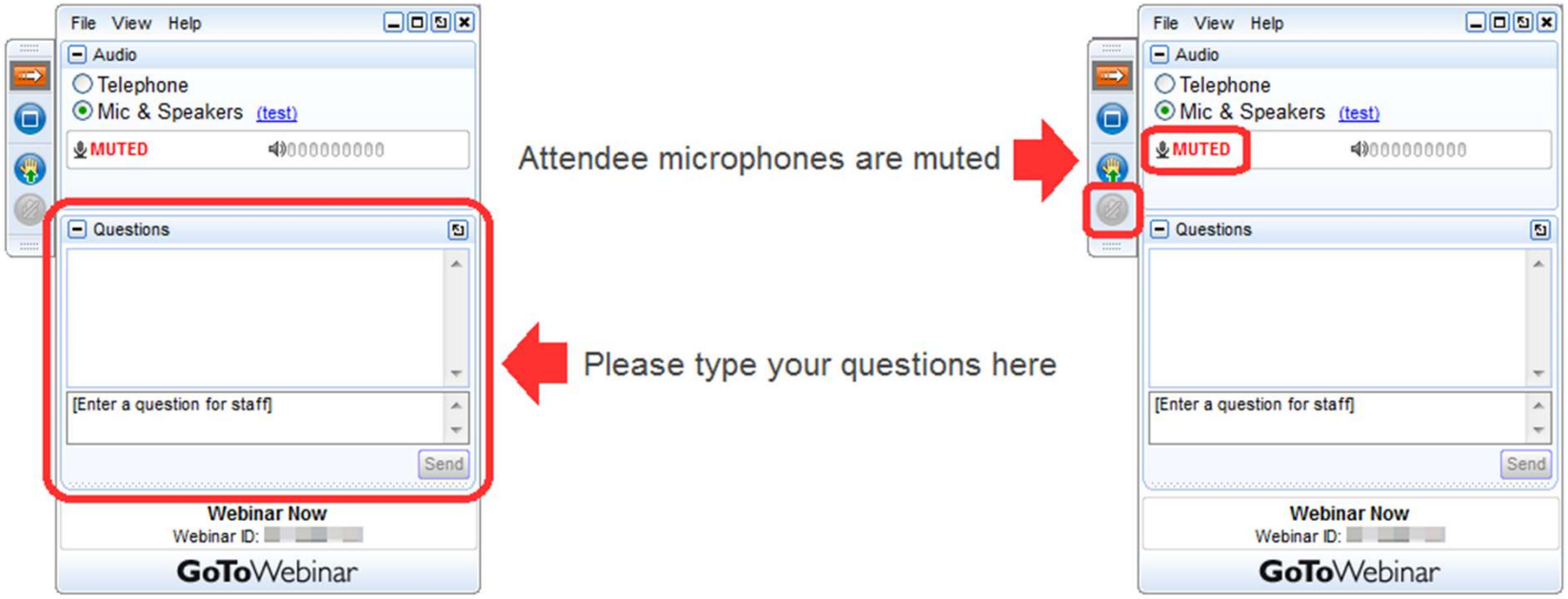

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Treatment thickness design using mechanistic-empirical procedure

