

Intent and Progress on SANRAL Research Panel Projects in Focus Area 3: Pavements

SANRAL



**BUILDING SOUTH AFRICA
THROUGH BETTER ROADS**

Project 3.2: Advanced Asphalt Technology

Project Objectives

Objective 1	Objective 2	Objective 3	Objective 4	Objective 5
<ul style="list-style-type: none">• Develop improved materials characterisation models based on available laboratory data.• Evaluate plastic deformation, and fatigue transfer functions for pavement design.• Evaluate the effect of confinement on asphalt mixes in the laboratory	<ul style="list-style-type: none">• Develop a framework for incorporating aggregate packing principles into asphalt mix design procedures.• Establish relationships between aggregate packing parameters and asphalt compaction parameters, rut resistance and permeability.• Use intelligent asphalt compaction analysis techniques to determine the density of asphalt pavement during construction in real-time.	<ul style="list-style-type: none">• Evaluate the use of innovative and sustainable non-conventional materials in asphalt layers with emphasis given to EME, WMA, RA, fly ash, recycled concrete, and plastic to determine their performance and economic benefit to road building in the country.	<ul style="list-style-type: none">• Assist with Project 3.8 to develop APT/LTPP protocols /procedures to collect performance data for the calibration and validation of plastic deformation and fatigue models.	<ul style="list-style-type: none">• Assess gaps and how the database established from this project can be used to support future revisions of national standards and specifications.

Human Capital Development

HR ACTUAL INPUTS	Description
Number of researchers active in the project	10: JK Anochie-Boateng, E Horak, F Johns, G Mturi, J Komba, J O'Connell, K Jenkins, M Mostafa, M Muthen, Ane Cromhout
Number of RSA black researchers active in the project	4: JK Anochie-Boateng, M Muthen, R Lutchminarian (Student); BN Sithole (Student)
Number of RSA female researchers active in the project	4: FM Johns, Ane Cromhout, R Lutchminarian (Student); BN Sithole (Student)
Number of RSA black project leaders	JK Anochie-Boateng
Number of active researchers with PhD	6: JK Anochie-Boateng, E Horak, F Johns, J Komba, K Jenkins and M Mostafa

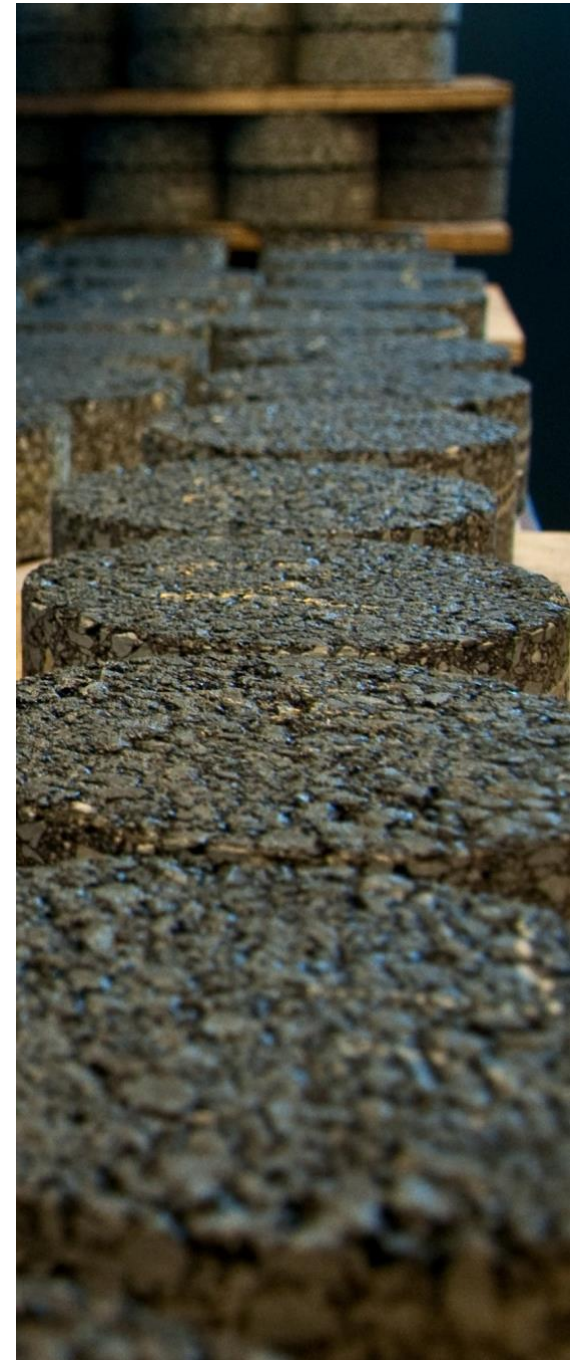
Student	University	Research topic
BN Sithole	University of Johannesburg	Cold Mix Asphalt In Lieu of HMA for Conventional Road Construction
Riyah Lutchminarian	University of Kwa-Zulu Natal	Incorporation of Waste Plastics into Asphalt Mixtures
Bastiaan Verhoek	University of Pretoria	Implementation of Balanced Mix Design Technique in South Africa

