Protocols for Improving the Proficiency of Material Testing Laboratories in Mozambique

Report on Initial Laboratory Visits and Protocol for the PTS (Final)

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Cover Image: Scenes from the laboratory visits

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Acronyms, Units and Currencies

$	United States Dollars
AASHTO	American Association of State Highway and Transport Officials
ACV	Aggregate Crushing Value
AFCAP	Africa Community Access Partnership
AIV	Aggregate Impact Value
ALD	Average Least Dimension
ANE	Administração Nacional de Estradas; National Road Administration
ARMFA	African Road Maintenance Fund Association
ASCAP	Asia Community Access Partnership
BS	British Standard
CBR	California Bearing Ratio
CDS	Civil Design Solutions
CSIR	Council for Scientific and Industrial Research
DCP	Dynamic Cone Penetrometer
DFID	Department for Further International Development
DIMAN	Directorate of Maintenance
DIPLAN	Directorate of Planning
DIPRO	Directorate of Projects
DN	Number of mm penetration per blow of a DCP
EU	European Union
FACT	Fines Aggregate Crushing Test
FI	Fineness Index
FM	Fineness Modulus
FWD	Falling Weight Deflectometer
GM	Grading Modulus
GPS	Global Positioning System
ISO	International Standards Organisation’s
INNOQ	Instituto Nacional de Normalização e Qualidade
LL	Liquid Limit
LNEC	Laboratório Nacional de Engenharia Civil (Portugal)
LS	Linear Shrinkage
LVR	Low Volume Road
MCA	Millennium Challenge Account
MDD	Maximum Dry Density
NLA	National Laboratory Association
NP	Non Plastic
OMC	Optimal Moisture Content
PMU	Project Management Unit
PI	Plasticity Index
PL	Plastic Limit
PT	Proficiency Testing
PTS	Proficiency Testing Scheme
ReCAP	Research for Community Access Partnership
RL	Reference Laboratory
RTFOT	Rolling Thin Film Oven Test
SA	South Africa
SADCAS	Southern African Development Community Accreditation Service
SANAS	South African Accreditation Service
SANS	South African National Standards
SE	Sand Equivalent
SC	Steering Committee
TMH	Technical Methods for Highways
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid (Department for International Development, UK)

Contents

1 Introduction

1.1 Background to the Project

The Africa Community Access Partnership (AfCAP) is building on the programme of high quality research established under AfCAP phase 1 and taking this forward to a sustainable future. The aim is to ensure that the results of the research are adopted in practice and influence future policy in the roads sector.

As part of this initiative AfCAP is providing a range of support to Mozambique, which is one of 12 countries in Africa that are participating in AfCAP. This support includes the development of design guidelines for low volume roads and the evaluation of existing road experimental sections constructed previously in Mozambique.

The validity of research on roads in Mozambique and the region depends on the reliability of laboratory test results. As a result, AfCAP is supporting the implementation of a pilot project for Proficiency Testing in selected laboratories. The overall objective is to establish laboratory testing in Mozambique that is "in line with international practices and standards and test results that can be used with confidence"[1].

The Proficiency Testing Scheme (PTS) will determine a baseline for the precision limits for each specific test included in the project. The baseline will be used to assess laboratory capacity and identify where the constraints lie and where specific training and other interventions may be required. It is expected that participating laboratories will ultimately become accredited to the International Standards Organisation's standard ISO/IEC 17025.

The Mozambique PTS project is a pilot project for Mozambique and for a possible AfCAP regional initiative to support capacity development in materials laboratory testing through a PTS process.

1.2 Objectives

The objectives of the assignment are as follows:

- To identify the repeatability and reproducibility (precision limits) of the principal test methods currently being carried out in Mozambican laboratories; evaluate the existing testing competence of laboratories in Mozambique.
- Determine how the test results of the Mozambican laboratories compare with those of internationally accredited (ISO/IEC 17025) laboratories and included these laboratories as independent controls in the baseline survey and PTS pilot.
- Identify where interventions are needed for improving test results and the type of intervention required.

[1] Terms of Reference.

- Design and manage a pilot PTS and transfer knowledge and expertise to Mozambican laboratory personnel on how to implement a PTS and to evaluate the test results obtained.
- Keep ANE and sector stakeholders fully informed on project implementation and outcomes in order for precision limits of tests to be included in relevant National Standards for Roads in Mozambique.