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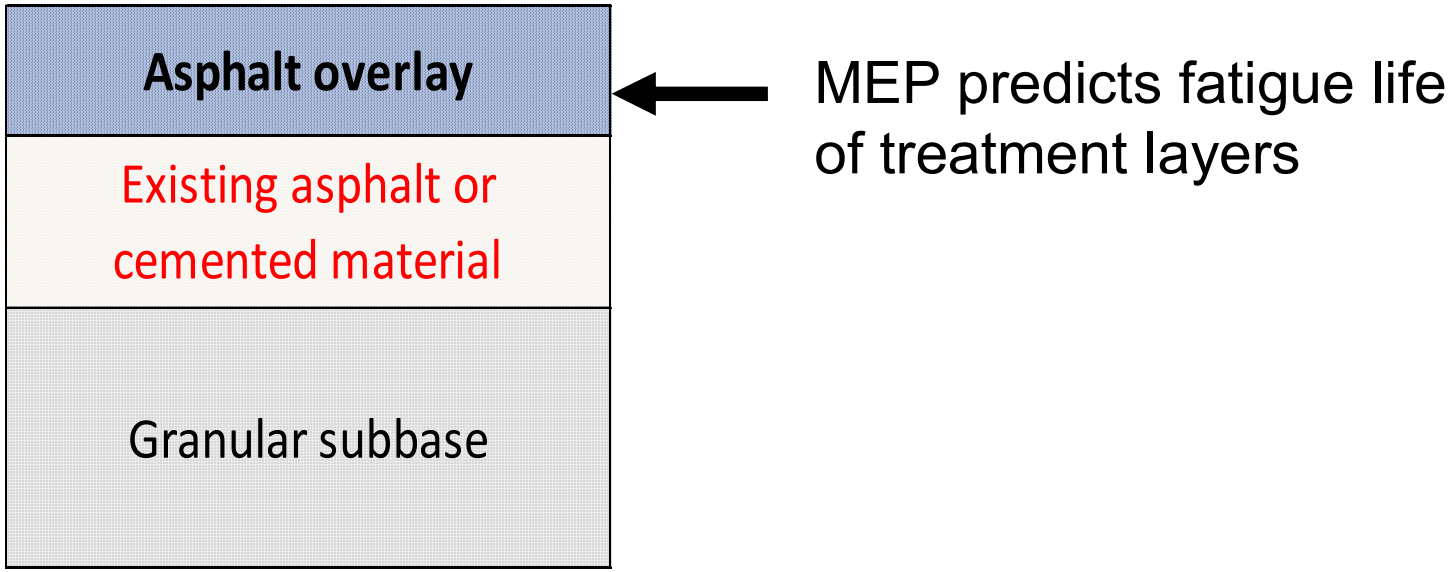
Mechanistic-empirical procedure (MEP)

- Previously called the GMP - **g**eneral **m**echanistic **p**rocedure to delineate it from the design chart method which was a simplified mechanistic method
- GMP now renamed MEP
- Used to design thickness of any treatment to a flexible pavement other than concrete overlays/inlays
  - Asphalt overlays
  - Asphalt inlays/major patchings
  - Stabilisation of pavement layers and subgrade

