A Practical Approach to Rehabilitate Thin Existing Pavements using Basegrade Stabilisation

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Stabilised Pavements of Australia

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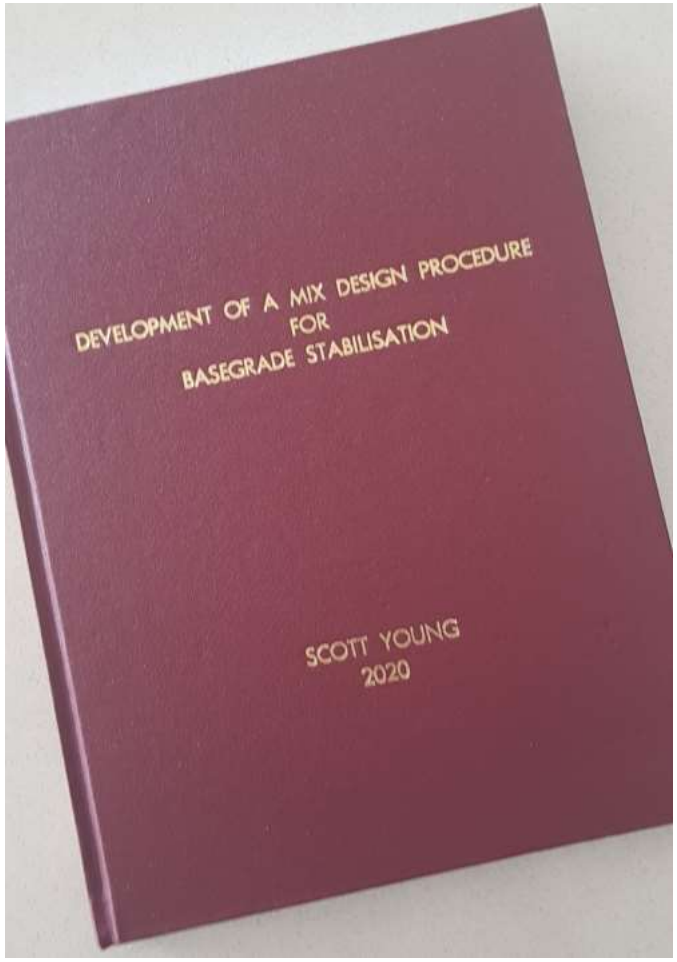
PREAMBLE


DEVELOPMENT OF A MIX DESIGN PROCEDURE
FOR
BASEGRADE STABILISATION
SCOTT YOUNG
2020

AGENDA

STABILISED PAVEMENTS OF AUSTRALIA PTY LTD
STRENGTH • FLEXIBILITY

1. Introduction
2. Defining Basegrade Stabilisation
3. The Research Program
4. Development of the Mix Design Procedure
5. Applications in Local Government
6. Summary

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STRENGTH • FLEXIBILITY

1 INTRODUCTION

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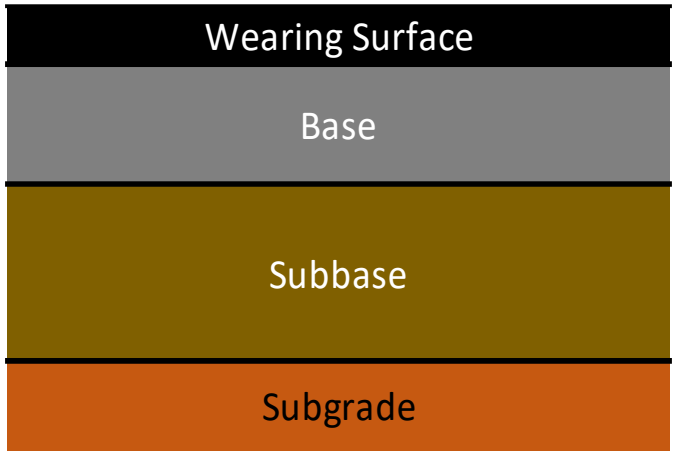
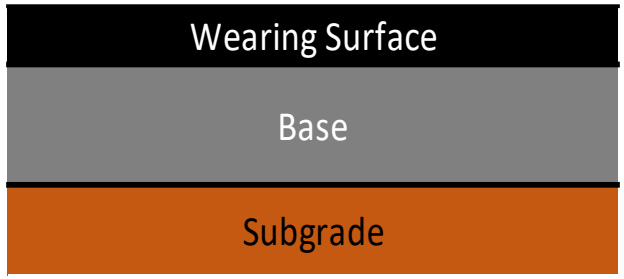
Pavement Structures



Typical Pavement Structure



Common Pavement Structure

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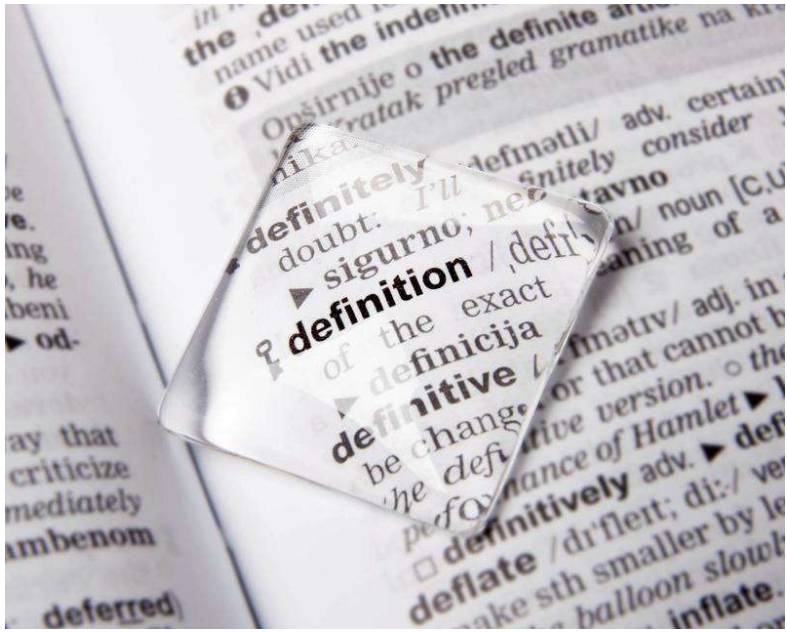
2 BASEGRADE STABILISATION



