



**Sand**



**Laterite**

## **The Use of Sand and Laterite in Road Construction**

### **Workshop Report: October 2013**

Submitted by:

A consortium of Consultants comprising:

InfraAfrica (Pty) Ltd, Botswana

TRL Ltd, UK

Paige-Green Consulting (Pty) Ltd, South Africa

CPP Botswana (Pty) Ltd

Frank Netterberg, South Africa

Submitted to:

Crown Agents for Overseas  
Governments and Administrations  
St. Nicholas House, St. Nicholas Road  
Sutton, Surrey SMI IEL  
UK

Attention Katie Macleod

Contact person:

Mike Pinard  
InfraAfrica (Pty) Ltd  
Private Bag 00426  
Gaborone  
Botswana

Tel: +267 3971281/71311629

E-mail: [mipinard@global.bw](mailto:mipinard@global.bw)

Submission date:

11 November, 2013

---

---

This project is funded by the Africa Community Access Programme (AFCAP) which promotes safe and sustainable access to markets, healthcare, education, employment and social and political networks for rural communities in Africa.

Launched in June 2008 and managed by Crown Agents, the five year-long, UK government (DFID) funded project, supports research and knowledge sharing between participating countries to enhance the uptake of low cost, proven solutions for rural access that maximise the use of local resources.

The programme is currently active in Ethiopia, Kenya, Ghana, Malawi, Mozambique, Tanzania, Zambia, South Africa, Democratic Republic of Congo and South Sudan and is developing relationships with a number of other countries and regional organisations across Africa.

This material has been funded by UKaid from the Department for International Development, however the views expressed do not necessarily reflect the department's or the managing agent's official policies.

For further information visit <https://www.afcap.org>

### Sands Project

The main purpose of the Sands project is to reduce the cost of low volume road construction in the SADC region by utilising naturally occurring sands to the maximum extent possible. To this end, Phase 2 of the project will build on the outputs of Phase 1, thereby deepening the understanding of the properties of certain types of sands which can which used as pavement materials for the construction of low volume roads in the SADC region.

### Laterites Project

The main purpose of the Laterites project is essentially to:

- Raise awareness of the existence of the performance-based specifications that have been developed specifically for the use of laterites in road construction in such countries as Angola, Brazil and Australia.
- Highlight the fact that such specifications are quite different to the more traditional ones that are still used in a number of countries in Africa, as a result of which unnecessary recourse is often made to their relatively expensive stabilization for use in low volume roads (LVR).
- Provide interim specifications for the use of laterites in LVR construction based on the outcome of a review of the most recent documentation on the subject, including the CIRIA Special Publication 47: *Laterite in Road Pavements*, the report on *Tropical Residual Soils* published by the Geological Society for distribution by the Overseas Development Administration, and other state-of-the-art reviews on laterites.

---

---

### Making maximum use of naturally occurring, local materials in LVR construction:

- **The** art of the roads engineer consists for a good part in utilising specifications that will make possible the use of materials he finds in the vicinity of the road works.
- Unfortunately, force of habit, inadequate specifications and lack of initiative have suppressed the use of local materials and innovative construction technologies.
- There is a need to consider materials' "fitness for purpose".
- There is a need to *make the specification fit materials* rather than *make the materials fit the specification*.
- The Sands and Laterites projects are expected to develop appropriate specifications that will contribute to the more extensive and cost-effective use of naturally occurring local materials in LVR construction.

---

# TABLE OF CONTENTS

|   |    |
|---|----|
| 1. INTRODUCTION                             |    |
| 1.1 Background .....                        | 1  |
| 1.2 Workshop .....                          | 1  |
| 2. WORKSHOP PRELIMINARIES AND PRESENTATIONS |    |
| 2.1 Opening Remarks .....                   | 3  |
| 2.2 Delegates' Presentations.....           | 3  |
| 2.3 Consultants' Presentations .....        | 5  |
| 3. FINDINGS AND DISCUSSIONS                 |    |
| 3.1 Sands Project .....                     | 6  |
| 3.2 Laterites Project .....                 | 6  |
| 4. WAY FORWARD AND CLOSURE                  |    |
| 4.1 Sands Project .....                     | 8  |
| 4.2 Laterites Project .....                 | 9  |
| 4.3 Closure .....                           | 9  |
| ANNEXES                                     |    |
| Annex A - Workshop Programme .....          | 11 |
| Annex B - Workshop Attendance .....         | 13 |

