Presentation by Malcolm Styles

International Public Works Engineering Conference

Hobart Australia

25-29 August 2019

# Can Marginal Materials Matter? — You Bet! Unsealed road trial results at Central Goldfields

# Introduction

Unsealed road trial conducted at Possum Gully Road, Central Goldfields Shire Council between December 2016 and December 2018

Australia

Victoria and Central Goldfields





# Why do a trial of unsealed roads?

Nearly 575,000km of them here in Oz

Some are really fit for purpose





# Why trial unsealed roads? (continued)

# Sustainable Liveability Issues:

- Road making material suitable for unsealed road surfaces becoming scarce
- Rough roads cause damage and expense
- Dust is dangerous and hazardous
- Unsealed surfaces require ongoing maintenance
- Poorly constructed unsealed pavements damage the surrounding environment after heavy rain
- Poor maintenance practice

# Imperatives for local councils:

- Find and test the properties of road making material for their suitability to construct unsealed road surfaces
- Measure the roughness of unsealed roads and investigate the reasons
- Experiment with unsealed road materials
   properties. Perhaps use additives to reduce dust
- Apply the science to construct and rehabilitate unsealed road pavements. Pay attention to compaction and functional pavement widths
- Ensure close attention is paid to pavement materials, compaction, and road drainage outfalls
- Train all staff and supervisors who undertake rehabilitation and maintenance of unsealed roads on good practice. Regularly monitor, report and document maintenance and rehabilitation

# Possum Gully Road Trial – the nine sections described

- > Section 1: Daisy Hill material with 3% foam bitumen, 3% cement
- Section 2: Daisy Hill material with 3% polymer
- > Section 3: Daisy Hill material with 1 litre enzyme per 30 cubic m material
- Section 4: Daisy Hill material with 46% class 4 FCR, 8% clay
- Section 5: Dunolly material with 1 litre enzyme per 30 cubic metres
- Section 6: Dunolly material crushed and screened
- Section 7: Dunolly material crushed and screened with 3% cement
- Section 8: Dunolly material crushed and screened with 5% clay
- Section 9: First 60 m Dunolly with 5% clay, citrus dust suppressant; then 180 m shape only and citrus spray.

# **Materials**

## Dunolly pit

# Daisy Hill pit



Screened twested at

02/06/2015

Revision No.

ate of Report:

GTSS Sample No

### Soil Analysis Report - Atterberg, Emerson, Grading, Moisture Content

Project:

Sieve Size

75.0 53.0

37.5

26.5

19.0

13.2

9.5

6.7

4.75

2.36

1.18

0.600

0.425 0.300

0.150

Central Goldfields Shire Council PO Box 194

Maryborough

VIC

Material Investigation

Dunolly Quarry Washed and Screened Sample 001 Sample supplied by : Client

Sandy Gravel, Brown, Some Silt and Clay

Client Identification2: Date Sampled: Material Description:

Sample %

Passing

100

100

100

42

28

PARTICLE SIZE DISTRIBUTION

100 L	Silt	Sand	Gravel	
100				2
90			/ /	
80			1 1	
70			// /	
60				
50	ARRE	30/		
40	ENVEZORE			
30		1/		
20		~/		
10	-			
0.0	1 0.1		10	100

ATTERBERG LIMITS						
Liquid Limit %	31					
Plastic Limit %	16					
Plasticity Index %	15					
Linear Shrinkage %	6.5					
Curling	No					
Crumbling	No					
Cracking	No					
Mould Length (mm):	250					

MOISTURE CONTEN	IT.
Moisture Content %	•
EMERSON CLASS NUM	BER
EMERSON CLASS NUM	IBER .
manage and deposit of the contract of the cont	BER:

MATERAIL PROPE	RTIES
Gravel Content %	42
Sand Content %	41
Silt/Clay Content %	17

PIX % PASSING 0-425=15x28= 420 (SHOULD BE 300 - 400)

- \* Represents test not preformed
- 1. Test Methods: AS 1289: 3.1.2 / 3.3.1 / 3.4.1 / 3.4.1 / 3.6.1
- 2. This laboratory is not be responsible for the correctness or accuracy of information provided by the client.
- 3. For Atterberg Limits and moisture contents; the sample history is oven dried, the preparation method is dry sieve.

Approved Signatory:

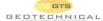
Date: June 2, 2015

Ptv: (02) 5441 4881 Fax: (03) 5441 4881

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GTSS Doc No. RS1 Verson: 01 April 2015: The controlled version of this document resides on the GTSS file server. This document is only controlled for the print date: 05/08/2015



DAISY HILL SAMPLE 100

of 4

28/10/2015

15B1659A

Revision No.