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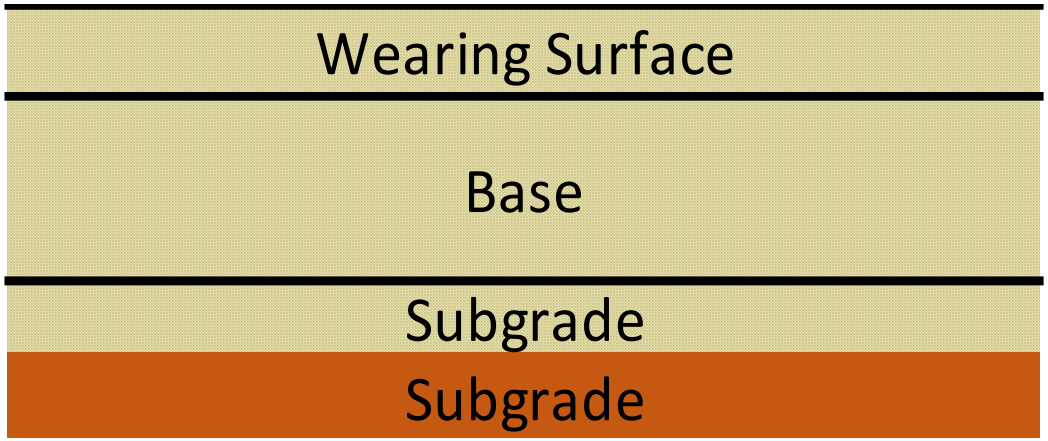
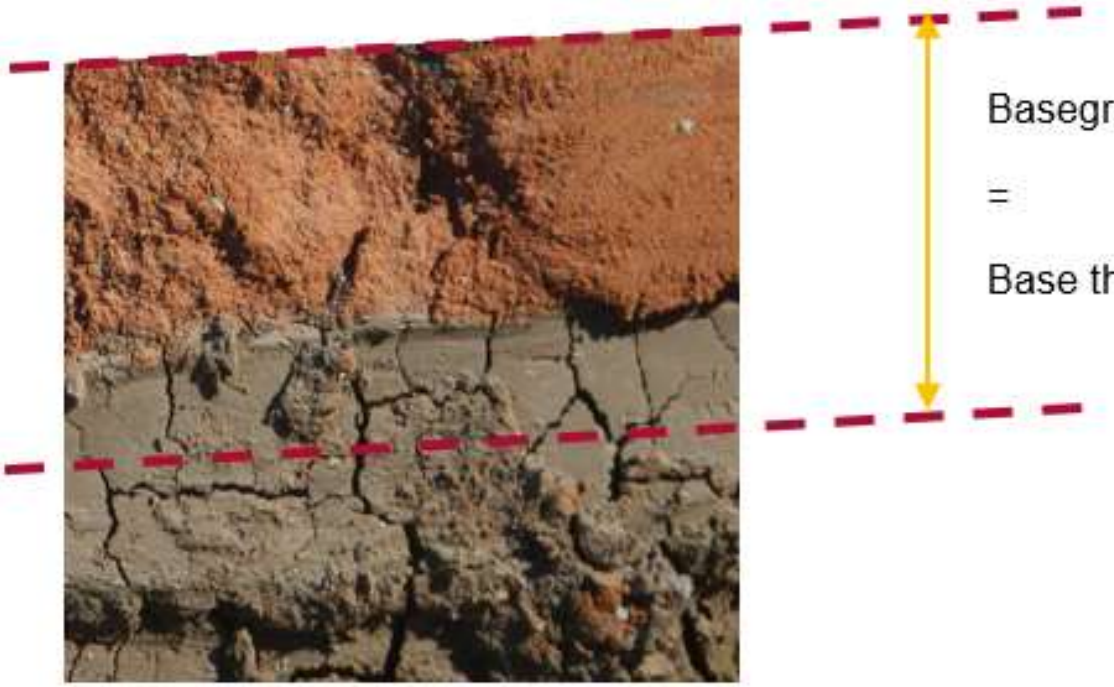
Thin Pavements



Required Depth of Stabilisation

Basegrade Stabilisation



Basegrade Stabilisation Thickness

=

Base thickness + Subgrade Thickness

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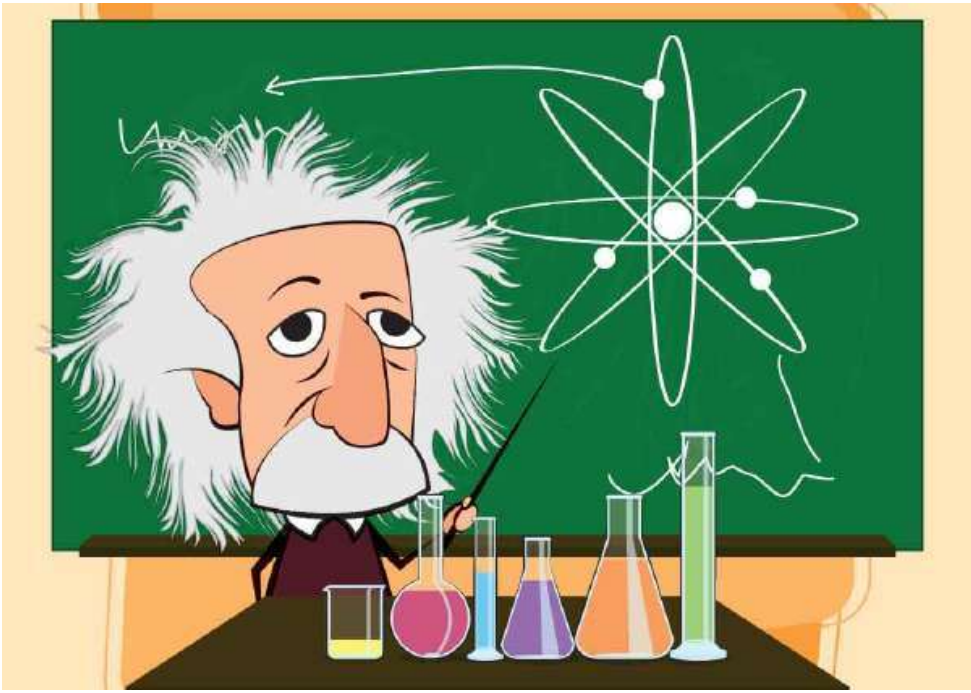
3 THE EXPERIMENTAL RESEARCH PROGRAM



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Research Objective

To develop a mix design procedure for basegrade stabilisation treatments on local government pavement rehabilitation projects identified in lightly trafficked environments.