Intended Outputs and Progress

Outputs	Description	Expected	Completed	Progress
Publications	Peer-reviewed conference papers	2	---	--
	Peer-reviewed journal articles	2	---	--
	Masters dissertation	2	---	WIP
	PhD thesis	1	---	WIP
Technology packages	Framework for aggregate packing	1	---	WIP
	Asphalt design tool	1	---	WIP
	Asphalt mix performance models	1	---	WIP
	Consolidated database for pavement design	1	---	WIP
SANRAL research reports	Quarterly Reports	12	4	2*
	Contract Report	2	---	---
	Project task & work package reports	14	2	7*
National guidelines	Guideline for cold mix asphalt for high volume roads	1	---	WIP
	Guideline for high content of recycle asphalt	1	---	WIP
	Guidelines for sustainable asphalt mixes (fly ash, recycled concrete, plastic)	2	---	WIP
	Guideline for aggregate packing data collection	1	---	---
Postgraduate study	Masters	2	---	WIP
	PhD	1	---	WIP

WIP: Work in progress

* Draft reports completed



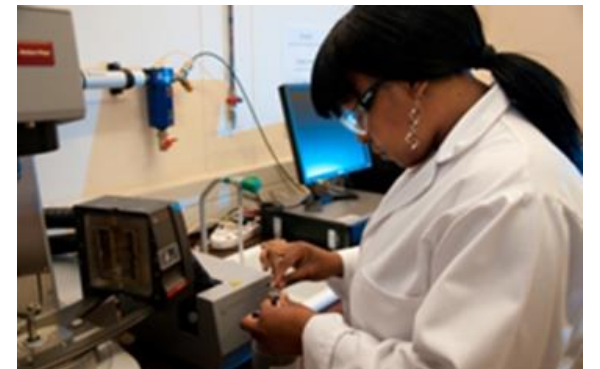
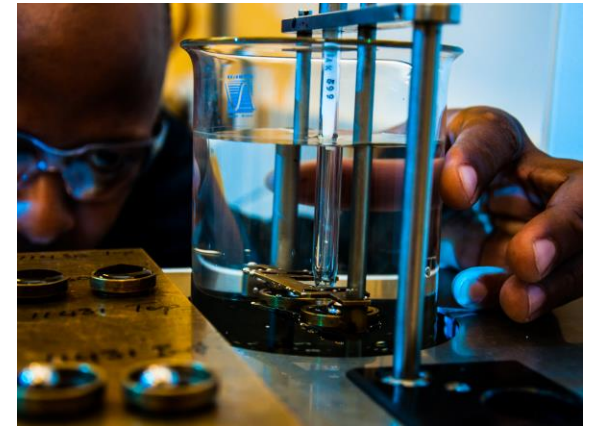
Project 3.3: Advanced Bituminous Binder Technology

Project Overview

- **Aim:** Exploration of diverse research fields to characterize bitumen for industry application
- **Project Duration:** 36 months (not officially started)
- **Project Team:**
 - G. Mturi (Project Leader)
 - A. Hefer
 - E. Mukandila
 - F. Johns
 - J. O'Connell
 - K. Jenkins
 - R. Burger
 - Other experts (road construction, bond coat and geologist)

Scope

- The project will cover the following research fields:
 - Bitumen extraction and recovery
 - Accelerated bitumen ageing
 - Cohesion, adhesion and compatibility of materials in binder-aggregate systems
 - Evaluation of the South African performance graded binder specification with regards to field performance
 - Mastic testing
 - Alternative binders
 - Chemical composition criteria for specification