1.3 Approach

The approach to the project implementation focuses on the following key objectives:

1. To ensure that ANE and LEM are the leaders of the research process.
2. To ensure effective linkages with parallel and associated project initiatives.
3. Establish linkages between the participating laboratories.

The purpose of establishing linkages between the participating laboratories is to promote the concept of a self-supporting network of laboratories, with a joint commitment to quality and reliability of results.

1.4 Purpose of this Report

This report covers the field visit of the CDS Materials Engineer to conduct an initial assessment of laboratories that were shortlisted to participate in the project. The shortlisting was carried out through a questionnaire sent by ANE to all known materials laboratories in the country.

The report includes the draft protocol for conducting the first round of the PTS pilot (see Annex A).

2 Visit Programme and Objectives

The laboratory audits were conducted between the 20th and 31st March 2017. The team included representatives of ANE, LEM as well as Mr Barry Pearce from the Consultant, CDS/LMetc.

A briefing meeting was held on 20th March at ANE's offices where feedback was provided on the analysis of the questionnaire circulated to 27 laboratory facilities in Mozambique. The approach to the laboratory assessments was outlined at the meeting including a discussion on the preferred test methods likely to be used by ANE in future contract documentation.

The visit itinerary was as follows:

- Monday 20th March: Arrive Maputo. Briefing meeting at ANE.
- Tuesday 21st March: Visit laboratories in Maputo (ANE Maputo, LEM, Geoma)
- Wednesday 22nd March: Visit laboratories in Maputo (SoilLab, JJR)
- Thursday 23rd March: Travel to Inhambane
- Friday 24th March: Visit Inhambane laboratory and return to Maputo
- Tuesday 28th March: Travel to Chimoio, visit ANE Manica laboratory
- Wednesday 29th March: Travel from Chimoio to Nampula
- Thursday 30th March: Visit ANE Nampula laboratories and return to Maputo
- Friday 31st March: Debriefing at ANE and end of mission.

The findings from each laboratory visit are summarised in the following sections.

3 ANE Maputo laboratory

3.1 Overview

There are limited testing facilities in the laboratory with the main emphasis being soils and concrete.

The following points were noted during the assessment of this facility on 21st March.

3.2 MDD/CBR

1. Mould base plate not fixed to the floor during compaction resulting in a loss of compaction effort.
2. CBR mould surcharge covered with water resulting in variable loading to the specimens.
3. Soaking base plate drainage holes blocked and need to be cleaned after each use to ensure moisture flow into the samples can occur during soaking period.

3.3 Atterberg Limits

1. No bowl used for mixing. The material is mixed on a glass plate resulting in possible moisture loss over the duration of the test method.
2. Liquid Limit (LL) grooving done towards back of bowl. This is a good process as it affects the material in the bowl less than cutting forwards.
3. Tapping of LL device too slow.
4. No timing devices in the facility to check for soaking periods and other timing issues.
5. 10 mm drop checked off the back of the grooving tool which is not a calibrated device.
6. The depression in the base plate of the LL device needs to be checked so as not to affect the distance the bowls falls through with each tap. The depression looks already to be too large to conform to the tolerance allowed.
7. No records of measurement for calibration or verifications. This is a traceability issue which would ensure better correlation in measurements between different facilities.

4 LEM laboratory - Maputo

4.1 Overview

This is an extensive laboratory facility with diverse testing ability. All the equipment looks new and in a good condition.

The following points where noted during the assessment of this facility on 21st March

4.2 MDD/CBR

1. TMH1 Methods A7 used. Sample is a sandy red/brown local material.
2. Sample once mixed not covered so moisture loss possible during compaction of the 5 layers.
3. Each layer not measured to check height and then next layer's mass not weighed off to ensure correct height increase for each layer.
4. Hammer bouncing too high between each blow resulting in more compaction if the hammer kept closer to the surface being compacted. Hand compaction used.
5. Moisture tins possibly too deep resulting in more time required to dry the samples. If not fully dried when removed from the oven it can lead to lower moisture contents being recorded. Larger flatter open pans could be more effective for the moisture content determinations. The samples will also tend to dry quicker if in a flatter pan.
6. Base of hammer not cleaned of material build-up between layers resulting on a curved compaction surface as against a flat face.
7. Base plate fixed to a concrete plinth on the ground.
8. No conditioning period of 30 minutes as per TMH1 once moisture mixed into each sample.
9. Mould used conforms to AASHTO dimensions and not TMH1 dimensions. Surcharge lies below the mould lip and therefore can't conform to the correct water height in the soaking bath. Water level covers both mould lip and surcharge.

