Blacks Road – Subgrade and Existing Granular Material Stabilisation

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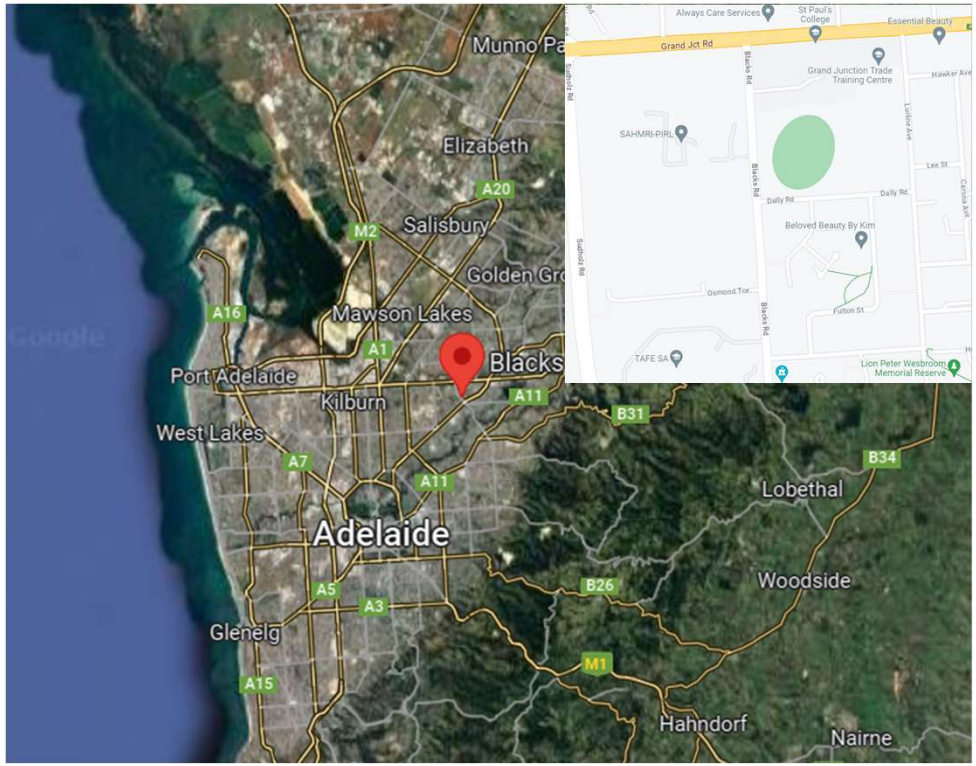
Hiway Stabilizers

AustStab
Pavement Recycling and Stabilisation Association

Location – Blacks Road – Gillies Plain



CITY OF Port Adelaide Enfield

- City of Port Adelaide Enfield Council
- Blacks Road extends between Grand Junction Road and Sudholz Road
- Reconstruction Section between Grand Junction Road and Dally Road
- Reconstruction length approx. 300m

Project Overview

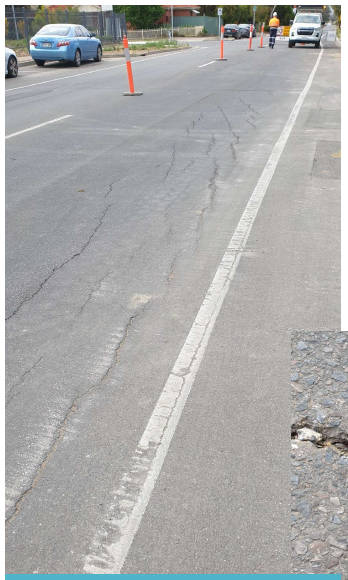
- The section of Blacks Road was constructed in 1969, and reconstructed in both 1985 (by Council) and 2023 (by Council and Hiways).
- Reseal in early 2000's.
- Highly reactive clays in this area – notable undulations when driving this section of road, typical of pavements in the surrounding area, resulting from large seasonal expansivity of fine, moisture sensitive soils.
- Reconstruction to address complaints by community regarding roughness.
- PAEC nominated pavement design was 300mm of granular material with a 40mm asphalt wearing surface.
- Hiways engaged to assess PAEC pavement design and offer alternative design options that challenged current construction methodologies used by PAEC meeting current design protocols.