Project 3.4: Surfacing Seals

Work Packages

WP1 – Seal Stone Orientation and Texture Depth

WP2 – SARDS for Seals

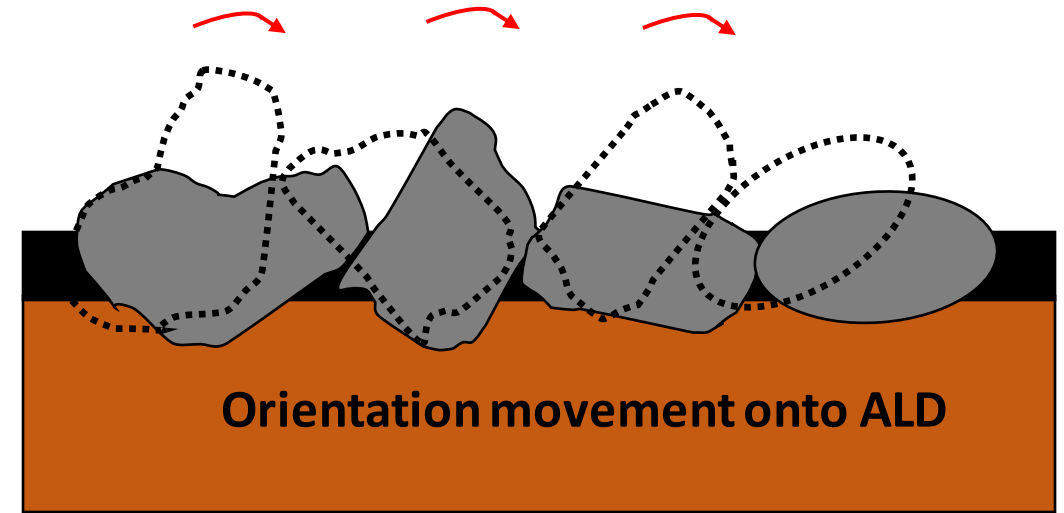
WP3 – Digitisation

WP4 – SPG (Seal Performance Grade)

Progress

Progress WP1 – most laboratory testing has been completed. Further analysis required

General Progress: Project 3.4 Agreement is currently being resigned due events out of the realm and control of research



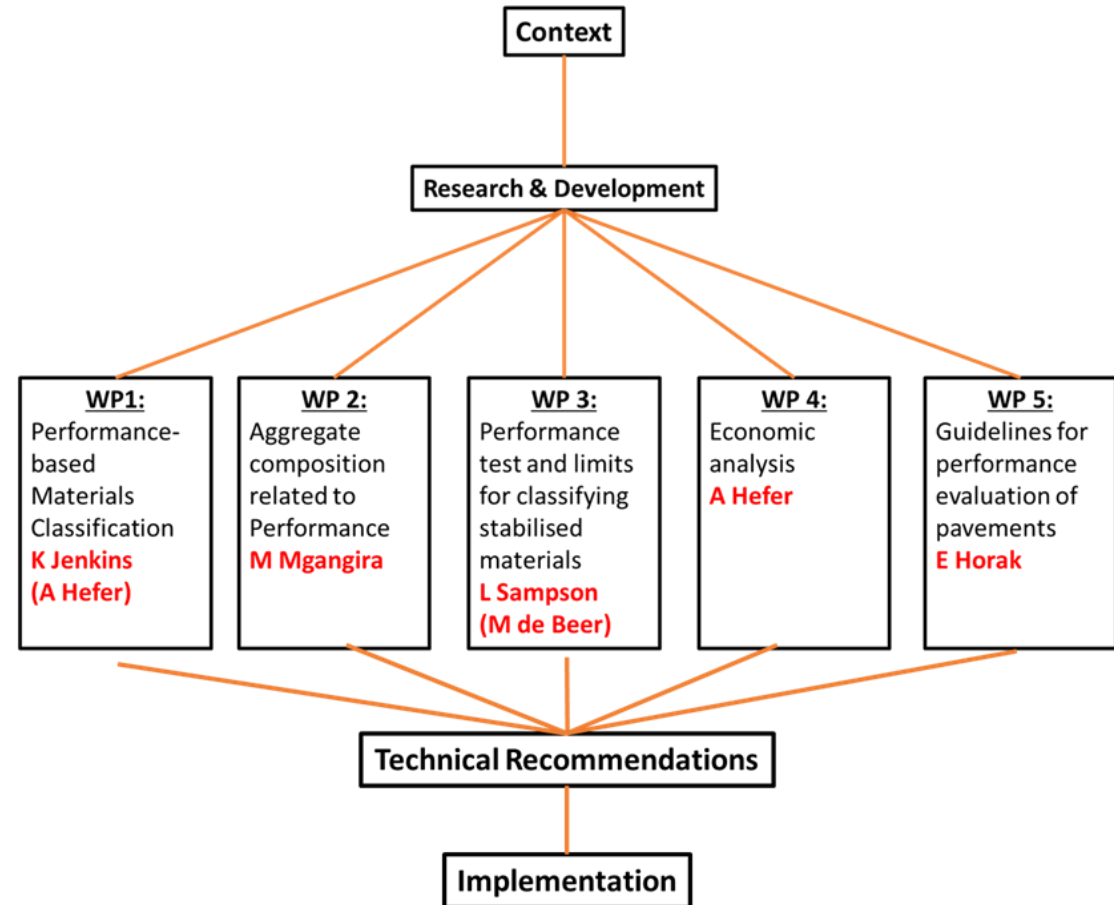
Trafficking of seals with tack coats (modified vs unmodified) as a variable. Wheel loading at controlled temperatures. Laser measurements of 3D profile linked to orientation