Raw Materials

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Raw Material Properties

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Raw Material #	1	2	3	4
Property	**Type 2.3 Gravel**	**Pittsworth Alluvial**	**Redlands Silt**	**Wallum Court Clay**
Liquid Limit (%)	19.6	82.4	65.4	38.8
Plastic Limit (%)	17.6	33	37	24.6
Plasticity Index (%)	2.0	49.4	28.4	14.2
Linear Shrinkage (%)	1.4	21.4	16	3.4
Maximum Dry Density (t/m^3)	2.18	1.34	1.35	1.68
Optimum Moisture Content (%)	8.5	29.5	38	21
4 Day Soaked CBR (%)	70	1.5	2.5	8
Swell (%)	0.0	0.8	0.3	1.9

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Research Pavement Types

Pavement Material	Type 2.3 Gravel RM1								
Subgrade Material	RM2 Pittsworth Alluvial			RM3 Redlands Silt			RM4 Wallum Court Clay		
Gravel / Subgrade Proportions (%)	80/20	65/35	50/50	80/20	65/35	50/50	80/20	65/35	50/50
Pavement Type	**PT1**	**PT2**	**PT3**	**PT4**	**PT5**	**PT6**	**PT7**	**PT8**	**PT9**

Test Phase 1 & 2: UNTREATED

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UNTREATED MATERIALS					
Phase 1 Testing	**Phase 1 Tests**	**Phase 2 Testing**			**Phase 2 Tests**
Raw Materials	PSD, Atterbergs, MDR, CBR	**Pavement Type**	**Base 1**	**Subgrade 1**	PSD, Atterbergs, MDR, CBR on all Pavement Types
Type 2.3 Gravel		PT1	80%	20%	
		PT2	65%	35%	
		PT3	50%	50%	
Pittsworth Alluvial		**Pavement Type**	**Base 1**	**Subgrade 2**	
		PT4	80%	20%	
		PT5	65%	35%	
Redlands Silt		PT6	50%	50%	
		Pavement Type	**Base 1**	**Subgrade 3**	
Wallum Court Clay		PT7	80%	20%	
		PT8	65%	35%	
		PT9	50%	50%	

Test Phase 3 & 4: TREATED

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	TREATED MATERIALS									
	Phase 3a Testing			Phase 3b Testing		Phase 3 Tests	Phase 4 Testing			Phase 4 Tests
	Lime/Cement/Flyash Triple Blend			60/40 Slag/Lime			Day 1: Lime Day 2: 70/30 GB Cement			
Pavement Type	**3%**	**5%**	**7%**	**5%**	**7%**					
PT1	30/40/30	30/40/30	30/40/30	60/40	60/40	UCS on all samples	3% lime/ 2% GB	3% lime/ 3% GB	3% lime/ 4% GB	UCS on all samples
PT2	40/40/20	40/40/20	40/40/20							
PT3	50/30/20	50/30/20	50/30/20							
Pavement Type	**Lime/Cement/Flyash Triple Blend**			**60/40 Slag/Lime**		MDR Atterbergs on Pavement Types PT2, PT5, PT8 (65/35 blend)	**Day 1 Lime / Day 2 Cement**			MDR Atterbergs on Pavement Types PT2, PT5, PT8 (65/35 blend)
PT4	30/40/30	30/40/30	30/40/30	60/40	60/40		3% lime/ 2% GB	3% lime/ 3% GB	3% lime/ 4% GB	
PT5	40/40/20	40/40/20	40/40/20							
PT6	50/30/20	50/30/20	50/30/20							
Pavement Type	**Lime/Cement/Flyash Triple Blend**			**60/40 Slag/Lime**			**Day 1 Lime / Day 2 Cement**			
PT7	30/40/30	30/40/30	30/40/30	60/40	60/40		3% lime/ 2% GB	3% lime/ 3% GB	3% lime/ 4% GB	
PT8	40/40/20	40/40/20	40/40/20							
PT9	50/30/20	50/30/20	50/30/20							
	1 Day Process						**2 Day Process**			

UCS Testing

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Summary of UCS Results

All in MPa

Averages	1.5			2.0			1.5				
	2.3	1.4	0.8	2.5	2.0	1.5	1.6	1.6	1.5		
	PT1	**PT2**	**PT3**	**PT4**	**PT5**	**PT6**	**PT7**	**PT8**	**PT9**	Averages	
3% Triple Blend	1.5	0.6	0.3	1.9	1.1	0.6	0.8	1.0	1.0	1.0	1.5
5% Triple Blend	1.8	1.5	0.6	2.0	1.9	1.6	1.3	1.5	1.3	1.5	
7% Triple Blend	2.3	1.7	1.3	3.1	1.9	1.3	1.8	2.0	1.8	1.9	
5% 60/40 Slag/Lime	2.9	1.2	0.7	3.3	2.1	1.0	2.0	1.8	1.3	1.8	2.0
7% 60/40 Slag/Lime	3.3	2.0	0.9	3.1	2.7	1.5	2.3	2.3	2.2	2.3	
3% Lime + 2% 70/30 GB	1.6	1.3	0.5	1.6	1.6	1.2	1.2	0.9	1.2	1.2	1.7
3% Lime + 3% 70/30 GB	1.9	1.6	1.2	2.4	1.9	2.0	1.4	1.3	1.6	1.6	
3% Lime + 4% 70/30 GB	3.1	2.1	0.8	2.8	2.6	2.6	1.7	1.8	1.6	2.1	
Subgrade %	20	35	50	20	35	50	20	35	50		

