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ROCK ENGINEERING REPORT – BOXCUT CONCERNS

Date: July 2018 *Report number 1807-001MOO - PC*

Colliery name: Mooiplaats Colliery

As part of the Rock Engineering Practitioners duties to assess the access ways to the mine this report was compiled to determine the stability of the Boxcut slopes. The Rock Engineering assessment forms part of the mines strategy to combat rock fall accidents and instability at the Colliery. To ensure that the input of a competent person is properly and timeously considered and integrated into mine design, planning and operation, according to Regulation 14.1(8) of the Mines Health and Safety Act No. 29 of 1996 (MHSA) the following is defined:

> ***A Competent person"*** according to Chapter 22.14.1(8) of the Mine Health and Safety Regulations, is a person who is at least in possession of a Chamber of Mines Certificate in Rock Mechanics.

Several discussions and meetings between the Rock Engineering Practitioner (Pierre Cronjé) and Mine Management (Fernando Gouveia and Piet van der Linde) were held pertaining to the stability of the Boxcut and the required support to assist in providing safe access to the underground workings. This report is a summary report based on previous investigations and discussions.

The Factor of Safety (FoS) is the internationally accepted basic design criteria for highwall slopes. Highwall slopes are designed according to the design criteria set apart by Priest and Brown (1983) illustrated below in the table (Table 1). The minimum FoS required for the design is 1.6. Ideally a slope of this importance should be designed to a FoS of 2.

Consequence of failure	Examples	Acceptable values		
		Mean FOS	Minimum P[FOS<1.0]	Maximum P[FOS<1.5}
Not serious	Individual benches; small (<50 m), temporary slopes, not adjacent to haulage roads	1.3	10%	20%
Moderately serious	Any slope of a permanent or semi-permanent nature	1.6	1%	10%
Very serious	Medium sized (50-100 m) and high slopes (<150 m) carrying major haulage roads or underlying permanent mine installation	2.0	0.3%	5%

Table 1: Design Criteria – Priest and Brown (1983)

Three scenarios was constructed with estimated strength values in the numeric modelling programme RS2 to determine the numeric FoS of the slopes at different depths within the Boxcut and Decline. These slopes are illustrated in Figure 1. Horizontal joint networks was incorporated into the shale to simulate the highly laminated nature of the shale.