Project 3.5: Unbound and Stabilised Material Testing and Design

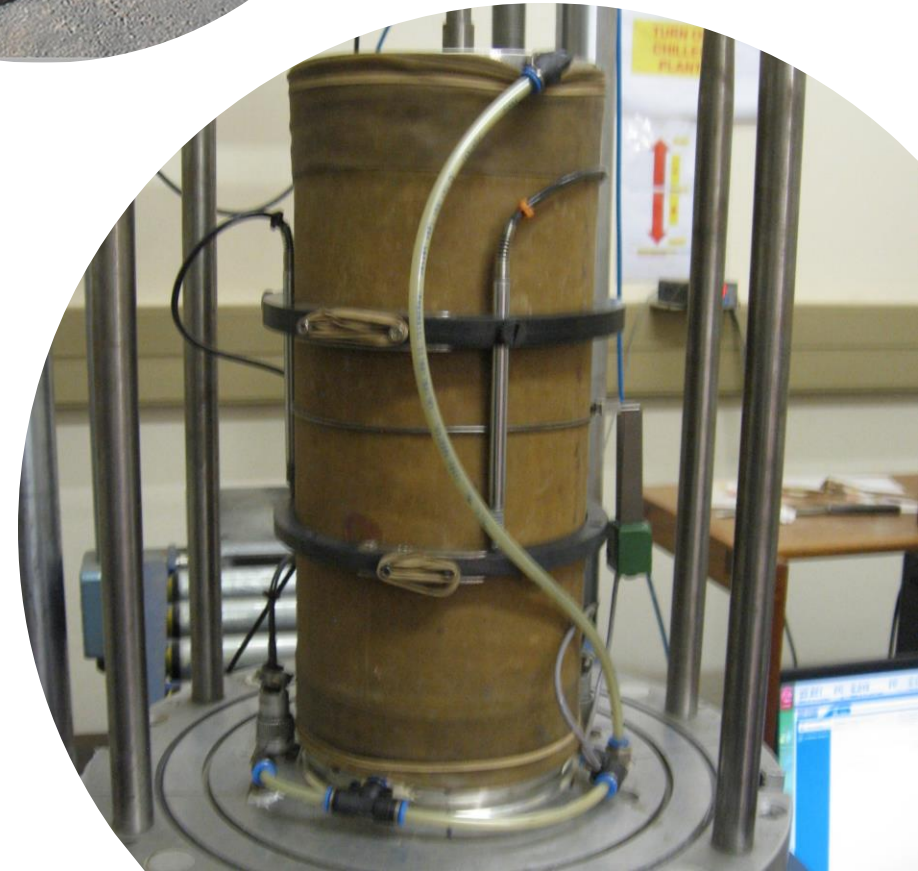
Project Objective

To develop **alternative tests** and limits for the **improved performance-based** characterisation and classification of unbound materials and their stabilised derivatives