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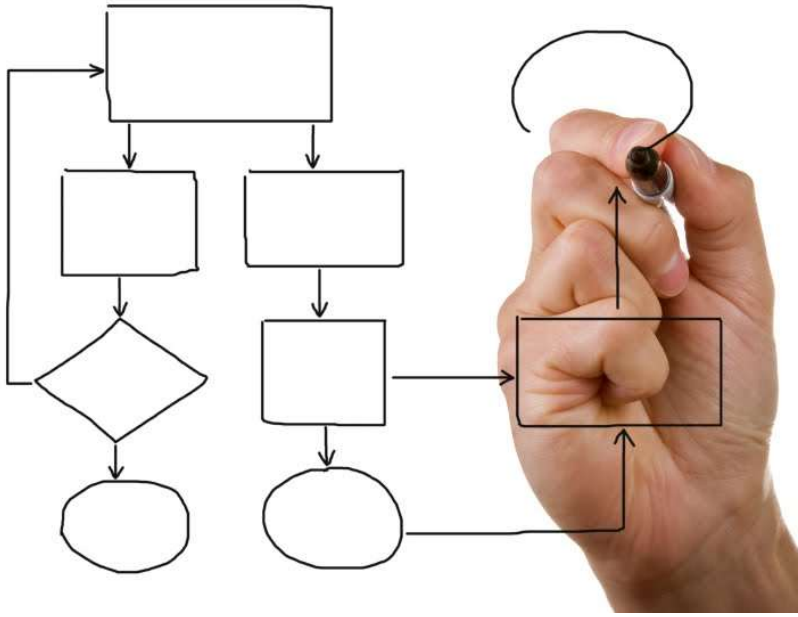
4 DEVELOPMENT OF THE MIX DESIGN PROCEDURE



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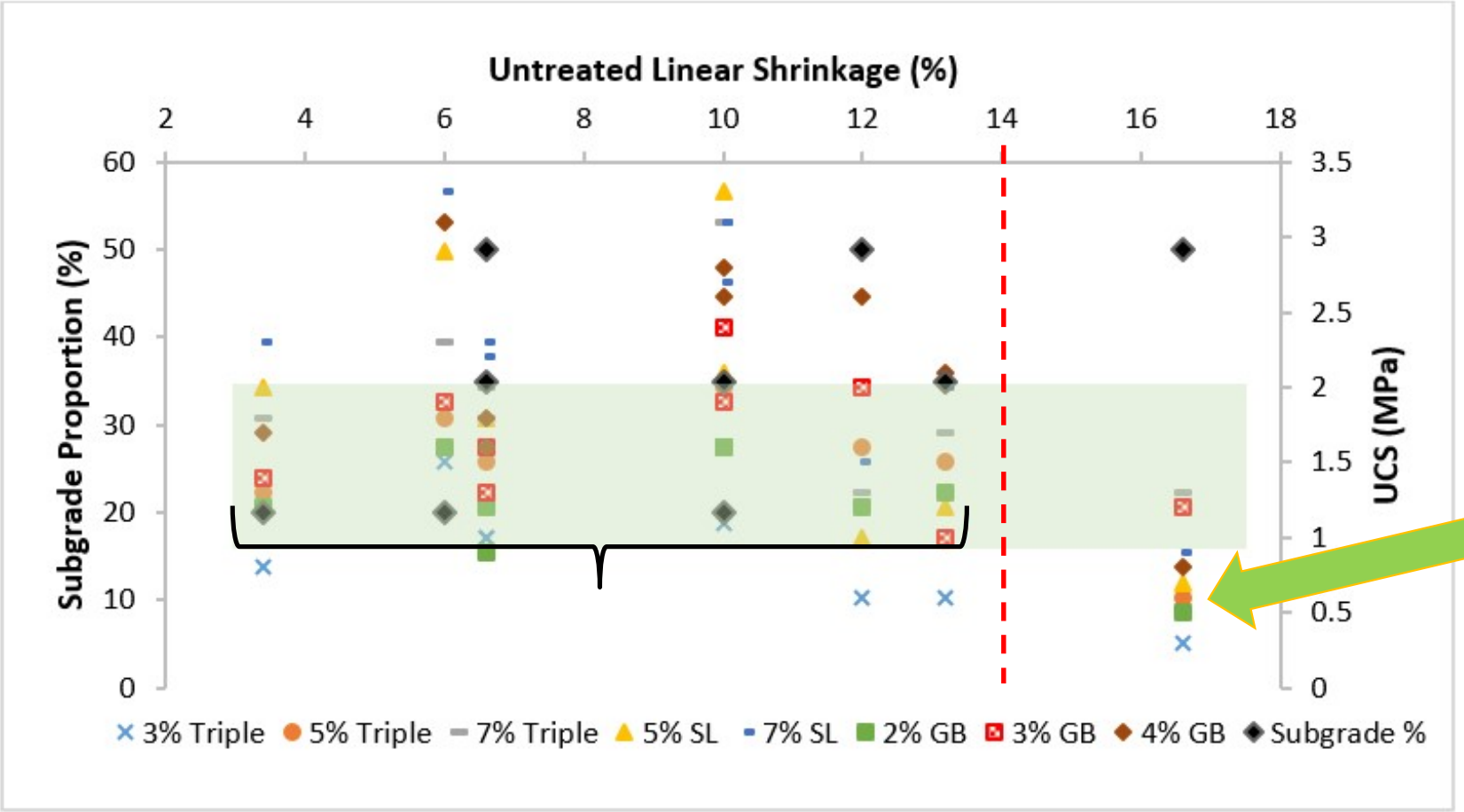
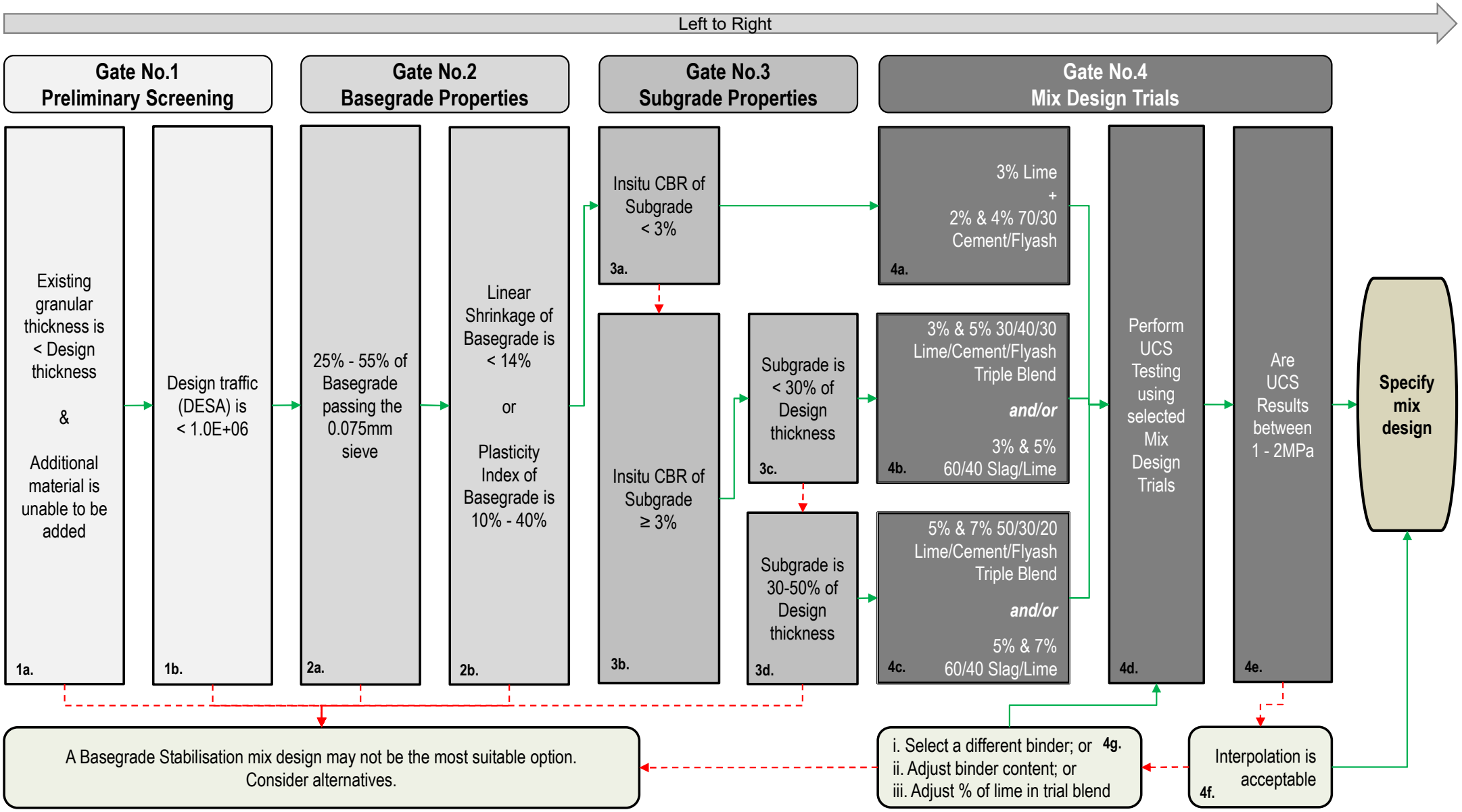
UCS v Linear Shrinkage



