February 2018

REPORT

ESKOM MEDUPI FGD

Geotechnical Impact Assessment Study

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Report Number: 1415881-299047-3

Distribution:

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Golder Associates

Executive Summary

Golder Associates Africa (PTY) Ltd (Golder) washas been appointed by Zitholele Consulting (Pty) Ltd (Zitholele) to undertake preliminary geotechnical investigations for the waste disposal facilities of three waste streams to be generated by the operation of the Flue Gas Desulfurization (FGD) at Medupi power station at Lephalale, Limpopo.

The Scope of Work was to undertake a preliminary geotechnical assessment of the Ash Disposal Facility on the preferred Alternative Site 13. The waste disposal infrastructures include a gypsum landfill and lagoons to dispose salts and sludge.

Alternative Site 13 is situated at the western portion of the Medupi power plant. Eight intrusive test pits were excavated in the area of Alternative Site 13.

A total of 8 test pits were excavated using a TLB to a median depth of 2m. The test pits intersected topsoil overlying alluvial non-cohesive material, with weathered sandstone intersected in only one test pit at a depth of 1.7m.

Recommendations have been provided on excavatability, engineering use, shear strength, shallow foundations and slope stability.

The scope of works was revised after the fieldwork was complete to include professional geotechnical opinion on additional scope items of infrastructure using supplied information.

No significant geotechnical hazards or fatal flaws were identified. All the geotechnical considerations mentioned can be mitigated in the design of the facility. Geotechnical investigations will be required as the project proceeds into design.

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1.0 INTRODUCTION

Golder Associates Africa (PTY) Ltd (Golder) was appointed by Zitholele Consulting (Pty) Ltd (Zitholele) to undertake preliminary geotechnical investigation for the waste disposal facility of the three waste streams to be generated by operation of the Flue Gas Desulfurization (FGD) at Medupi power station at Lephalale, Limpopo.

This is a report of the geotechnical impact assessment findings.

2.0 OBJECTIVES

The objectives of the geotechnical investigation and impact assessment were as follows:

- Undertake a site visit, taking cognisance of the geotechnical sensitivity of the site;
- Undertake a review of existing information and conceptual plans of the study area;
  - founding material
  - waste dump material (using previous or supplied reports, published, empirical or other data sources)
  - liner system (using previous or supplied reports, published, empirical or other data sources)
- Provide mitigation measures to prevent and/or mitigate any impacts that may occur due to the proposed project;
- Assess groundwater conditions encountered during the investigation and their potential engineering impact on the proposed development.
- Provide a Geotechnical Impact Assessment commenting on any visible or readily identifiable geotechnical issues exposed during the investigations which may affect the proposed development.

3.0 SCOPE OF WORK

The scope of works was initially to assess the footprint of the ash dump waste disposal facility extension, but was revised after the fieldwork was complete to include the following:

1) Construction and operation of a rail yard/siding to transport Limestone from a source defined point via the existing rail network to the Medupi Power Station and proposed rail yard / siding. The rail yard infrastructure will include storage of fuel (diesel) in above ground tanks and 15m deep excavation for tippler building infrastructure;
2) Construction and operation of limestone storage area, preparation area, handling and transport via truck and conveyor to the FGD system located near the generation units of the Medupi Power Station;
3) The construction and operation of the wet FGD system that will reduce the SO_2 content in the flue gas emitted;
4) Construction and operation of associated infrastructure required for operation of the FGD system and required services to ensure optimal functioning of the wet FGD system. The associated FGD infrastructure include a facility for storage of fuel (diesel), installation of stormwater infrastructure and conservancy tanks for sewage;
5) The handling, treatment and conveyance of gypsum and effluent from the gypsum dewatering plant. Disposal of gypsum on the existing ADF is not included in the current EIA application and will be addressed in the ADF WML amendment application.
6) Pipeline for the transportation of waste water from the gypsum dewatering plant and its treatment at the WWTP that will be located close to the FGD infrastructure within the Medupi Power Station;

7) Construction and operation of the WWTP;

8) Management, handling, transport and storage of salts and sludge generated through the waste water treatment process at a temporary waste storage facility. In terms of the EIA process impacts related to the management of salts and sludge will be considered in the EIR. However, licencing of the storage activity and requirements relating to the waste storage facility will be assessed in the WML registration application process.

9) The transportation of salts and sludge via trucks from the temporary waste storage facility to a final Waste Disposal Facility to be contracted by Eskom for the first 5 years of operation of the FGD system. Long term disposal of salts and sludge will be addressed though a separate independent EIA process to be commissioned by Eskom in future.

10) Disposal of gypsum together with ash on the existing licenced ash disposal facility (ADF), with resulting increase in height of the ADF from 60m to 72m.

4.0 ASH DISPOSAL FACILITY SITE DESCRIPTION

4.1 Site Description

The Medupi power plant is located approximately 25km west of the town of Lephalale in Limpopo. Alternative Site 13 is within the bounds of the plant. The sites were accessed by gravel tracks that lead off the main road from the town of Lephalale.

The site layout map showing the location of the preferred Ash Disposal Facility (Alternative Site 13) in relation to alternative Sites initially considered is presented in Figure 1 below.

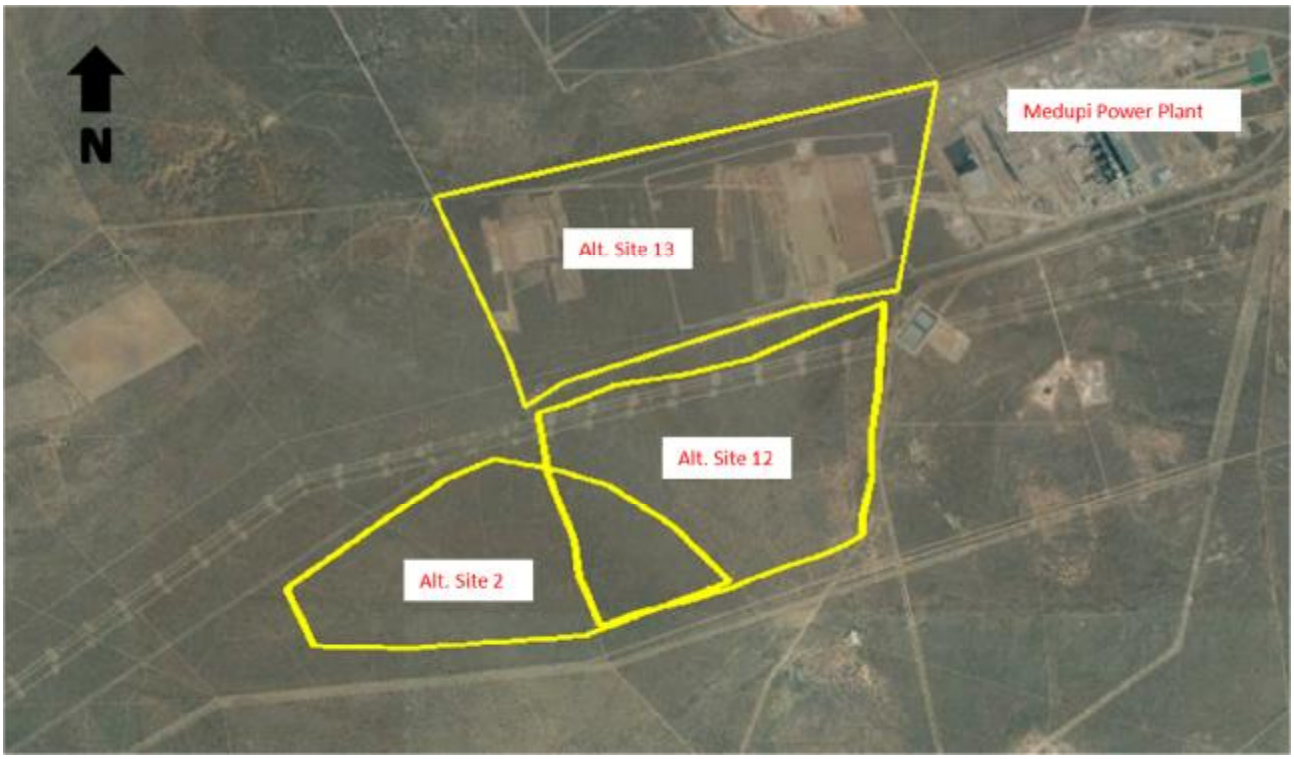

Figure 1: Site layout

The general topography of the site comprises large level plains with wild animals (bucks and warthogs) seen on the sites during the investigation. Construction is currently taking place in an area adjacent to Alternative Site 13, but it is a progressing development.

The bush comprises a thick concentration of trees, shrubs and grass interspersed with large trees. Movement through the bush by vehicles is generally difficult, with some tracks used by Eskom. The site investigation team relied on tracks formed by the excavator to navigate the site. No major rivers or water bodies were observed.

Photographs of the sites, taken during the geotechnical fieldwork, are included below:

Alternative Site 13

Figure 2: Construction activity seen on site

Figure 3: Typical test pit investigated on site (shallow refusal)

Figure 4: Typical material excavated from site

Figure 5: Typical vegetation on site

4.2 Nature of the Investigation

4.2.1 Field Investigation over the ADF Footprint

Geotechnical fieldwork was undertaken from 3 November to 6 November 2015 and comprised the following:

- Mechanical excavation, using an excavator provided by Golder, of 8 test pits at pre-determined positions. The pre-determined GPS positions of each test pit were located on site using a handheld GPS unit accurate to within about 5 m. Test pits were excavated to depths of approximately 3 m below natural ground level (NGL). Test pits were profiled according to the method of prescribed in SANS 633. Retrieval of representative soil samples was undertaken from some test pits for laboratory testing purposes.

The approximate fieldwork positions are presented in the figure attached in Appendix B.

4.2.2 Laboratory Testing

Soil samples were collected from the test pits and transported to a specialist laboratory in Johannesburg. The soil samples were submitted for testing to determine fundamental geotechnical engineering properties of the materials including soil classification, material and compaction properties.

The following sample types and number of samples were retrieved during the investigations:

Table 1: Samples types and quantities

Source	Disturbed Soil	Disturbed Soil (Bulk)
Test Pits	5	1

4.3 Geology and Soil Profile

4.3.1 Geology and Climatic Value

The published 1:250 000 Geological Map of Elisras (1993) shows the proposed site area is underlain by coarse grained brown sandstone and conglomerates of the Mogalakwena Formation, Waterberg Group. In the area of interest, thick profiles of sandy Alluvium can be expected.

The area is classified as having a climatic N-value (Weinert, 1980) of almost 5, which indicates that both chemical weathering and mechanical weathering are likely. From the description of the geology of the area it can be expected that residual soils are generally shallow and transported soils vary greatly in thickness.

4.3.2 Soil Profile

A total of 8 test pits were excavated within the footprint of Alternative Site 13. This is a deviation from the original 9 test pits that where initially planned. Test Pit 7 was inaccessible during the field investigation.

The excavated test pits intersected a relatively uniform near surface ground profile across all alternative sites. The intersected ground profile within the 3.0 m from NGL generally comprises four successive horizons. These general horizons have been described below for interpretive purposes.

Table 2: Typical Soil Profiles the Alternative ASF Site

Topsoil	Dry to slightly moist, brown to brownish grey, very loose becoming loose with increasing depth, intact, fine grained; SILTY SAND – *Topsoil* with some roots and organic material.
Transported Sand (Alluvium)	Slightly moist, reddish brown, medium dense to dense with increasing depth, intact to slightly shattered, fine to medium grained; slightly SILTY CLAYEY SAND to SILTY SAND – *Transported (Alluvium).*
Transported Gravel	Dry, brown speckled black, dense becoming dense with depth, homogenous, medium to coarse grained, matrix supported, blocky, rounded, smooth to granular, hard rock; weakly cemented GRAVEL, excavates as gravel – *Transported*
Sandstone	This material was only encountered in MTP9 at depth 1.1. Reddish brown, highly weathered, fine grained, soft rock, in situ weathered SANDSTONE excavated as rounded, subangular gravel.

Table 3: Ground Profile underlying the ADF Footprint Alternative Site 13

Test Pit ID	Depth (m)	Depth to the base of indicated horizon (or base of excavation, where indicated) (m)			
		Topsoil	Transported Sand	Transported Gravel	Sandstone
Alternative Site 13					
MTP1	1.1	0.2	1.1*	-	-
MTP2	1.2	0.4	1.2	-	-
MTP3	1.1	0.4	1.1	-	-
MTP4	1.4	0.4	1.3	1.4*	-
MTP5	1.6	0.5	1.6*	-	-
MTP6	2.5	0.4	1.5	2.5*	-
MTP8	1.5	0.5	1.0	1.5*	-
MTP9	1.7	0.4	1.1	-	1.7*

*Base of excavation

The area of the proposed development appears to be covered in its entirety by relatively thick alluvial sand. This surface horizon was found to be dry and was up to 2 m thick in some test pits.

Cemented gravel material was found is some test pits. This material is interpreted to be also be of transported origin.

Of the 8 test pits, weathered rock was only encountered in MTP9.

4.3.3 Moisture Condition

No seepage or groundwater was encountered in any of the test pits, which reached a maximum depth of 2.5m.

4.4 Laboratory test results

4.4.1 Foundation Indicators

Table 4: Foundation Indicator test results

Test Pit ID	Depth (m)	Material type	Soil Composition				GM	SG	LL (%)	PI (%)	LS (%)	USC
			Clay (%)	Silt (%)	Sand (%)	Gravel (%)						
Alternative site 13												
MTP1	0.4 – 1.1	Transported	15	12	72	1	1.01	2.598	22	11	4	SC
MTP2	1.2	Transported	19	9	63	9	1.21	2.825	26	12	6.5	SC
MTP3	0.4 – 1.1	Transported	12	7	71	10	1.41	-	24	8	4	SC
MTP5	0.5-1.0	Transported	14	9	74	3	1.14	2.658	20	10	3.5	SC
MTP8	0.5-1.0	Transported	9	8	80	3	1.18	2.852	NP	NP	NP	SM

Legend:

GM = Grading Modulus
SG = Specific Gravity
LL = Liquid Limit
PI = Plasticity Index
LS = Linear Shrinkage
SC = Clayey Sand
SM = Silty Sand

Table 4 indicates that:

- The **Transported** soil of **Alternative Site 13** comprises mostly of sand (63% to 80%) and some fraction of clay and silt. The material can be classified as Clayey Sand (SC) and Silty Sand (SM) according to the Unified Soil Classification (USC). The Plasticity Index of the material is low (8% to 12%), this together with the low clay contents are indicative of a low plastic material with a low potential expansiveness according to the method proposed by Van der Merwe (Reference 5).

4.4.2 Compaction Characteristics

Table 5: Compaction Test Results

Test pit ID	Depth (m)	Material Type	OMC (%)	MDD (kg/m^3)	Swell (%)	Soaked CBR at various ratios of MDD compactive efforts						TRH 14 Classification
						90%	93 %	95 %	97 %	98 %	100 %	
Alternative site 13												
MTP3	0.4-1.1	Transported	8.4	2115	0.2	9	13	18	21	21	23	G9

Legend

OMC = Optimum moisture content
MDD = Maximum dry density (Modified AASHTO)
Swell = Soaked at 100% Mod AASHTO compaction
TRH = Material classification according to TRH14 guidelines
CBR = California Bearing Ratio

The **Transported** sand for **Alternative Site 13** has a moderate dry density of 1961 kg/m^3 and 2115 kg/m^3 and a relatively high moisture content of 11.3 and 8.4% respectively. The swell is low at 1.4% and 0.2% respectively. The CBR value of 93% and 95% compaction effort are relatively low, but typical for sandy material. Accordingly to the TRH 14, the material can be classified as G9 material.

4.4.3 Falling Head Permeability

Table 6: Permeability Test Results

Test Pit ID	Depth (m)	Moisture Content		Dry density (Kg/m3)		Coefficient of Permeability (m/s)		
		Before Test (%)	After Test (%)	Initial	As Tested	Range		Average
						Minimum	Maximum	
Alternative Site 13								
MTP 2	0.4-1.2	8.7	14.7	1395	1760	1.9×10^{-7}	2.5×10^{-7}	2.1×10^{-7}
MTP 8	0.5-1.0	4.3	14.5	1427	1743	5.3×10^{-7}	6.9×10^{-7}	6.2×10^{-7}

The laboratory test results show a relatively low permeability. This is due to the moderate content of clay and silt in the Transported material. Should the in-situ transported soil be used in the construction of embankments or liner material, a permeability of 1×10^{-7} m/s can be expected when compacted to 95% Mod AASHTO effort.

4.4.4 pH and Conductivity

Table 7: pH and Conductivity test results

Test Pit ID	Depth (m)	pH-value	Conductivity mS/cm
Alternative Site 13			
MPT1	0.40-1.10	5.74	0.3300
MTP5	0.50-1.00	4.56	0.0897

The pH and conductivity of soil is generally determined to get an indication of the potential corrosiveness of the soil. The pH of a soil gives an indication of the acidity of the soil. As a general guideline Evans (Reference 8) noted that corrosion may take place in soil with a pH of less than 6 and that should the pH be less than 4,5 , the problem may be serious. It should however be noted that a low pH value is not necessarily an indication of serious corrosiveness as the pH of the surrounding soil will generally start to rise as soon as corrosion starts.

Corrosion is an electrochemical process whereby metals are changed and electrical energy is released. The conductivity of the soil therefore has a profound influence on the rate of corrosion of buried metallic objects.

The conductivity results are generally very corrosive (0.25 – 0.5 mS/cm) corrosion classification accordingly to the method proposed by Duligal E (Reference 7) with the exception MTP 5 in Alternative site 13. The pH value obtained are indicative of material with medium potential to corrode.

4.5 Geotechnical Impact Assessment

An evaluation of the impact of geotechnical conditions on Alternative Site 13 is presented in the sections below.

4.5.1 Excavation Class

Excavation Class was assessed according to SANS 1200D: Earthworks Specification (Reference 4) for the areas investigated by means of test pits and at the positions of the test pits, based on a summary of the Excavation Class provided below:

- *Soft* excavation, which is possible using conventional light earthmoving equipment (TLB or similar)
- *Intermediate* excavation, which will require heavier plant (tracked excavator) or pneumatic tools to break up material prior to excavation
- *Hard excavation*, requiring drill-and-blast operations, and boulder material potentially requiring localised drill and blast operations and heavy plant for removal thereof.
- *Boulder* Class, requiring individual drilling and blasting in order to be loosened

The interpreted excavation class for the sites are as follows:

Table 8: Evaluation of Excavation Class

Site	Approximate Average Depths (m)		
	Soft Excavation Class	**Soft to Intermediate Excavation Class**	**Boulder and Hard Rock Excavation Class**
Alternative Site 13	0 – 0.4m	0.6 – 2.5m	Approximately 2.5m+

Since rock was encountered from relatively shallow depths elsewhere, variation to the above can be anticipated between points of excavation. An allowance should therefore be made for boulder and hard excavation in areas not inspected, or where TLB refusal was encountered.

4.5.2 Engineering Use

A geotechnical evaluation of the engineering properties of the materials encountered on site, together with an appraisal of the suitability of the materials for engineering use and construction based on Wagner (Reference 6), is tabulated below:

Table 9: Preliminary engineering use and construction suitability

Material Type	USC Range	Workability	Homogeneous Embankment Earth Fill	Road Pavement Fill	Liner material
Transported/ Residual	SC to SM	Fair - good	Good	Poor	Fair
Transported	SC	Good	Good	Poor	Fair

USC – Unified Soil Classification

Transported sand was found within the footprint of Alternative Site 13. This material is expected to be found in abundance, although intermediate excavation measures will have to be employed to access this material. This material can be used in embankment fills. The laboratory test results revealed that there is a considerable amount of cohesive material present in the transported material and can, therefore, be appropriate for use as a lining material. Imported clay or a synthetic liner may be needed in addition to the transported material for the construction of the liner for the waste disposal facilities.

4.5.3 Shear Strength

The effective shear strength properties of the in situ soils have been estimated based on the laboratory test results, engineering experience and available literature, as follows:

Table 10: Preliminary effective shear strength parameters

Material Type	Estimated effective in situ shear strength parameters		Estimated effective shear strength parameters of material compacted to at least 95% of MDD	
	c' (kPa)	**ϕ' (degrees)**	**c' (kPa)**	**ϕ' (degrees)**
Transported	0	26 - 30	0	32

MDD: Maximum dry density

4.5.4 Shallow Foundations

The following recommendations on bearing capacity should be considered preliminary and subject to further investigation and analysis as the design proceeds.

Design of shallow strip and pad footings are considered suitable on properly compacted alluvial sand and gravel which covers the majority of Alternative Site 13. These should generally be designed for light structures (loads not exceeding 100kPa), subject to depth of embedment and minimum footing width requirements. The suitability of the site for deep pad foundations in order to found statically loaded heavy structures is considered suitable up to about 300kPa, subject to similar requirements as per lightly loaded structures above. Note that final recommendations need to be reviewed once the details of the waste disposal facilities and their accompanying loads are known. Further ground intrusive investigations (core drilling, geophysical investigation and SPT) will be required.

4.5.5 Lateral Stability of Excavation

The lateral stability of excavation side walls are not expected to be problematic. We recommend the following preliminary slopes:

- Permanent cut slopes in non-cohesive sand and gravel: 1 Vertical (V): 3.0 Horizontal (H)
- Temporary cut slopes in sand and gravel: 1V: 2H
- Permanent embankment fill slopes in non-cohesive sand and gravel: 1V: 2.5H

4.5.6 Summary of Geotechnical Impact Assessment

Table 11: Geotechnical Impact Assessment of Alternative Site 13

Activity	Nature of Impact	Impact type	Extent	Duration	Potential Intensity	Likelihood	Rating	Mitigation	Interpretation
Excavation Class	Excavation Class was assessed according to SANS 1200D: Earthworks Specification for the areas investigated by means of test pits and at the positions of the test pits.	Existing	2	1	2	1	6 - Moderate	The use of mechanical equipment or blasting to excavate below 2.5m	A contingency should be allowed from depths of 2.5m below NGL
Engineering Use	A geotechnical evaluation of the engineering properties of the materials encountered on site, together with an appraisal of the suitability of the materials for engineering use and construction based on Wagner (1957)	Existing	2	1	2	0.75	5.75 - Moderate	The material is good for use as an embankment fill but better material would need to be imported to construct the roads leading to the facility.	Gravel material (G6 or better) and clay material may need to be imported in the construction phase to use as liner and construction material
Shear strength	The effective shear strength properties of the in situ soils have been estimated based on the laboratory test results, engineering experience and available literature	Residual	2	2	2	0.75	6.75 - Moderate	The shear strength of the material is quite low and would need to be further tested. The shear strength can be improved by stabilising the material with lime or cement.	The shear strength is appropriate for lightly loaded structures but would need to be improved for heavy structures
Bearing Capacity	Bearing capacity should be considered preliminary and subject to further investigation and analysis as the design proceeds.	Existing	2	5	8	1	16 - High	Bearing capacity for shallow founding is suitable for lightly loaded structures, deep foundations would be necessary for heavy structures (bigger than 300kPa)	The bearing capacity is appropriate for lightly loaded structures but would need to be improved for heavy structures
Lateral Stability	The lateral stability of excavation side walls are not expected to be problematic. We recommend the following preliminary slopes:	Existing	2	2	4	1	9- Moderate	1V:2.5H excavations are recommended for permanent slopes while 1V:2H excavations are recommended for temporary slopes. Benching of slopes may be required.	The lateral stability of excavation side walls are not expected to be problematic if mitigation measures are implemented

5.0 FGD SYSTEM WITHIN THE MEDUPI POWER STATION FOOTPRINT

We provide a brief geotechnical assessment of the FGD system within the Power Station footprint using only supplied information, as this area was not included within our original scope of works.