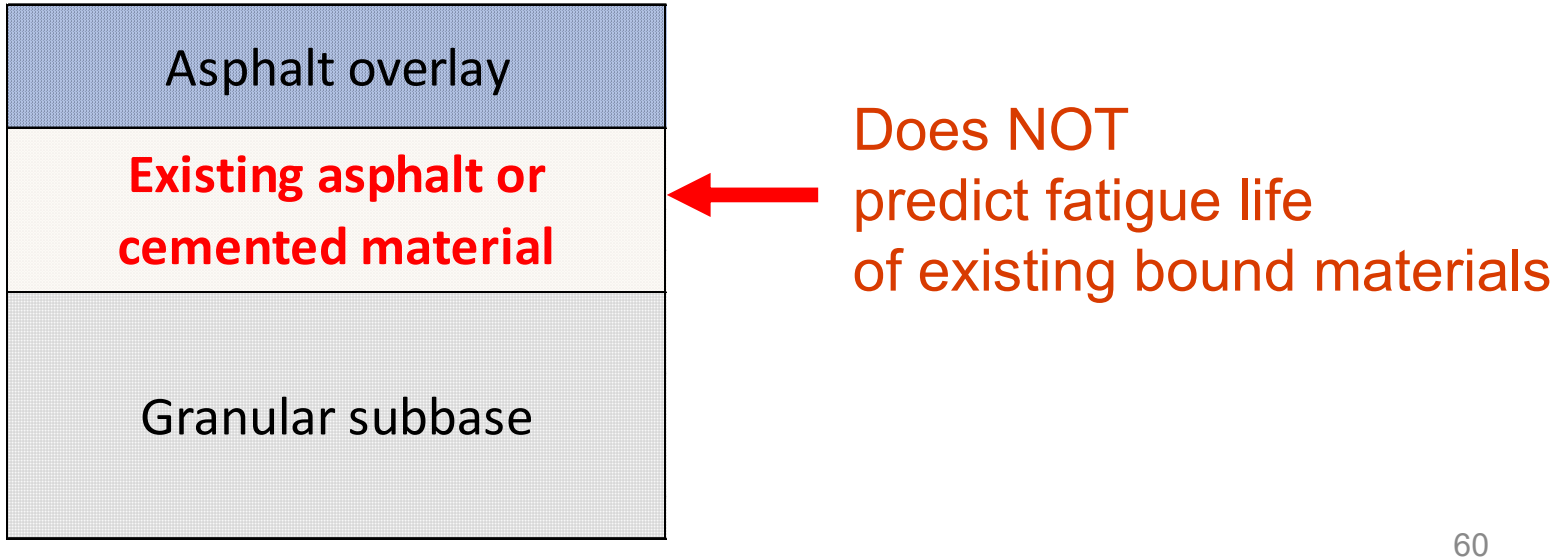
Scope of the MEP

- Strengthening treatments are designed to limit fatigue cracking in treatment layers and permanent deformation of the treated pavement



Scope of the MEP

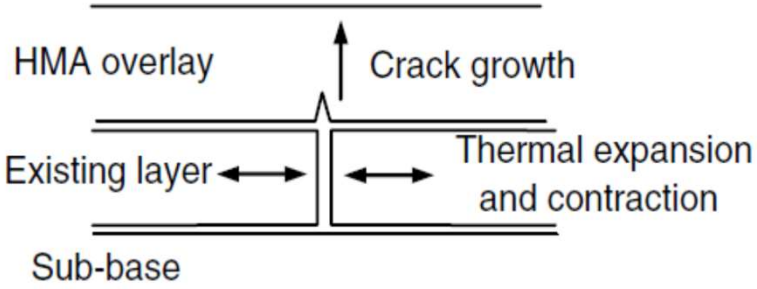
- Procedures yet to be develop to design treatments to limit fatigue cracking of existing bound materials
- Concepts of remaining structural life yet to be developed
- Similarly MEP not applicable to newly-constructed pavements



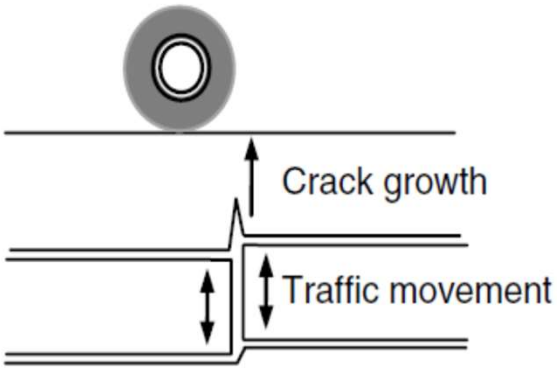
Reflective cracking

- The MEP does not predict allowable traffic loading in terms of reflective cracking from any cracked underlying material