The Mix Design Procedure


Left to Right
Gate No.1
Preliminary Screening
Gate No.2
Basegrade Properties
Gate No.3
Subgrade Properties
Gate No.4
Mix Design Trials
Existing granular thickness is < Design thickness
&
Additional material is unable to be added
1a.
Design traffic (DESA) is < 1.0E+06
1b.
25% - 55% of Basegrade passing the 0.075mm sieve
2a.
Linear Shrinkage of Basegrade is < 14%
or
Plasticity Index of Basegrade is 10% - 40%
2b.
Insitu CBR of Subgrade < 3%
3a.
Insitu CBR of Subgrade ≥ 3%
3b.
Subgrade is < 30% of Design thickness
3c.
Subgrade is 30-50% of Design thickness
3d.
3% Lime
+
2% & 4% 70/30 Cement/Flyash
4a.
3% & 5% 30/40/30 Lime/Cement/Flyash Triple Blend
and/or
3% & 5% 60/40 Slag/Lime
4b.
5% & 7% 50/30/20 Lime/Cement/Flyash Triple Blend
and/or
5% & 7% 60/40 Slag/Lime
4c.
Perform UCS Testing using selected Mix Design Trials
4d.
Are UCS Results between 1 - 2MPa
4e.
Specify mix design
Interpolation is acceptable
4f.
i. Select a different binder; or
ii. Adjust binder content; or
iii. Adjust % of lime in trial blend
4g.
A Basegrade Stabilisation mix design may not be the most suitable option.
Consider alternatives.

User Guidance

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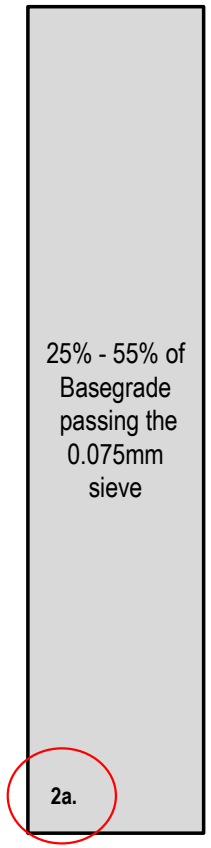
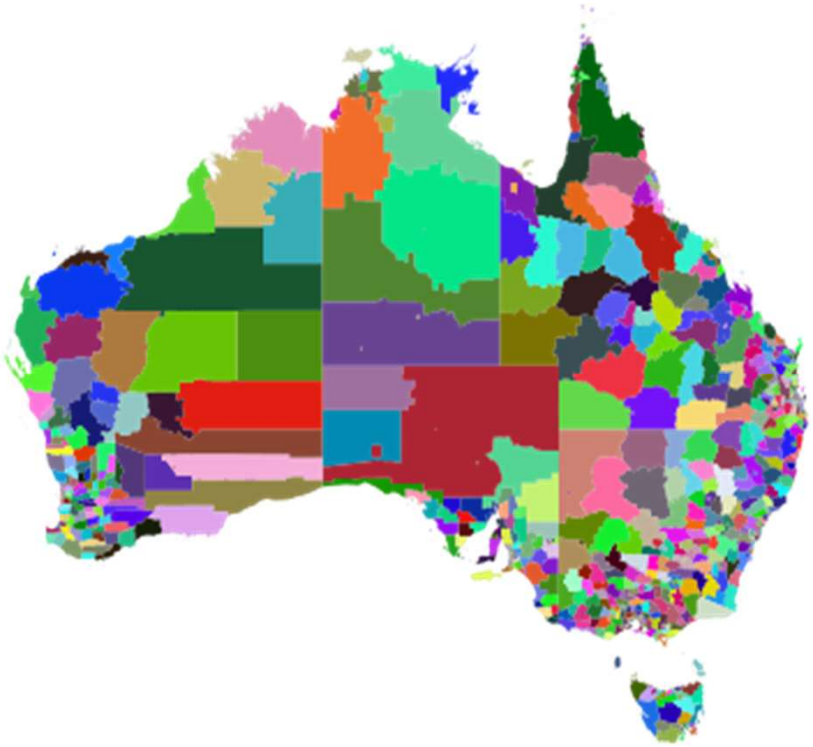


Specific Notes:

1a. Existing granular thickness can include bituminous wearing surface where no level restrictions exist. Additional material refers to a review of the opportunity to raise the level of the existing pavement with another suitable unbound material (eg. a granular overlay).