Pavement Failure Mechanisms

Deflection and Curvature Results – Tested by a Deflectograph

Testing Date – Sept 2021

	90th Percentile Run 211460	90th Percentile Run 211460
Deflection (mm)	1.09	1.26
Curvature (mm)	0.34	0.38

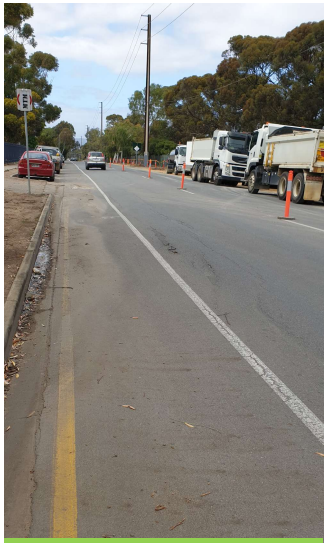


Longitudinal Cracking

Oxidised Asphalt

Geofabric under asphalt wearing surface

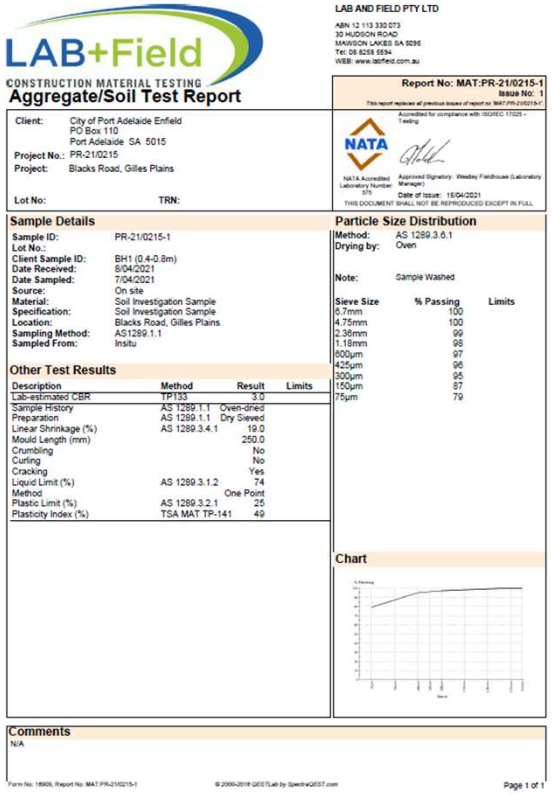
Crocodile Cracking



Undulating Surface

Technical Data Provided

- PAEC provided geotechnical data and consisted of:
- *Two borelogs to a depth of 1.0m*
- *Gradings of subgrade and Atterbergs*
- Plastic Index for the sampled subgrade for BH1 and BH2 were 49 and 41 respectively.
- Linear Shrinkage for the sampled subgrade for BH1 and BH2 were 19% and 17% respectively
- Traffic Count Data – Nov 2020
- Pavement Design Life – 20 years



LAB+Field

CONSTRUCTION MATERIAL TESTING

Aggregate/Soil Test Report

LAB AND FIELD PTY LTD
ABN 12 113 330 073
30 HUDSON ROAD
MAWSON LAKES SA 5095
Tel: 08 8258 5594
WEB: www.labfield.com.au

Report No: MAT:PR-21/0215-1
Issue No: 1

Client: City of Port Adelaide Enfield
PO Box 110
Port Adelaide SA 5015
Project No.: PR-21/0215
Project: Blacks Road, Gilles Plains
Lot No: TRN:

NATA
NATA Accredited Laboratory Number: 375
Accredited for compliance with ISO/IEC 17025 - Testing
Approved Signatory: Wesley Fleichouse (Laboratory Manager)
Date of Issue: 15/04/2021
THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	PR-21/0215-1
Lot No.:	
Client Sample ID:	BH1 (0.4-0.8m)
Date Received:	6/04/2021
Date Sampled:	7/04/2021
Source:	On site
Material:	Soil Investigation Sample
Specification:	Soil Investigation Sample
Location:	Blacks Road, Gilles Plains
Sampling Method:	AS1289.1.1
Sampled From:	Insitu

Other Test Results

Description	Method	Result	Limits
Lab-estimated CBR	TP133	3.0	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	19.0	
Mould Length (mm)		250.0	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.2	74	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	25	
Plasticity Index (%)	TSA MAT TP-141	49	

Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven

Note: Sample Washed

Sieve Size	% Passing	Limits
6.7mm	100	
4.75mm	100	
2.36mm	99	
1.18mm	98	
600µm	97	
425µm	96	
300µm	95	
150µm	87	
75µm	79	

Chart

Comments
N/A

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Australian Pavement Recycling and Stabilisation Conference
Sustainable Pavements for Future Generations
Pullman Albert Park, Melbourne • 22nd August 2023

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Pavement Recycling and Stabilisation Association

Expansive Nature of Subgrade

- PAEC does not have anyway of classifying the expansive subgrades.
- Refer to Austroads Methodology (Austroads Part 2 – Table 5.2 Guide to classification of expansive soils).
- Two reports provided by PAEC – the data available and assessed is LL (%) and PI.
- Although CBR test was undertaken swell was not reported.
- Based on the information provided the subgrade Expansive Nature was deemed to be Very High.