Based on the Golder report reference 12087-8856-1 entitled: *Medupi Power Station: Shallow Groundwater Study,* and dated June 2009 (Reference 2), a number of percussion (hydrological) boreholes were drilled in and around the Power Station footprint. The location of these boreholes are provided in the figure in Appendix B.

The profiles presented in the report indicates the following ground conditions:

- The site is underlain by a sequence of pebbles, weathered quartzitic conglomerate with fresh variously fractured quartzitic conglomerate at depth.
- The conglomerate is interbedded with bluish grey siltstone (bands). The drilling has shown the siltstone forms discontinuous layers of up to 50cm thick but mostly about 20cm thick.
- Generally surface weathering to shallow depth (<5m) occurs. In some boreholes a second fractured and associated weathered zone is observed and is normally found between 7 - 14m.
- Some boreholes (e.g. GA001, GA003, GA004, GA005 and GA014) have no surface weathering.
- Boreholes in the extreme north or west, show the presence of deep weathering, up to 21m.
- Water strikes were made in 14 of the 35 boreholes at depths between 6 and 10.5m below surface.

Based on this information, the following brief comments are provided:

- The site is mainly underlain by quartzites, shale, sandstones and conglomerates. Soils and weathered and fractures rock are present to depths typically varying from 10 to 15m, below which the soils become relatively fresh.
- Standard foundation systems are expected to be applicable, comprising generally shallow foundations.
- Excavatability is expected to be soft to intermediate, with hard rock class (drill and blast) for excavation in moderately weathered or harder rock (location dependent, but generally below about 5m depth).

6.0 RAILWAY YARD AND LIMESTONE AND GYPSUM HANDLING FACILITIES

We provide a brief geotechnical assessment of the Railway Yard and Limestone and Gypsum Handling facilities using supplied information only, as this area was not included in our original scope of works.

Based on the supplied Rockland Geocscience report (Reference 3), the following is noted:

The investigation comprised the excavation of test pits and geophysical surveys over the site. Test pit TP7 and TP23 are located near to the proposed railway yard. These encountered medium dense silty sand to between 1.1m and 1.8m, underlain by dense gravel to between 1.5m and 2.4m, underlain by very soft rock quartzite in TP7, with TLB refusal at 1.8m on medium hard rock quartzite in TP7, and refusal on hardpan ferricrete at 2.4m in TP23. The geophysical continuous surface wave (CSW) survey CSW4 conducted adjacent to TP7 interpreted a shear wave velocity profile with highly weathered (quartzite) rock below about 1.5m, becoming moderately weathered below about 4m, then slightly weathered below about 8.5m.

Based on the Golder report reference 12087-8856-1 entitled: *Medupi Power Station: Shallow Groundwater Study* and dated June 2009, a number of boreholes were drilled in and around the Power Station footprint. We have reviewed the two boreholes closest to the proposed Railway Yard, GA026 and GA027, which are located about 800 to 1000m away. The water level measured in GA026 was dry, and in GA027 was 2.6m below surface.

Borehole GA026 indicates slightly and moderately weathered conglomeratic quartzite in zones below 3.5m depth, becoming fresh from 14.5m depth, whilst GA027 indicated the boundary between slightly to moderately weathered quartzite and fresh quartzite at 16.5m.

The Limestone Offloading Facility below the railway yard is proposed to be 15m in depth. Based on the above, the following is interpreted:

Hard rock (drill and blast excavation) will be required from a depth of about 2m.

Dependent on the thickness of the surficial soils and any fill materials over the area, a contingency allowance should be made for encountering rock during the installation of such services or shallow foundations, where hard rock excavation (hydraulic rock hammer or drill and blast) may be necessary.

Standard footing systems such as shallow pad and strip footings are expected to be applicable for the area.

Deep excavations are expected to require reinforcement and/or stabilisation, particularly at shallow depths. Dependent on the quality of the rock and degree of fracturing, the lower half of the 15m deep excavation may potentially be unreinforced and unstabilised. Core orientated geotechnical drilling and associated structural analysis of the ground will be required prior to design to test for this design solution.

Groundwater can be expected from a shallow depth in the excavation. The volume of water seepage is expected to be relatively low, and reducing as the excavation proceeds into less fractured rock.

7.0 CONCLUSION

A total of 8 test pits were excavated at the site of the ash disposal facility using a TLB to a median depth of 2m. The test pits intersected topsoil overlying alluvial non-cohesive material, with weathered sandstone intersected in only one test pit at a depth of 1.7m. Recommendations have been provided on excavatibility, engineering use, shear strength, shallow foundations and slope angles at the ash disposal facility.

The ground conditions at the site of the FGD system within the plant site were assessed using percussion (hydrological) boreholes. Based on this, weathered rock is expected from about 5m depth. We note that this depth will be highly variable, and further testing will be needed to confirm the ground conditions at each item of infrastructure.

The ground conditions at the site of the Rail Yard and the Limestone and Gypsum Offloading Facility were assessed using percussion (hydrological) boreholes about 800m to 1000m away from the area, as well as test pits and geophysics conducted near to the area. Based on this, weathered rock and/or hardpan ferricrete can be expected from about 2m depth. This is underlain by weathered quartzite, becoming slightly weathered to fresh from about 8m.

No significant geotechnical hazards or fatal flaws were identified. All the geotechnical considerations mentioned can be mitigated in the design of the facility. Significant further investigations will be required for all items of infrastructure as the design proceeds.

8.0 REFERENCES

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9.0 DOCUMENT LIMITATIONS

Your attention is drawn to the attached: “Document Limitations”. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the groundworks for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

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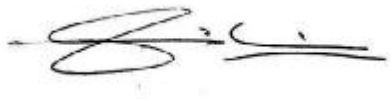

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Senior Engineering Geologist

KM-SOC/SOC/soc

c:\users\sowens-collins\appdata\local\microsoft\windows\temporary internet files\content.outlook\8ldyissg\1415881-299047-3_rep_geotechnical impact assessment_20180207.docx

APPENDIX A

Document Limitations

DOCUMENT LIMITATIONS

DOCUMENT LIMITATION

This Document has been provided by Golder Associates Africa Pty Ltd ("Golder") subject to the following limitations:

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iv) In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Golder's opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed Golder to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

v) Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.

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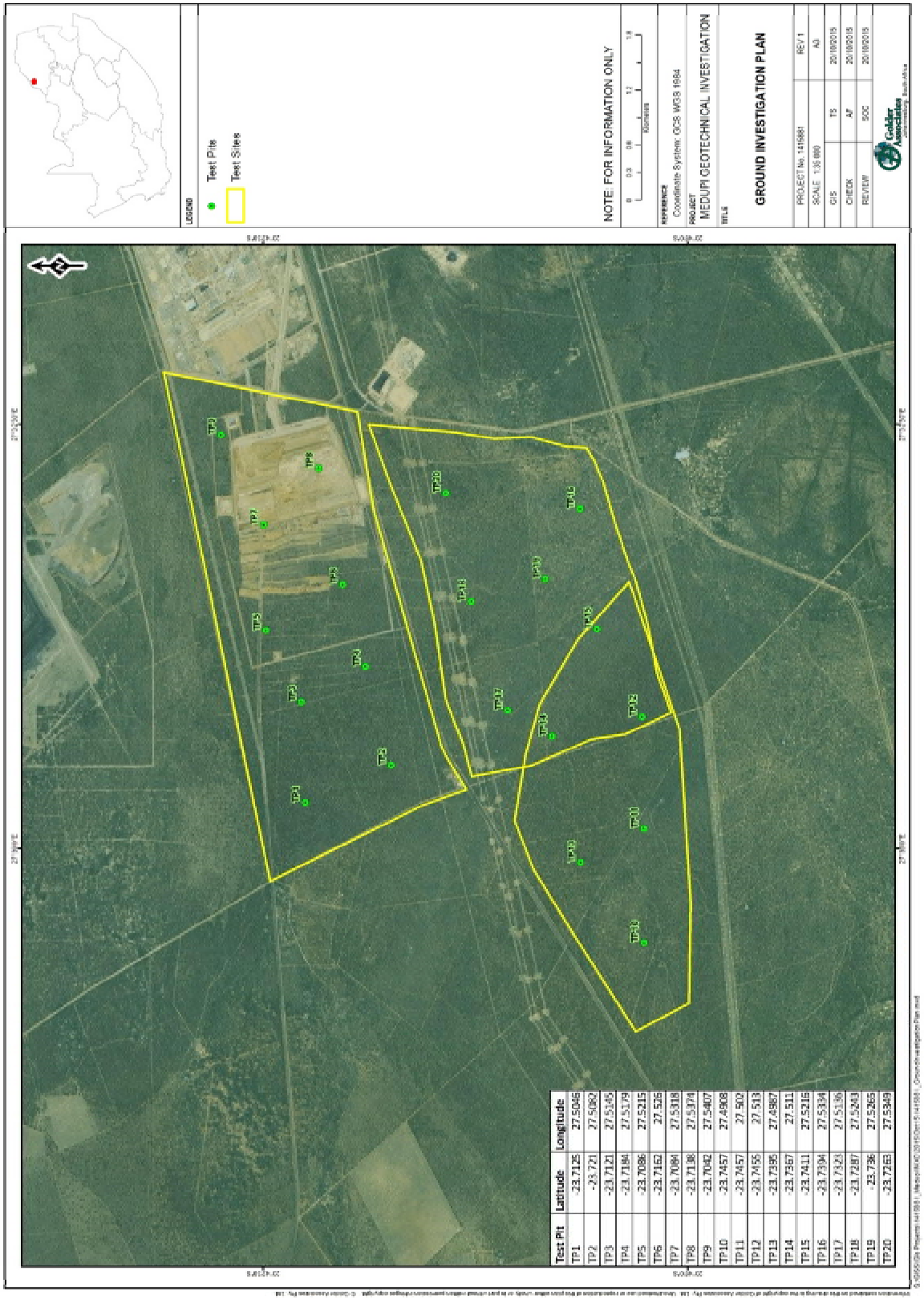
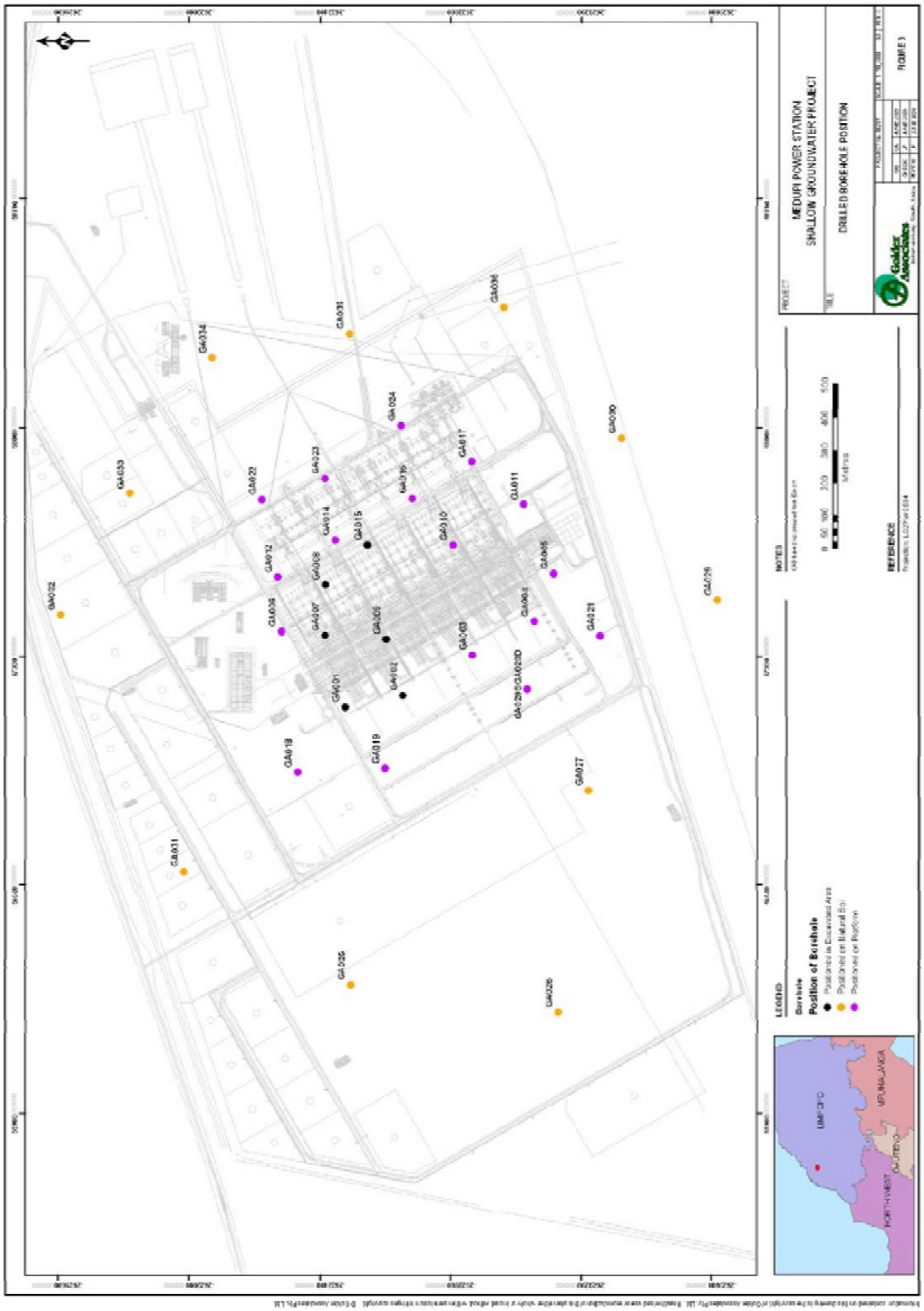
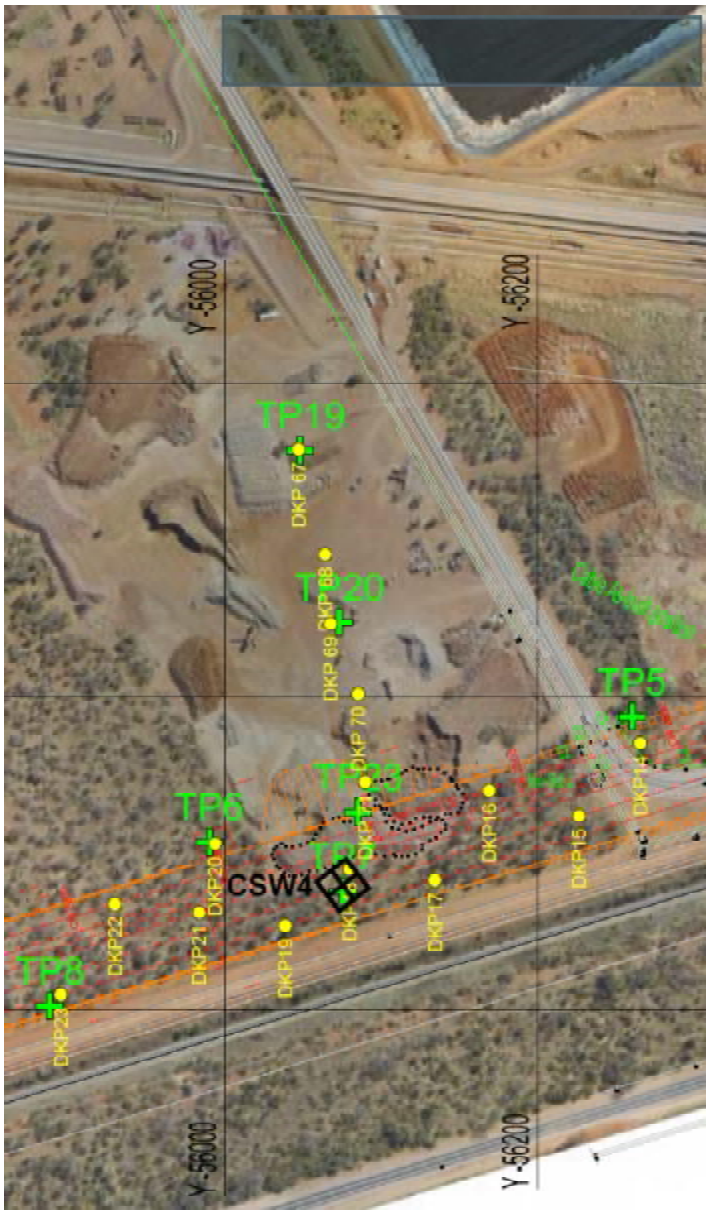
APPENDIX B

Figures


LEGEND
Test Pits
Test Sites
NOTE: FOR INFORMATION ONLY
Kilometres
REFERENCE
Coordinate System: GCS WGS 1984
PROJECT
MEDUPI GEOTECHNICAL INVESTIGATION
TITLE
GROUND INVESTIGATION PLAN
PROJECT No: 1415881
REV 1
SCALE: 1:5 000
A3
GIS
TS
20/09/2015
CHECK
AF
20/09/2015
REVIEW
SOC
20/09/2015
Golder Associates
Test Pit | Latitude | Longitude
TP1 | -23.7125 | 27.5045
TP2 | -23.721 | 27.5062
TP3 | -23.7121 | 27.5345
TP4 | -23.7184 | 27.5179
TP5 | -23.7086 | 27.5215
TP6 | -23.7162 | 27.535
TP7 | -23.7084 | 27.5318
TP8 | -23.7136 | 27.5374
TP9 | -23.7042 | 27.5407
TP10 | -23.7457 | 27.4908
TP11 | -23.7457 | 27.502
TP12 | -23.7455 | 27.513
TP13 | -23.7395 | 27.4867
TP14 | -23.7367 | 27.511
TP15 | -23.7411 | 27.5216
TP16 | -23.7394 | 27.5334
TP17 | -23.7323 | 27.5136
TP18 | -23.7287 | 27.5243
TP19 | -23.736 | 27.5265
TP20 | -23.7263 | 27.5349


MEDUPI POWER STATION
SHALLOW GROUNDWATER PROJECT
DRILLED BOREHOLE POSITION
FIGURE 3
LEGEND
Borehole
Position of Borehole
Positioned in Excavated Area
Positioned on Natural Soil
Positioned on Platform
NOTES
REFERENCE
LIMPOPO
MPUMALANGA
GAUTENG
NORTH WEST



Excerpt from Rockland Geocscience report reference RG014/169/Rev0 over area of proposed Railway Yard

APPENDIX C

Profile logs

TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MPT2
X COORD: 27.50
Y COORD: - 23.71
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, medium dense, intact, fine sand with roots. **TOPSOIL**.
		0.40	Dry, brown speckled red, dense to very dense, intact, coarse sand. **TRANSPORTED**.
0.5			
1.0			
		1.20	End of log

NOTES:
1: Medium to hard excavation
2: Refusal at 1.2m (very dense material)
3: No water
4: Side walls stable
5: Sample at 0.4-1.2m (FI, Permeability)

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/06
DATE PROFILED: 2015/11/06
PROFILED BY: KM/DM
CHECKED BY:

Golder Associates Africa (PTY) Ltd
Buildinjg 1, Maxwell Office Park
Waterfall City, Midrand 1685
Telephone: +27-11-254-4800
Fax: +27-86-582-1561

Golder Associates

TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MPT3
X COORD: 27.51
Y COORD: - 23.72
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, medium dense, intact, fine sand. **TOPSOIL**.
		0.40	Dry, reddish brown, dense to very dense, intact, fine sand. **TRANSPORTED**.
0.5			
1.0			
1.5			
		1.70	End of log

NOTES:
1: Medium excavation
2: Sample at 0.4-1.1m (CBR-Mod)
3: No water
4: Side walls stable
5: Refusal at 1.7m

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/06
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TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP1
X COORD: 27.51
Y COORD: - 23.71
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, loose to medium dense, intact, fine sand. **TOPSOIL**.
		0.20	Dry, brown, dense, intact, fine sand. **TRANSPORTED**.
		0.40	Dry, brown, very dense, intact, sand. **TRANSPORTED**.
0.5			
1.0			
			End of log

NOTES:
1: Medium excavation
2: No water
3: Side wall stable
4: Hole terminated at 1.1m (slow excavation)
5: Sample at 0.4 - 1.1 m (FI and permeability)

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/06
DATE PROFILED: 2015/11/06
PROFILED BY: KM/DM
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TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP4
X COORD: 27.52
Y COORD: - 23.72
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, loose, intact, fine sand. **TOPSOIL**.
		0.35	Dry, reddish brown, medium dense to dense, intact, fine sand. **TRANSPORTED**.
0.5			
1.0			
		1.25	Dry, brown speckled black and red, dense, homogeneous, ferruginised gravel excavated as gravel. **TRANSPORTED (PEBBLE MARKER?)**.
		1.40	
1.5			End of log

NOTES:
1: No water
2: Side walls stable
3: No sample taken
4: Medium to hard excavation
5: Refusal at 1.4m

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/06
DATE PROFILED: 2015/11/06
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TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP5
X COORD: 27.52
Y COORD: - 23.71
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, loose to medium dense, intact, fine sand. **TOPSOIL**.
0.5		0.50	Dry, reddish brown, medium dense to dense, intact, silty sand. **TRANSPORTED**.
1.0			
1.5		1.60	End of log

NOTES:
1: No water
2: Side walls stable
3: Sample taken at 0.5-1m). (FI, chemical)
4: Easy to medium excavation
5: Refusal at 1.6m

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/06
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Fax: +27-86-582-1561

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TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP6
X COORD: 27.53
Y COORD: - 23.72
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, loose, intact, fine sand. **TOPSOIL**.
		0.40	
0.5			Dry, reddish brown, medium dense to dense, intact, coarse sand. **TRANSPORTED**.
1.0			
1.5		1.50	
			Dry, yellowish brown, dense, homogeneous, cemented gravel excavated as gravelly sand. **TRANSPORTED (PEBBLE MARKER?)**.
2.0			
2.5		2.50	End of log

NOTES:
1: No water
2: Side walls stable
3: No sample taken
4: Medium excavation
5: Hole terminated at 2.5m