Date of Report:

GTSS Sample No

Sheet:

### Soil Analysis Report - Atterberg, Emerson, Grading, Moisture Content

Central Goldfields Shire Council P.O. Box 194

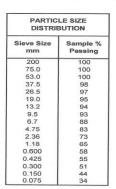
VICTORIA

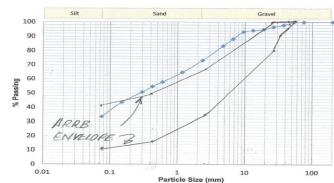
3465

Material Investigation - Daisy Hill

Project: Sample Location Client Identification2:

Date Sampled: Sample supplied by : Client **Material Description** Gravelly Sand, Brown/Orange, Some Silt & Clay





-							
	ATTERBERG LIMITS						
	Liquid Limit %	23	-				
	Plastic Limit %	13					
	Plasticity Index %	9					
	Linear Shrinkage %	1.5					
	Curling	No					
	Crumbling	No					
	Cracking	Yes					
	Mould Length (mm):	250					

MOISTURE CONTENT		MATERIAL PROPERTIES				
Moisture Content %						
EMERSON CLASS NU	IMBER	Gravel Content % Sand Content %	27 40			
Water Type		Silt/Clay Content %	34			
Water Temperature (°C)	*	11				
Emerson Class Number	*	11				

\* Represents test not preformed

1. Test Methods: AS 1289: 3.1.2 / 3.3.1 / 3.4.1 / 3.4.1 / 3.6.1

2. This laboratory is not be responsible for the correctness or accuracy of information provided by the client.

Approved Signatory:

C.J.Milne

Date: October 28, 2015

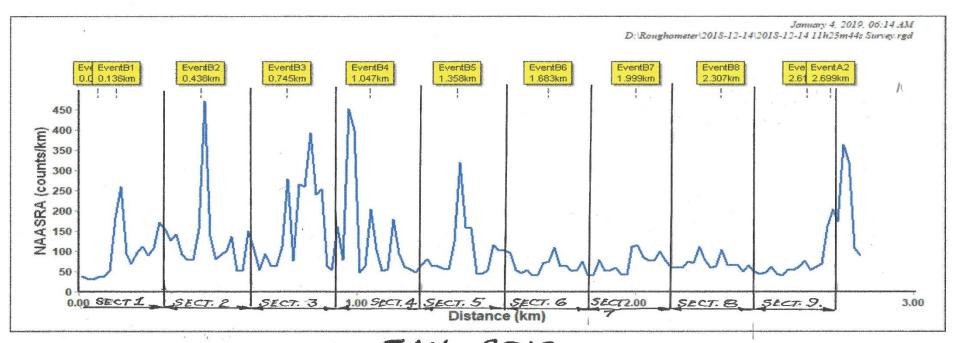
Geotechnical Testing Services, Southern Geotechnical Investigations, Soil Concrete and Aggregate Testing Laboratories (or/off site), Contract Drilling, Compection Control Testing, Site Classifications, Land Capebility Assessments, Contamination Assessments

Bendigo Soil and Concrete Testing Laboratory Corporate Site #835 La Trobe University Campus, Sharon Street, Bendigo 3550 Ph; (03) 5441 4881 Fax: (03) 5441 4881 email: Info@geotestsouthern.com.au

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# Roughness



5AN. 2019

# Dust

Trial Section	Observ.
1.Daisy Hill material with 3% foam bitumen and 3% cement stabilisation	4.1
2. Daisy Hill sourced with 3% polymer	2.6
3. Daisy Hill material with enzyme 1 litre to 30 m <sup>3</sup>	1.9
4. Daisy Hill material with 46% class 4 bluestone FCR plus 8% clay	1.3
5. Dunolly material with enzyme 1 litre to 30 m <sup>3</sup>	2.6
6. Dunolly material crushed and screened	2.7
7. Dunolly material crushed and screened with 3% cement	2.9
8. Dunolly material crushed and screened with 5% clay mixed at the source	3.2
9. Dunolly material uncrushed with citrus organic binder dust suppressant	2.5