---

## LIST OF ABBREVIATIONS

|       |  |
|-------|--|
| AFCAP | African community Access Programme             |
| CBD   | Citrate-Bicarbonate-Dithionite                 |
| CBR   | California Bearing Ratio                       |
| CSIR  | Council for Scientific and Industrial Research |
| DCP   | Dynamic Cone Penetrometer                      |
| DN    | (DCP) Resistance to Penetration (mm/blow)      |
| LVR   | Low Volume Road                                |
| LVSR  | Low Volume Sealed Road                         |
| PI    | Plasticity index                               |
| PL    | Plastic Limit                                  |
| SADC  | Southern Africa Development Community          |
| SSA   | Sub-Saharan Africa                             |
| S/R   | Silica-Sesquioxide Ratio                       |
| TRL   | Transport Research Laboratory                  |
| UK    | United Kingdom                                 |
| XRD   | X-Ray Diffraction                              |
| XRF   | X-Ray Fluorescence                             |

---

# 1. INTRODUCTION

## 1.1 Background

Through a consortium of Consultants comprising Infra Africa (Pty) Ltd, Botswana; TRL Ltd, UK; Paige-Green Consulting, South Africa; CPP Botswana; and Frank Netterberg, South Africa, the Africa Community Access Programme (AFCAP) is undertaking the following two projects which both aim to maximize the use of naturally occurring materials in the pavements of low volume roads:

- (1) The Use of Sands in Road construction in the SADC Region: Phase 2 – Additional Investigations, (hereafter referred to as the “Sands project”) ,
- (2) Verification of Specifications for the Use of Laterites in Road Pavements: Phase 1: Literature Survey and Awareness raising (hereafter referred to as the “Laterites project”).

Both projects commenced in July 2013 and both have now reached their preliminary reporting stage. Prior to the submission of the Inception Reports, members of the consortium would normally have met to discuss their preliminary findings before submitting these reports. However, on this occasion, AFCAP requested that the Consultant's include representatives from a number of selected member states to participate in, and contribute to, the deliberations in the Consultants' team meeting. In order to achieve this objective, a mini workshop was arranged with details as described below.

## 1.2 Workshop

### 1.2.1 Objectives

The main objectives of the workshop were to:

- Present the preliminary findings of both the Sands and Laterites projects as a basis for their subsequent discussion by the workshop delegates;
- Engage in discussion with representatives from selected, mostly AFCAP, member states based on their presentations pertaining to the use of laterites in their countries.
- Agree the way forward to the completion of the Draft Sands and Laterites reports. .

### 1.2.2 Venue, programme and attendance

The workshop was held in Johannesburg, South Africa on the 23<sup>rd</sup> and 24<sup>th</sup> October 2013 at the City Lodge Hotel which is situated close to the ORT International Airport.

The programme for the workshop is presented in Annex A and included Power Point presentations by both the Consultants and selected country representatives followed by a discussion period after each presentation. Day 1 dealt with the Sands project whilst Day 2 dealt with the Laterites project.

---

In addition to the Consultants team, the workshop was attended by delegates from the following countries:

- Ethiopia
- Malawi
- Mozambique
- Nigeria

An invitation was also extended to representatives from both Botswana and Kenya to participate in the workshop but, unfortunately, they were unable to attend.

The list of participants is presented in Annex B.

### 1.2.3 Report

This Workshop Report documents the outcome of the workshop proceedings and is structured as follows:

**Section 1** (this section): Provides the background to the projects and the details of the workshop.

**Section 2:** Presents a summary of the workshop preliminaries, including the opening remarks by AFCAP and a summary of the presentations made by both the country representatives and the Consultants. .

**Section 3:** Provides the findings of the projects and the ensuing discussions.

**Section 4:** Indicated the way forward to the completion of the projects and the closing remarks by the AFCAP Technical manager and the Consultants' project manager.