4.3 Atterberg

1. The National Portuguese standards & AASHTO methods tend to have the sample dished in the LL bowl as against parallel with the base plate which is difficult to keep constant between laboratories building in more variability.
2. Taps for the LL methods within acceptable tolerance.
3. No block to check height drop for LL device. Back of grooving tool used to check height.
4. Starts LL on the wet side and dries material to a dryer state. Additional dry material is added to reduce moisture which can build in variability. It was stated that this was checked during an Inter-Laboratory Comparison (ILC) and found not to affect the results.
5. LL determined off 4 points.
6. Plastic Limit (PL) was rolled out on dry material to assist in the drying process. Again, this can affect the result as the outer dryer material could be in a different moisture state than

the existing material that has be moistened for a longer period of time. The material is worked by hand and rolled out well.

7. Gauging the 3mm thread thickness is done by eye.
8. Linear Shrinkage (LS) is done using the square TMH1 trough & not the AASHTO method.
9. All results recorded in a bound book.

5 Geoma Laboratory - Maputo

5.1 Overview

This is a very compact laboratory setup in a residential area of Maputo.

The following points where noted during the assessment of this facility on 21st March

5.2 MDD/CBR

1. MDD sample exposed to heat and not covered after mixing therefore moisture loss occurring during the 5 layers being compacted.
2. Moisture taken at the start and not after the 2nd layer as per test method.
3. No 30-minute conditioning period for soaking after water mixed in for each sample.
4. No control over the height of each layer and the material mass added per layer. The standard approach using a fixed mass per layer is used. The material is scooped out of the basin and added to the previous layer.
5. Circular rubber conveyor belt disk is used to keep the material level. It is placed on top of the loose material and compaction takes place onto the disk. The sandy material tends to climb up the side walls and the conveyor disk is used to keep the material more of less level. The cover, being rubberized, tends to absorb of the compactive effort and would result in a lower MDD. The MDD should increase if the disk was not used.
6. The hammer tends to drift more to the centre of the mould during compaction giving more compaction to the centre than the outer sides. The material that climbs up the side walls needs to be levelled after each layer to ensure a more even distribution of compactive effort.
7. Compaction is undertaken by hand.

5.3 Atterberg

1. Plasticity Index (PI) undertaken using TMH1 methods
2. No 10-minute mixing period undertaken for the preparation of the sample for the LL
3. LS trough tapped when half filled. This is not necessary if material is non-plastic. It need not be tapped but it would make more sense to do the taps at the end once all 3 layers are filled in before striking off the excess material.
4. Striking off excess material should be a single action, not multiple times.
5. The material was non-plastic (NP) so LL was not undertaken and this activity could not be evaluated.
6. Testing done from dry to wet as per TMH1
7. 10 mm block used to check for fall. It was not clear on the calibration of the block if it is transferred verification from a caliper or if the block itself is calibrated.

5.4 General points

1. Calibration undertaken on major equipment by Protsurv and a Portuguese company.

2. No control sheets used to verify measurements between calibrations. Balances are checked monthly (as against daily checks).

6 SoilLab laboratory - Maputo

6.1 Overview

SoilLab makes use of rented property close to ANE offices in Maputo and is currently looking to establish themselves in their own premises. They are affiliated to the South Africa SoilLab group.

A good range of test methods is undertaken in the facility including concrete, geotechnical investigations, aggregates and limited asphalt methods.

The following points where noted during the assessment of this facility on 22nd March

6.2 MDD/CBR

1. This laboratory also makes use of the rubber conveyor disk when compacting soils.
2. 5 samples made up for MDD & CBR demo.
3. Moisture sample taken at beginning of compaction.
4. Counts for the blows per layer varied from 65 – 55. Compaction was done by hand as there was a power cut. The lab does have an automatic hammer, which is normally used given that there is electricity.
5. Layer thinness is corrected by eye resulting in variable layer thicknesses. Correction is mainly done on the final layer when it is easiest to see the height against the top of the mould.
6. Water baths were not filled so no comment can be made on the depth of the water when soaking CBR specimens.