Table 5.2: Guide to classification of expansive soils

Expansive nature	Liquid limit (%)	Plasticity Index	PI x % < 0.425 mm	Swell (%) (1)
Very high	> 70	> 45	> 3200	> 5.0
High	> 70	> 45	2200–3200	2.5–5.0
Moderate	50–70	25–45	1200–2200	0.5–2.5
Low	< 50	< 25	< 1200	< 0.5

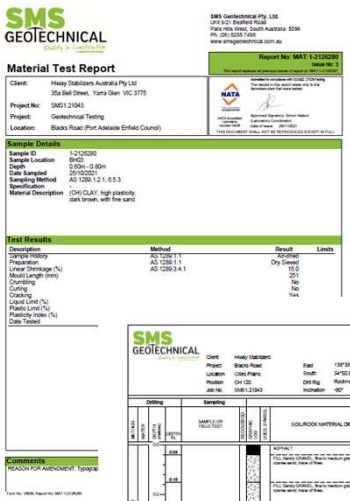
1 Swell at OMC and 98% MDD using standard compactive effort; four-day soak. Based on 4.5 kg surcharge.

Project Outcomes

- Prepare a suitable pavement design to:
  - Recycle and reuse as much of the insitu aggregate as possible.
  - Consider options to minimise subgrade weakness and moisture sensitivity
  - Limit the impact on the community – construction during school holidays.
  - Reduce/eliminate the amount of spoil to landfill.
  - Improve the ride quality, long term.
  - Part Service – Requirement to use PAEC road construction team.
  - Upskill PAEC road construction team.

Geotechnical and Laboratory Testing

- An additional 3 test pits were undertaken to provide the following data:
  - Subgrade
    - *Field DCP*
    - *Remoulded 4 Day soaked CBR*
    - *Swell*
    - *Linear Shrinkage of the subgrade*
    - *Atterberg limits*
  - Granular Material
    - *Gradings*
    - *Linear Shrinkage of the subgrade*
    - *Atterberg limits*

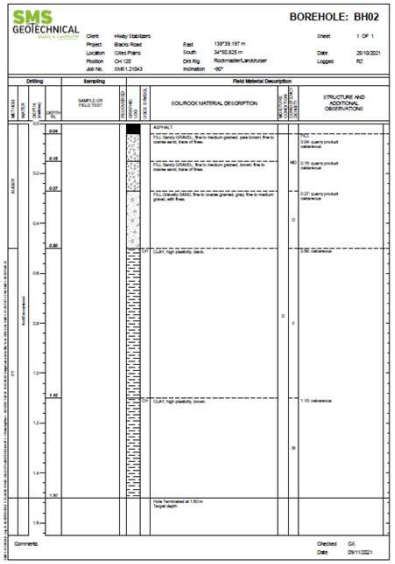

SMS GEOTECHNICAL

Material Test Report

Report No: MAT: 1-2126280
Issue No: 3

Sample Details

Test Results


SMS GEOTECHNICAL

BORE HOLE: BH02

- Mix Design Testing:
  - Lime Demand - Subgrade
    - *Design lime content = 4.0%*
    - *Quicklime used*
  - UCS - Cement (LBCM)
    - *UCS testing results at 7 day and 28 day cure*
    - *Two application rates – 2.0% and 2.5%, UCS after 28 days was 2.6MPa and 3.0MPa respectively*
    - *Design cement content = 1.5%*