- Designer needs to consider cost-effective treatment options



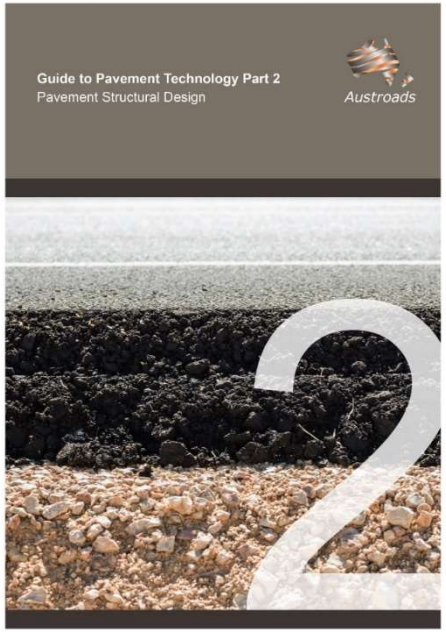
Thermally induced fatigue

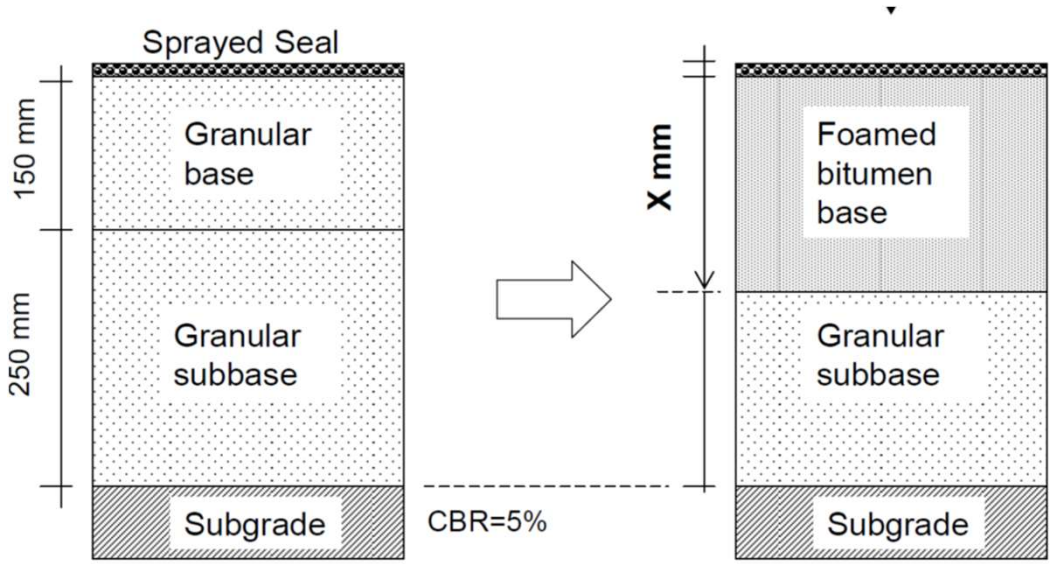


Traffic induced fatigue

MEP treatment design similar to Part 2

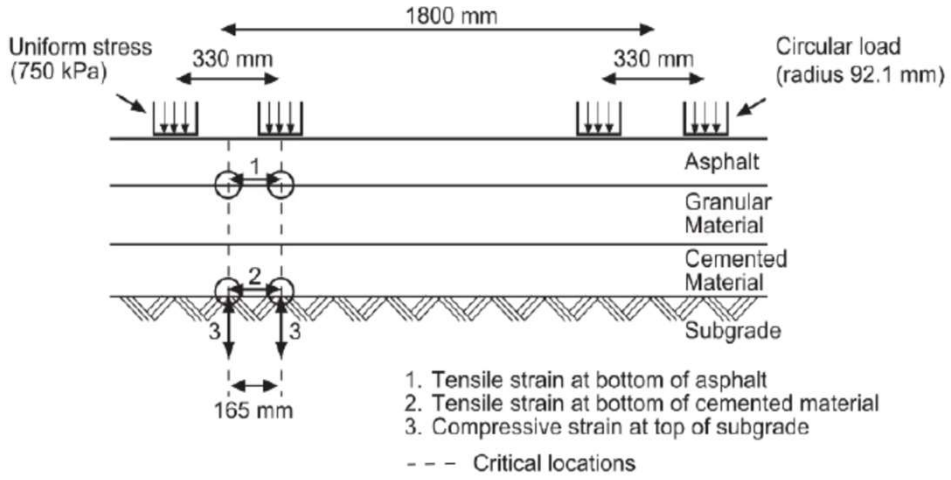
Similar to Part 2 for new pavement design, except there is an initial phase in which the properties of in situ materials are determined





Design steps

- design modulus of pavement layers and subgrade
- calculate critical strains under truck axle loads using a linear elastic model
- predict allowable traffic using performance relationships
- compare allowable traffic with design traffic