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/06
DATE PROFILED: 2015/11/06
PROFILED BY: KM/DM
CHECKED BY:

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TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP8
X COORD: 27.54
Y COORD: - 23.71
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, loose, intact, fine sand. **TOPSOIL**.
0.5		0.50	Dry, reddish brown, medium dense, intact, fine sand. **TRANSPORTED**.
1.0		1.00	Dry, reddish brown, dense to very dense, homogeneous, ferruginised fine gravel. **TRANSPORTED**.
1.5		1.50	End of log

NOTES:
1: No water
2: Side walls stable
3: Medium excavation
4: Refusal at 1.5m
5: Sample taken at 0.5m- 1m

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/06
DATE PROFILED: 2015/11/06
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TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP9
X COORD: 27.54
Y COORD: - 23.70
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, loose, intact, fine sand. **TOPSOIL**.
		0.40	
0.5			Dry, reddish brown, medium dense, intact, medium-coarse sand and gravel. **TRANSPORTED**.
1.0			
		1.40	
1.5			Reddish dark brown, highly weathered, fine grained, rounded-subangular rock excavated as gravel and cobbles, soft rock
		1.70	
			End of log

NOTES:
1: No water
2: Side walls stable
3: No sample taken
4: Hard excavatiom

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/06
DATE PROFILED: 2015/11/06
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TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP10
X COORD: 27.49
Y COORD: - 23.75
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, loose to medium dense, intact, fine sand with roots. **TOPSOIL**.
		0.30	Dry, brown, medium dense to dense, intact, fine sand. **TRANSPORTED**.
0.5			
1.0		1.00	End of log

NOTES:
1: No water
2: Side walls stable
3: 2 samples taken at 0.3-1.0m
4: Refusal on dense sand at 1m

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/04
DATE PROFILED: 2015/11/04
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TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP11
X COORD: 27.50
Y COORD: - 23.75
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, loose, intact, fine sand with roots. **TOPSOIL**.
		0.30	Dry, light brown, medium dense to dense, intact, fine-medium coarse sand. **TRANSPORTED**.
0.5		0.70	Dry, brown mottled white, dense to very dense, homogeneous, calcretised gravels excavated as sub-rouded to angular, medium to coarse gravels. **TRANSPORTED**.
1.0		1.00	End of log

NOTES:
1: No water
2: Side walls stable
3: No sample taken
4: Refusal at 1m
5: Medium to hard excavation

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/04
DATE PROFILED: 2015/11/04
PROFILED BY: KM/DM
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Golder Associates

TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP12
X COORD: 27.51
Y COORD: - 23.75
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, loose to medium dense, intact, fine sand with roots. **TOPSOIL**.
		0.40	
0.5			Dry, reddish brown, loose to medium dense, intact, fine sand. **TRANSPORTED**.
1.0			
		1.20	
			Dry, reddish brown, medium dense to dense, homogeneous, cemented gravel. **TRANSPORTED**.
1.5			
2.0			
		2.40	
2.5			End of log

NOTES:
1: No water
2: Side walls stable
3: Sample taken at 1.4m, (FI)
4: Excavation stopped at 2.4m
5: Medium excavation

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/05
DATE PROFILED: 2015/11/05
PROFILED BY: KM/DM
CHECKED BY:

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Golder Associates

TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP13
X COORD: 27.50
Y COORD: - 23.74
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, loose, intact, fine sand. **TOPSOIL**.
0.5		0.60	Dry, reddish brown, medium dense, intact, fine sand. **TRANSPORTED**.
1.0		1.40	Dry, reddish brown, dense, intact, fine sand. **TRANSPORTED**.
1.5			
2.0		2.00	End of log

NOTES:
1: No water
2: Side walls stable
3: No sample taken
4: Refusal on dense sand at 2m

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/04
DATE PROFILED: 2015/11/04
PROFILED BY: KM/DM
CHECKED BY:

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Golder Associates

TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP14
X COORD: 27.51
Y COORD: - 23.74
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, loose, intact, fine sand. **TOPSOIL**.
		0.20	Dry, brown, dense, intact, fine sand. **TRANSPORTED**.
0.5			
1.0			
		1.20	Dry, brown, dense, homogeneous, cemented sandy gravel excavated as gravel. **TRANSPORTED**.
1.5			
		1.80	End of log

NOTES:
1: No water
2: Side walls stable
3: Sample taken at 1.5m
4: Refusal cemented gravel at 1.8m
5: Medium to hard excavation

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/05
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TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP15
X COORD: 27.52
Y COORD: - 23.74
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, medium dense, intact, fine sand. **TOPSOIL**.
		0.30	Dry, brown, dense, intact, sand. **TRANSPORTED**.
0.5		0.80	Dry, brown mottled orange, very dense, gravelly sand. **RESIDUAL**.
1.0		1.00	End of log

NOTES:
1: No water
2: Side walls stable
3: Sample taken at 1m (chemical)
4: Refusal on residual material at 1m
5: Soft to medium excavation

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/05
DATE PROFILED: 2015/11/05
PROFILED BY: KM/DM
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Fax: +27-86-582-1561

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TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP16
X COORD: 27.53
Y COORD: - 23.74
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, medium dense, intact, fine sand. **TOPSOIL**.
		0.40	Dry, brown, very dense, intact, coarse sand. **TRANSPORTED**.
0.5			
1.0			
		1.20	End of log

NOTES:
1: No water
2: Side walls stable
3: Sample taken at 0.4-1.2m
4: Medium to hard excavation
5: Refusal at 1.2m

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/05
DATE PROFILED: 2015/11/05
PROFILED BY: KM/DM
CHECKED BY:

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TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP17
X COORD: 27.51
Y COORD: - 23.73
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, loose, intact, fine sand. **TOPSOIL**.
0.5		0.50	Dry, brown, dense to very dense, intact, fine sand. **TRANSPORTED**.
1.0		1.00	End of log

NOTES:
1: No water
2: Side walls stable
3: Refusal at 1m
4: 2 samples taken at 1m (FI,FH permeability)
5: Medium to hard excavation

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/05
DATE PROFILED: 2015/11/05
PROFILED BY: KM/DM
CHECKED BY:

Golder Associates Africa (PTY) Ltd
Buildinjg 1, Maxwell Office Park
Waterfall City, Midrand 1685
Telephone: +27-11-254-4800
Fax: +27-86-582-1561

Golder Associates

TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP19
X COORD: 27.53
Y COORD: - 23.74
DATUM: WGS84
ELEVATION:

Scale	Legend	Depth	Description
		0.00	Dry, brown, loose to medium dense, intact, fine sand with roots. **RESIDUAL**.
		0.30	Dry, brown, medium dense to dense, intact, fine sand. **TRANSPORTED**.
0.5		0.90	Dry, brown speckled red, dense, homogeneous, gravelly sand. **RESIDUAL**.
1.0		1.20	End of log

NOTES:
1: No water
2: Side walls stable
3: Sample at 0.9-1.2m
4: Easy to medium excavation
5: Refusal at 1.2m

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/05
DATE PROFILED: 2015/11/05
PROFILED BY: KM/DM
CHECKED BY:

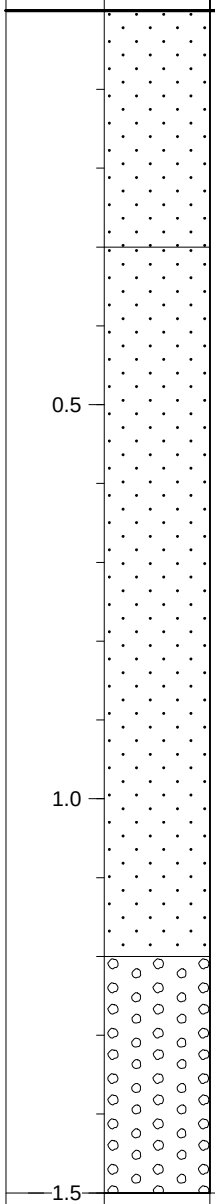
Golder Associates Africa (PTY) Ltd
Buildinjg 1, Maxwell Office Park
Waterfall City, Midrand 1685
Telephone: +27-11-254-4800
Fax: +27-86-582-1561

Golder Associates

TEST PIT PROFILE

CLIENT: ESKOM
PROJECT: Medupi Geotechnical investigation
LOCATION: Lephalale, Limpopo
PROJECT NO: 1415881

HOLE No: MTP20
X COORD: 27.53
Y COORD: - 23.73
DATUM: WGS84
ELEVATION:



Depth	Description
0.00	Dry, brown, medium dense, intact, fine sand. **TOPSOIL**.
0.30	Dry, brown, dense to very dense, intact, coarse sand. **TRANSPORTED**.
1.20	Dry, whittish brown, very dense, homogeneous, calcretised gravel. **TRANSPORTED (PEDOGENIC?)**.
1.50	End of log

NOTES:
1: No water
2: Side walls stable
3: No sample taken
4: Easy to medium excavation
5: Refusal at 1.5m

CONTRACTOR: Labante 5 (PTY) Ltd
MACHINE: CAT 48.8E TLB
PIT LxB: 2x 0.8 m
FILE REF: ESKOM.GPJ

DATE EXCAVATED: 2015/11/05
DATE PROFILED: 2015/11/05
PROFILED BY: KM/DM
CHECKED BY:

Golder Associates Africa (PTY) Ltd
Buildinjg 1, Maxwell Office Park
Waterfall City, Midrand 1685
Telephone: +27-11-254-4800
Fax: +27-86-582-1561

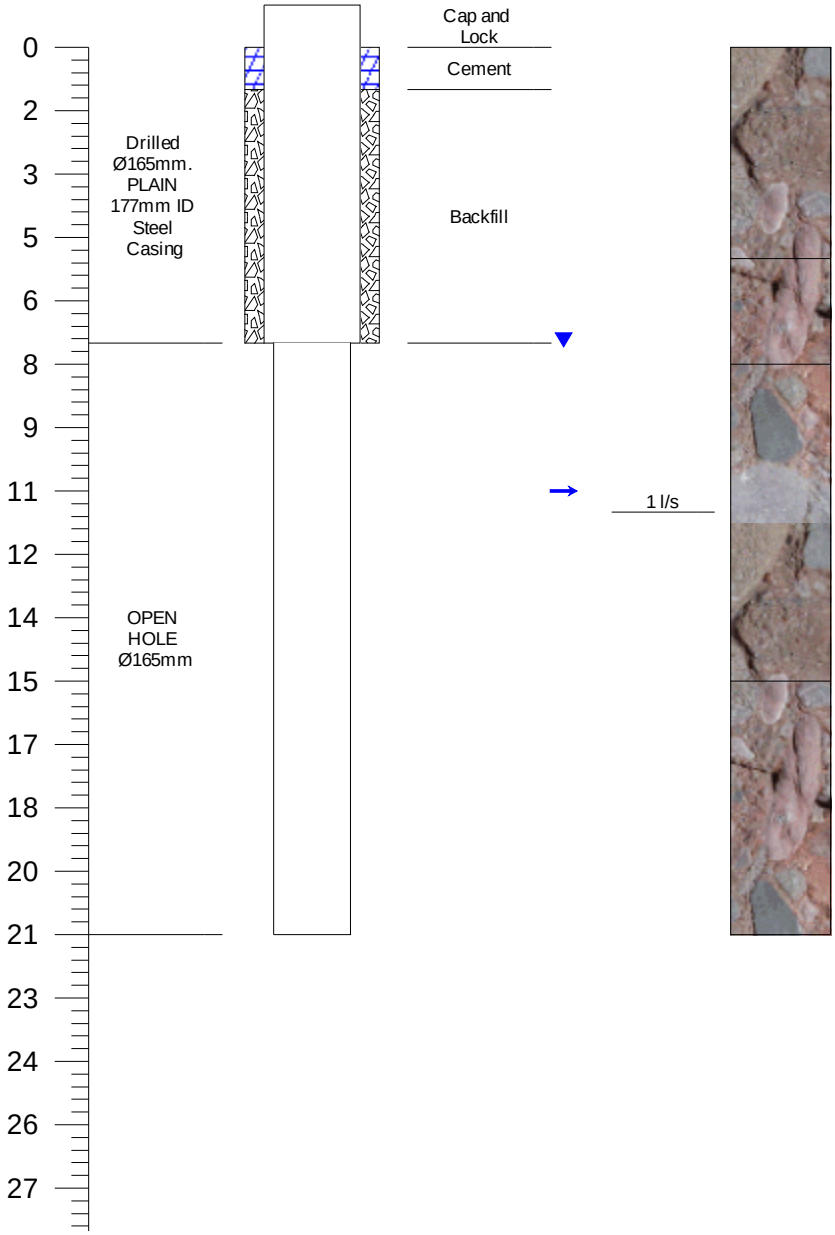
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57148 S**
Longitude: **2622479 E**
Elevation: **900.81 mamsl**

Project No.:**12087**
Borehole Number
GA001

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



(0 - 5.0) CONGLOMERATIC QUARTZITE dark red grey, fresh

(5.0 - 7.5) CONGLOMERATIC QUARTZITE pinkish grey banded, moderately fractured

(7.5 - 15.0) CONGLOMERATIC QUARTZITE dark red grey, fresh

(15.0 - 21.0) CONGLOMERATIC QUARTZITE pinkish grey, fresh weathered

Note : soft, MICACEOUS SILTSTONE at 5.5m, 10.5m, 12.5m, 13.5m, 14.5m and 21.5m

Date drilled:	18/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	1 l/s
Hydrogeologist	J. Pretorius	Collar height:	-1.28m

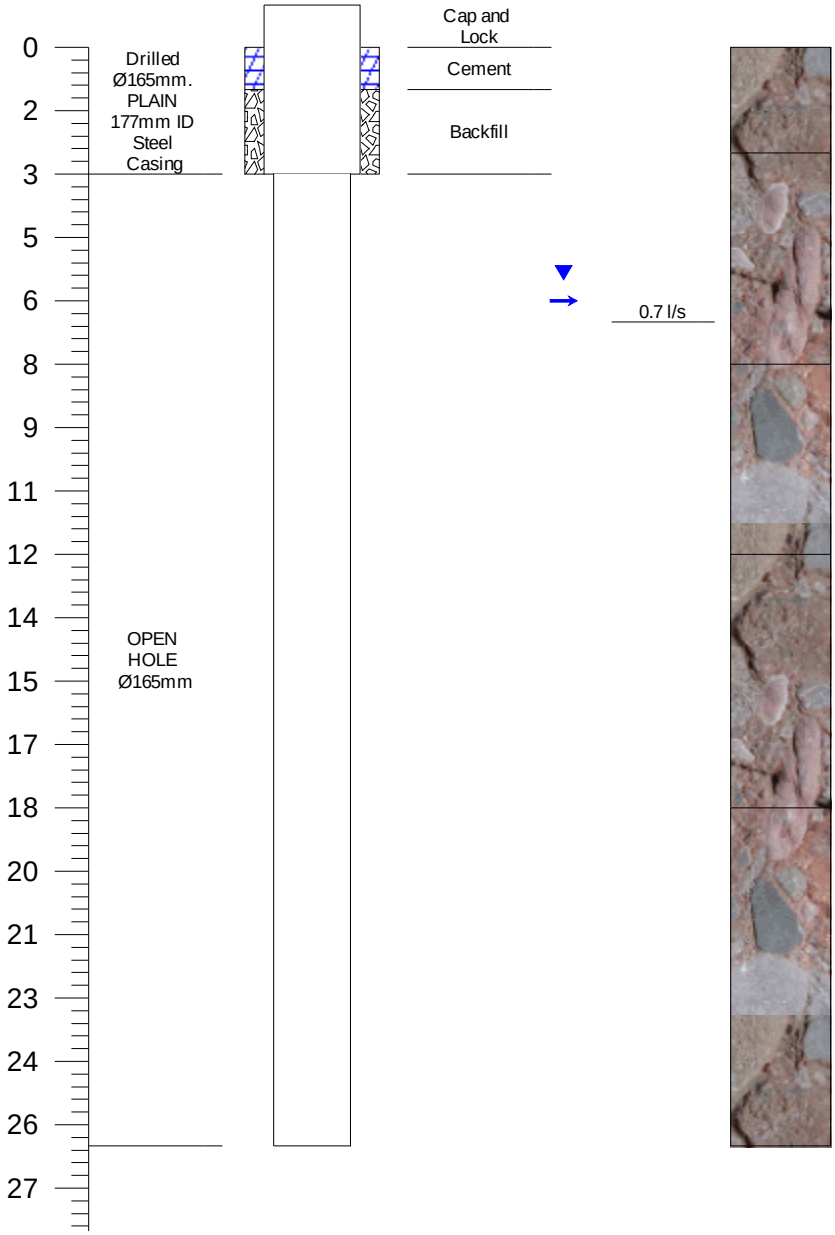
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57183 S**
Longitude: **2622654 E**
Elevation: **901.54 mamsl**

Project No.:**12087**
Borehole Number
GA002

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



(0 - 2.5) CONGLOMERATIC QUARTZITE brown grey, moderately weathered

(2.5 - 7.5) CONGLOMERATIC QUARTZITE purple grey, slightly weathered

(7.5 - 12.0) CONGLOMERATIC QUARTZITE dark red grey, fresh

(12.0 - 18.0) CONGLOMERATIC QUARTZITE brown grey, moderately weathered

(18.0 - 26.0) CONGLOMERATIC QUARTZITE dark red grey, fresh

Note : soft, MICACEOUS SILTSTONE at 2.5m, 3.5m, 7.5m, 10m, 12.5m and 14m

Date drilled:	23/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	0.7 l/s
Hydrogeologist	J. Pretorius	Collar height:	-1.34 m

Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57307 S**
Longitude: **2622868 E**
Elevation: **902.77 mamsl**

Project No.:**12087**
Borehole Number
GA003

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description
0	Drilled Ø165mm. PLAIN 177mm ID Steel Casing			(0 - 1.5) FILL MATERIAL
2	Cap and Lock			
3	Cement			(1.5 - 5.5) CONGLOMERATIC QUARTZITE dark red brown, slightly weathered
5	Backfill			
6				(5.5 - 6.0) CONGLOMERATIC QUARTZITE purple grey, slightly fractured and weathered
8				(6.0 - 8.5) CONGLOMERATIC QUARTZITE dark red brown, slightly weathered
9				(8.5 - 12.0) CONGLOMERATIC QUARTZITE dark brown, moderately weathered
11				
12	OPEN HOLE Ø165mm			(12.0 - 13.0) MICACEOUS SILTSTONE blue , soft (1m thick)
14				(13.0 - 15.5) CONGLOMERATIC QUARTZITE dark red brown, slightly weathered
15				
17				15.5 - 17.0) ONGLOMERATIC QUARTZITE pinkish grey, slightly fractured and weathered
18				(17.0 - 21.0) CONGLOMERATIC QUARTZITE dark red brown, fresh
20				
21				Note : soft, MICACEOUS SILTSTONE at 15.5m, 16m, 16.5m and 20m
23				
24				
26				
27				

Date drilled:	23/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.36m

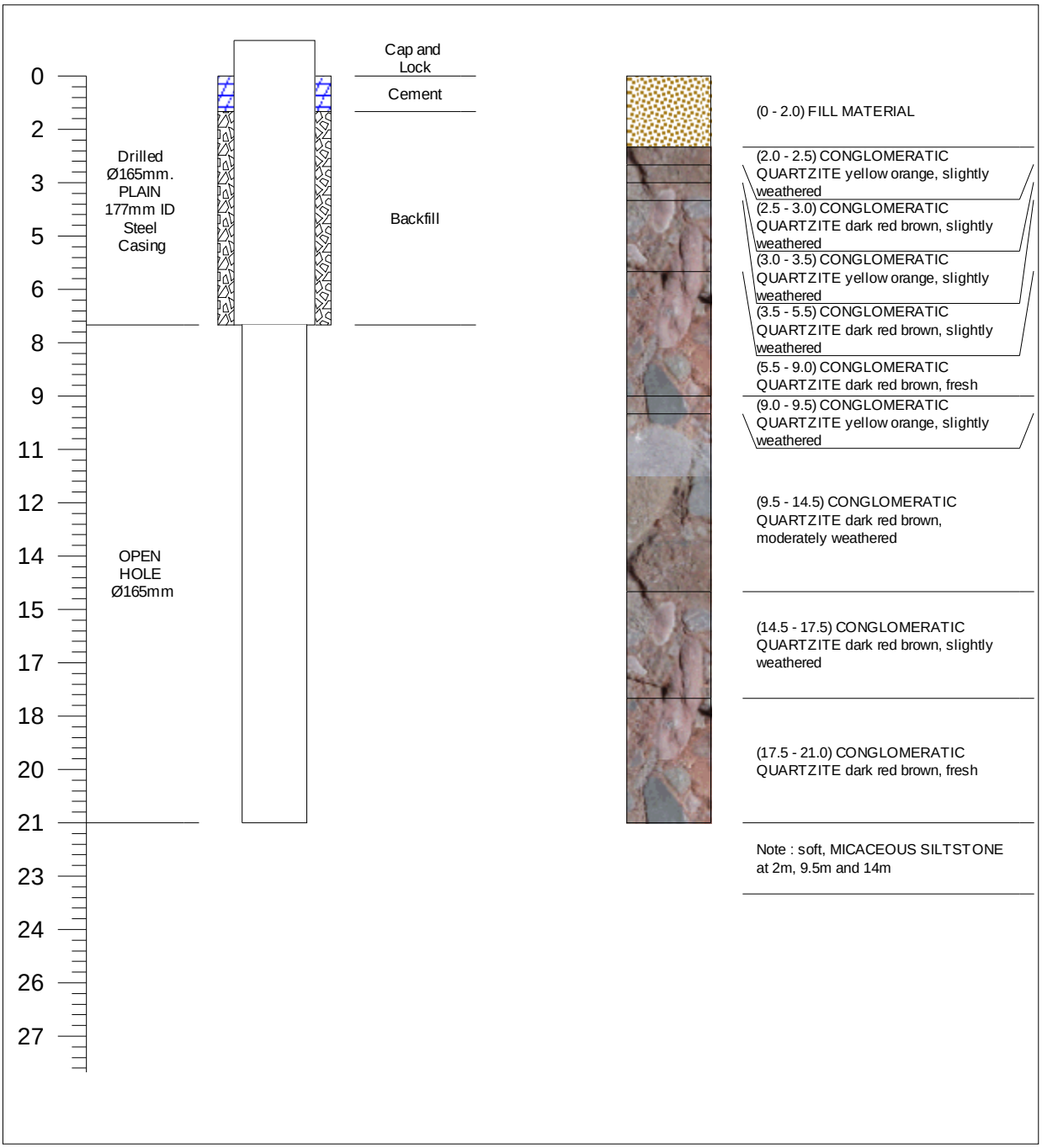
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57410 S**
Longitude: **2623058 E**
Elevation: **902.34 mamsl**