1b. Engineering judgement is required on a case by case basis to assess the heavy vehicle traffic spectrum for the site against the specific basegrade pavement being considered.

5 APPLICATIONS IN LOCAL GOVERNMENT



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Urban / Residential
Lightly Trafficked
K&C Level Restrictions

Sunshine Coast Council

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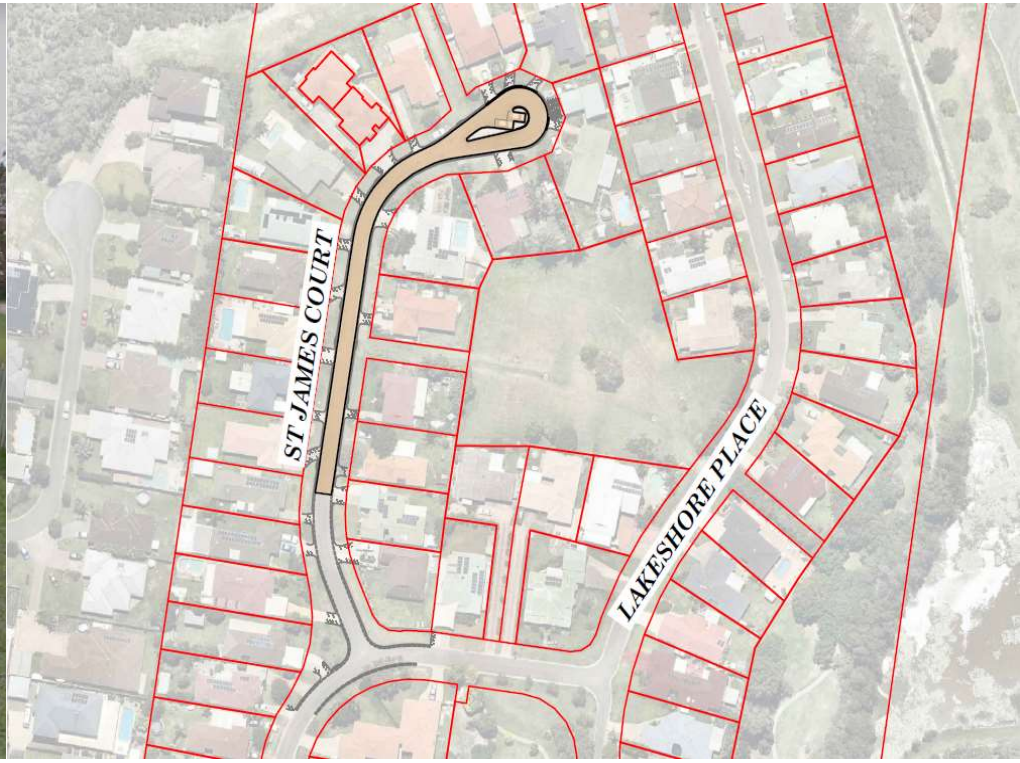

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Rehab Solution

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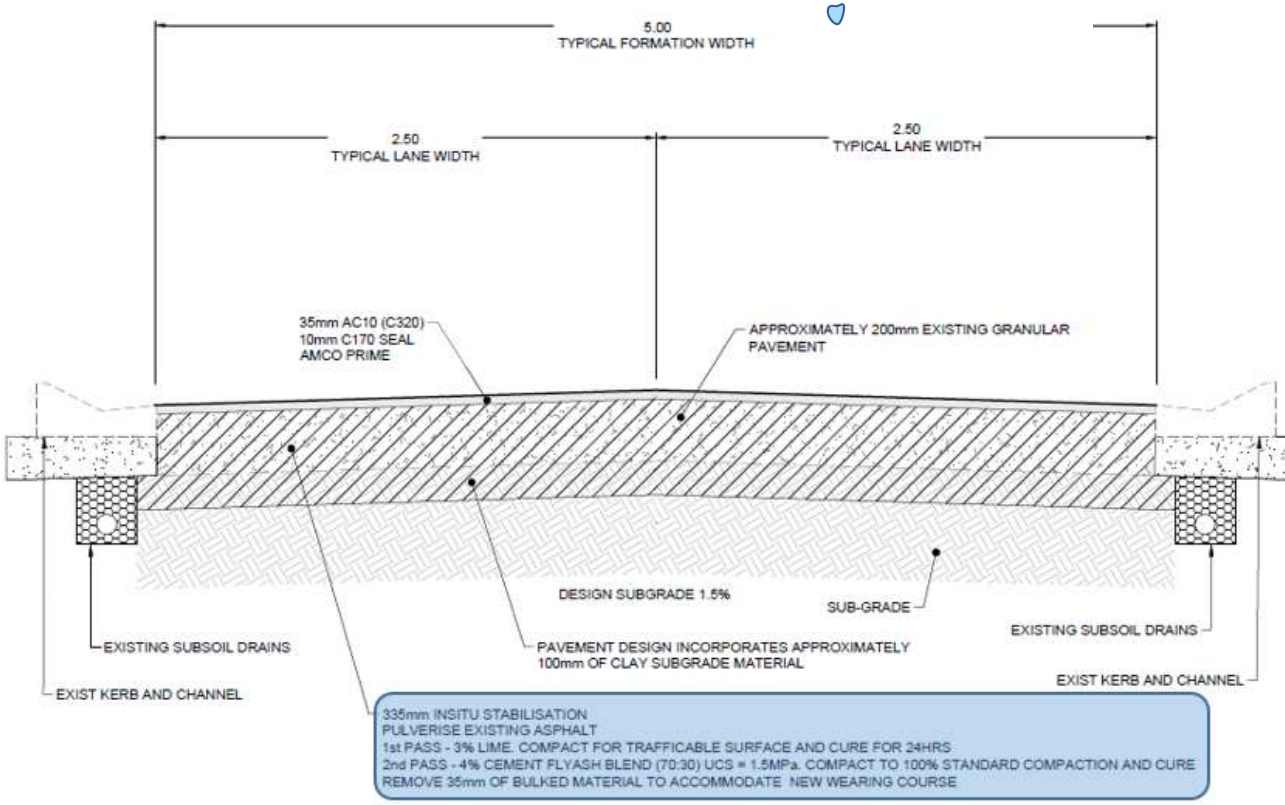