Contribution to state of knowledge

- This project will contribute to the development of the capabilities within the Pavement Materials platform
- The end product will be **improved classification and characterisation methods** for the design, construction, rehabilitation and maintenance of roads
- The generated knowledge and outputs will provide input information for the characterisation of aggregate/binder behaviour, aggregate packing and alternative stabilised materials design, i.e., RFA 3 Projects 3.1, 3.2, 3.3, 3.5 and 3.6



Deliverables to date:

- Inception Report
- Comprehensive literature review
- Protocols and test methods
- Experimental design and matrix
- Initial testing of G2 quality material

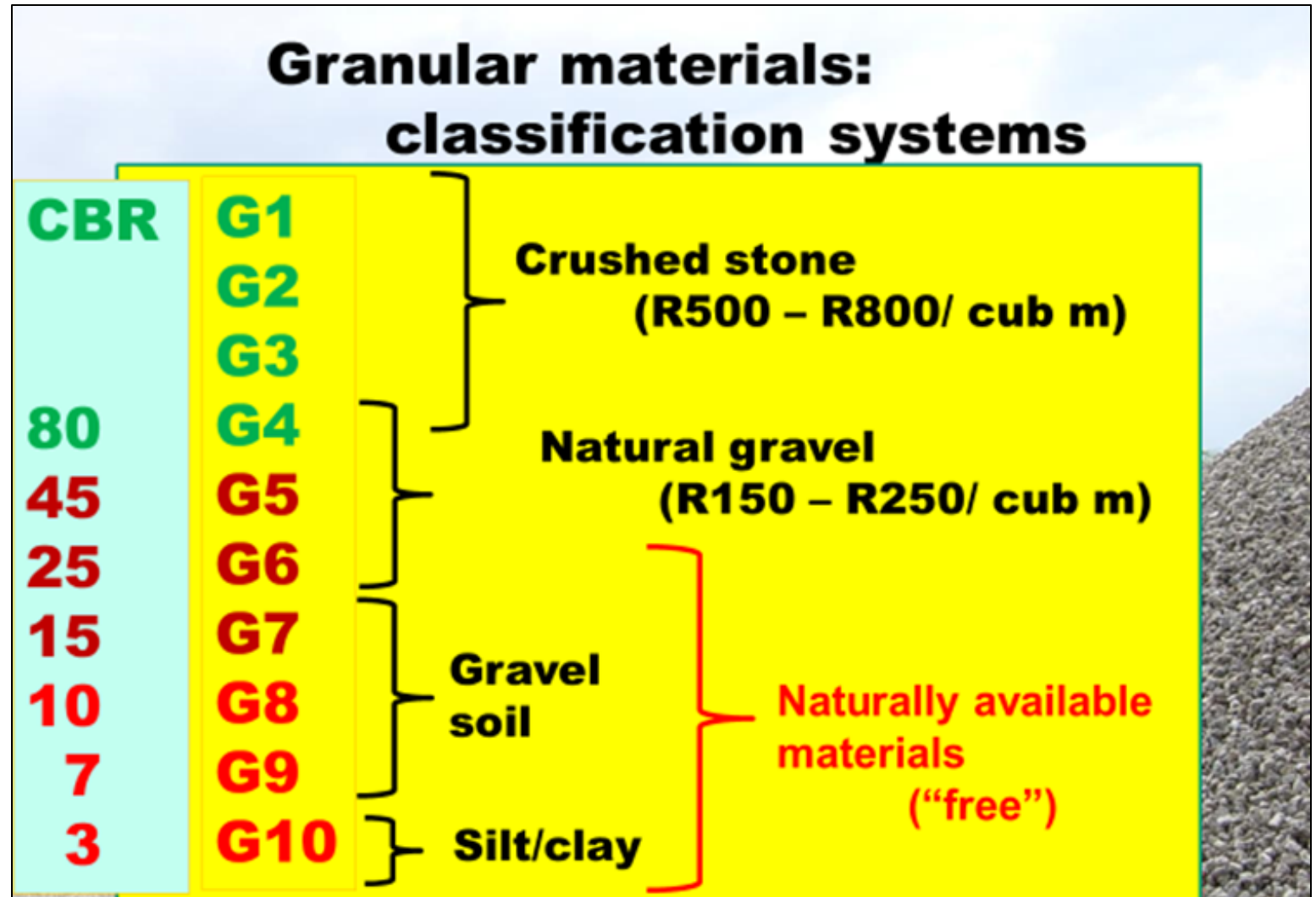
Next activities

- Testing on G5B quality material (at Eng 4.0, CSIR and SU)
- Testing on stabilised derivative

Project 3.6: Innovative and Alternative Materials

Main objective:

Investigate new technologies for the cost-effective utilisation of naturally available materials in road structures.