Project No.:**12087**
Borehole Number
GA004

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	17/022009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-0.66m

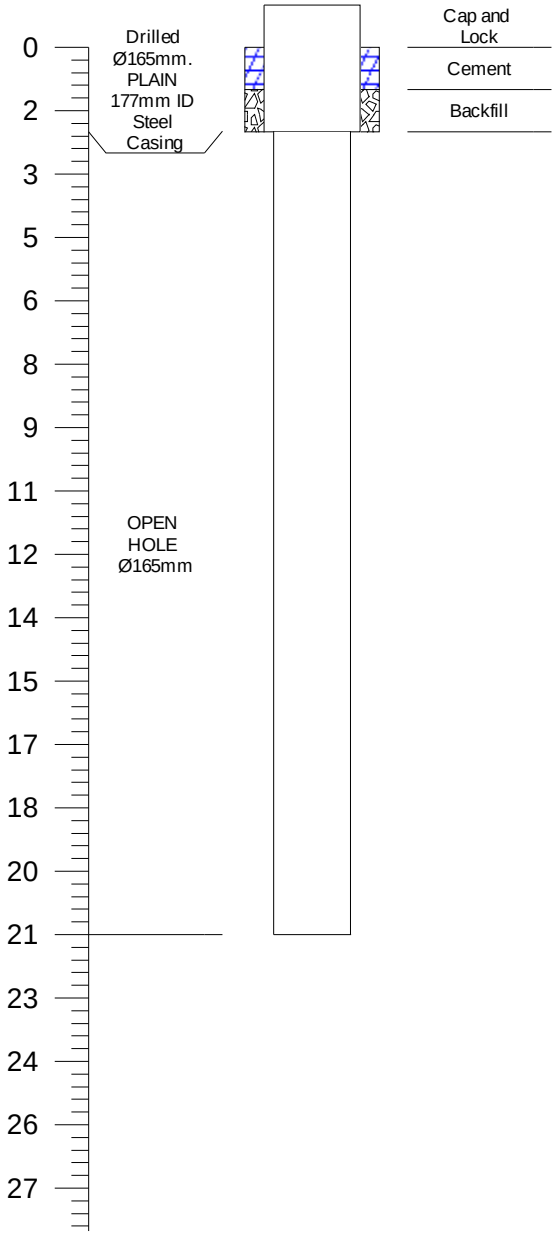
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57555 S**
Longitude: **2623117 E**
Elevation: **901.91 mamsl**

Project No.:**12087**
Borehole Number
GA005

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



(0 - 1.5) FILL MATERIAL

(1.5 - 3.0) CONGLOMERATIC QUARTZITE brown grey, moderately weathered

(3.0 - 5.0) CONGLOMERATIC QUARTZITE pinkish grey, slightly weathered

(5.0 - 7.0) CONGLOMERATIC QUARTZITE dark red grey, fresh

(7.0 - 12.5) CONGLOMERATIC QUARTZITE brown grey, moderately weathered

(12.5 - 21.0) CONGLOMERATIC QUARTZITE dark red grey, fresh

Note : soft MICACEOUS SILTSTONE at 2.5m, 3.5m and 7.5m

Date drilled:	16/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.37m

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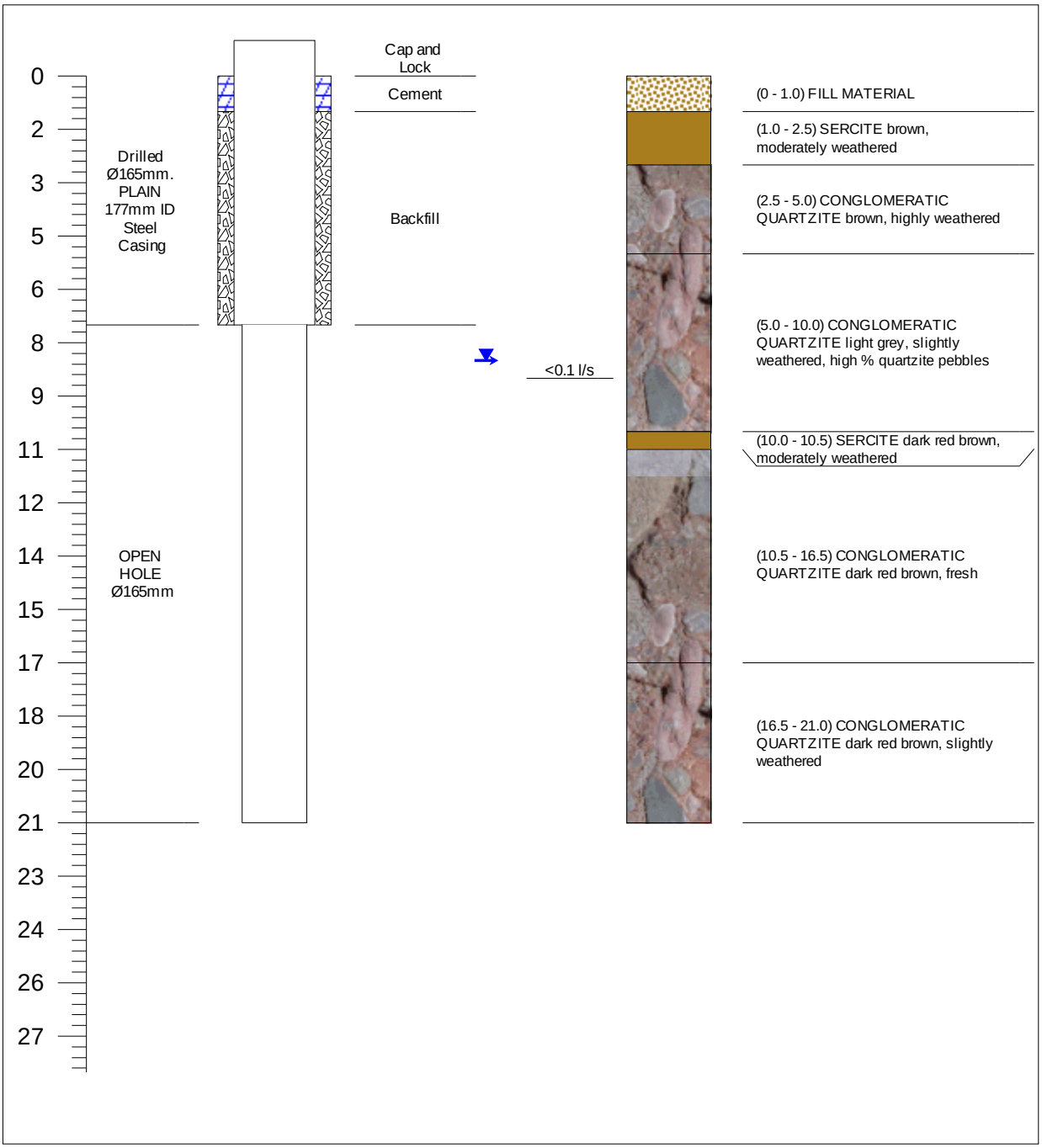
BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57380 S**
Longitude: **2622283 E**
Elevation: **900.75 mamsl**

Project No.:**12087**
Borehole Number
GA006

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	21/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	<0.1 l/s
Hydrogeologist	J. Pretorius	Collar height:	-1.45m

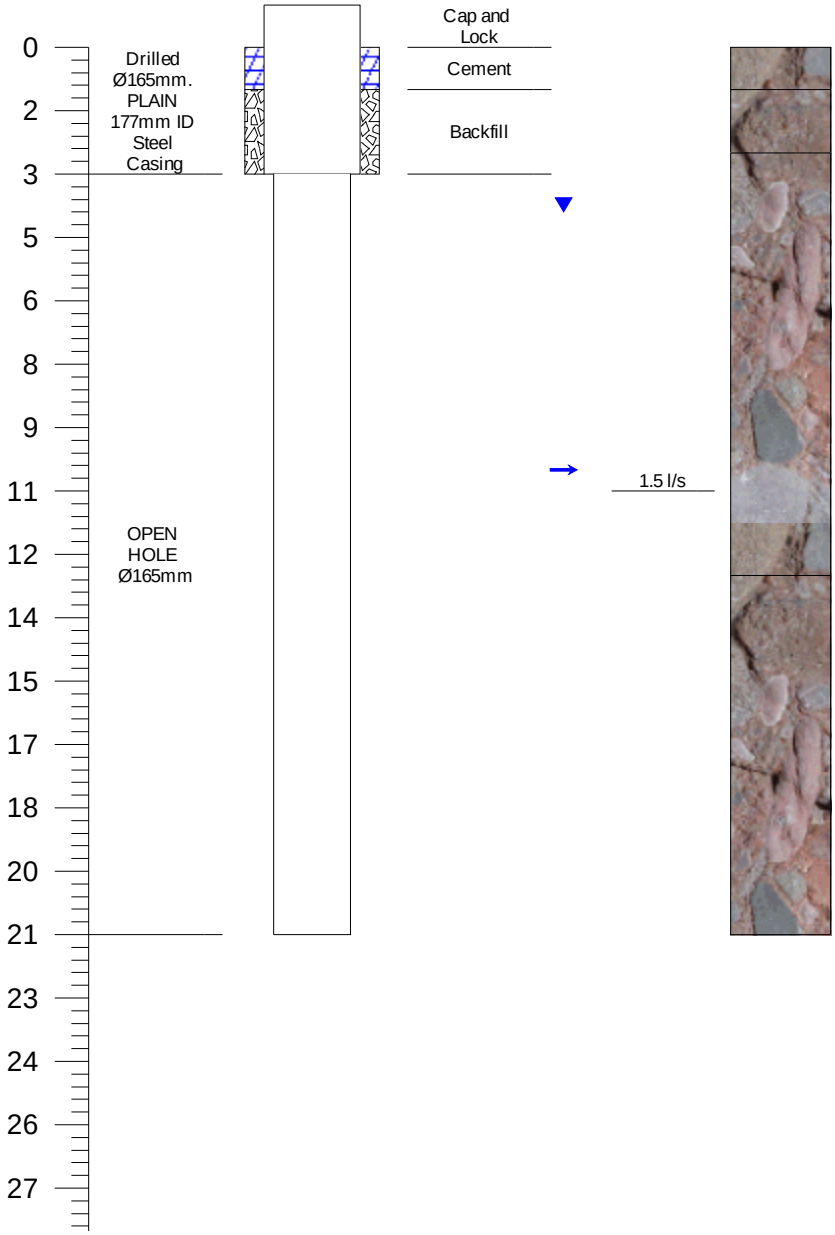
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57367 S**
Longitude: **2622416 E**
Elevation: **896.62 mamsl**

Project No.:**12087**
Borehole Number
GA007

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



(0 - 1) CONGLOMERATIC QUARTZITE dark grey, fresh

(1 - 2.5) CONGLOMERATIC QUARTZITE brown grey, highly fractured, moderately weathered

(2.5 - 12.5) CONGLOMERATIC QUARTZITE red grey, slightly fractured and weathered

(12.5 - 21.0) CONGLOMERATIC QUARTZITE dark grey, fresh

Note : soft, MICACEOUS SILTSTONE at 7.5m, 12.5m, 14m, 16.5m, 17.5m, 18.5m and 20.5m

Date drilled:	20/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	1.5 l/s
Hydrogeologist	J. Pretorius	Collar height:	-1.47m

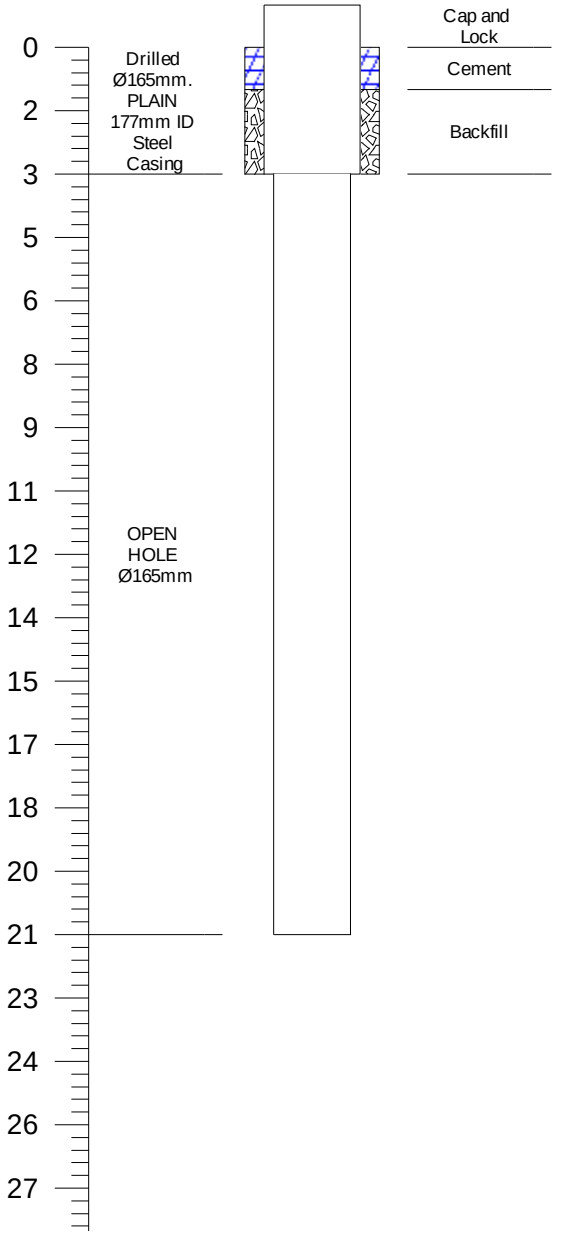
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57521 S**
Longitude: **2622418 E**
Elevation: **896.23 mamsl**

Project No.:**12087**
Borehole Number
GA008

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



(0 - 1.5) CONGLOMERATIC QUARTZITE dark grey, fresh

(1.5 - 5.5) CONGLOMERATIC QUARTZITE brown grey, slightly fractured weathered

(5.5 - 19.5) CONGLOMERATIC QUARTZITE reddish grey, slightly weathered

(19.5 - 21.0) CONGLOMERATIC QUARTZITE dark grey, fresh

Note : soft, MICACEOUS SILTSTONE at 8.5m, 13.5m, 14m, 17.5m and 20.5m

Date drilled:	20/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.15m

Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57356 S**
Longitude: **2622604 E**
Elevation: **895.23 mamsl**

Project No.:**12087**
Borehole Number
GA009

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description
0	Drilled Ø165mm. PLAIN 177mm ID Steel Casing	Cap and Lock		(0 - 1.0) CONGLOMERATIC QUARTZITE dark grey, fresh
2		Cement		
3		Backfill		(1.0 - 4.0) CONGLOMERATIC QUARTZITE brown grey, highly fractured, moderately weathered
5				
6				
8				
9		1 l/s		(4.0 - 16.0) CONGLOMERATIC QUARTZITE red grey, highly fractured
11				
12	OPEN HOLE Ø165mm			
14				
15				
17				(16.0 - 21.0) CONGLOMERATIC QUARTZITE dark grey, fresh
18				
20				
21				Note : soft, MICACEOUS SILTSTONE at 2.5m, 3.5m, 5.5m, 10.5m, 12.5m and 14.0m
23				
24				
26				
27				

Date drilled:	23/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	1 l/s
Hydrogeologist	J. Pretorius	Collar height:	-1.29m

Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57643 S**
Longitude: **2622808 E**
Elevation: **898.13 mamsl**

Project No.:**12087**
Borehole Number
GA010

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description
0	Drilled Ø165mm. PLAIN 177mm ID Steel Casing			(0 - 1.0) FILL MATERIAL
2	Cap and Lock			(1.0 - 2.5) CONGLOMERATIC QUARTZITE dark grey, fresh
3	Cement			(2.5 - 3.5) CONGLOMERATIC QUARTZITE pinkish grey, fresh
5	Backfill	▼		
6				(3.5 - 10.0) CONGLOMERATIC QUARTZITE dark grey, slightly fractured to fresh
8				
9				
11				
12	OPEN HOLE Ø165mm			(10.0 - 17.5) CONGLOMERATIC QUARTZITE dark red brown, fresh
14				
15				
17				
18				(17.5 - 19.0) CONGLOMERATIC QUARTZITE pinkish grey, slightly weathered to fresh
20				(19.0 - 21.0) CONGLOMERATIC QUARTZITE pinkish grey, slightly fractured and weathered
21				Note : soft, MICACEOUS SILTSTONE at 7.5m, 11.5m and 18.0m
23				
24				
26				
27				

Date drilled:	17/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.23m

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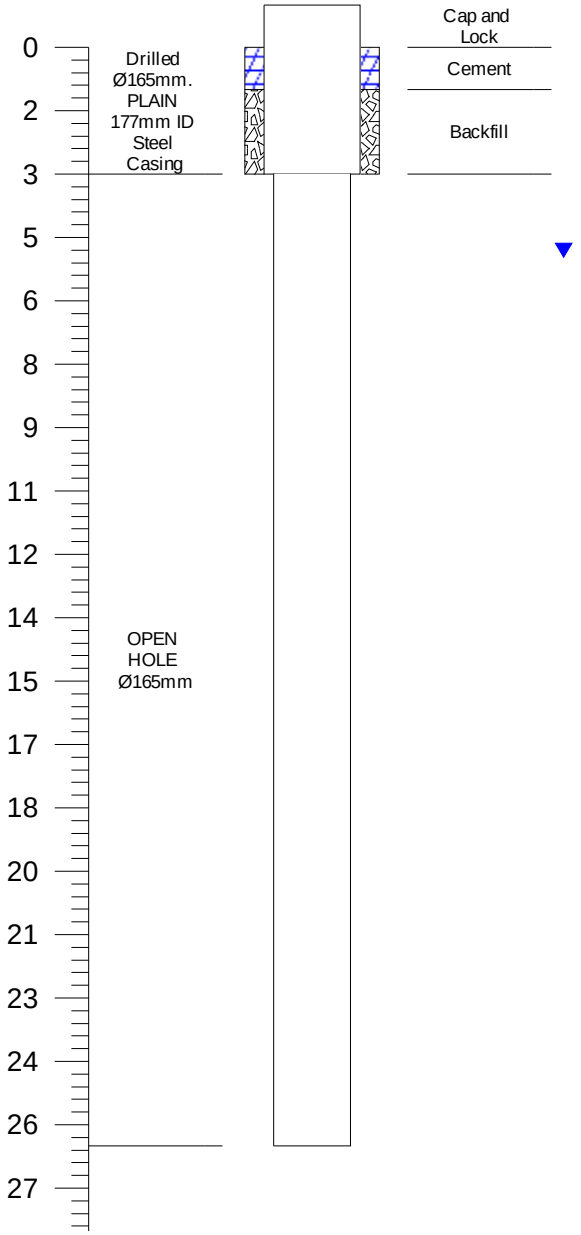
BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57769 S**
Longitude: **2623026 E**
Elevation: **899 mamsl**

Project No.:**12087**
Borehole Number
GA011

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



(0 - 1.0) FILL MATERIAL

(1.0 - 2.0) CONGLOMERATIC QUARTZITE pinkish grey, fresh

(2.0 - 3.5) CONGLOMERATIC QUARTZITE pinkish grey, slightly fractured

(3.5 - 6.0) CONGLOMERATIC QUARTZITE pinkish grey fresh

(6.0 - 7.0) CONGLOMERATIC QUARTZITE yellow orange, slightly fractured and weathered

(7.0 - 8.5) CONGLOMERATIC QUARTZITE pinkish grey, fresh

(8.5 - 11.5) CONGLOMERATIC QUARTZITE pinkish grey, slightly fractured and weathered

(11.5 -20.5) CONGLOMERATIC QUARTZITE dark grey, slightly fractured

(20.5 -22.5) CONGLOMERATIC QUARTZITE yellow orange, fresh

(22.5 - 26.0) CONGLOMERATIC QUARTZITE dark red brown, fresh

Note : soft, MICACEOUS SILTSTONE at 6.5m, 7.5m, 11.5m and 20.5m

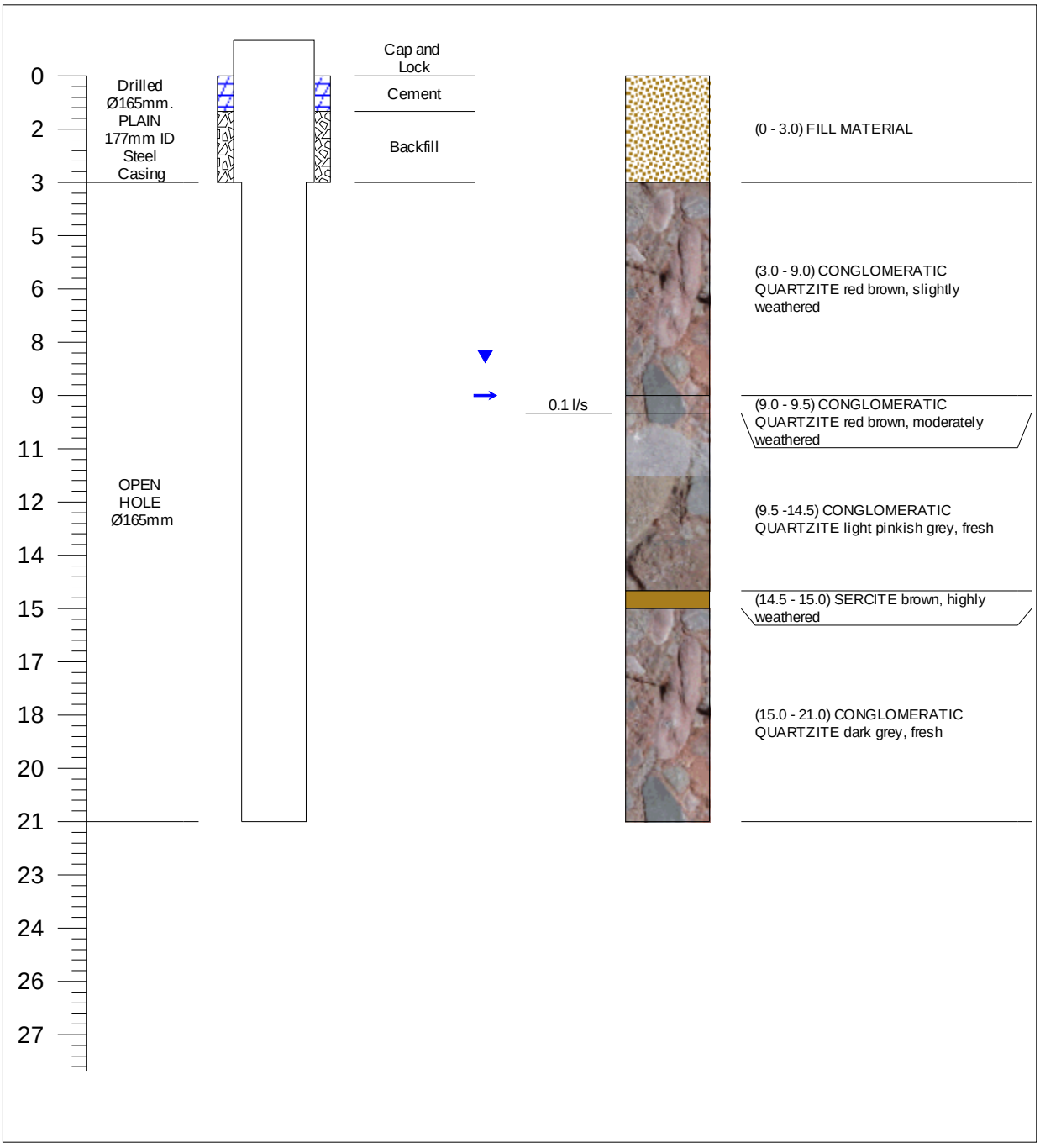
Date drilled:	18/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	0.1l/s
Hydrogeologist	J. Pretorius	Collar height:	-1.25m

Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57545 S**
Longitude: **2622271 E**
Elevation: **900.15 mamsl**

Project No.:**12087**
Borehole Number
GA012



Date drilled:	20/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	0.1 l/s
Hydrogeologist	J. Pretorius	Collar height:	-1.19m

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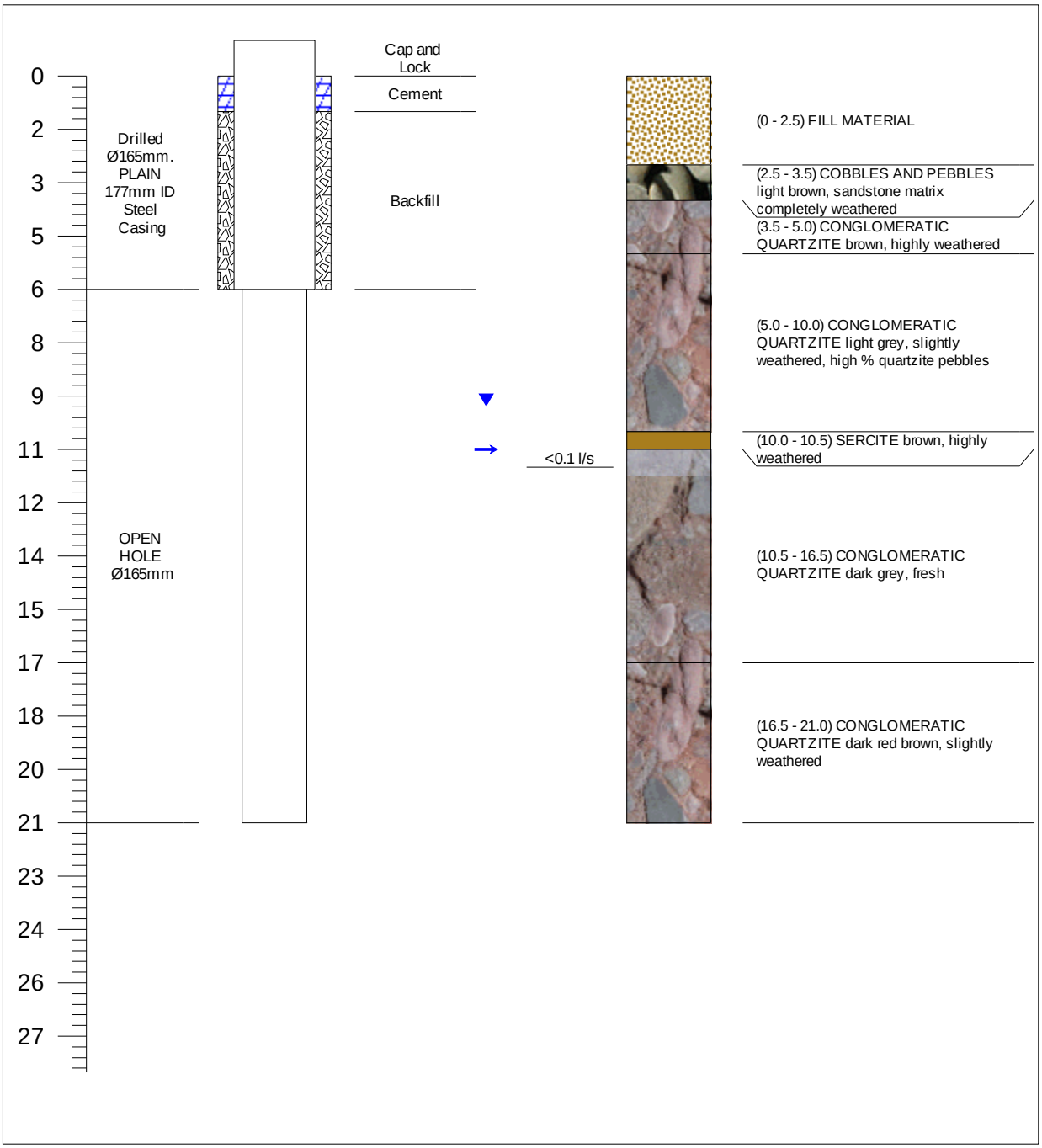
BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57659 S**
Longitude: **2622448 E**
Elevation: **901.6 mamsl**

Project No.:**12087**
Borehole Number
GA014

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	23/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	<0.1 l/s
Hydrogeologist	J. Pretorius	Collar height:	-1.36 m

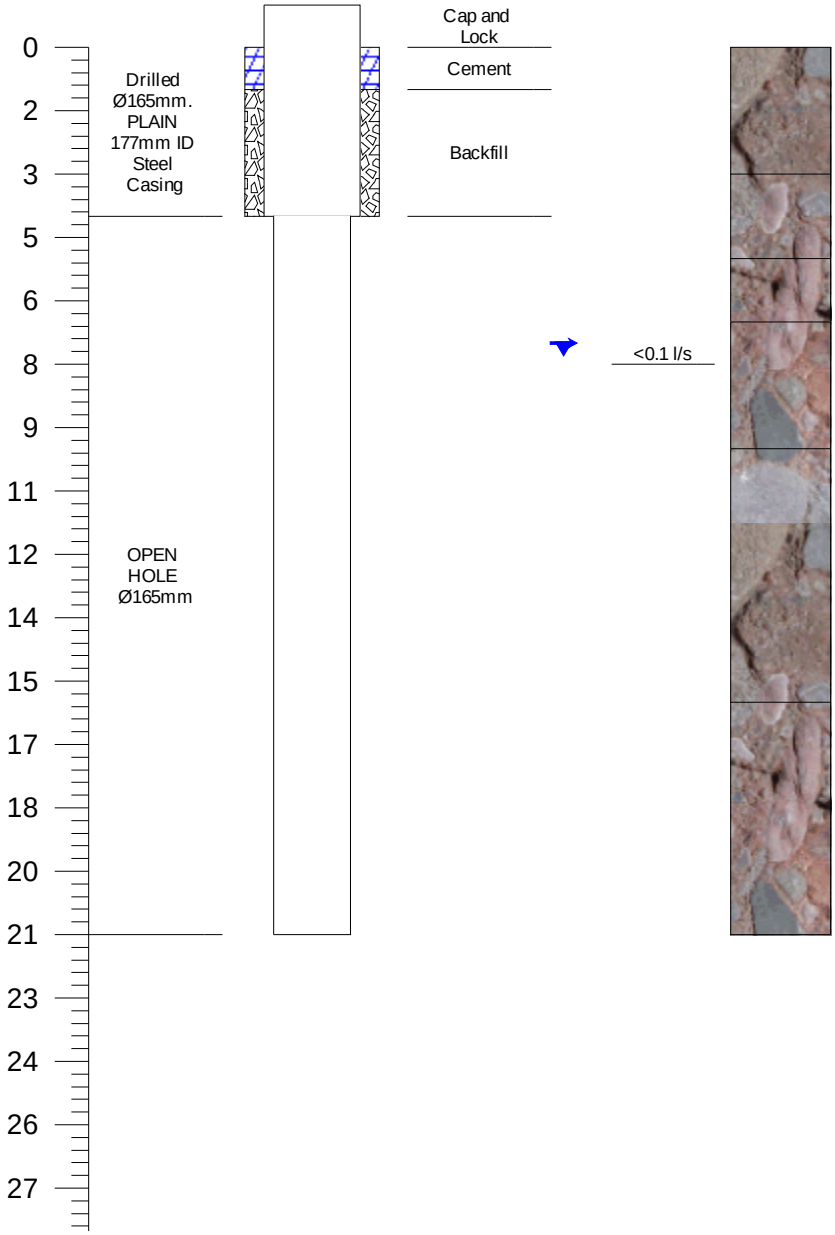
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57644 S**
Longitude: **2622547 E**
Elevation: **899.25 mamsl**

Project No.:**12087**
Borehole Number
GA015

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



(0 - 3.0) CONGLOMERATE (COBBLE) light brown, sandstone matrix completely weathered

(3.0 - 5.0) CONGLOMERATE (PEBBLE) light brown, sandstone matrix completely weathered

(5.0 - 6.5) CONGLOMERATIC QUARTZITE yellow orange, slightly weathered

(6.5 - 9.5) CONGLOMERATIC QUARTZITE dark brown, slightly weathered

(9.5 - 15.5) CONGLOMERATIC QUARTZITE dark red brown, sligtly weathered/green SHALE at 15.0m (<5 cm)

(15.5 - 21.0) CONCLOMERATIC QUARTZITE dark brown, slightly weathered

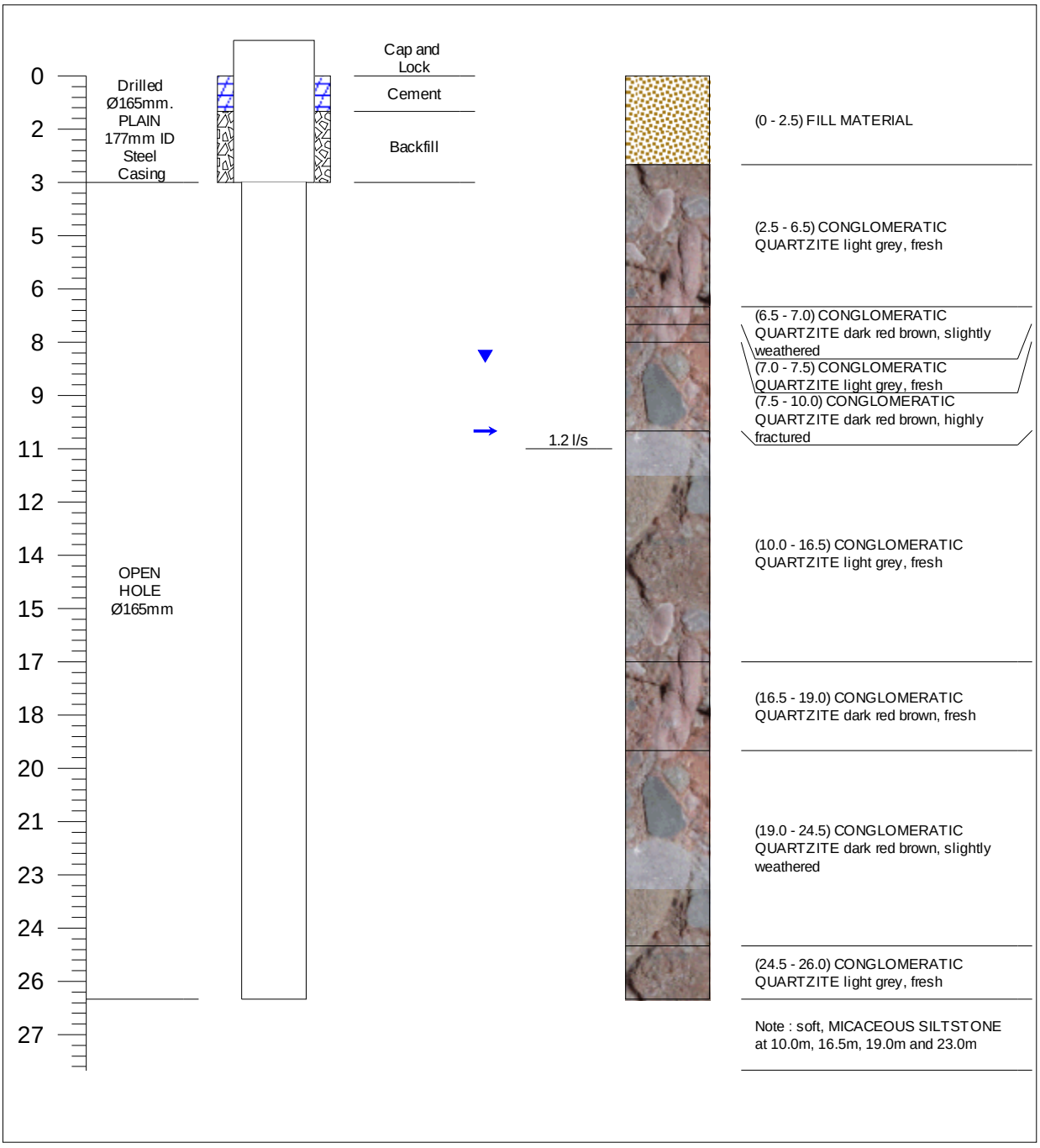
Date drilled:	20/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	0.1l/s
Hydrogeologist	J. Pretorius	Collar height:	-1.38m

Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57786 S**
Longitude: **2622683 E**
Elevation: **901.38 mamsl**

Project No.:**12087**
Borehole Number
GA016



Date drilled:	17/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	1.2 l/s
Hydrogeologist	J. Pretorius	Collar height:	-1.22m

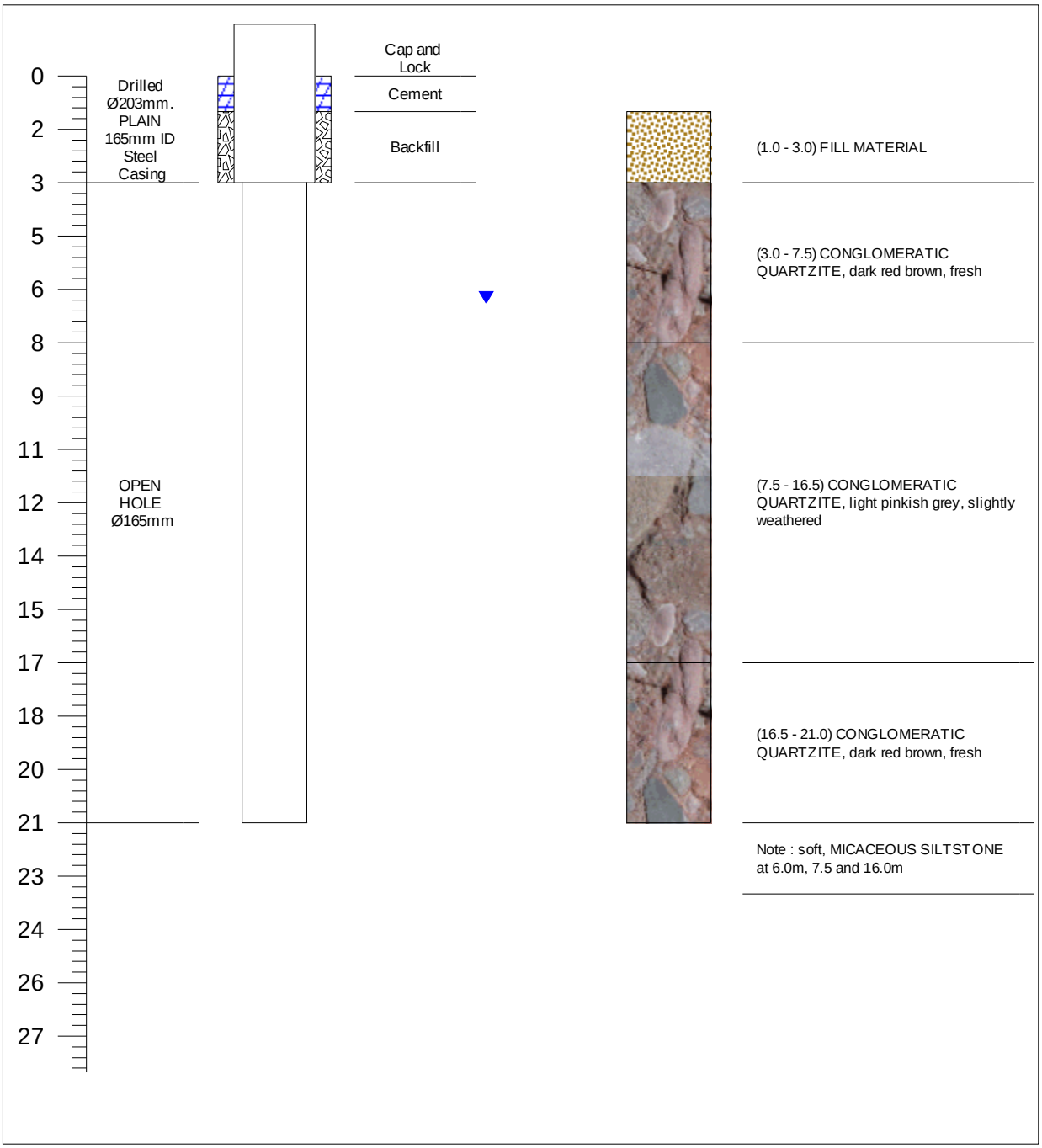
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57899 S**
Longitude: **2622866 E**
Elevation: **900.68 mamsl**

Project No.:**12087**
Borehole Number
GA017

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	17/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.45m

Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-56948 S**
Longitude: **2622332 E**
Elevation: **902.11 mamsl**

Project No.:**12087**
Borehole Number
GA018

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description
0	Drilled Ø165mm. PLAIN 177mm ID Steel Casing			(0 - 1.5) FILL MATERIAL
2	Cap and Lock			(1.5 - 4.0) PEBBLES residual conglomeratic quartzite with matrix completely weathered
3	Cement			
5	Backfill			(4.0 - 6.0) CONGLOMERATIC QUARTZITE yellow orange, matrix highly weathered
6				(6.0 - 8.0) CONGLOMERATIC QUARTZITE yellow orange, moderately weathered
8				
9				(8.0 - 12.5) CONGLOMERATIC QUARTZITE yellow orange, slightly weathered
11				
12	OPEN HOLE Ø165mm			(12.5 - 13.5) CONGLOMERATIC QUARTZITE dark red brown, fresh
14				
15				(13.5 - 19.0) CONGLOMERATIC QUARTZITE dark red brown, slightly weathered
17				
18				
20				(19.0 - 21.0) CONGLOMERATIC QUARTZITE yellow orange, slightly weathered
21				
23				
24				
26				
27				

Date drilled:	23/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.2 m

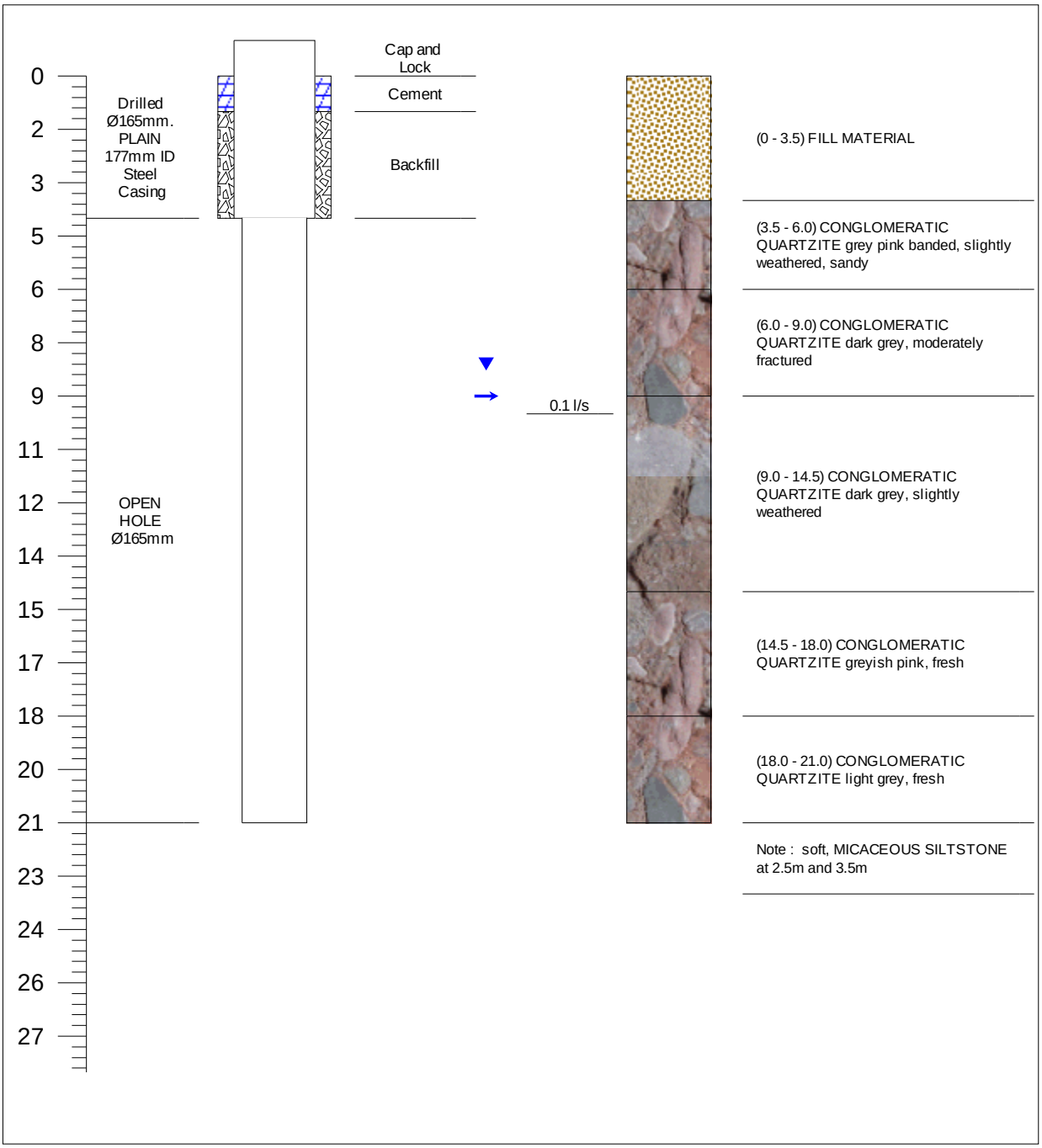
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-56960 S**
Longitude: **2622601 E**
Elevation: **903.92 mamsl**

Project No.:**12087**
Borehole Number
GA019

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	19/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	0.1 l/s
Hydrogeologist	J. Pretorius	Collar height:	-0.74m

