How Green was the First Takapuna City Stabilised Pavement Undertaken in 1978?

A Lifetime Review says "Very Green".

Peter Rolls - McDonalds Lime

Allen Browne – Hiway Stabilizers

Paving the Way for Greener Roads

Conference 2010

NZIHT

Paremoremo Road

Takapuna City Council

Contract 77/17

Paremoremo Road

Cutts Ave to Sanders Road

Constructed 1978

Paremoremo Road

- Paper outlines first tendered stabilisation project undertaken for Takapuna City Council now North Shore City Council 1977/78
- Project has real benefits having had extensive post construction evaluation of insitu testing through 70's, 80's
- Evaluated late 90's for Transfund Research report
- Co-operation with NSCC and others re-opened late 2009 for insitu and laboratory testing, to provide ongoing records particularly the lime stabilised subgrade section
- This paper will draw all information together to provide a measure of performance and durability of this section initially designed for a 15 year life

Paremoremo Road

- Lime Stabilisation used sparingly before 1978
- Gained momentum, Robin Dunlop's "Lime Stabilisation for New Zealand Roads" TR 1977
- Early 70's Allan Malcolm's won overseas scholarship
- Enthused that stabilisation had a place in NZ
- Buy-in from Takapuna City Council
- Coincided with the release of Robin Dunlop's manual

Paremoremo Road

- Convinced Council to let a tender to trial Stabilisation
- Tender let for the upgrading of Paremoremo Road, Iona Ave and Sanders Road outside the prison. Total length approx 1180m
- Tender had 2 options comprising
- Conventional overlay, 175mm AP65 sub-base plus 125mm NRB AP40 base course
- Lime stabilised 250mm subgrade plus 125mm NRB AP40 base course

Paremoremo Road Contract

- Stabilised option selected
- Awarded to Hopper Construction Limited in 1977 for tendered price of $117k (price range $117k to $138k for 10,200m2 contract area
- Became first lime subgrade stabilisation project for TCC
- Construction commenced in February 1978
- Stabilisation still integral part of North Shore City's roading program

Paremoremo Road Schedule

6.2 Addit.temp.metal	m^3	200		200	7.75			1,550.	00
6.4 N.R.B.M4 basecourse	m^3	1420		1420	22.50			31,950.	00
6.5 Soil Treatment									
Alternative Rates									
6.5.1 supply & spread quicklime	tonnes	170		156.47	114.00			17,837.	58
6.5.2 Pulvermix,mix & roll	m^2	10200		10020	1.07			10,721.	40
CHARGE TO: 2362				SUB TOTAL		$394.	88	$76,317.	96