TYPICAL CROSS SECTION - PAVEMENT TYPE A

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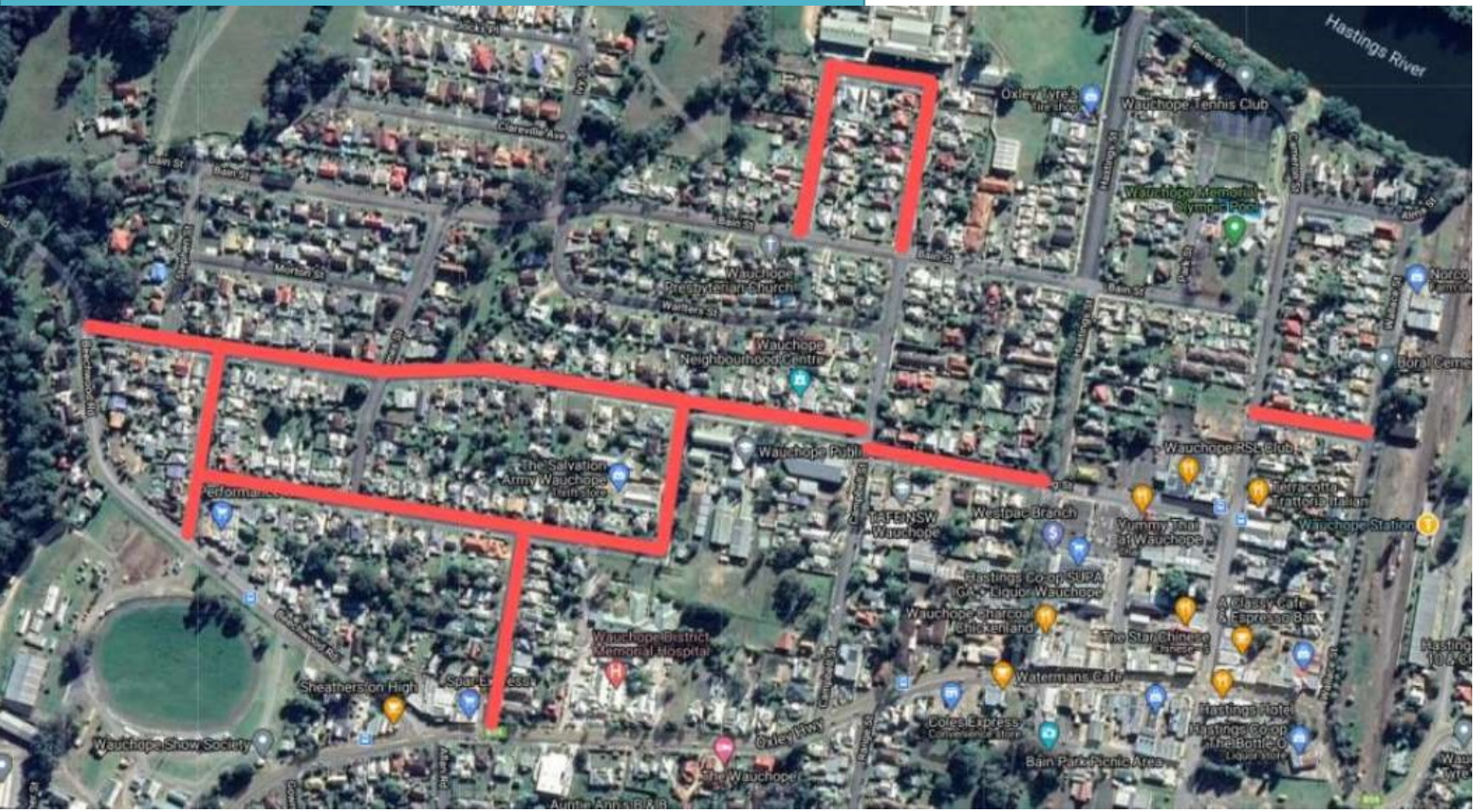
Redland City Council
15 April 2021

Port Macquarie Hastings Council, NSW



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7 SUMMARY

Evolution

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Conventional Stabilisation

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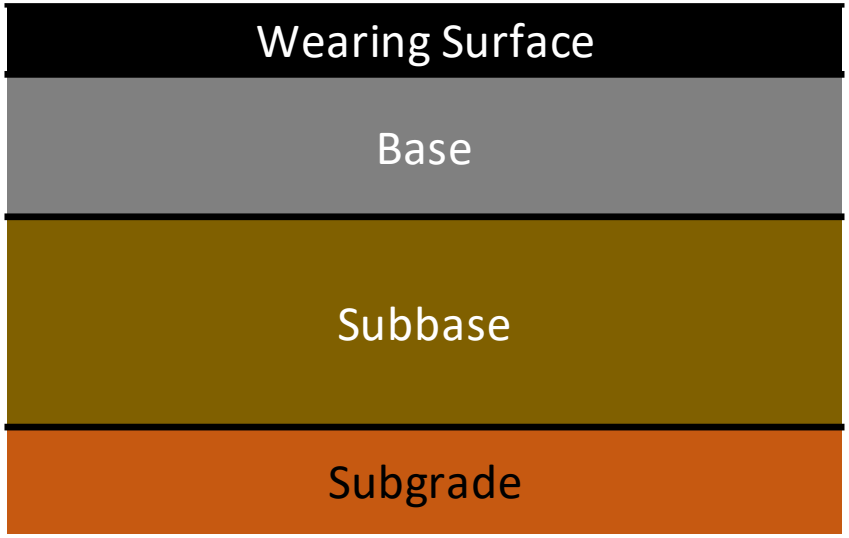
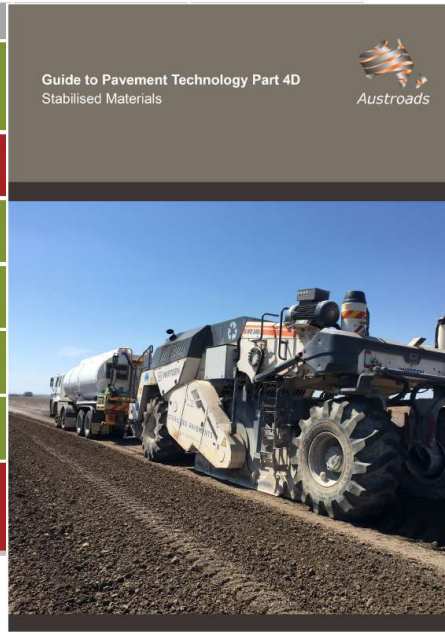