6.3 Atterberg

1. The lab uses of a combination of TMH1 and AASHTO methods.
2. A 100g sample is used.
3. Mixing is done from wet to dry state
4. Grooving of LL sample is done to the back of the bowl. The groove should result in a clean 2 mm gap separating the material in the bowl into 2 more of less equal halves.
5. The LS trough is filled with 2 layers rather than 3 as per TMH1.
6. The LS trough is to be levelled with a single action and not multiple strokes.
7. The mixing was timed for 10 minutes.

6.4 General points

1. There were some possible table stability issues. Some tables were free standing and not stable enough for balance readings.
2. Calibration of major equipment is undertaken by Geosol.

7 JJR quarry

7.1 Overview

This is a very neat operation supplying crushed material to JJR contracts only. There are no laboratory facilities on quarry site for testing. All testing is conducted at the main JJR facility in Maputo. It is proposed that some basic testing facility e.g. grading FI & ALD should be established at the facility for production control purposes.

7.2 Use of JJS Material in the PTS

The following points where noted during the visit to the facility regarding the appropriateness of the material for granular testing and aggregate testing samples for the Proficiency Testing Scheme (PTS).

1. Crushed material is most likely to be non-plastic (NP). (A sample of a plastic material (only -0.425 mm fraction) will be sourced in Inhambane to test the laboratories' capabilities for testing plastic materials).
2. Concrete stone can be used for grading, FI & 10% FACT samples. ALD samples are not available at the quarry.
3. Good sand source that can be used for SE (Sand Equivalent) if required.

Figure 7.1: Granular material at JJR Facility

8 JJR laboratory

8.1 Overview

This is a very neat and clean facility in all departments including asphalt, emulsion and bitumen division. The facility has an asphalt plant on site with a large variety of construction plant for all asphalt and surface treatment applications.

The following points where noted during the assessment of this facility on 22nd March.

8.2 General

1. No demo sample was available so the processes where spoken through. This could differ from what is done in practice.
2. There was a request for information on calibration facilities in South Africa that could assist with major equipment calibrations for JJR's facility. This should be coordinated with other facilities in Mozambique requiring calibration to save on the travel costs from SA.

8.3 Riffling

1. Pans used for riffling samples are held either vertically or horizontally into the riffles. One of the methods needs to be adopted to reduce variability. Vertical methods are used in SANS 3001 series.
2. Various riffler opening sizes are available.

8.4 MDD/CBR

3. TMH1 methods are used in the laboratory besides bitumen, which is ASTM based.
4. The base plate for the MDD & CBR compaction needs to be fixed to a concrete base. Currently it is a loose plate which tends to move around under the hand compaction movements. The same base is used for the asphalt briquette manufacturing.
5. Both manual and automatic hammers are available for soils. Manual hammers also include the Proctor hammer.
6. Soaking is done in the same bath as for concrete curing which raises similar issues as seen in the other laboratories around the water level for the CBR soaking.
7. No control sheets are used to record verifications of the measuring devices used.
8. Rubber conveyor disk are used for compaction with similar commentary relating to the possible loss of compaction. They are only used for sandy type materials and not crushed layer works materials.

8.5 Atterberg

1. All equipment looks acceptable although no control sheets were available to check on the critical dimensions.
2. No material was available for demonstration proposes.

8.6 Aggregates

1. Flakiness Gauges are available for both BS & TMH1 methods. Care is required to ensure the correct gauge is used based in the sieve opening used for the material.

9 Inhambane - ANE

The following points where noted during the assessment of this facility on 22nd March

9.1 General

1. ACV/10 % FACT device is not working at present.

9.2 Riffling

1. A good variety of rifflers is available – 6.7 mm, 20 mm & 25 mm. These are acceptable for sand and other fine material but would need a larger opening size if crushed material was used.

9.3 MDD/CBR

1. CBR bath water too high.
2. Mass of material per layer not weighed off & corrected where necessary.
3. No 30-minute soaking period.
4. No gauze below the soaking plate.
5. Soaking plate drainage holes not clean.
6. Soaking plate placed flat on floor of soaking bath therefore no place for water to drain up into the specimen. Soaking bath is also used for concrete curing. Two baths are available so one could be used for concrete and the other for CBR so the depth of water can be correct for both applications.
7. Samples are covered with plastic to prevent moisture loss.
8. Hand compaction is used.
9. The baseplate is not fixed to floor. The lab is looking at casting a foundation and securing bolts to do the compaction outside the main building.
10. Oil is used to lubricate the moulds.
11. No rubber conveyor disk used to assist with keeping the material level in the mould.
12. Hammer mass is only 4,300 g.
13. The lab use only 100 g for moisture determination – too small a sample to be representative. Samples are taken for A, B & C moulds.
14. LEM calibration stickers were seen on major apparatus.