**Annexes:** Annex A presents the workshop programme whilst Annex B provides the list of workshop participants.

:

---

## 2. WORKSHOP PRELIMINARIES AND PRESENTATIONS

### 2.1 Opening Remarks

The opening remarks on Day 1 and Day 2 of the workshop were made respectively by Messrs. Geddes and Leta, the AFCAP Technical Services Managers. In summary, they:

- outlined the role of AFCAP in the SSA region which included capacity building, knowledge exchange and technology transfer amongst practitioners – one of the key objectives of the workshop.
- highlighted the importance of the two projects under discussion in terms of the extensive occurrence of sands and laterites in the region and the exciting possibility of utilising them in the pavements of low volume roads (LVRs), despite their non-compliance with traditional specifications.
- Indicated the significant potential savings in construction and life-cycle costs that could be gained from the more extensive use of sands and laterites in LVR pavements.
- emphasised the benefits to be gained by involving stakeholders in critical stages of project development so as to engender ownership of the outputs;
- encouraged all delegates to engage in robust discussions on the topics being presented so as to gain a full understanding of the underlying factors affecting the selection, specification, design and construction of LVRs using sands and laterites.

### 2.2 Delegates' Presentations

#### 2.2.1 Nigeria

Presentation by Ms. F. Alayaki, PhD Research Student, Cambridge University, UK, on: *Laterite Soils Research in Nigeria*. The key issues arising from this presentation may be summarised as follows:

- Different types of laterite occur extensively in the central Interior Zone of the country.
- Current specifications are not traffic or material-type related, i.e. they are applied in a blanket fashion to any level of traffic and are not differentiated on the basis of material type (e.g. pedogenic (e.g laterite) or non-pedogenic materials.
- There is still much scope for undertaking further research on laterite to develop appropriate specifications for their use in road pavements.

#### 2.2.2 Ethiopia

Presentation by Eng. Alemayehu on: *Ethiopia – Laterite Road base Trials: Design and Construction report*. The key issues arising from this presentation may be summarised as follows:

- Laterite occurs mostly in the western region of the country and is seldom, if ever, used as a pavement material due to its non-compliance with traditional specifications.

- 
- As part of an AFCAP-supported project, trial sections incorporating a laterite base course have recently been constructed on a section of the Assosa to Kurmuk road and will be monitored to evaluate their performance.
  - Traffic related specifications for laterites are included in the recently developed Design Manuals for Low Volume Roads and have been applied in the design of the Assosa to Kurmuk trial section.

### 2.2.3 Malawi

Presentation by Eng. S. Banda on: *The Use of Laterites in Road Construction in Malawi*. The key issues arising from this presentation may be summarised as follows:

- There is a long history of the successful use of laterites in the construction of main roads in Malawi which dates back to the early 1970s (e.g. Liwonde-Zomba) and early 1980s (e.g. Lilongwe-Mchinji and Kasunga-Mzimba).
- The Roads Authority has also more recently constructed (in the early 2000s) a number of District Roads using a single layer of laterite as road base (e.g. Nchisi Boma roads and Mponela-Nchisi).
- Despite their non-compliance with traditional specifications, all the roads constructed with laterite had performed very satisfactorily.
- Malawi now has a relatively new manual (2013) for the design of LVRs based on the DCP-DN method – the output of an AFCAP-supported project.
- There are currently approximately 1624 km of LVRs that are earmarked for upgrading to a sealed standard using locally available materials, such as laterite, and based on the DCP design manual.
- There is still a need to revise the current national specifications which do not cater adequately for the use of local materials in LVR construction.

### 2.2.4 Mozambique

Presentation by Eng. F. Manheche on: *Laterites in Mozambique*. The key issues arising from this presentation may be summarised as follows:

- Laterites occur in many provinces in Mozambique but are little used as a pavement material, even in low volume roads..
- Laterites were used extensively in road pavement construction by the Portuguese in the mid-1970s. However, much of this experience has since been lost.
- Laterites were recently investigated as part of the AFCAP-supported Back-Analysis project and the results are very interesting in that despite their non-compliance with traditional specifications, these materials have performed very successfully as basecourse in both low and high volume roads.



- 
- 
- There is much scope for further investigations on the use of laterites in road pavements of both low and high volume roads in Mozambique and there is a need to develop appropriate specifications.

## 2.3 Consultants' Presentations

### 2.3.1 Sands project

The Consultant's presentation was based on their Inception Report which had been sent to delegates in advance of the workshop. The following is a summary of the topics presented, as detailed in the report.