Pavement Design

Existing Pavement Structure

Borehole Logs - Blacks Road				
SMS Geotechnical (Hiway)			LAB+Field (Provided by PAEC)	
TP2	TP3	TP4	TP1	TP2
40 Asphalt	30 Asphalt	60 Asphalt	40 Asphalt	50 Asphalt
110 - Fill Sandy GRAVEL, fine to medium grained, pale brown, fine to coarse sand, trace of fines	190 - Fill Sandy GRAVEL, fine to coarse grained, grey, fine to coarse sand, trace of fines	230 - Fill Sandy GRAVEL, fine to coarse grained, pale brown, fine to coarse sand, trace of fines	160 - 20mm Quarry Rubble, Yellow	160 - 20mm Quarry Rubble, Yellow
120 - Fill - Sandy GRAVEL, fine to medium grained, brown, fine to coarse sand, trace of fines	170 - Sandy GRAVEL/Gravelly SAND, fine to medium grained, grey, trace of fines.	90 - Fill Sandy GRAVEL, fine to medium grained, grey, fine to coarse sand, with fines	200 - Gravelly SAND, fine to coarse, Yellow	
230 - Fill Gravelly SAND, fine to coarse grained, grey, fine to medium gravel, with fines	210 - Fill Sandy SAND, fine to coarse grained brwon, fine to medium gravel, trace of fines	60 - Fill Silty Sandy CLAY, low plasticity, brown, fine sand	600 - Sandy CLAY, high plasticit, dark grey, slightly calcareous	300 - 20mm Quarry Rubble, grey
600 - CLAY, high plasticity, black	900 - CLAY, high plasticity, dark brown, with fine sand	410 CLAY, high plasticity, mottled dark brown/pale brown	End Bore 1.0	500 - Sandy CLAY, high plasticit, dark grey, slightly calcareous
400 - CALY, high plasticity, brown		650 CLAY, high plasticity, brown		End Bore 1.0
End Bore 1.5m	End Bore 1.5m	End Bore 1.5m		

Existing Pavement Thickness
Ranged between 400 – 600mm

Pavement Design Options

	Full Depth Granular	Full Depth Granular + Stabilised Subgrade	LBCM (500MPa) + Stabilised Subgrade	FBS (1500MPa) + Stabilised Subgrade
	Option 1	Option 2	Option 3	Option 4
Wearing Surface (DIT AC10 A15E)	40	40	40	40
Basecourse	220	240	200	270
Subbase	450	150	150	150
Stabilised Subgrade (CBR =6)		300	300	300
Natural Subgrade – CBR = 2				
Excavation Depth	710	430	390	460
Total Pavement Depth	710	730	690	760

It can be seen Lightly Bound Cemented Material (LBCM) Basecourse requires the least amount of excavation / new granular material

Removal of Existing Pavement

- Profiling of the surface and reuse as RAP in the final asphalt wearing surface.

- Profiler used to excavate to top of design subgrade level, some remnant granular material retained.
- Material stockpiled and stored at a local Downer yard, close to site.

Subgrade Stabilisation

- Application of 3.0% lime to exposed subgrade (Highly Plastic and Reactive Clays)
- Dependable treatment depth of 300mm
- Lime content determined by lime demand testing
- Use of Quicklime
- Addition of water to hydrate the lime – slaking
- Mix hydrated lime into subgrade
- Watermain was struck on the last run.
- Free water was pumped from the surface and construction continued; no soft spots in treated subgrade.

Recycling Won Granular Material

- Imported recycled granular material that was won and stockpiled – PAEC.
- Some additional granular imported (PM2/20), approximately 2% of the total amount of granular material required – PAEC.
- Mix Design undertaken for cement content – Target UCS 1.0 – 2.0MPa, noted previously.
- Recycled granular material (incorporating minor imported quarried granular PM2/20) placed in two layers.
- Layer 1 – subbase / working platform, placed at 200mm.
- Layer 2 – LBCM layer – placed at 150mm – mixed at 200mm – capture part of the subbase layer to minimise any chance of a delamination horizon – PAEC.
- Stabilisation by insitu recycling of granular material by Hiways.
- Compaction and trimming – PAEC.

Construction of LBCM




- Prior to placement of base layer, subbase compacted to design specification 96% MMDD.
- Base layer placed, compacted but not to any requirement.
- Spread cement at the nominated spread rate of 1.5%
- Mix with the addition of water to achieve OMC.
- Compact to 98%MMDD
- Finish primary compaction and trim - within 2 hours of completion of mixing

Construction of the Wearing Surface

Wearing surface constructed by Downer – 40mm DIT AC10M A15E

No prime or tack coat applied

Final Outcomes

- Eliminated the need to dump existing granular material, estimated cost saving of approximately $70,000.
- The cost of stabilising the subgrade and granular material, was a cost neutral option, when compared to a standard granular option.
- Adopting the stabilising methodology offers the following advantages when assessed against an unmodified granular pavement:
  - A pavement structure that has improved shear capacity.
  - Good load capacity – lower curvature for good asphalt wearing course performance
  - Improved moisture resilience of both basecourse and subgrade.
  - Addressed the reactive clay and tripled design strength.
  - Recycle by reuse existing granular (and subgrade) materials – about 98%.
  - Minimised the amount of imported virgin granular material – about 2.0% of the total volume.