G8 – NME stabilised base
G7 – NME stabilised sub-base
G10 - subgrade
Design Traffic loading – 3 MESA

Benefits:

Improved utilisation of naturally available materials through the improvement thereof using available / proven technologies could result in saving of 30 % to 50% (and more) in road infrastructure provision and maintenance



Accelerated Pavement Testing (CSIR)
– Dec 2018
80 kN



APT – Jan 2019
80 kN + water (surface + 500 mm)



Tested bearing capacity ~ 10 MESA
(assuming damage co-efficient of $n=4$)

Project 3.8: Long-Term Pavement Performance and Accelerated Pavement Testing

Project Objectives

Objective 1	Objective 2	Objective 3	Objective 4	Objective 5
<ul style="list-style-type: none"> Develop protocols for LTPP and APT studies 	<ul style="list-style-type: none"> Develop a catalogue of environmental, behavioural and performance monitoring equipment for use at LTPP and APT sites 	<ul style="list-style-type: none"> Develop methods for analysis of APT and LTPP data, including development of processes, hubs and platforms for such purposes 	<ul style="list-style-type: none"> Explore and evaluate innovative and sustainable techniques to monitor and model deterioration behaviour of pavements 	<ul style="list-style-type: none"> Design and build an advanced, high-speed APT prototype and evaluate its performance

Work Packages

- WP1 – Long-Term Pavement Performance (LTPP)
- WP2 – Accelerated Pavement Testing (APT)
- WP3 – Traffic Stream Simulator (TSS)
- WP4 – LTPP and APT Sensors and Instrumentation



Main deliverables to date

- **Long-Term Pavement Performance (LTPP)**

- Protocol for LTPP, addressing:
 - Management and responsibilities
 - LTPP monitoring
 - Planning the monitoring programme
 - Data parameters
 - Accuracy and validation
 - Field and laboratory measurements
 - Data management
 - Reporting criteria and data analysis

- **Accelerated Pavement Testing (APT)**

- Protocol for APT testing, irrespective of loading device used, addressing:
 - APT programme strategy
 - Test section selection and layout
 - Test programmes
 - Instrumentation selection and installation
 - Data acquisition and processing
 - Data management
 - Quality management