- Project background, Purpose and Scope
- Fieldwork
  - Botswana report + discussion
  - Mozambique report + discussion
- Laboratory Testing programme
  - Overview of tests carried out
- Preliminary Results and Analyses
  - Summary of results and analyses to date

### 2.3.2 Laterites Project

The Consultant's presentation was based on their Literature Survey and Desk Study Report which had been sent to delegates in advance of the workshop. The following is a summary of the topics presented, as detailed in the report.

- Project background, Purpose and Scope
- General Characteristics
  - Formation and development
  - Definition, description and distribution
  - Classification and composition
- Geotechnical Properties and Testing
  - Geotechnical properties
  - Tests
- Specifications
  - Current range of specifications
  - Recommended specifications
- Construction and use
  - Examples of use
  - Quality control
  - Performance-related studies

---

## 3. FINDINGS AND DISCUSSION

### 3.1 Sands Project

#### 3.1.1 Summary

The key findings and conclusions emanating from the Consultants' presentation on the Sands project are included in the Inception Report (15<sup>th</sup> Oct.2013) and are not repeated here.

### 3.2 Laterites Project

#### 3.2.1 Summary

##### (a) Delegates presentations

The following are the key findings and conclusions arising from the discussions on the delegates' presentations.

- There are now numerous documented examples of the successful use of laterites in the upper layers of both low and high volume roads in a number of countries in the southern African region including Botswana, Kenya, Malawi, Mozambique and Zimbabwe, despite their non-compliance with the traditional specifications typically enforced in these countries.
- Ironically, despite the excellent research carried out by the Portuguese into the use of laterites in road construction in both Angola and Mozambique, there appears to be little awareness of this wealth of information by practitioners in most of the southern and eastern Africa region, and probably elsewhere in Africa.
- The majority of road authorities in the eastern and southern African region, and elsewhere in the African region, continue to use unnecessarily restrictive standards that greatly suppress the use of this material in its untreated state in the upper pavement layers of both high and low volume roads.
- There is a need to revise/update the specifications pertaining to the use of laterites in most countries in the southern and eastern African region and elsewhere in the African region.

##### (b) Consultants' presentations

The following are the key findings and conclusions arising from the discussions on the Consultants' presentations.

- In view of the many definitions of laterite, there was a need to agree on a common definition. The amount of the cementing material (iron and aluminium oxide) and the inclusion of a silica/sesquioxide (S/R) ratio are important ingredients of such a definition.
- Only laterites with a S/R ratio of less than 2.0 (those formed by residual accumulation of sesquioxides) can be considered to probably only contain kaolinite, a clay mineral with a 1:1 lattice structure which reduces the ability of the clay to absorb water. This is in contrast with more expansive clay minerals, such as illite and smectite, that exhibit a 2:1 type of lattice structure which facilitates the greater absorption of water.

- 
- 
- Other laterites formed by absolute accumulation of sesquioxides (e.g. the so-called ferricretes found in parts of South Africa) may well contain smectite, but will probably have a S/R ratio  $> 2$ .
  - Relaxations in Atterberg limits, grading and CBR requirements seem to be the norm when using laterites. However, **this applies only to those laterites with a S/R ratio  $< 2$ .**
  - No information is apparently available on the S/R ratios of the laterites and lateritic soils actually used in the construction of road pavements in southern and eastern Africa. Thus, the determination of this ratio will be a key priority in Phase 2 of the project.
  - Although numerous specifications have been proposed, mostly based on the limited study of existing roads and their material properties, very few of these have been implemented and monitored on a research basis.
  - The specification that has probably been the most successfully applied to the greatest length of roads over the past 40 years is that used in Brazil for both fine and coarse grained laterites. These specifications allow “relaxations” in Atterberg limits, grading and CBR requirements, but with a requirement for the S/R ratio to be  $< 2$ . They would appear to offer the best option (with minor adjustments where necessary to account for varying test methods) for application in the eastern and southern African region, and elsewhere in Africa.

---

## 4. WAY FORWARD AND CLOSURE

### 4.1 Sands Project

#### 4.1.1 Status of project

The following tests are still to be carried out and will be reported upon in the Draft Final Guideline:

- Duplicate and triplicate gradings and Atterberg limits as specified
- Remaining CBR and dried back CBR using dynamic compaction
- Remaining densities and CBRs (soaked and dried back) using vibrating hammer
- Remaining DN values
- Cycled CBRs
- X-ray fluorescence (XRF) and X-ray diffraction (XRD).
- CBD testing for the iron, aluminium and manganese content (Univ. of Stellenbosch)
- Surface roughness (Much Asphalt)

#### 4.1.2 Way forward

Upon completion of the laboratory testing, two separate reports will be produced as follows:

- (a) **Fieldwork and Laboratory Testing:** This will include a summary of the fieldwork and laboratory testing undertaken in Phase 2 of the project.
- (b) **Guideline on the Use of sands in Road Construction:** This will be an update of the Phase 1 report in which the outputs of the Fieldwork and Laboratory Testing aspects of the project will be integrated in a seamless manner to produce a final, self-standing report.