Particle size	More than 25% passing 75 µm sieve			Less than 25% passing 75 µm sieve		
Plasticity index (PI)	PI ≤ 10	10 < PI < 20	PI ≥ 20	PI ≤ 6 & PI x %passing 75 µm ≤ 60	PI ≤ 10	PI > 10
Binder type						
Cement and cementitious blends[1,3]	Usually suitable	Doubtful	Usually not suitable	Usually suitable		
Lime	Doubtful	Usually suitable	Usually suitable	Usually not suitable		
Bitumen	Doubtful	Doubtful	Usually not suitable	Usually suitable		
Bitumen/ lime blends	Usually suitable	Doubtful	Usually not suitable	Usually suitable		
Granular	Usually suitable	Usually not suitable	Usually not suitable	Usually suitable		
Dry powder polymers	Usually suitable	Usually suitable	Usually unsuitable	Usually suitable		
Other proprietary chemical products[2]	Usually not suitable	Usually suitable	Usually suitable	Usually not suitable		



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Basegrade Stabilisation

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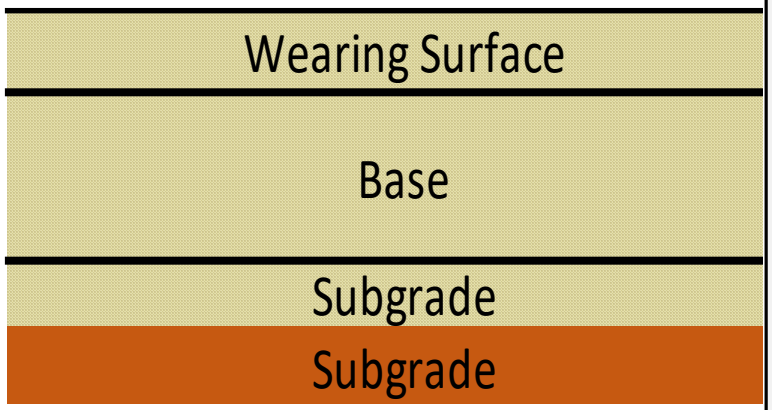

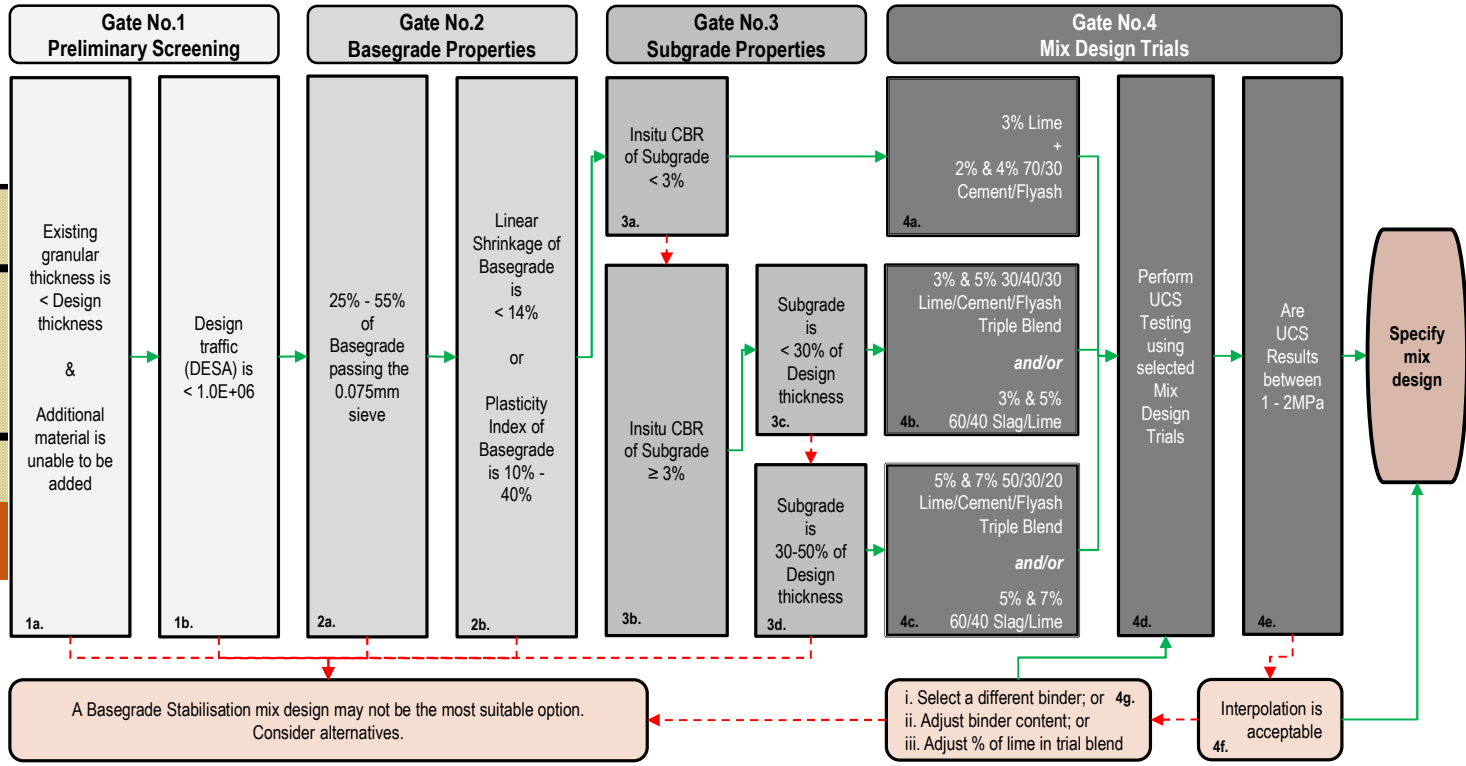

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