- **Traffic Stream Simulator (TSS)**

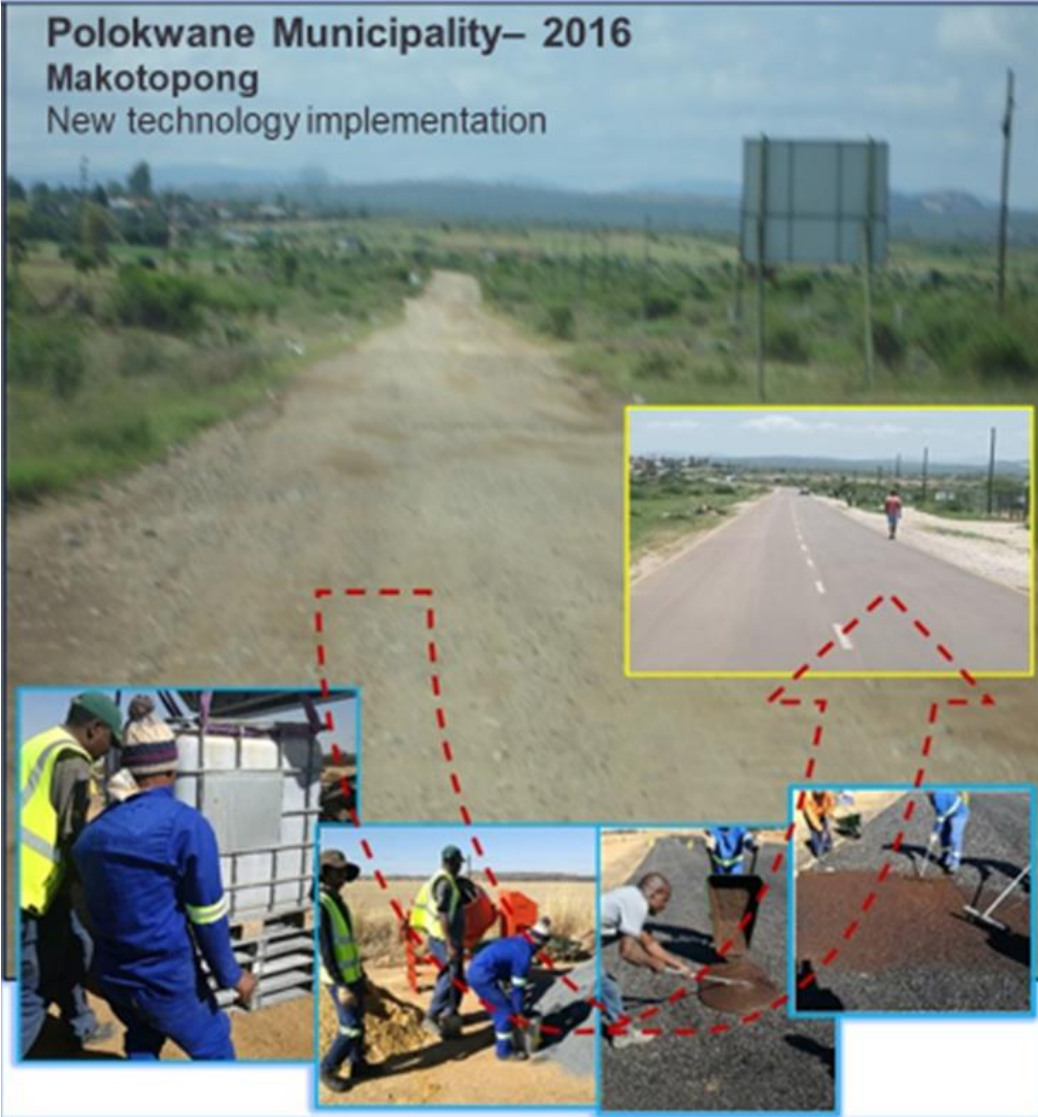
- TSS prototype conceptual design completed, modelling and manufacturing to follow
- The TSS consists of an array of dual tyre feet that can be loaded rapidly in succession thus simulating a rolling wheel. TSS can simulate:
 - Wheel speeds in excess of 35 km/h unidirectional and bidirectional at wheel loads up to 80 kN
 - Multiple axles on the section simultaneously
 - Mixed traffic
 - Rest periods in traffic
 - Wheel dynamics
 - In excess of 80,000 wheel load repetitions per day in single axle mode at 35 km/h

- **LTPP and APT Sensors and Instrumentation**

- Review of international LTPP and APT sensors and instrumentation

PICC Project - SANRAL

Project 3.11: Upgrading of unsurfaced roads



- **Current:**

- General perception

Costs ~ **R10 million / km**

- **Improve:**

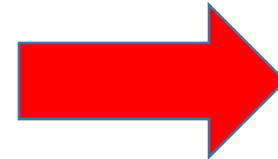
- Warrants for upgrading
- Applicable standards:
 - Geometry/Drainage
- Optimisation of resources – improve material utilisation through the introduction of proven available new technologies

- **Aim:**

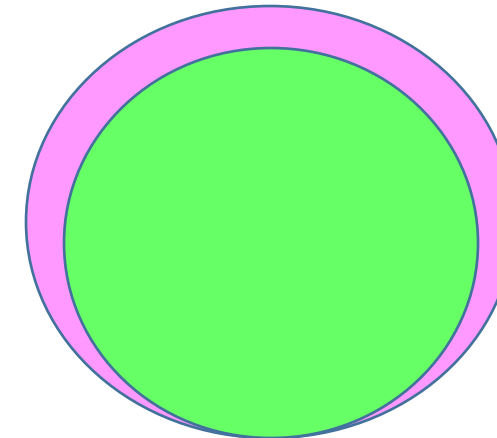
• ~ **R2 million / km**

PICC project – SANRAL managed Upgrading of unsurfaced roads

R10 m/km



R 2 m/km



Retain/Ensure:

- Safety of road user
- Integrity of road structure



THANK YOU