#### 4.1.3 Programme

The Consultants reported delays in the completion of the laboratory testing programme for a number of reasons reported in Progress Report No. 3. This has had a knock-on effect on the completion of the project which is now expected to be completed 4 weeks later than indicated in the original programme. The original and revised targets for completion of the project are summarised below:

| Activity                      | Programme           |                    |
|-------------------------------|---------------------|--------------------|
|                               | Original            | Revised            |
| Completion of lab testing     | End August 2013     | End October, 2013  |
| Analysis of test results      | Mid-September, 2013 | Mid-November, 2013 |
| Submission of Draft Guideline | End-November, 2013* | Mid-December, 2013 |
| Hold workshop                 | Mid-December, 2013  | Mid-February, 2014 |
| Submit Final Guideline        | End January, 2014   | End February, 2014 |

\* Contractual agreement in contrast to the work programme which shows submission by mid-November, 2013.

---

## 4.2 Laterites Project

### 4.2.1 Status of project

The main activities that remain to be carried out on the project include:

- (1) Review of back-analysis projects undertaken in Botswana, Malawi, Mozambique, Ethiopia and elsewhere.
- (2) Drafting of the Preliminary Report (essentially the completion of the Literature Review and Desk Study Report).
- (3) Presentation of the Preliminary Report at the regional workshop
- (4) Finalisation and submission of the Final Report.

### 4.2.2 Way forward

The activities listed above will be undertaken in the coming weeks.

### 4.2.3 Programme

The original and revised targets for completion of the project are summarised below:

| Activity                         | Programme          |                    |
|----------------------------------|--------------------|--------------------|
|                                  | Original           | Revised            |
| Submission of Preliminary Report | End August 2013    | End October, 2013  |
| Hold workshop                    | Mid-December, 2013 | Mid-February, 2014 |
| Submit Final Report              | End January, 2014  | End February, 2014 |

In essence, the project is on programme and, if it were feasible, the workshop could be held in mid-December, 2013 and the Final Report submitted by end-January, 2014. However, in view of the synergies to be derived from holding both the Sands and Laterites workshops on a back-to-back basis, it is proposed to defer the holding of the Laterites project to mid-February, 2014 and to submit the Final Report by end-February, 2014.

## 4.3 Closure

The closing remarks were made by the AFCAP Technical Manager (Rob Geddes), and the Consultant's project manager (Mike Pinard) and may be summarised as follows:

AFCAP Technical Manager:

- The workshop afforded the opportunity for the country delegates to participate in detailed discussions with the Consultants on various aspects of the evolving outputs of the project in a manner not possible at a regional workshop.
- The presentations made by the country delegates were to be lauded as they served the important purpose of involving the recipient countries in the on-going research work in a manner that was likely to create country ownership of the eventual outputs of the projects.

- 
- The presentations made by the Consultants were very informative and beneficial to all who participated in the workshop and they must be commended for the excellent arrangements made in the holding the event.

Consultants' Project Manager:

- The discussions arising from the various presentations made during the workshop were very beneficial to the Consultants in advancing the projects to their completion.
- The presentations made by the country delegates on the use of laterites in road pavements in their countries provided a very useful input to the project.
- The findings emanating from the literature survey and desk study of laterites were particularly interesting as they revealed a wealth of existing, largely untapped, research information that was highly applicable to the region, although there appeared to be little apparent awareness of this.
- The workshop had achieved at least one of the important objectives of the Laterites project – raising awareness of the existence of existing information on the use of laterites in road pavements that would eventually enable road authorities to revise their technical specifications for the use of laterites in road pavements, thereby leading to potentially significant cost savings in the construction of such roads.