9.4 Atterberg

1. Oven thermometer only able to read up to 50 ^{o}C. Therefore, the lab is unable to confirm drying temperatures of 105 – 110 ^{o}C.
2. Very large spatulas used for mixing.
3. 100 g mixed on glass plate.
4. No timing done on mixing process.
5. A wet to dry mixing process is used although TMH1 is the method being used.
6. Balance beam scales are used for measurements, not electronic balances.
7. Taps are applied quicker than 2 per second although they are constantly applied.

8. A large amount of the material was used for the moisture content determination – 40 g.
9. The LS trough was filled well although 2 strokes were used to level the top.
10. The groove was formed by a forward stroke, with material flowing together at 24 taps.
11. The grooving tool is a bit rusted at the tip.

10 Chimoio - ANE

The following points where noted during the assessment of this facility on 22nd March

10.1 General

1. No thermometer, stop watch or weights < 500 g are used regularly to assist with verification of the apparatus.
2. The rod for ACV/10% FACT and concrete slump is a Y16 rebar. Ends are not rounded.
3. No traceable calibration on the major equipment.
4. Bitumen testing apparatus is available for bitumen penetration and softening point,
5. Concrete cube crushing and a vibrating table for cube manufacture are available.
6. Sieve shakers are available.

10.2 MDD/CBR

1. Standard errors were observed as at other facilities, e.g.
    a. Layers not measured and material per layer weighted off,
    b. Soaking plate holes blocked,
    c. Mould base not fixed to the floor,
    d. 30-minute soak period not observed once water mixed in.

10.3 Atterberg

1. TMH1 & AASHTO methods combined into one.
2. LS trough is filled in a single lift.

11 Nampula - ANE

The following points were noted during the assessment of this facility on 22nd March:

11.1 General

1. There are no timing devices in the facility.
2. A Teltru thermometer is used to check oven temperature but the probe point is bent.
3. Good selection of weights is available
4. All sieves conform to TMH1 sizes.
5. Flakiness gauge and ALD device are available and in good working order.

11.2 MDD/CBR

1. Hammer mass 4,457 g.
2. Mould base to be fixed to the floor
3. Sample not covered once mixed with water resulting in moisture loss during compaction of the 5 layers.
4. Thin plastic canvas disk used as against filter paper.
5. Layers not checked, measured and mass per layer revised to get the correct heights. This resulted in a large portion of the final layer being removed in preparing the surface after compaction was completed.
6. Blows per layer varied from 65 – 44 per layer with hand compaction.
7. The moisture containers are possibly too small for representative samples of coarser material. Tin capacity maximum of 500 g.
8. No 30-minute soak time after mixing in water.
9. Swell gauge set up well on marked mould rim.
10. Water level for CBR soak too high.
11. The lab requires 7 kg samples for coarser material although most facilities use 6 kg when testing sandy material

11.3 Atterberg

1. Grooving tool looked fairly worn.
2. TMH1 method is used although the material is processed from wet to dry.
3. The material is mixed on a glass plate from wet to dry state.
4. A very large spatula used, which makes it difficult to manipulate the sample in the bowl.
5. The bowl is possibly over-filled and sample not placed parallel to the base plate. The material was bowed to the back of the bowl in a semi-arch.
6. The 2nd point was done on an air-dried sample on the glass plate.
7. The trough was not filled in 3 portions and wet material was tapped into place and able to flow quite easily.

11.4 Second laboratory facility (approx. 20 km outside of Nampula)

This is very well stocked with brand new equipment which mostly hasn't been used. Most of the equipment is in the original packaging. The equipment includes pans, hammers, DCP's, shovels, sample bags, sieve sets, presses, ignition oven, centrifuges (2 types), balances, pipettes, Marshall press, automatic MDD hammer, concrete cubes, etc.

12 Summary of main points observed

12.1 Mixing of methods between TMH1 and AASHTO

1. The MDD/CBR mould dimensions differ.
2. The mixing of material for the Atterberg LL is done wet to dry as against dry to wet.
3. Levelling of LL material in the bowl is not done well.
4. There are differing LS trough sizes.