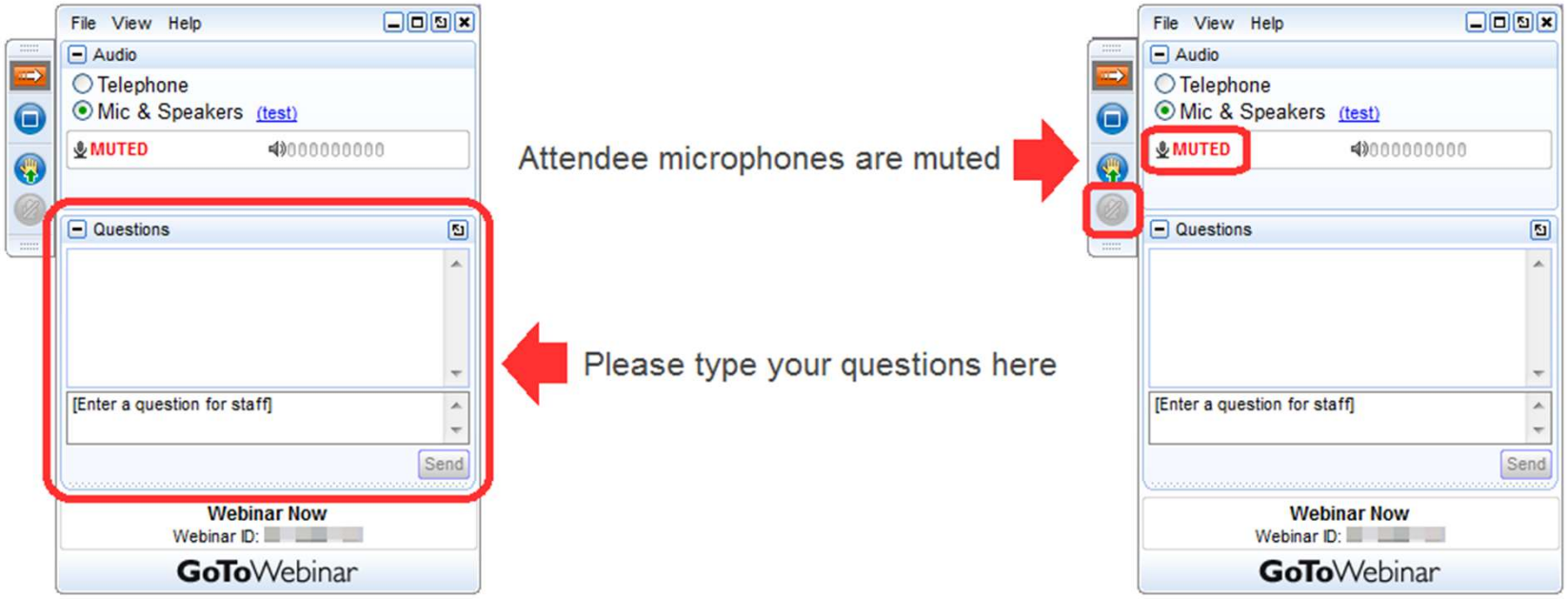
Asphalt fatigue relationship

$$N = \frac{SF}{RF}\left[\frac{6918(0.856V_b + 1.08)}{E^{0.36}\mu\varepsilon}\right]^5$$

Summary

- Project objectives
- Supplement development process
- MRWA feedback on needs
- Overview of Supplement
- Design of granular overlays
- Design of asphalt overlays and inlays
- Mechanistic-empirical procedure for structural treatements

Please send your questions with slide number



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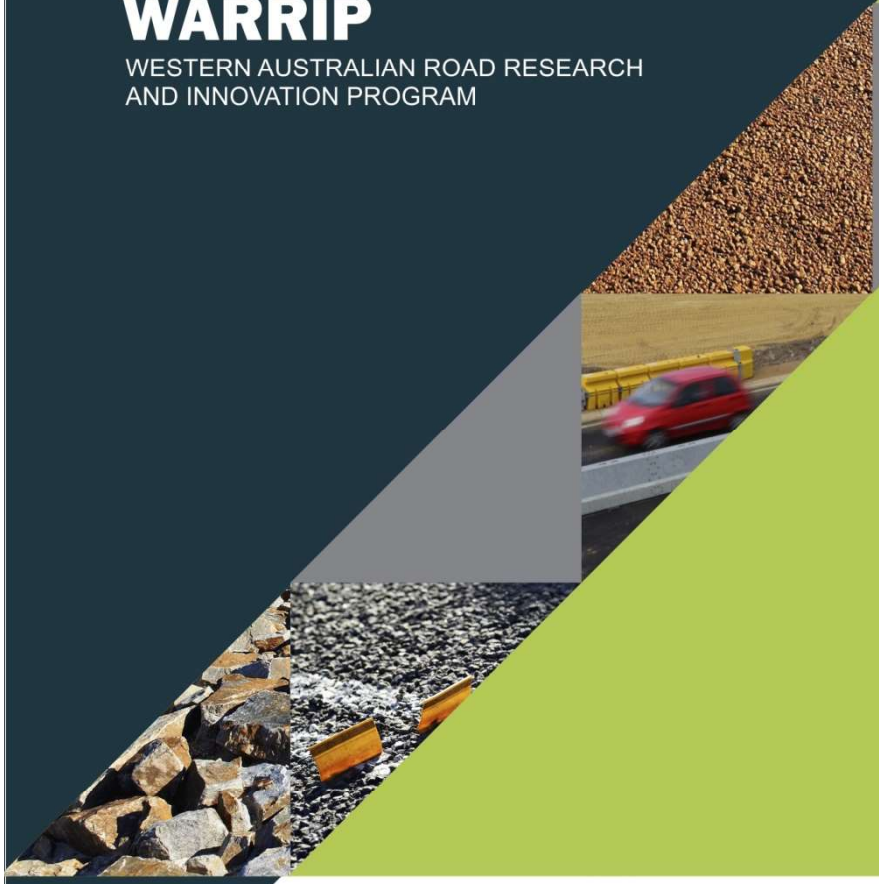
AND INNOVATION PROGRAM