DEVON

Certified Correct: 27/6/1978
Contract Supervisor

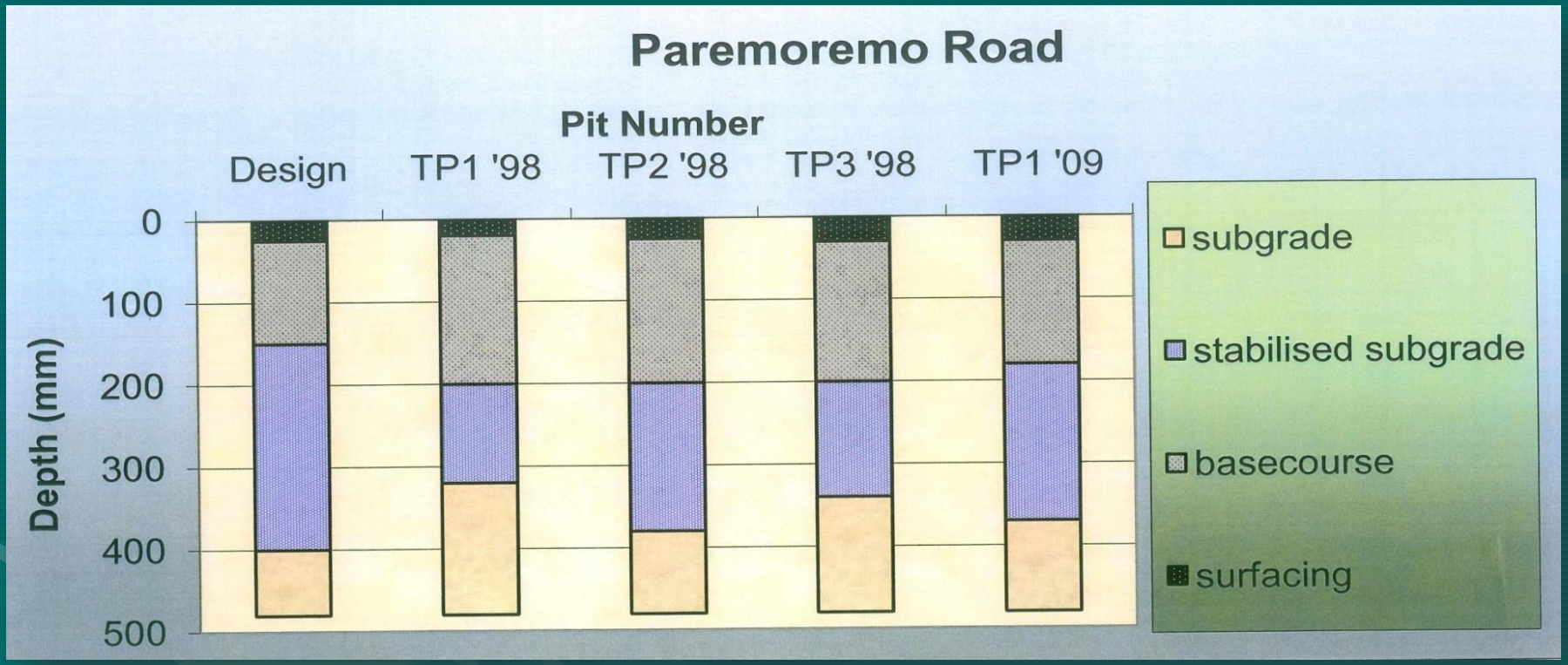
..... 27/6/19..
District Engineer

Paremoremo Road Subgrade

- Clay subgrade stabilised February 1978
- CBR range 6 – 9
- Remoulded at OMC, CBR 12
- Remoulded, soaked, CBR 4
- 4% Lime, remoulded, cured, soaked, CBR 28
  - Insitu test after 20 months, CBR 165
  - Insitu test Dec 1983, CBR 225.

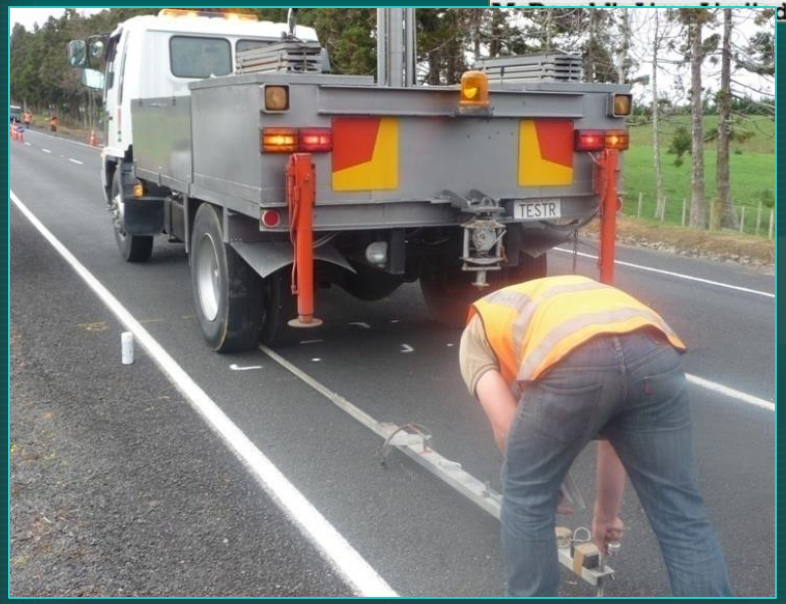
1978 Stabilising Plant

Investigation ‘98 & ‘09



	Design	TP1 ‘98	TP2 ‘98	TP3 ‘98	TP1 ‘09
Basecourse	***125 mm***	180 mm	175 mm	170 mm	150 mm
Stab Subgrade	***250 mm***	120 mm	180 mm	140 mm	190 mm
Total Cover	***375 mm***	300 mm	355 mm	310 mm	340 mm