**Development of Guidelines for the Use of Sands  
in Road Construction in the SADC Region  
Phase 2 - Additional Investigations**

**Project Team Meeting, City Lodge Hotel, Johannesburg, South Africa  
Day 1 - Wednesday 23<sup>rd</sup> October 2013**

**Agenda**

- 09.00 – 09.10: Welcome Remarks – R. Geddes  
*AFCAP Technical Services Manager*
- 09.10 – 09.45 Introduction, Project Background, Purpose & Scope  
*Consultants*
- 09.45 – 10.30 Fieldwork Report-Botswana + Discussion  
*Consultants*
- 10.30 – 11.00 Tea/Coffee Break
- 11.00 – 11.45 Fieldwork Report-Mozambique + Discussion  
*Consultants*
- 11.45 – 12.30 Laboratory Testing Programme + Preliminary Results and Analysis  
*Consultants*
- 12.30 – 13.15 Lunch
- 13.15 – 15.30 Preliminary Results and Analysis (Cont'd) + Discussion  
*Consultants*
- 15.30– 16.00 Tea
- 16.00 – 16.30 Summary and Way Forward  
*Consultants*
- 16.30 -16.40 Closing Remarks – N. Leta  
*AFCAP Technical Services Manager*

\*\*\*\*\*

**Verification of Specifications for the  
Use of Laterite in Road Pavements  
Phase 1: Literature Survey and Awareness Raising**

**Project Team Meeting, City Lodge Hotel, Johannesburg, South Africa  
Day 2 – Thursday 24<sup>th</sup> October 2013**

**Agenda**

- 09.00 – 09.10: Welcome Remarks – N. Leta  
*AFCAP Technical Services Manager*
- 09.10 – 09.30 Introduction, Background and Scope of Project  
*Consultants*
- 09.30 – 10.30 Country Presentations  
*Nigeria and Ethiopia*
- 10.30 – 11.00 Tea/Coffee Break
- 11.00 – 12.30 Country Presentations (Cont'd)  
*Malawi, Mozambique and Kenya*
- 12.30 – 13.15 Lunch
- 13.15 – 13.45 General Characteristics + Discussion  
*Consultants*
- 13.45 – 14.30 Geotechnical Properties and Testing + Discussion  
*Consultants*
- 14.30 – 15.30 Specification + Discussion  
*Consultants*
- 15.30– 16.00 Tea
- 16.00 – 16.30 Construction and Use + Discussion  
*Consultants*
- 16.30 – 17.00 Conclusions and Recommendations  
*Consultants*
- 17.00 -17.10 Closing Remarks – R. Geddes  
*AFCAP Technical Services Manager*

\*\*\*\*\*



**AFCAP Workshop on:**

- (1) Development of Guidelines for the Use of Sands in Road Construction in the SADC Region. Phase 2 - Additional Investigations**  
**(2) Verification of Specifications for the Use of Laterite in Road pavements. Phase 1 – Literature Survey and Awareness Raising**

**Attendance List**

| <b>Name</b>        | <b>Organization</b>      | <b>Designation</b>                 | <b>E-mail Address</b>             |
|--------------------|--------------------------|------------------------------------|-----------------------------------|
| Francisco Manheche | ANE, Mozambique          | Directorate - Project Monitoring   | fmanheche@ane.gov.mz              |
| Alemayehu Endale   | ERA, Ethiopia            | Director: research and Development | alemayehu_yl@yahoo.com            |
| Funmilayo Alayaki  | Univ. of Cambridge, UK   | PhD research Student               | fma23@cam.ac.uk                   |
| Sharmey Banda      | Roads authority, Malawi  | Senior Engineer (P & D)            | sbanda@ra.org.mw                  |
| Rob Geddes         | AFCAP                    | Technical Manager                  | robert.geddes@uk.crownagents.com  |
| Nkululeko.Leta     | AFCAP                    | Technical Manager                  | nkululeko.leta@uk.crownagents.com |
| Frank Netterberg   | F Netterberg             | Materials Specialist               | fnetterberg@absamail.co.za        |
| Phil Paige-Green   | Paige-Green Consulting   | Director                           | paigegreenconsult@gmail.com       |
| Kabelo Motswagole  | CPP Botswana             | Director                           | kabelo@herbco.co.bw               |
| Kenneth Mukura     | TRL                      | Regional Manager                   | kmukura@yahoo.com                 |
| Mike Pinard        | Infra Africa Consultants | MD                                 | mipinard@global.bw                |