12.2 Methods not being followed correctly

1. No timing for conditioning is undertaken in various methods
    a. 10-minute mixing of PI samples,
    b. 30-minute soaking of MDD & CBR samples.
2. Layers for MDD & CBR are not measured and mass per layer adjusted where necessary.
3. Base plate for compaction is not fixed to a concrete block on the floor.
4. Overfilling of water bath level for CBR soaking.
5. 6 kg samples used as against 7 kg per mould.

12.3 Additional steps or apparatus added to methods

1. Conveyor belting used to retain sandy type materials for MDD & CBR compaction.
2. Adding of dry material to wet LL material to dry. A similar process is used to dry PL material but it is only rolled onto the outside.

12.4 Equipment calibration and verification

1. Very few facilities have calibration certificates that are traceable to international or international standards.
2. Very little verification is undertaken to some fixed period of time (e.g. daily, weekly, monthly, 6 monthly, annually) with records kept on the status of apparatus related to the tolerances given in the methods. This refers to balances, ovens, hammer mass, hammer fall and head dimensions, LL fall, etc.
3. Very few facilities have a master set of sieves to verify working sieves.
4. Thermometers, timers, mass pieces and calipers are not available in most facilities.
5. Most MDD/CBR hammers are too light in relation to the apparatus tolerances. In some cases, the hammer was up to 100 g lighter (a difference of > 2 % specified).

12.5 Staff competency

1. No continued competency records of staff were observed.
2. Staff in all facilities were very responsive to comments made and extremely keen to learn and develop their knowledge of the methods. This is very encouraging.
3. Most facilities have a small staff complement (less than 5 members), with qualifications ranging from degrees and diplomas to in-house trained staff.

4. The interaction with the CDS consultants was very open with questions being asked by the staff members at all the facilities on the test methods being observed as well as some enquiring about additional methods.

12.6 Test Methods

AASHTO methods have been proposed as standard for Mozambique, although the actual methods used by the laboratories include TMH1, British Standards and various aspects from AASHTO. The reasoning for proposing the AASHTO methods is due to the similarity of the methods to TMH1. This however is problematic as the TMH1 methods have now been replaced with the SANS 3001 series which differs in various aspects from TMH1. As TMH1 will be discontinued in South Africa from the end of 2017 it is felt that the AASHTO method should be replaced in Mozambique over time with the SANS 3001 series for consistency in the SADC region.

This decision needs to be very carefully considered to ensure that the methods proposed are followed in the laboratories and are not a combination of various methods used in the past.

Test methods are being mixed with regards to the preparation of samples, apparatus dimensions, and method followed.

It could be difficult to force the laboratories to test by a method they are unfamiliar with. It may be better to analyse the results by method as well as by a combination of methods to assess the variability in the individual methods as well as when combined.

13 The way forward

13.1 PTS Protocols

The following is a summary of the protocol to be used for the first round of the PTS.

1. No test methods will be specified in the pilot round e.g. TMH1 or AASHTO. Each facility will undertake the test (MDD/CBR, etc.) in the manner they are used to. No sieve sizes will be specified due to the different methods that may be utilized.
2. Sand from ANE borrow pit will be tested for:
    1. Grading
    2. PI
    3. MDD/CBR
3. Crushed material from the JJR quarry will be tested for:
    1. Grading
    2. PI
    3. MDD/CBR
4. Plastic material obtained by ANE from Inhambane will be tested for:
    1. PI only on -0.425 mm fraction
5. Single sized aggregate material from the JJR quarry will be tested for:
    1. Grading
    2. FI
    3. ALD (As the material is a concrete stone, the ALD may not show a reliable result. However, the process may point to basic testing errors which would assist in identifying issues that need to be addressed).
    4. ACV
    5. 10% FACT

The full Draft Protocol is included in Annex A.

13.2 Follow-up PTS rounds

The provisional timing for the PTS rounds is as follows:

a. Round 1 – May/June analysed by B Pearce
b. Round 2 – August – analysed by LEM/ANE and reviewed by B Pearce
c. Round 3 – October - analysed by LEM/ANE and reviewed by B Pearce

13.3 Participating Laboratories

Samples will be sent to all eight laboratories that participated in the initial visit. However, training and support will only be provided to the government laboratories in Maputo and the provinces. Samples will also be sent to two SANAS accredited laboratories in South Africa.

Annex A: Draft Protocol for First Round of PTS

See separate Word file