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Attention: Mr. M. Dane **e-mail: mike.dane@encogobajv.com**

Dear Sir

IMPUMELELO SHAFT PROJECT: GEOTECHNICAL DESK STUDY REVIEW

1. INTRODUCTION

This review presents a desk study analysis of expected profile conditions, profile properties and geotechnical considerations for the Impumelelo Shaft Project (Shaft and Overland Conveyor) that is located to the west south west of Secunda.

Neither recommendations nor detailed soil profiles nor details on soil properties are provided due to the nature of the study.

2. GEOLOGY

The study area is situated within the Highveld Coal Field[1] and is underlain by a sedimentary sequence of siltstones and sandstones and coal of the Vryheid Formation, Ecca Group, Karoo Sequence.

These rocks have been intruded by numerous dolerite dykes and sills.

3. TOPOGRAPHY

The topography in the study area is characterised by an undulating to rolling topography. The dominant perennial drainage systems in the area include the Wolwespruit, Kaalspruit and the Watervalspruit all draining in a southerly direction. Numerous seasonal tributaries to these streams are present.

1 Jordaan, J. 1986 Highveld Coalfield 1985-1994 In Anhauesser, C.R. and Marke, S eds, Mineral Deposits of South Africa Vol. 2 Geol. Soc. SA.

4. TERRAIN UNITS

A terrain unit defines a specific landform feature that is characterised by specific topographic form, geology and soil profile. Similar units underlain by similar geology will exhibit similar soil profiles and consequently similar soil properties and therefore will exhibit similar geotechnical characteristics.

The terrain units that will be encountered within the area will include:

- Crestal unit.
- Convex sideslope unit
- Concave sideslope unit
- Drainage gullies.
- River beds / alluvial flood plains.

5. GEOTECHNICAL ASPECTS

5.1 The crestal unit

This unit is characterised by a flat to gentle sloping convex landform.

Within the areas underlain by dolerite, the transported horizon is generally fairly thin and clayey in nature and boulder outcrop and outcrop zones will be encountered. The residual soils will comprise clayey silts that grade into friable sandy gravels and spheroidal (boulder) weathering can be expected. Hard rock bedrock is often encountered within the upper 3m to 5m of the profile.

Geotechnical considerations:

- Boulder / hard rock excavation.
- Generally good founding conditions.
- Heave in transported and residual soils.
- Friable residual dolerite usually suitable for construction purposes typically up to G6 requirements.

The crestal zone underlain by Karoo rocks often characterised by thicker transported sandy soils and residual silts or sands derived from the siltstones or sandstone. Pans are often encountered on the crestal unit underlain by Karoo rocks and ferricrete is present around the perimeter of the pans.

Geotechnical considerations:

- Collapse of grain structure in transported soils.
- Moderate heave potential with residual siltstones.
- Slaking / deterioration of rock on exposure.
- Fair to good founding conditions.
- Excavated material generally only suitable as bulk fill.

- Ferricrete, where well developed, does provide a source of construction material up to G7[2] quality.

5.2 Sideslope

The sideslopes define gently dipping slopes developed on the pediment. The slopes are convex in the upper reaches and grade into concave slopes as alluvial flood plains are approached.

The profile developed on the dolerite typically will comprise transported silt clays (hillwash 500mm to 700mm thick) on an irregularly developed pebble marker overlying friable silty sands (residual dolerite). Clayey reworked residual soils can be irregularly developed and expected in the lower concave slope areas. Weathered, closely jointed dolerite bedrock often present below a depth of 3m.

Geotechnical considerations:

- Heave in transported and residual soils.
- Intermediate to hard excavation.
- Generally good shallow founding conditions.
- Friable dolerite will provide material suitable for construction purposes.

Within the lower sideslopes, the thickness of the transported soil and residual clays can extend to depths in excess of 3m. Specialised footings may be required in these areas.

The profile developed over the Karoo is characterised by moderately thick transported silty sands (hillwash 1,0m to 1,5m thick). Nodular ferricrete 300mm to 500mm thick typically developed at the transported / residual interface.

The residual soils, generally clayey silts, extend to depths of 5m. Lenses of sandstone may be encountered that can result in shallow bedrock conditions.

Geotechnical considerations:

- Collapse of grain structure in the transported soils.
- Hardpan ferricrete may be present in areas near gully zones and along the alluvial floodplain sideslope interface.
- Fair foundation conditions.
- Nodular ferricrete and ferricrete hillwash blend can provide materials suitable for construction requirements up to G7 quality.
- The residual siltstone likely to classify as G10 to spoil. Soft rock fragments will slake and break down on exposure.

[2] TRH14:1985. **Guidelines for Road Construction Materials**. Committee for State Road Authorities, Department of Transport, Pretoria.

5.3 Gully Units

This unit is characterised by a concave landform with gentle to moderate sideslopes. Erosion from sideslopes is common. The gullies are generally only seasonally saturated.

The transported soils, sandy clays, are derived from the source material (i.e. dolerite or Karoo sediments) and therefore they range from sands to clays. The more broad the gully floor, the deeper the thickness of transported and residual soils.

In well incised gullies, bedrock dolerite or siltstone often present as outcrop.

Geotechnical considerations:

Any foundations located in this zone must take cognisance of seasonal flooding potential. Dispersive soils and calcrete nodules can be expected.

5.4 Alluvial flood plain unit

The alluvial flood plain is typically characterised by a broad, flat to slightly concave form. This zone is likely to represent the 1:50 year flood line. Streams are usually perennial.

The soil profile will typically comprise a thick (6m to 10m) interbedded, medium grained, washed sand and dark grey, clayey silts to silty clays. A boulder bed (boulders in a sand matrix) is often developed on a hard rock bedrock. The flanks of the flood plain are usually characterised by dark grey clays.

Geotechnical consideration:

- Piled foundations usually required.
- Flooding.

6. SEEPAGE AND PROFILE PERMEABILITY

Perched seasonal water tables can develop at the interface of the transported and residual profiles.

The dolerite profile is generally moderately permeable while the Karoo profile is fairly impermeable.

7. DISCUSSION

The above provides a general desk study assessment of the expected soil profile and soil property conditions within the Impumelelo study area.

The profiles expected for the proposed project are unlikely to result in geotechnical conditions that could be considered as fatal flaws. In general suitable founding conditions for conventional founding options are expected. The only possible deviation to this could be at the major perennial drainage features where thick alluvial soils are expected and consequently specialised founding options (i.e. piles) may be required.

Detailed geotechnical investigations (borehole drilling, laboratory testing, etc.) will be required to confirm the expected conditions, prior to construction.

Yours faithfully

BRYAN ANTROBUS
for Jones & Wagener

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