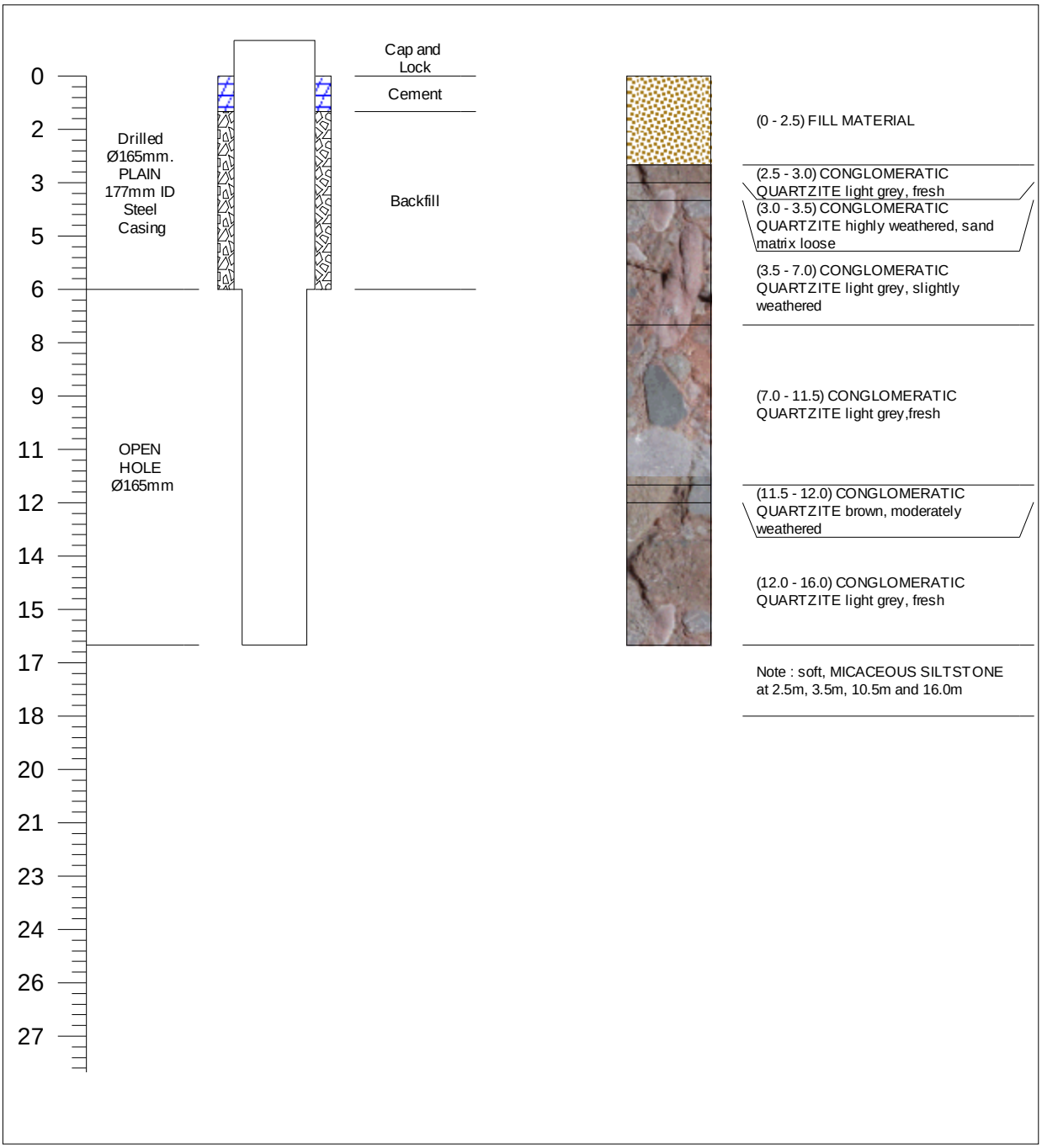
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57203 S**
Longitude: **2623036 E**
Elevation: **904.66 mamsl**

Project No.:**12087**
Borehole Number
GA020D

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	16/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.13m

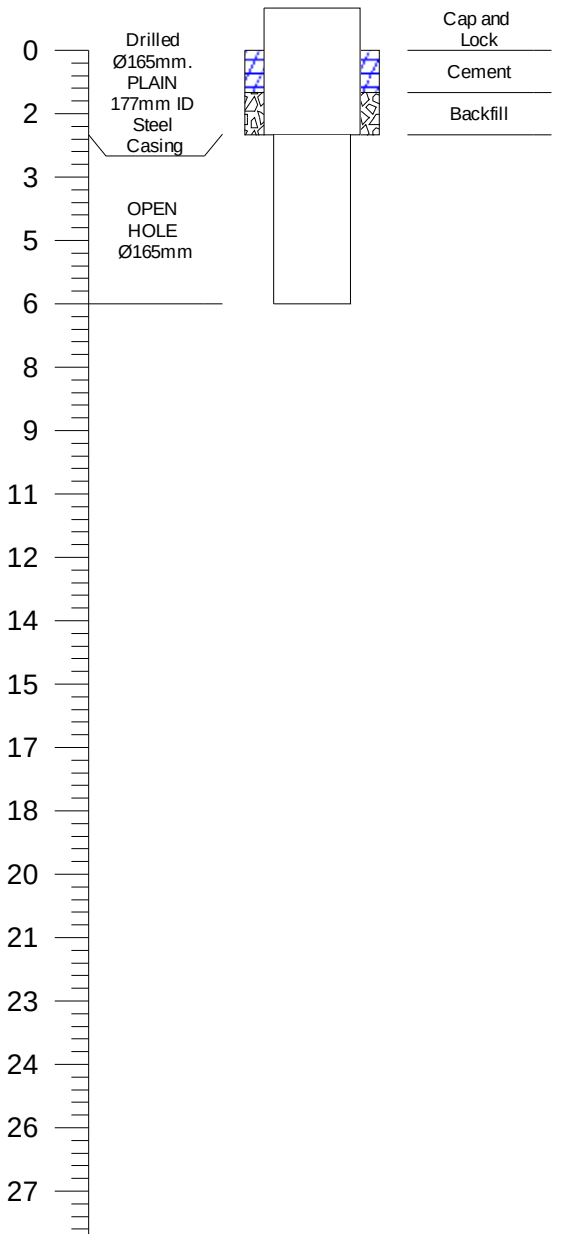
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57203 S**
Longitude: **2623036 E**
Elevation: **904.66 mamsl**

Project No.:**12087**
Borehole Number
GA020S

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



(0 - 2.5) FILL MATERIAL

(2.5 - 3.0) CONGLOMERATIC QUARTZITE light grey, fresh

(3.0 - 3.5) CONGLOMERATIC QUARTZITE highly weathered, sand matrix loose

(3.5 - 4.0) CONGLOMERATIC QUARTZITE light grey, slightly weathered

(4.0 - 4.5) CONGLOMERATIC QUARTZITE brown, highly weathered

(4.5 - 6.0) CONGLOMERATIC QUARTZITE light grey, fresh

Note : soft, MICACEOUS SILTSTONE at 2.5m and 3.5m

Date drilled:	16/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.37m

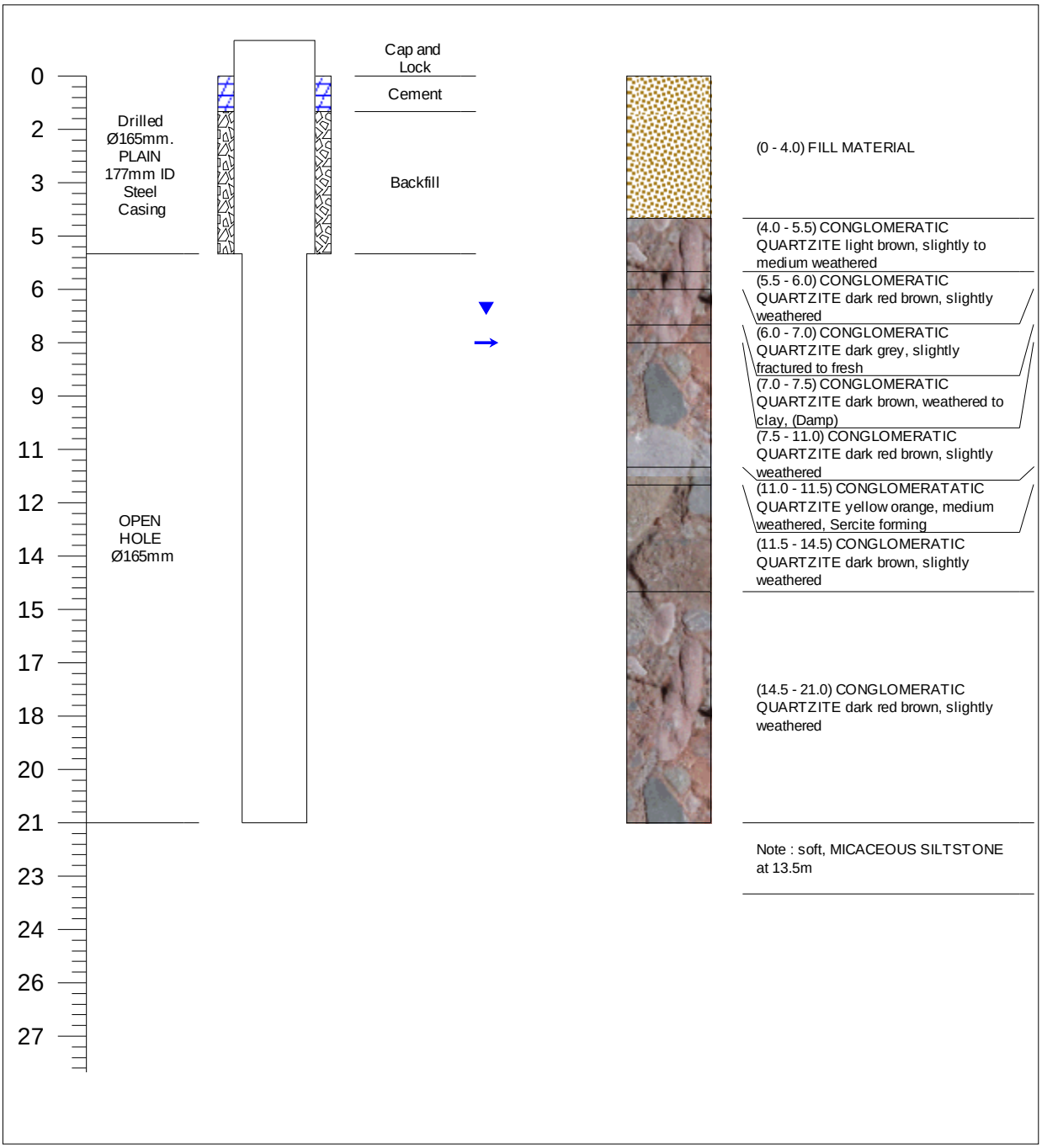
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57366 S**
Longitude: **2623259 E**
Elevation: **903.2 mamsl**

Project No.:**12087**
Borehole Number
GA021

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	19/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	0.1l/s
Hydrogeologist	J. Pretorius	Collar height:	-1.27m

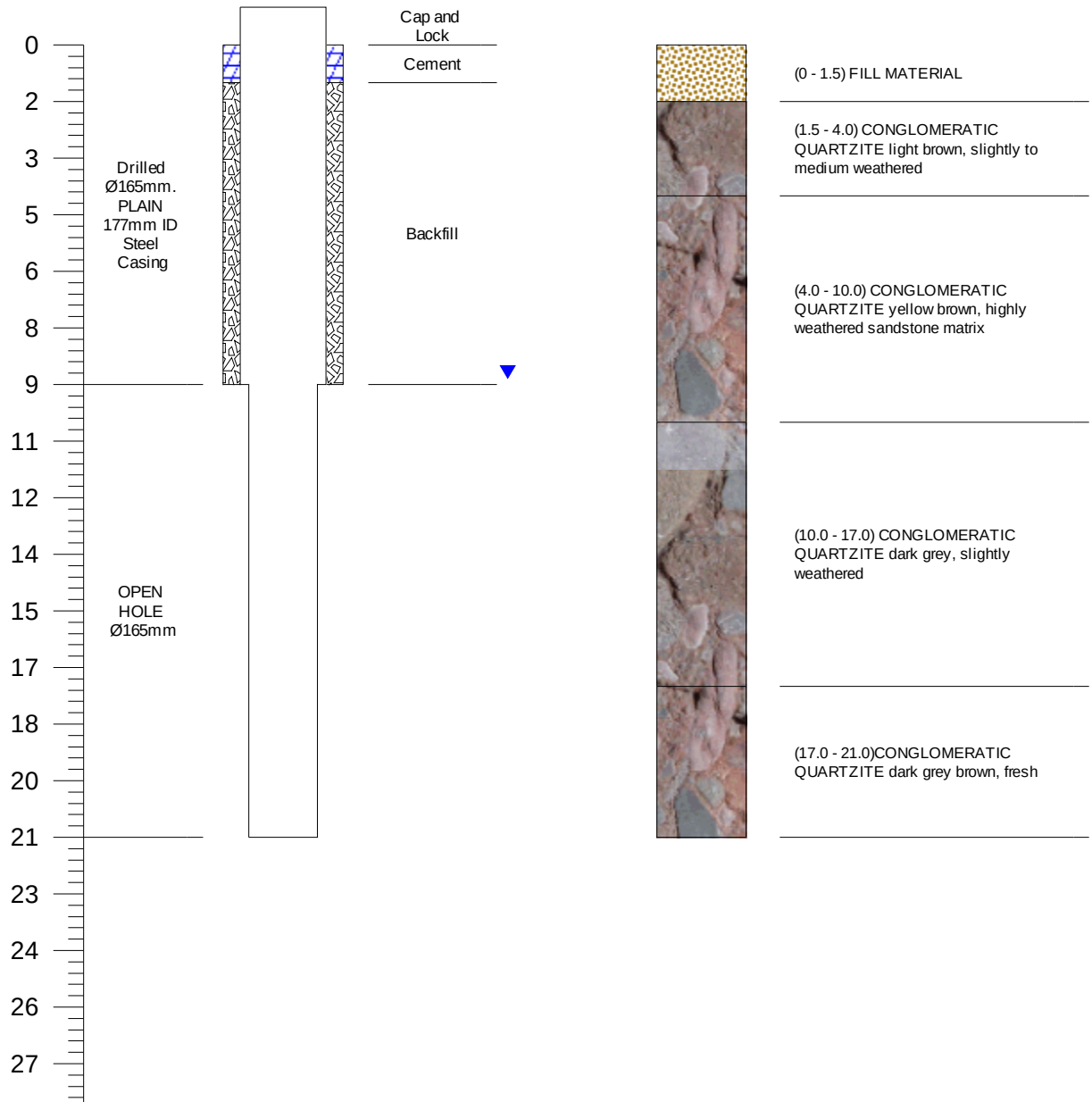
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57783 S**
Longitude: **2622222 E**
Elevation: **899.33 mamsl**

Project No.:**12087**
Borehole Number
GA022

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



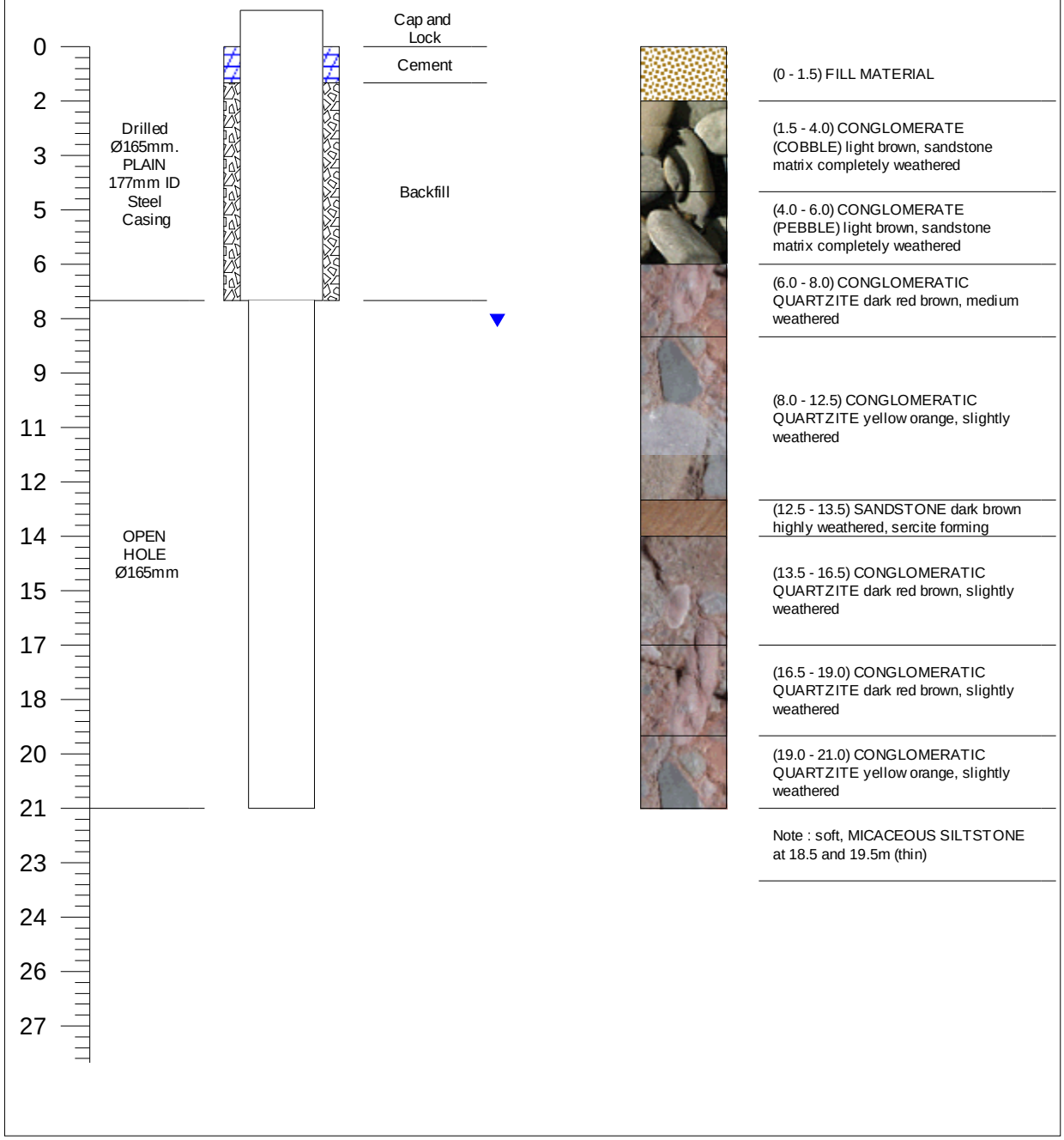
Date drilled:	18/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.46m

Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57846 S**
Longitude: **2622415 E**
Elevation: **900.36 mamsl**

Project No.:**12087**
Borehole Number
GA023



Date drilled:	20/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	0.1l/s
Hydrogeologist	J. Pretorius	Collar height:	-1.2 m

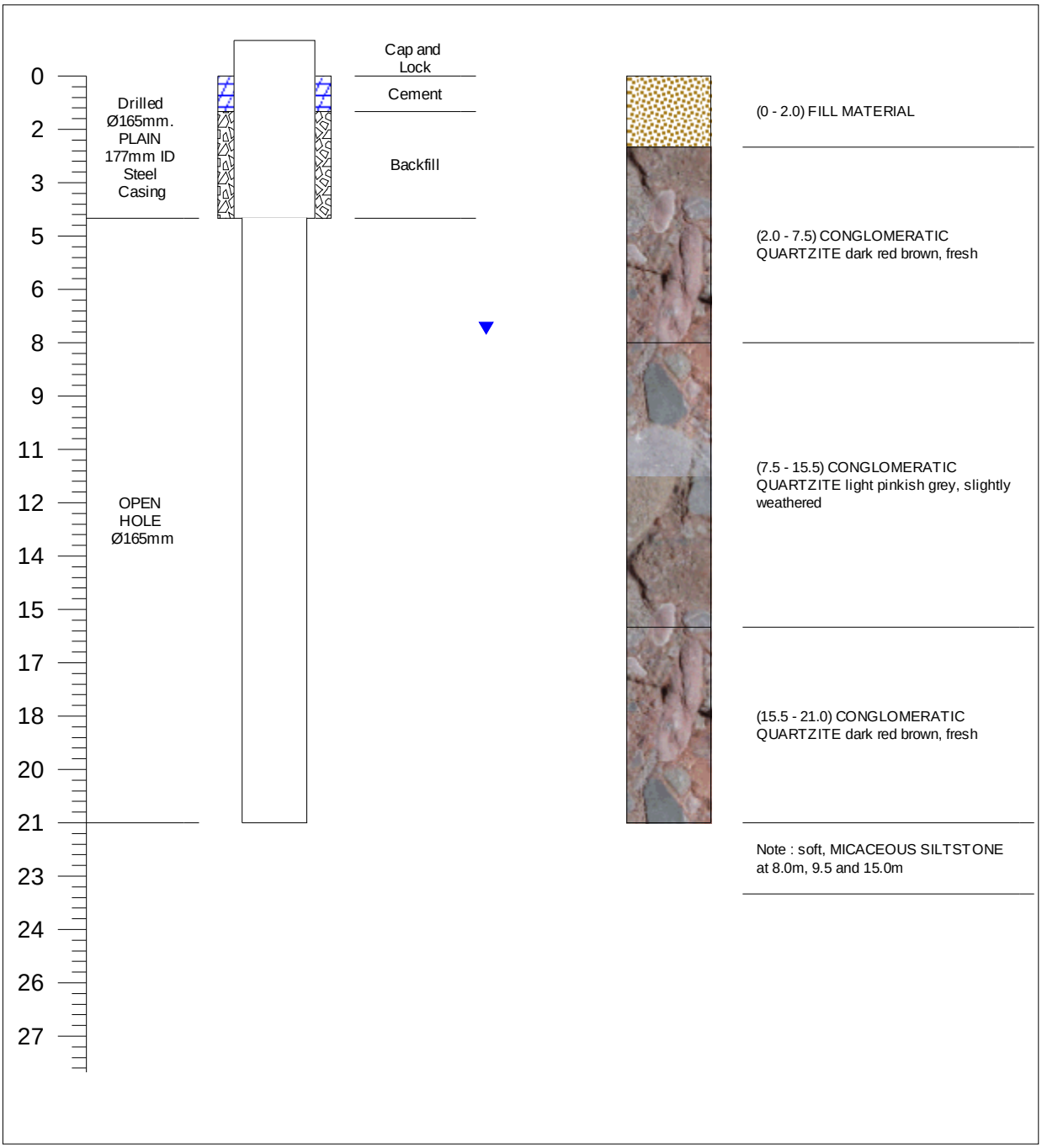
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-58010 S**
Longitude: **2622649 E**
Elevation: **899.24 mamsl**