Investigation 2009



Investigation 2009

Hiway Stabilizers NEW ZEALAND LIMITED

McDonald's

McDonald's Lime Limited

Investigation 2009

Insitu CBR
Insitu Clegg Impact Hammer
Insitu Scala CBR

Investigation 2009

Hiway Stabilizers
NEW ZEALAND LIMITED

McDonald's
McDonald's Lime Limited

Investigation 2009

Two distinct layers with smooth interface.
Testing couldn't prevent inter-layer shear

Summary of Testing

- Stabilised Subgrade:
  - Initial Design CBR = 25+
  - Insitu CBR testing 1985 CBR = ~230
  - Insitu testing 1998 CBR = 90 to 150* (inferred)
  - Insitu CBR testing 2009 CBR = 110
  - Insitu Clegg tests 2009 CBR = 85 to 315#(Inferred)
  - Laboratory testing 2009 CBR = 85+
  - 32+ years service life – still >>300 % design value

  - *Loadman portable FWD
  - # Clegg Impact Hammer Converted Value
  - + shearing of sample understated strength

Whole of Life Performance

Despite lower-spec plant - stabilised subgrade material properties >>>1978 design values

Reinforces benefit of stabilised subgrade

Despite some variable layer thickness and intra-layer stab subgrade laminations

- Currently at 4 x design loading
- No obvious distress – low deflection / rut
- Only maintenance cost since '78 is reseal

Answers concerns regarding durability / permanence

Durability of Lime Stabilised Subgrade

Immediate Strength Improvement - modification
Cation exchange followed by flocculation / agglomeration

- Reduces size of adsorbed water layer
- Increased internal friction
- Textural change from plastic clay to friable silt/sand

Long Term Strength Improvement – stabilisation
Pozzolanic reaction: Clay = pozzolan: source silica / alumina)
requires residual calcium
requires pH high enough to solubilize clay silica/alumina

Co-operative reaction between lime and clay.

Whole of Life Performance

Hiway Stabilizers NEW ZEALAND LIMITED

McDonald's Lime Limited

Westbound Lane widened and shoulder sealed in 2003.
These works didn't extent into carriageway

Benkelman Beam deflections:

Within 50m;	D0 =	0.56 to 1.12mm
Test position	D0 =	1.44mm
	D250 – D0 =	0.65mm

*Typical curvature for a "good" basecourse is 0.2 mm or less

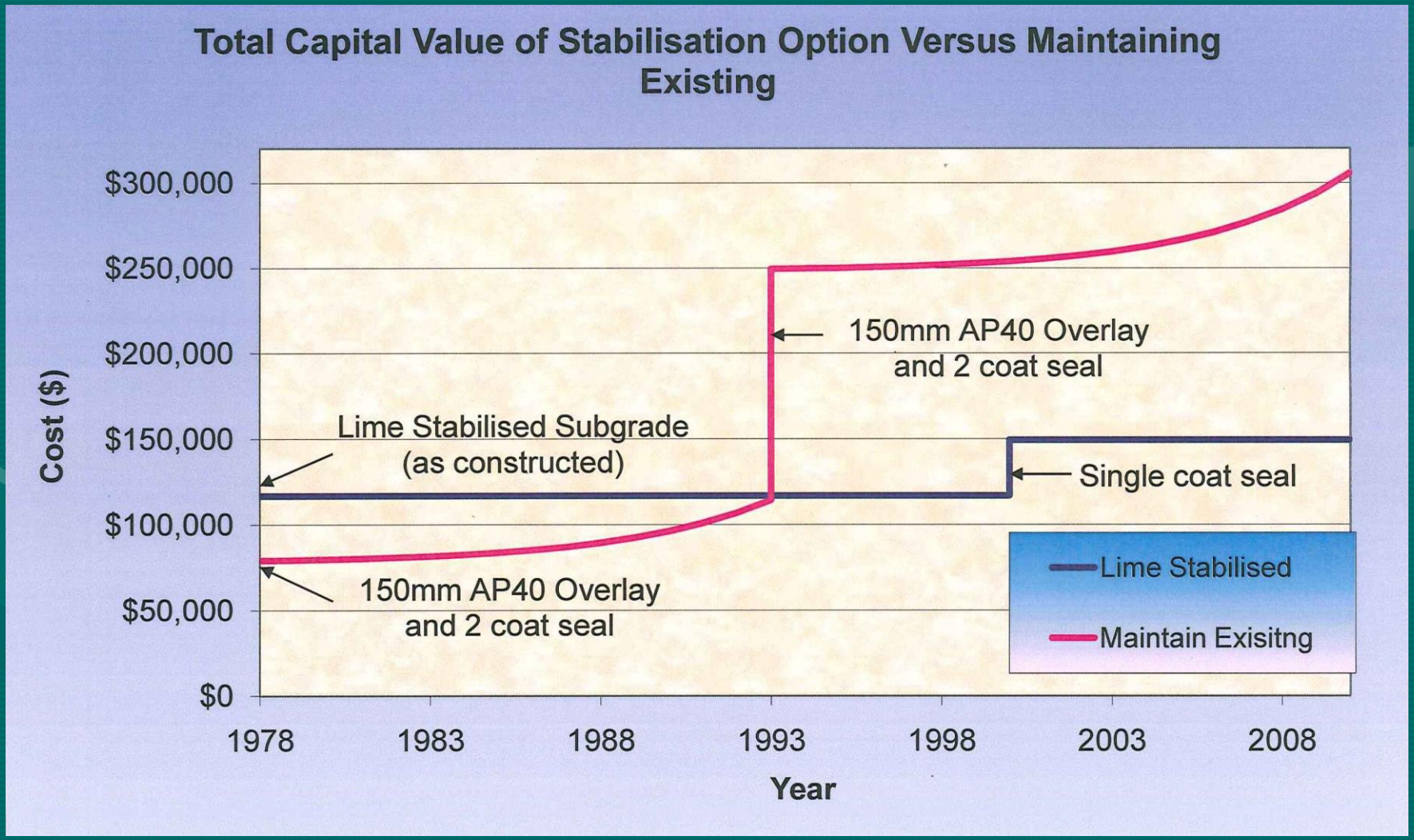
Why is Performance so Good

- Emulsion Cure Coat
- Inc. shear & flexural strength
- Inc. resistance to moisture / Reduced volume change potential
- Flocc. / agglomeration resists fines movement
- Fully compact materials being constructed over the top. Aggregate / Surfacing perform better
- Hard anvil and maintains shape rather than rut and ‘trap water’