Q & A

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Upcoming WARRIP Webinars

Title	Presenters	Date/time
Development of Crumb Rubber Modified Binder Asphalts in WA	• Steve Middleton (ARRB) • Steve Halligan (Main Roads)	18 June 2:30pm (AWST)
The Use of Reclaimed Asphalt Pavement from Crumb Rubber Modified Asphalt	• Zia Rice (ARRB) • Steve Halligan (Main Roads)	23 June 2:30pm (AWST)

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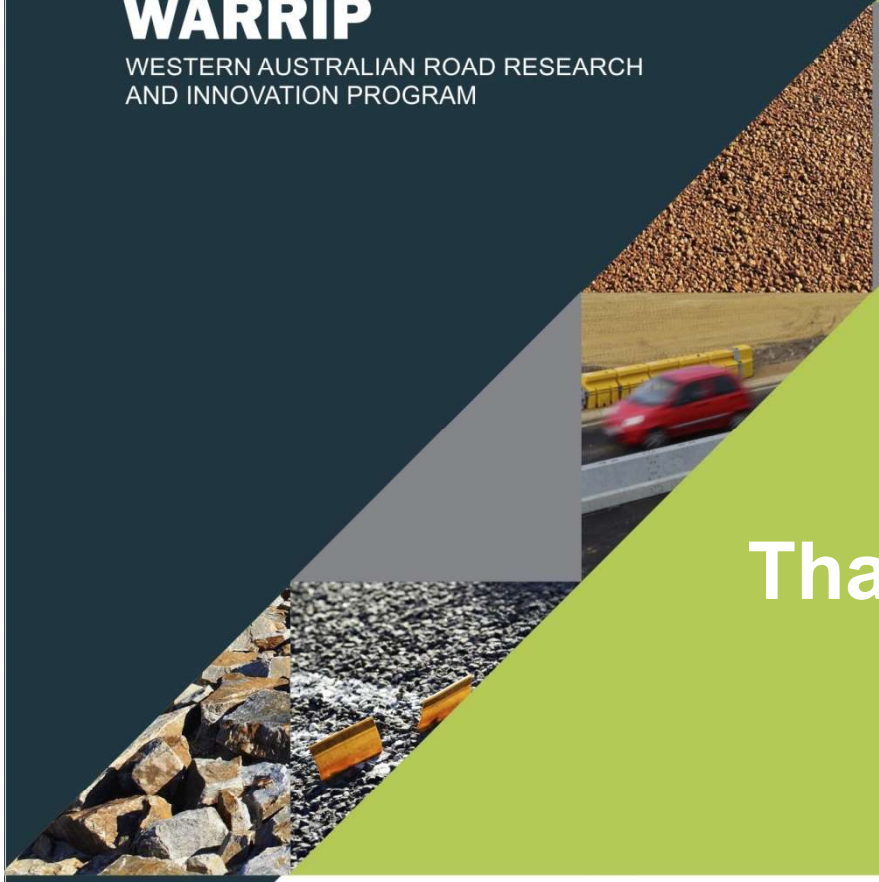

Thanks for listening!

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