Project No.:**12087**
Borehole Number
GA024

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	19/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-0.85m

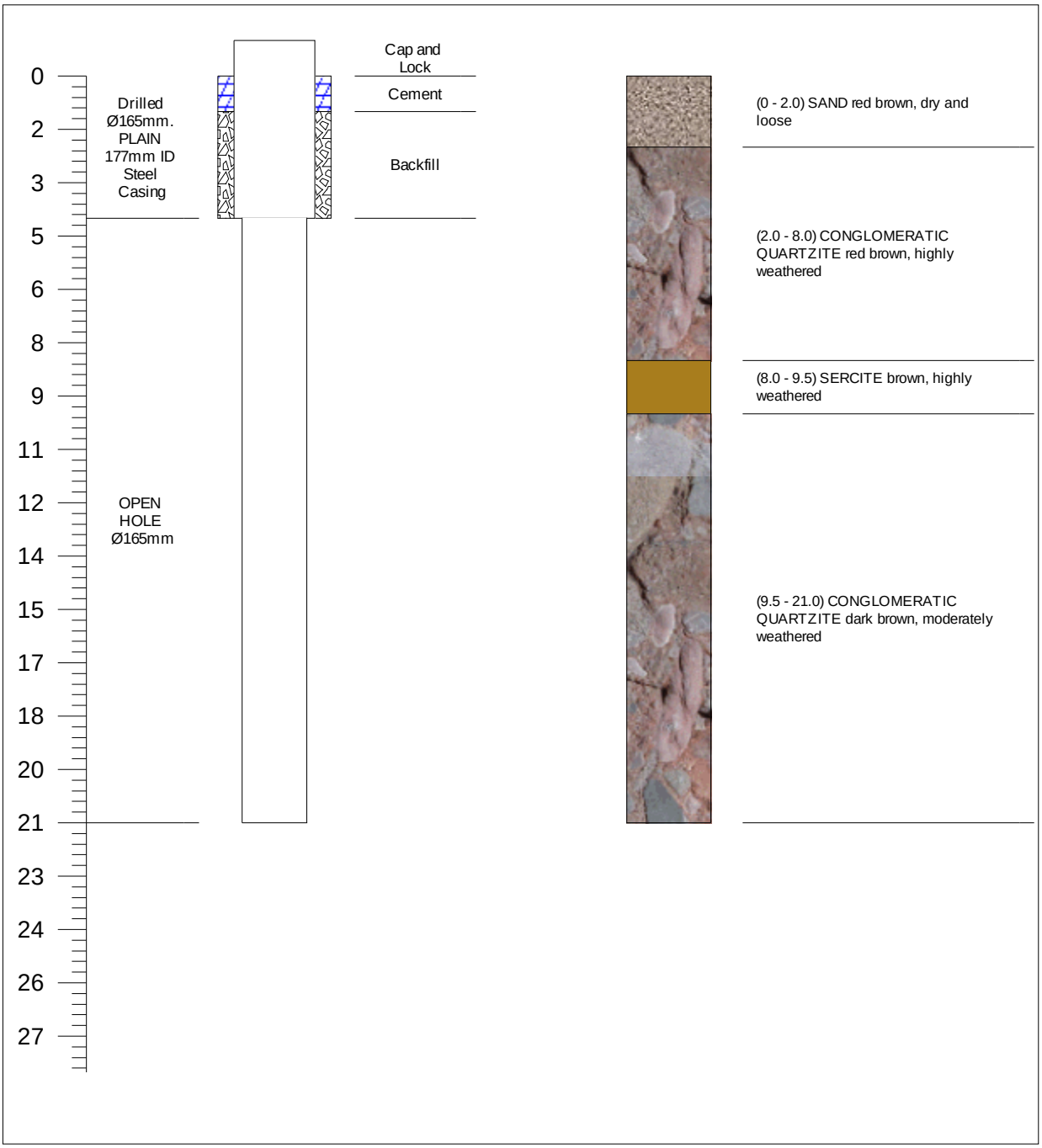
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-56296 S**
Longitude: **2622495 E**
Elevation: **902.39 mamsl**

Project No.:**12087**
Borehole Number
GA025

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	24/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.16m

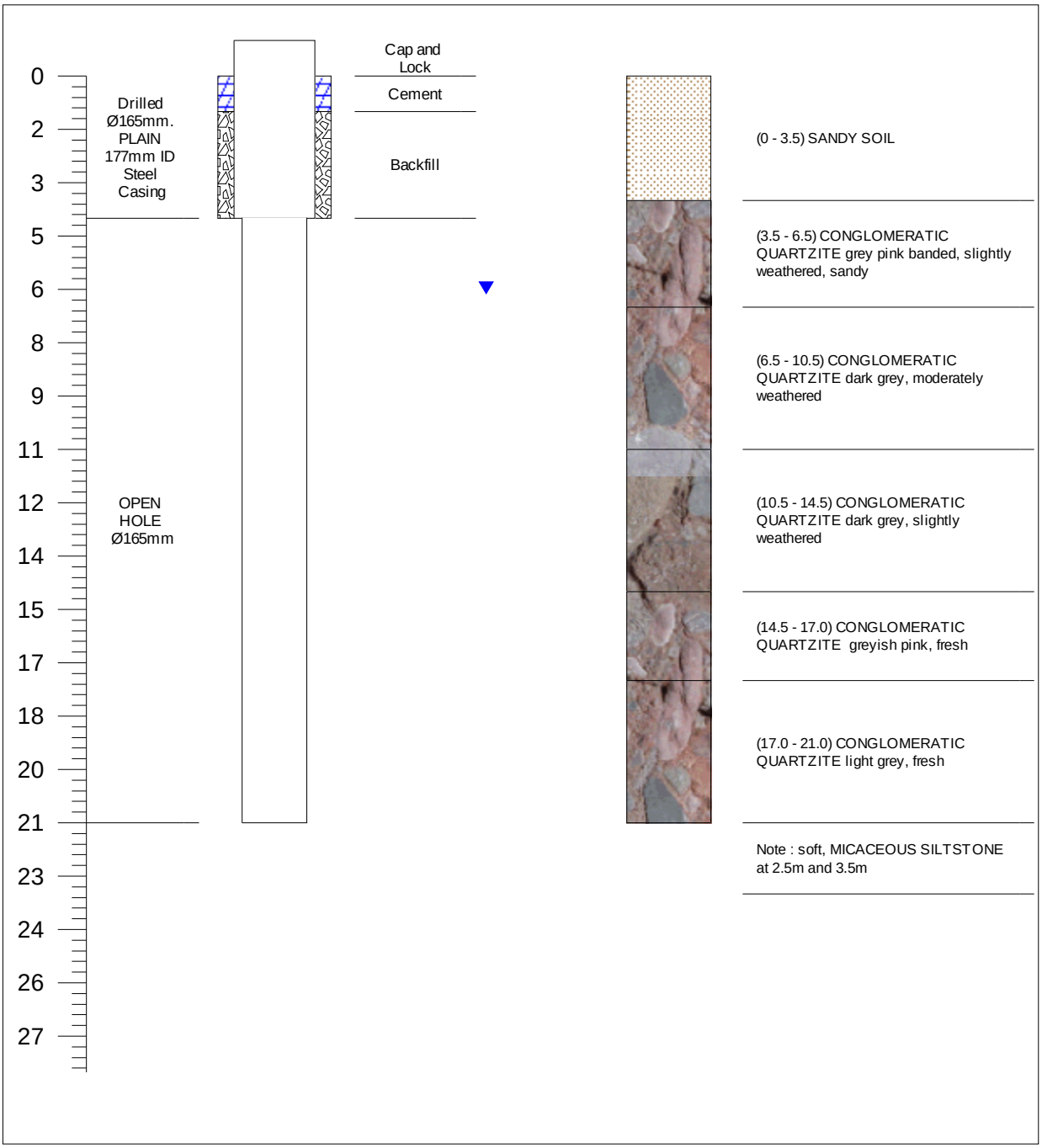
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-56213 S**
Longitude: **2623131 E**
Elevation: **902.04 mamsl**

Project No.:**12087**
Borehole Number
GA026

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	24/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.5 m

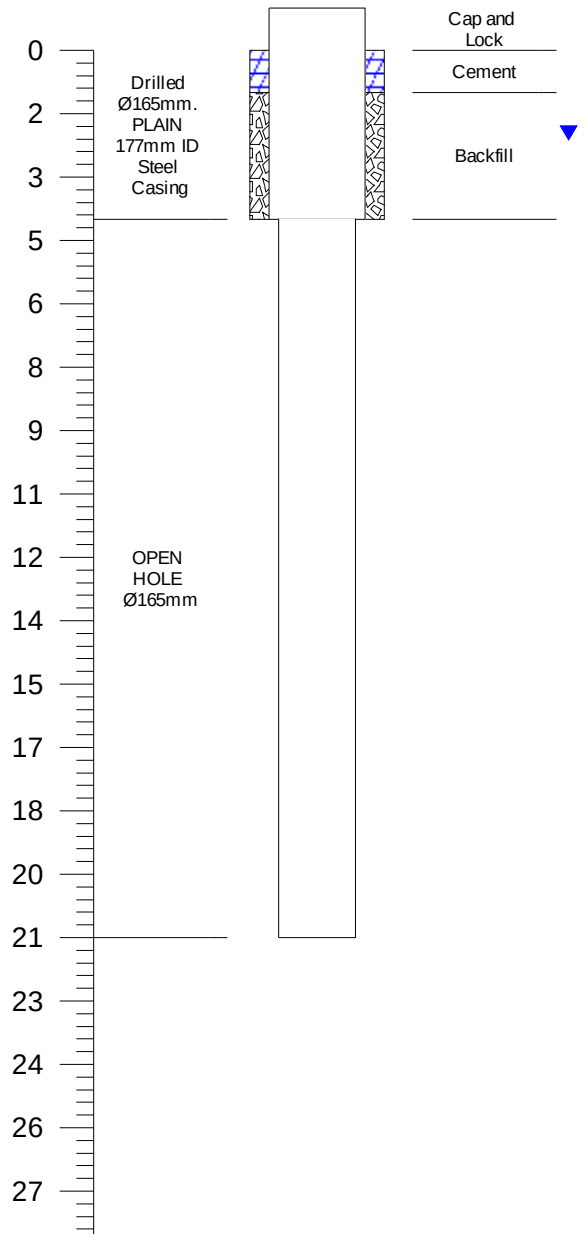
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-56892 S**
Longitude: **2623224 E**
Elevation: **898.82 mamsl**

Project No.:**12087**
Borehole Number
GA027

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



(0 - 1.5) SANDY SOIL

(1.5 - 9.5) CONGLOMERATIC QUARTZITE grey pink banded, slightly weathered

(9.5 - 10.5) CONGLOMERATIC QUARTZITE dark grey, moderately fractured

(10.5 - 16.5) CONGLOMERATIC QUARTZITE dark grey, slightly weathered

(16.5 - 21.0) CONGLOMERATIC QUARTZITE greyish pink, fresh

Note : soft, MICACEOUS SILTSTONE at 8.5m and 13.5m

Date drilled:	24/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.12m

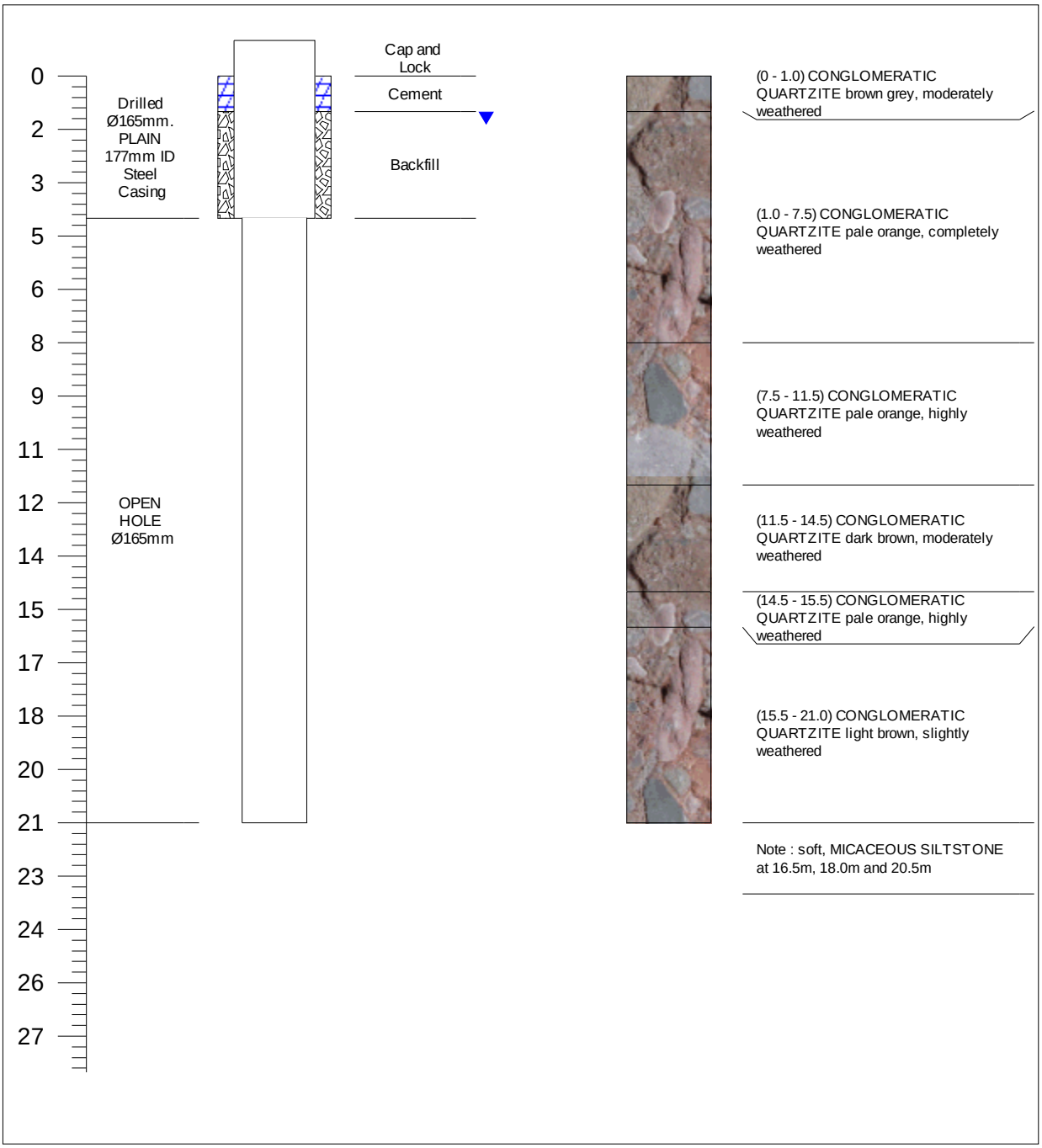
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57475 S**
Longitude: **2623619 E**
Elevation: **894.18 mamsl**

Project No.:**12087**
Borehole Number
GA029

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	25/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.23m

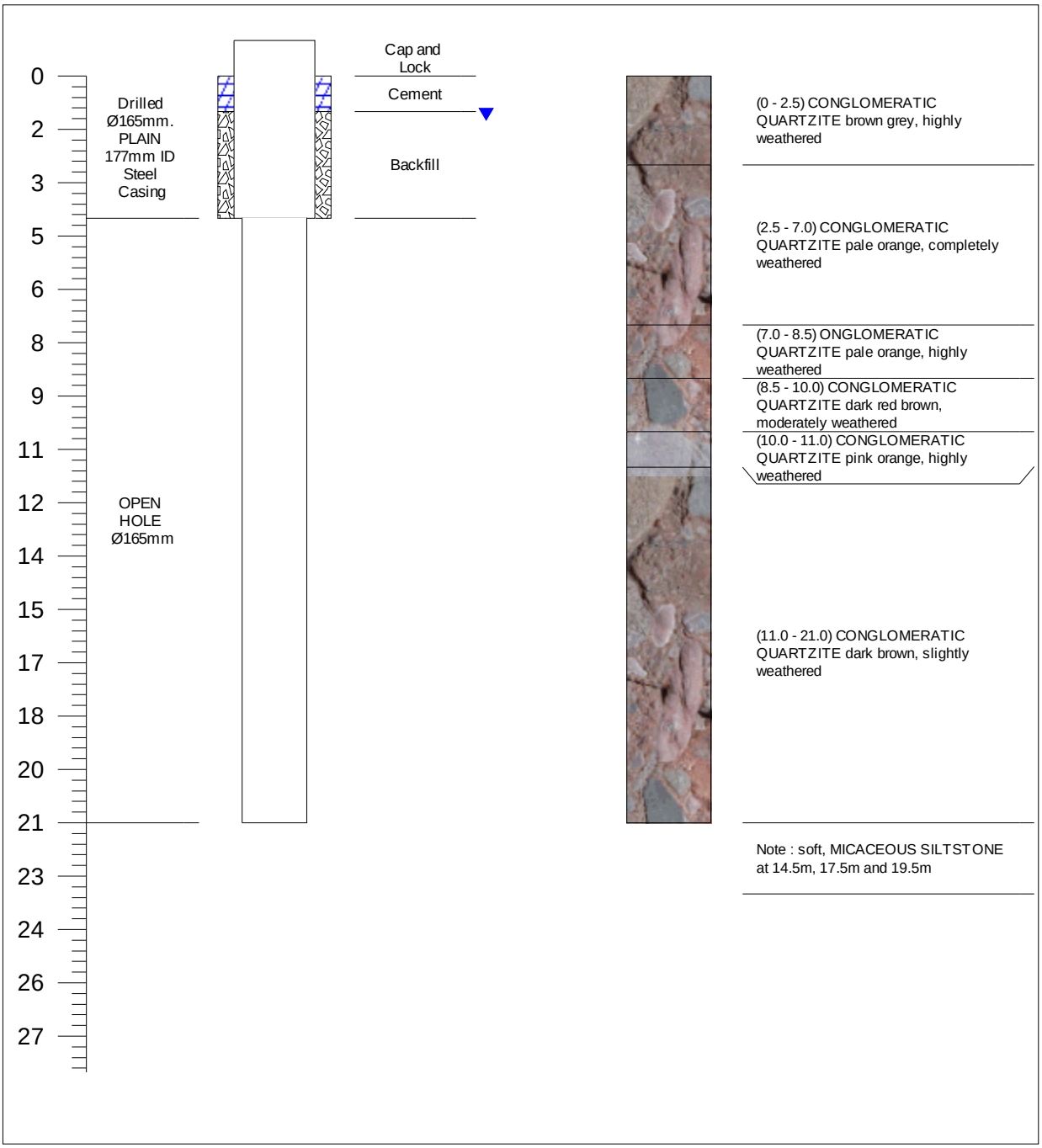
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57970 S**
Longitude: **2623325 E**
Elevation: **893.62 mamsl**

Project No.:**12087**
Borehole Number
GA030

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	25/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.1 m

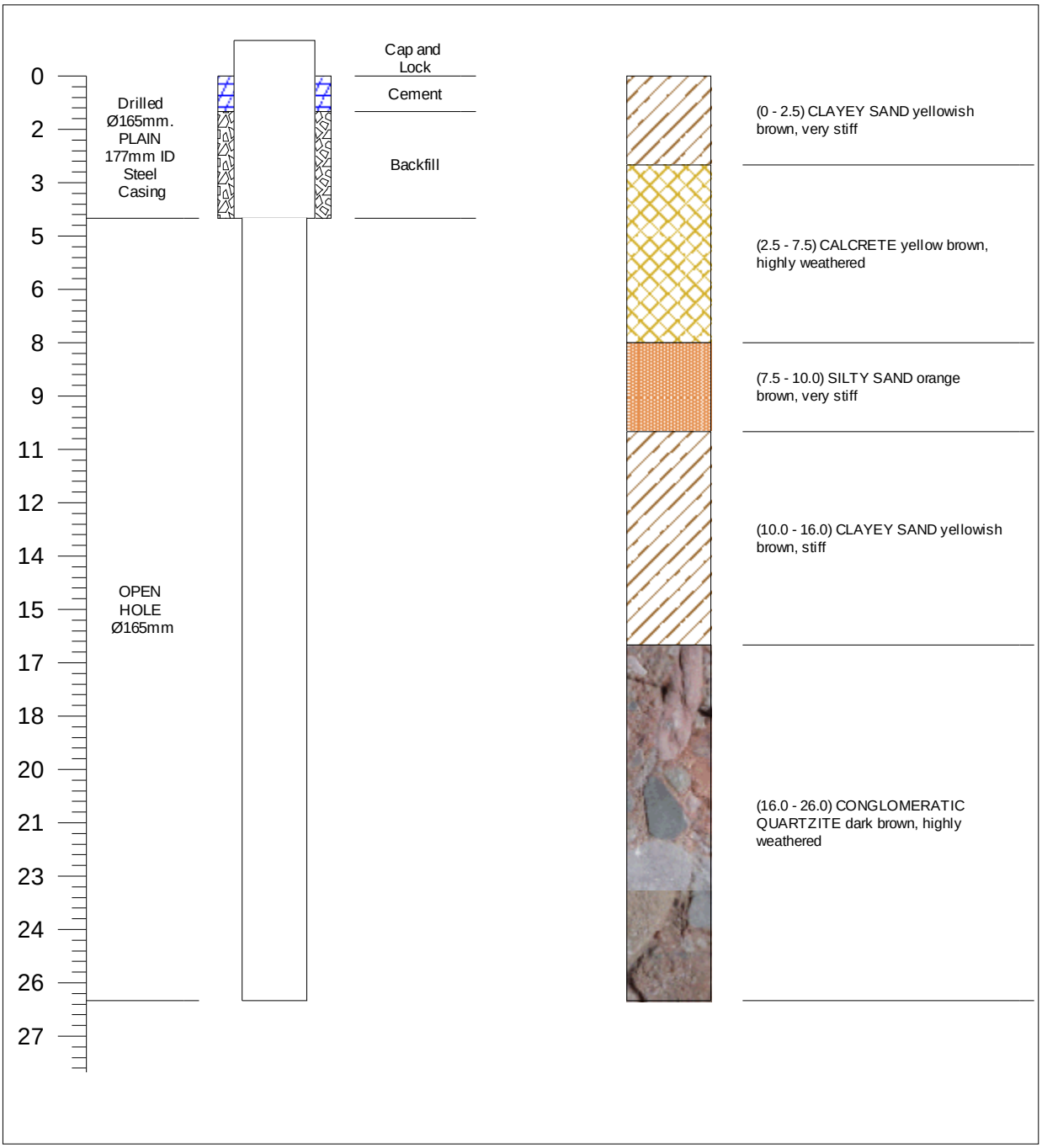
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-56643 S**
Longitude: **2621984 E**
Elevation: **898.67 mamsl**

Project No.:**12087**
Borehole Number
GA031

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	24/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.26m