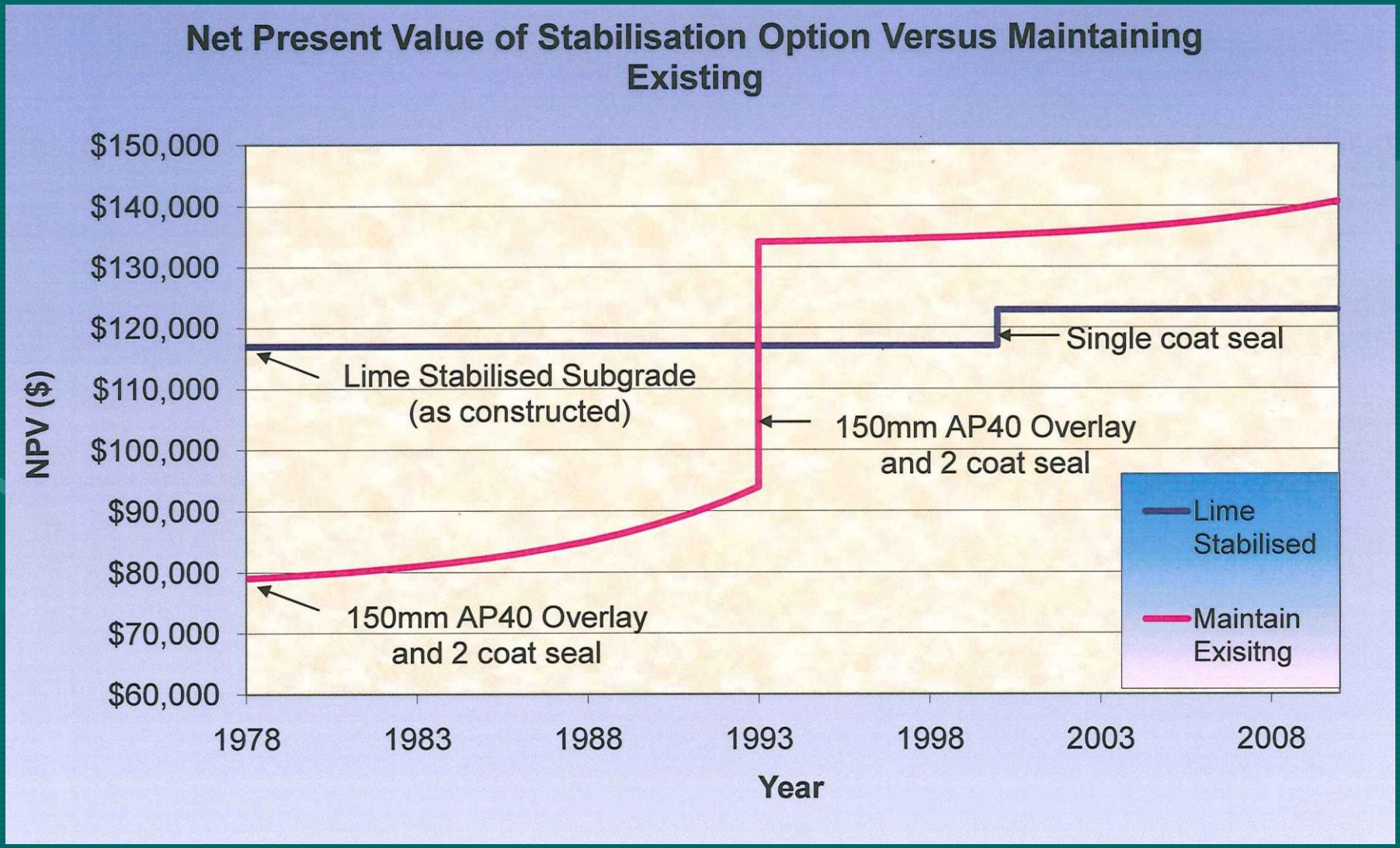
So…….How Green?

- *Green Pavement = "safe, efficient, economic, environmentally friendly, meeting the needs of present-day users without compromising those of future generations."*
- reduce our consumption of raw materials and energy consumption by designing and building durable pavements more efficiently
- The longer a pavement lasts, the less need there is to expend materials and energy replacing it.

Whole of Life – Total Capital



Whole of Life – NPV



In Summary…..

- 1978 – clear inadequacies in process control and methodology.
- Large departures from design profile
- QA… – what QA?
- Yet - Performed well beyond expectations
- Strength maintained and enhanced
- Emulsion seal cure coat – significant benefit
- Virtually zero maintenance costs

In Summary…..

- This meets criteria for a "Green" pavement

The longer a pavement lasts, the less need there is to expend materials and energy replacing it

- Robin Dunlop Quote:

"There appears a great future for lime modification of subgrades…….. Its use as a bottom layer is in line with general theory of stress distribution within a flexible pavement"

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