# Construction

Section 1 Cement and foam bitumen emulsion additives to Daisy Hill material

Section 1 Mixed preparatory to grading, watering and rolling





# **Issues and Constraints**

e.g. Result of inattention to crossfall

At crown

Section 3 at 8 months

Section 3 at 8 months





Triple Bottom Line assessment

SECTION	1	2	3	4	5	6	7	8	9	Criterion	Average
Capital cost AU\$	\$22.97	\$10.64	\$16.95	\$15.10	\$18.14	\$4.71	\$11.89	\$10.38	\$4.83	Economic	\$12.85
Score	-9.12	3.21	-3.10	-1.25	-4.29	9.14	1.96	3.47	9.02		
Weight	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Weighted score	-9.12	3.21	-3.10	-1.25	-4.29	9.14	1.96	3.47	9.02		
Maintenance over 2 years		0	0110	1120				0.11	\$375.0		
(cost AU\$)	\$255.30	\$254.49	\$713.87	\$69.11	\$281.32	\$139.85	\$48.78	\$0.00	0	Economic	\$237.52
				·		·				(Section 9 regrade	
Score	-1.68	-1.60	-47.53	16.94	-4.28	9.87	18.97	23.85	-13.65	Aug.17)	
Weight	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00		
Weighted score	-3.36	-3.19	-95.07	33.88	-8.56	19.73	37.95	47.70	-27.30		
Roughness NAASRA)	93.90	130.50	165.40	137.90	97.10	68.20	70.50	71.90	67.20	Principally Social	100.29
Score	0.74	-2.92	-6.41	-3.66	0.42	3.31	3.08	2.94	3.41		
Weight	5	5	5	5	5	5	5	5	5		
Weighted score	3.69	-14.61	-32.06	-18.31	2.09	16.54	15.39	14.69	17.04		
Dust	4.1	2.6	1.9	1.3	2.6	2.7	2.9	3.2	2.5	Environmental	2.64
Score	1.46	-0.04	-0.74	-1.34	-0.04	0.06	0.26	0.56	-0.14		
Weight	5	5	5	5	5	5	5	5	5		
Weighted score	7.28	-0.22	-3.72	-6.72	-0.22	0.28	1.28	2.78	-0.72		
Shana laga 1.0 m laft /mm)	-27.50	-63.50	-73.50	-41.00	-43.50	-39.50	-41.50	-32.00	-20.50	Environmental	-42.50
Shape loss 1.0 m left (mm)	1.60		-3.00	0.25			0.20		2.30	Environmental	-42.50
Score Weight	2.50	-2.00 2.50	2.50	2.50	0.00 2.50	0.40 2.50	2.50	1.15 2.50	2.50		
	<b>4.00</b>	<b>-5.00</b>	- <b>7.50</b>	<b>0.63</b>	2.50 <b>0.00</b>	2.50 <b>1.00</b>	2.50 <b>0.50</b>	2.50 <b>2.88</b>	2.50 <b>5.75</b>		
Weighted score Shape loss 1.0 m right	4.00	-5.00	-7.50	0.63	0.00	1.00	0.50	2.00	5.75		
(mm)	-16.50	-37.00	-72.00	-29.50	-50.50	-37.50	-31.00	-46.00	-28.50	Environmental	-38.72
Score	2.32	0.27	-3.23	1.02	-1.08	0.22	0.87	-0.63	1.12		JUII E
Weight	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50		
Weighted score	5.81	0.68	-8.07	2.56	<b>-2.69</b>	0.56	2.18	-1.57	2.81		
TOTALS	8.29		-149.52		-13.68		59.25	69.94	6.59		

# Observations and Thoughts Triple bottom line assessment (cont.)

SECTION	1 Daisy Hill	2 Daisy Hill	3 Daisy Hill	4 Daisy Hill	5 Dunolly	6 Dunolly	7 Dunolly	8 Dunolly	9 Dunolly unscreened
Economic factors (weighted scores)	-12.48	0.02	-98.17	32.63	-12.85	28.87	39.91	51.17	-18.28
Social	3.69	-14.61	-32.06	-18.31	2.09	16.54	15.39	14.69	17.04
Environmental	17.09	-4.54	-19.29	-3.53	-2.91	1.84	3.96	4.09	7.84
Total Score	8.30	-19.13	-149.52	10.79	-13.67	47.25	59.96	69.95	-6.60
Notes	Little dust	Rough	Rough, high maint.	Rough, dusty	Loss of shape		Little maint. costs	<b>No</b> maint. req.	Regrade req. after 7 months

# Conclusions (first slide of three)

- ✓ Daisy Fill material too marginal for purpose?
- ✓ Some merit in blending with bluestone
- Trial Section 3 Daisy Hill material at 18 months

- Screened and crushed Dunolly material fits
- ✓ Section 8 with 5% clay best performer at end of 2 years
- Establish with care pays!





# Conclusions continued (second slide of three)

Importance of supervisor and staff training inclusive of understanding the science

Bother to measure

Get materials, moisture mix and compaction right

Always make, and fund, the effort at rehabilitation time



# Conclusions continued (third slide of three)

- Find and test potential pavement materials sources
  - Good natural materials becoming scarce – don't be frightened to experiment and search

Do it right when rehabilitating

Will save heaps economically and environmentally





# **End of Presentation**