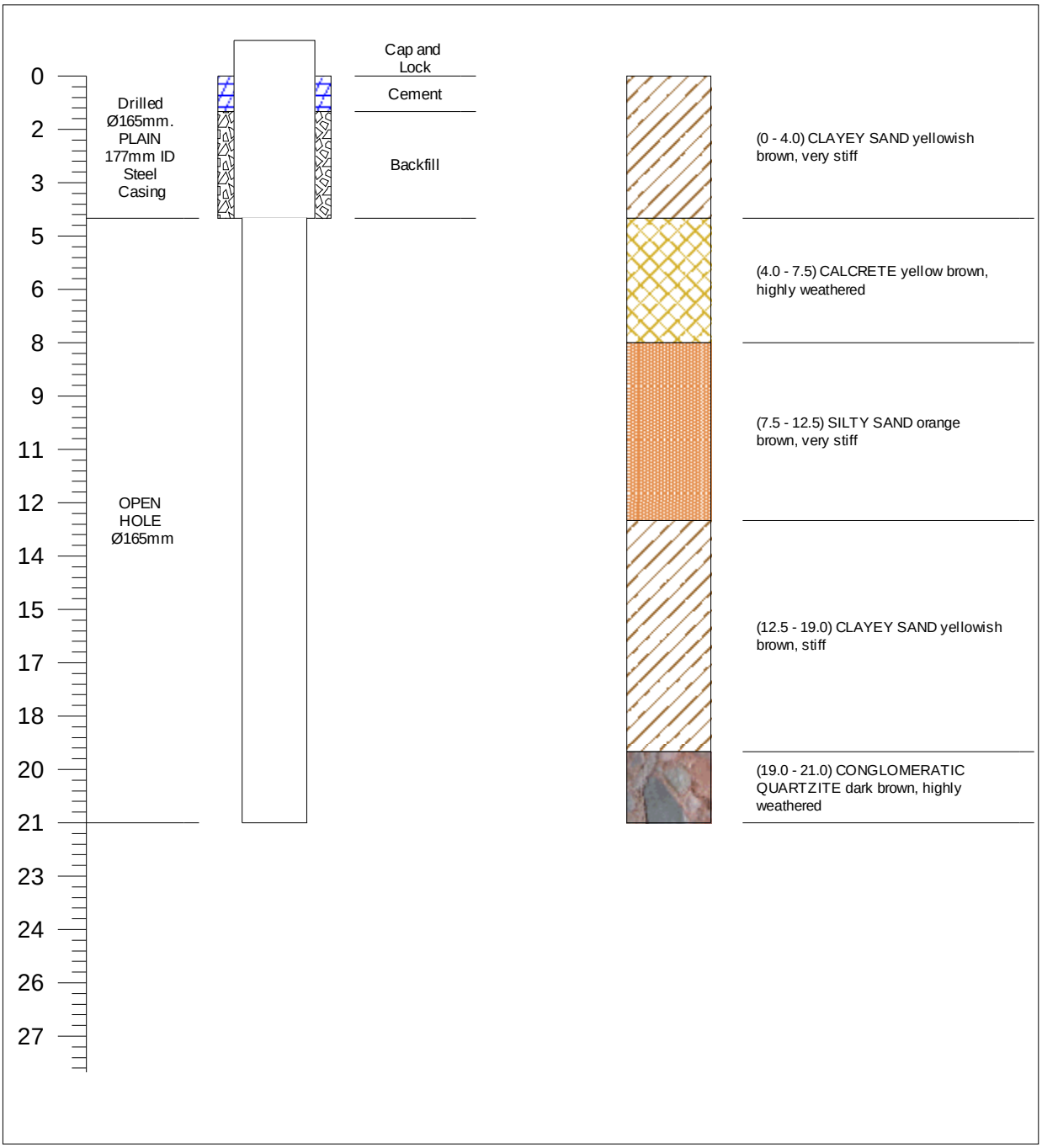
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57430 S**
Longitude: **2621610 E**
Elevation: **895.09 mamsl**

Project No.:**12087**
Borehole Number
GA032

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	24/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.2 m

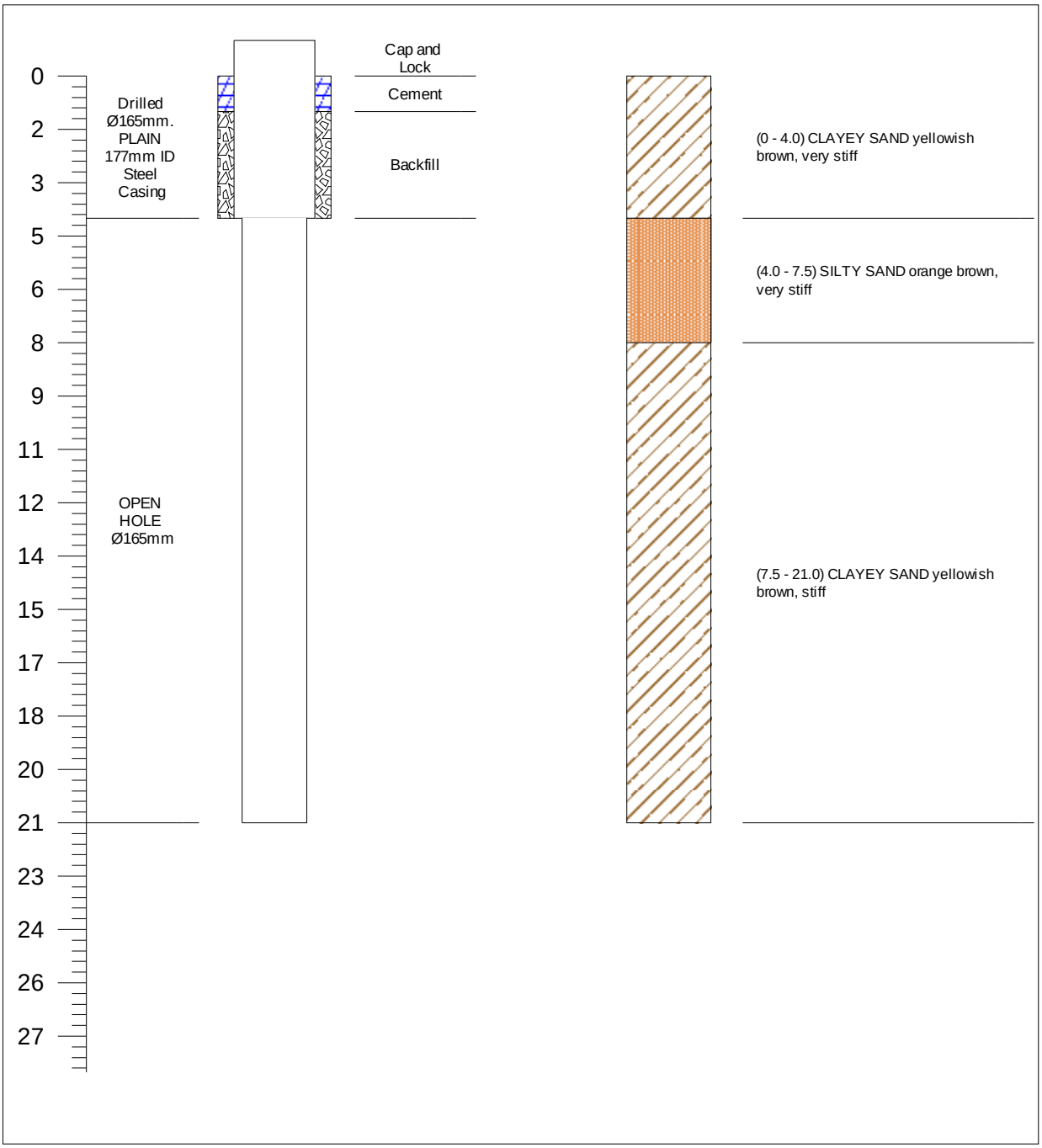
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-57802 S**
Longitude: **2621821 E**
Elevation: **894.36 mamsl**

Project No.:**12087**
Borehole Number
GA033

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



Date drilled:	23/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.27m

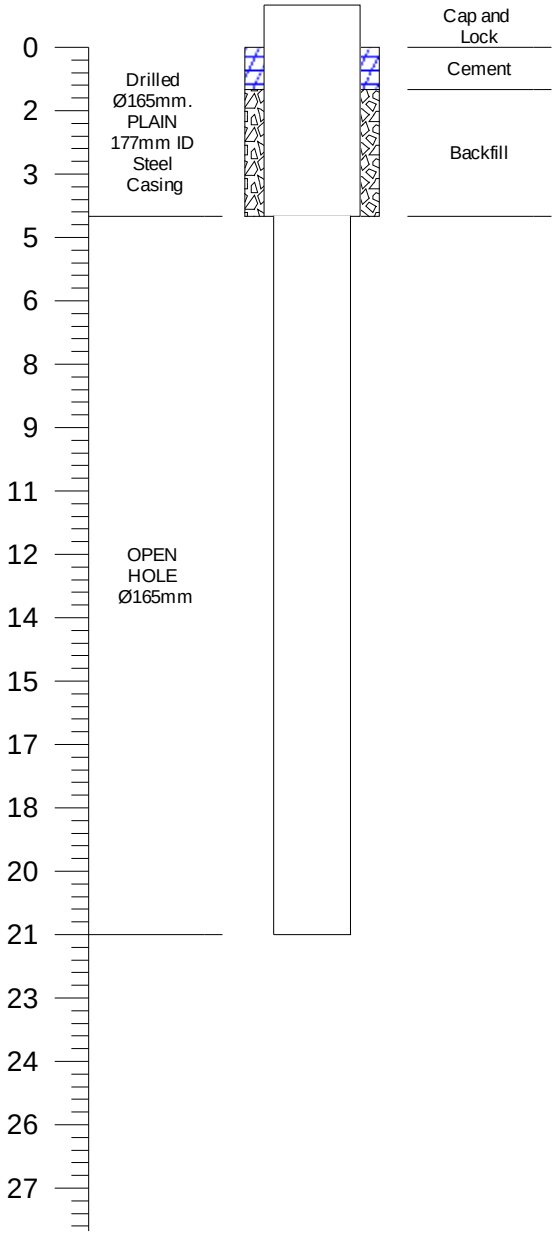
Golder Associates

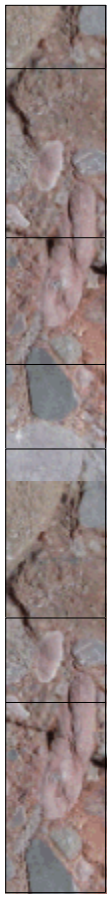
BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-58217 S**
Longitude: **2622071 E**
Elevation: **899 mamsl**

Project No.:**12087**
Borehole Number
GA034

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description





(0 - 1.5) CONGLOMERATIC QUARTZITE dark brown, clay in weathering

(1.5 - 5.5) CONGLOMERATIC QUARTZITE yellow brown, highly weathered

(5.5 - 8.5) CONGLOMERATIC QUARTZITE grey brown, medium weathered

(8.5 - 10.5) CONGLOMERATIC QUARTZITE light grey, slightly weathered

(10.5 - 14.5) CONGLOMERATIC QUARTZITE dark red brown, fresh

(14.5 - 16.5) CONGLOMERATIC QUARTZITE purple grey, fresh

(16.5 - 21.0) CONGLOMERATIC QUARTZITE purple grey, medium weathered

Note : soft, MICACEOUS SILTSTONE at 2.5m, 4.0m, 5.5m, 7.5, 13.0, 14.5 and 19.5m

Date drilled:	19/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.25m

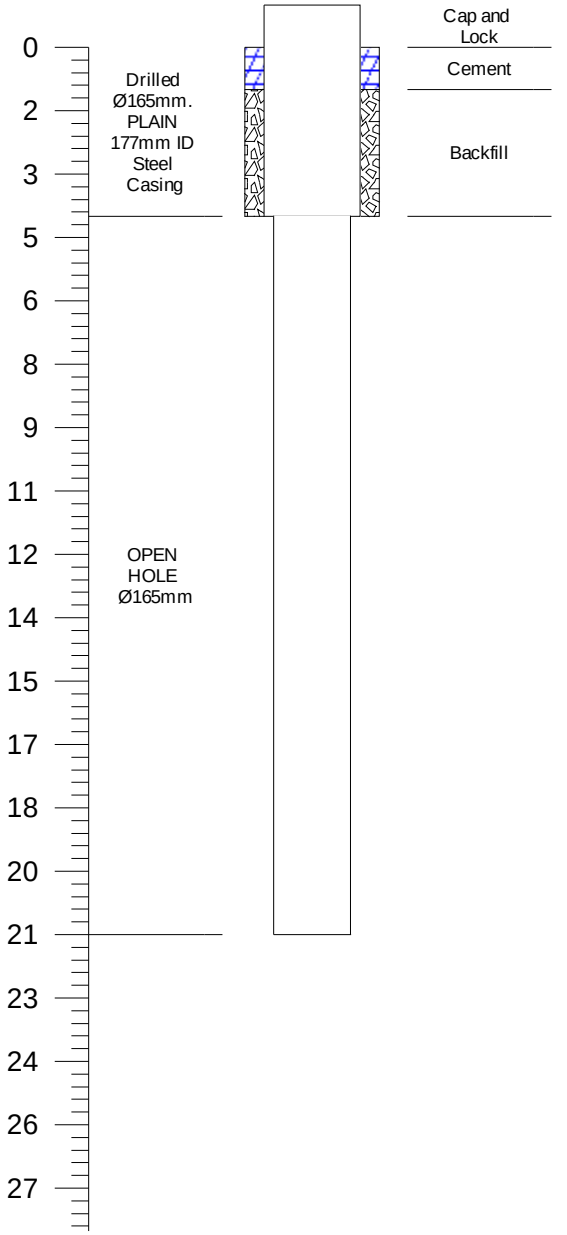
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-58291 S**
Longitude: **2622492 E**
Elevation: **902 mamsl**

Project No.:**12087**
Borehole Number
GA035

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



(0 - 2.0) CONGLOMERATIC QUARTZITE dark brown, clay in weathering

(2.0 - 6.0) CONGLOMERATIC QUARTZITE yellow brown, highly weathered

(6.0 - 10.5) CONGLOMERATIC QUARTZITE grey brown, medium weathered

(10.5 - 13.5) CONGLOMERATIC QUARTZITE light grey, slightly weathered

(13.5 - 17.0) CONGLOMERATIC QUARTZITE dark red brown, fresh

(17.0 - 21.0) CONGLOMERATIC QUARTZITE purple grey, fresh

Date drilled:	19/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	DRY
Hydrogeologist	J. Pretorius	Collar height:	-1.18m

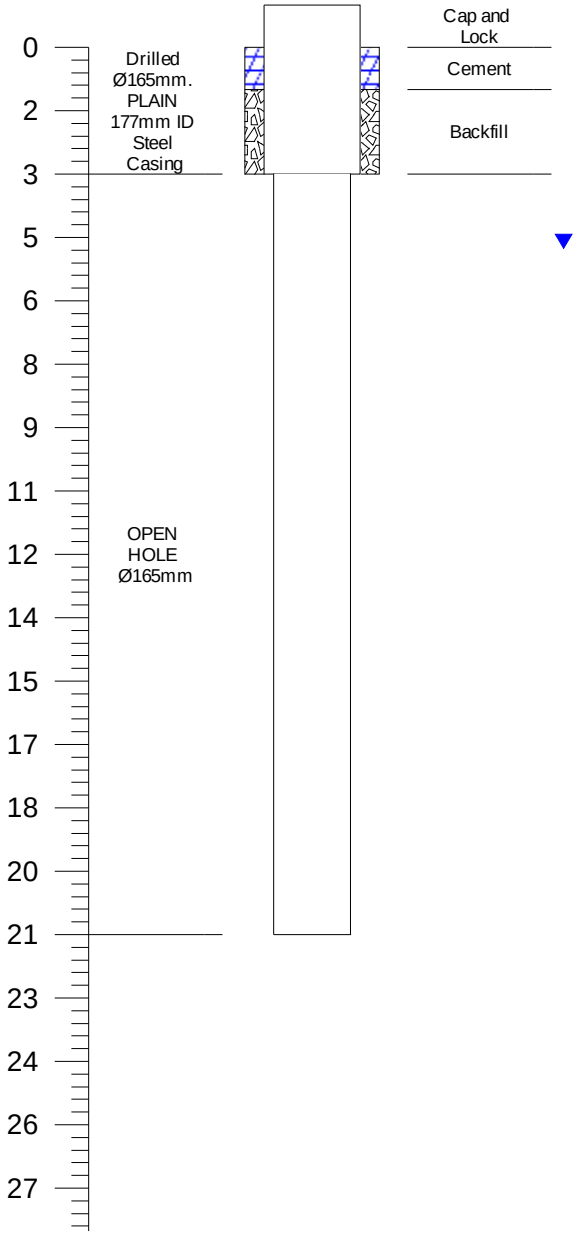
Golder Associates

BOREHOLE LOG

Project: **Medupi Hydrogeological Study**
Location: **Medupi Power Station**
Latitude: **-58372 S**
Longitude: **2622964 E**
Elevation: **899 mamsl**

Project No.:**12087**
Borehole Number
GA036

Depth (m)	Well Construction	Water strike(s) and Water level (mbgl)	Lithology	Lithology Description



(0 - 0.5) PEBBLES residual conglomeratic quartzite with matrix completely weathered

(0.5 - 2.5) CONGLOMERATIC QUARTZITE light brown, completely weathered to sand

(2.5 - 4.5) CONGLOMERATIC QUARTZITE pale orange, highly weathered

(4.5 - 6.5) CONGLOMERATIC QUARTZITE light grey, medium weathered

(6.5 - 13.0)CONGLOMERATIC QUARTZITE dark red brown, fresh

(13.0 - 14.5) CONGLOMERATIC QUARTZITE dark red brown, medium weathered

(14.5 - 21.0) CONGLOMERATIC QUARTZITE dark red brown, slightly weathered

Date drilled:	24/02/2009	Drilling diameter:	165 mm
Drilling contractor:	Brewis	Final blow yield:	0.1l/s
Hydrogeologist	J. Pretorius	Collar height:	-1.2 m

Golder Associates

Rockland Geoscience (Pty) Ltd
Geotechnical & Geological Consultants

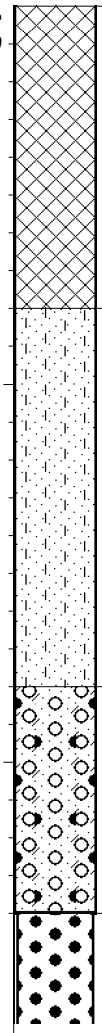
HOLE No: TP23
Sheet 1 of 1

MEDUPI POWER STATION
RAIL YARD

JOB: RG014169

GEOTECHNICAL INVESTIGATION

Scale 1:20



0.00 Grey, angular, fine to coarse gravel size and minor boulder size, medium hard to hard rock QUARTZITE, densely packed in silty SAND. **FILL**.

0.80 Slightly moist, orange brown, medium dense, pinholed, silty SAND. **HILLWASH.**

1.80 Slightly moist, grey brown mottled red and black, matrix supported fine to coarse subrounded quartz GRAVEL and FERRICRETE NODULES in a matrix of clayey SAND. **FERRUGINISED PEBBLE MARKER**.

2.40 EOH: Refusal on HARDPAN FERRICRETE.

NOTES

1) Termination: Refusal on well hardpan ferricrete.

2) Water: No groundwater or seepage encountered.

3) Profiled: In-situ.

4) Stability: Sidewalls stable short term - **HILLWASH** potential unstable.

5) Sample: No Sample

6) Photos: Nr. 1235

CONTRACTOR : Labonte 5
MACHINE : CAT 428D
DRILLED BY : Sonty
PROFILED BY : I Deale

INCLINATION : Vertical
DIAM : 0,7m
DATE :
DATE : 10 November 2014

COORDINATE SYSTEM : WGS84 (Lo 27)
X-COORD : 56085
Y-COORD : -2623674

HOLE No: TP23

TYPE SET BY : EM
SETUP FILE : ROCKLAND.SET

DATE : 09/12/2014 10:46
TEXT : C\WP51\PROFILES\ROC057.TXT

D079 E Mouton

dotPLOT 7016 PBpH7

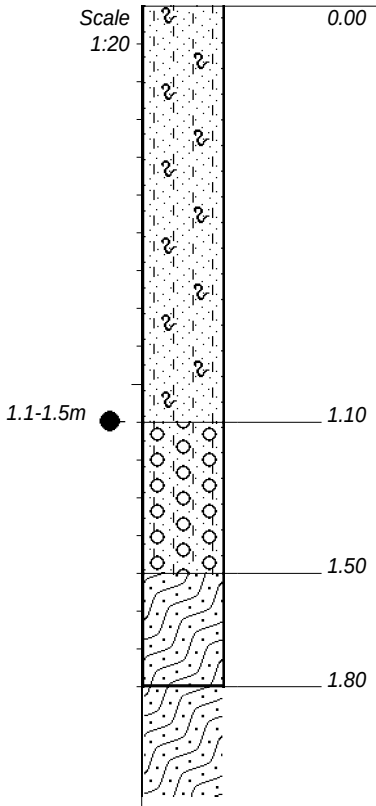
Rockland Geoscience (Pty) Ltd
Geotechnical & Geological Consultants

HOLE No: TP07
Sheet 1 of 1

JOB: RG014169

MEDUPI POWER STATION
RAIL YARD

GEOTECHNICAL INVESTIGATION



0.00	Slightly moist, yellow brown, medium dense, pinholed, silty SAND. **HILLWASH**. Abundant roots.
1.10	Dry, brown, dense, matrix supported, fine to coarse subrounded quartz GRAVEL in a matrix of slightly moist, silty sand. **PEBBLE MARKER**.
1.50	Pink yellow and grey, highly weathered, closely jointed, very soft rock QUARTZITE.
1.80	EOH: Refusal on medium hard rock QUARTZITE.

NOTES

1) Termination: Refusal on medium hard rock quartzite.

2) Water: No groundwater or seepage encountered

3) Profiled: In-situ.

4) Stability: Sidewalls unstable stable 0-1.1m.

5) Sample: Disturbed sample 0-1.1m and 1.1-1.5m.

6) Sample: Undisturbed sample 0-1.1m.

7) Photos: None

CONTRACTOR : Labonte 5
MACHINE : CAT 428D
DRILLED BY : Sonty
PROFILED BY : I Deale

INCLINATION : VERTICAL
DIAM : 0,7m
DATE :
DATE : 28 October 2014

COORDINATE SYSTEM : WGS84 (Lo 27)
X-COORD : 56075
Y-COORD : -2623725

HOLE No: TP07

TYPE SET BY : EM
SETUP FILE : ROCKLAND.SET

DATE : 09/12/2014 10:45
TEXT : C\WP51\PROFILES\ROC057.TXT

D079 E Mouton

dotPLOT 7016 PBpH7

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