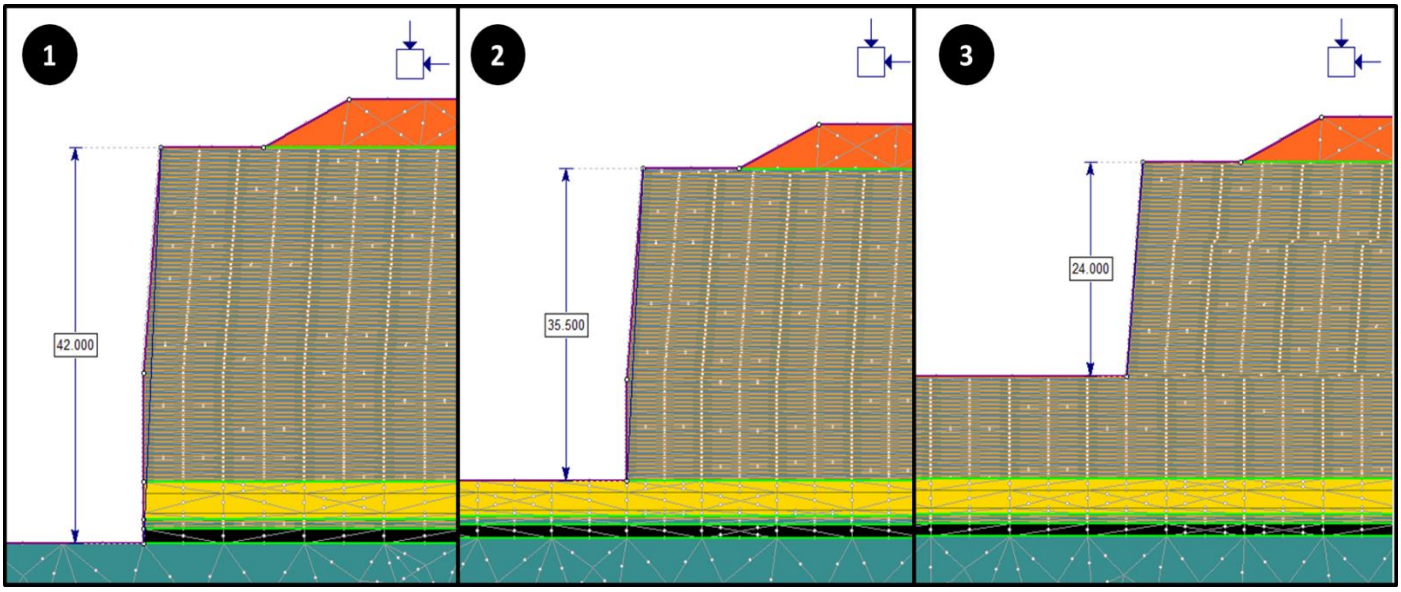

Figure 1: Construction Phase – Slope Scenarios

The numeric analysis indicated that the FoS of scenarios 1 and 2 illustrated below in Figure 2 is below the minimum required 1.6 (Scenario 1 has and Fos of 1.05 and Scenario 2 has an FoS of 1.18). Scenario 3 indicated an acceptable FoS of 1.6.

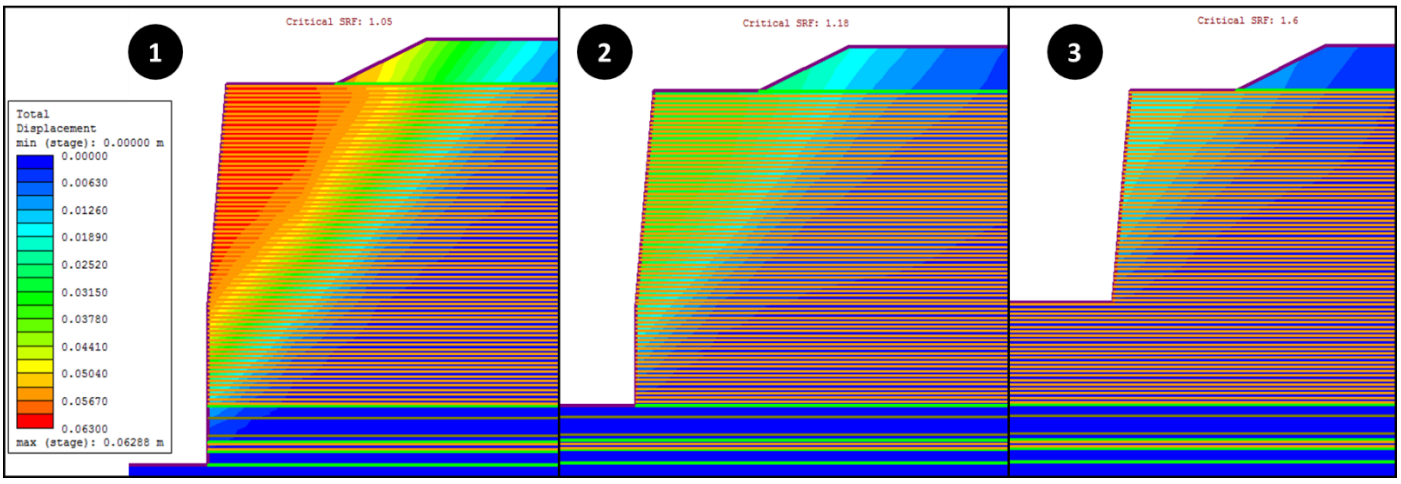

Figure 2: Outcome – Slope Displacement for the different scenarios

The above outcome was used to determine the areas of the highwall considered to have a high risk i.e. areas with a FoS of less than 1.6. These are the areas that should be addressed with additional standing support as per the current Arch Support being constructed. These areas are illustrated below in Figure 3 and 4.

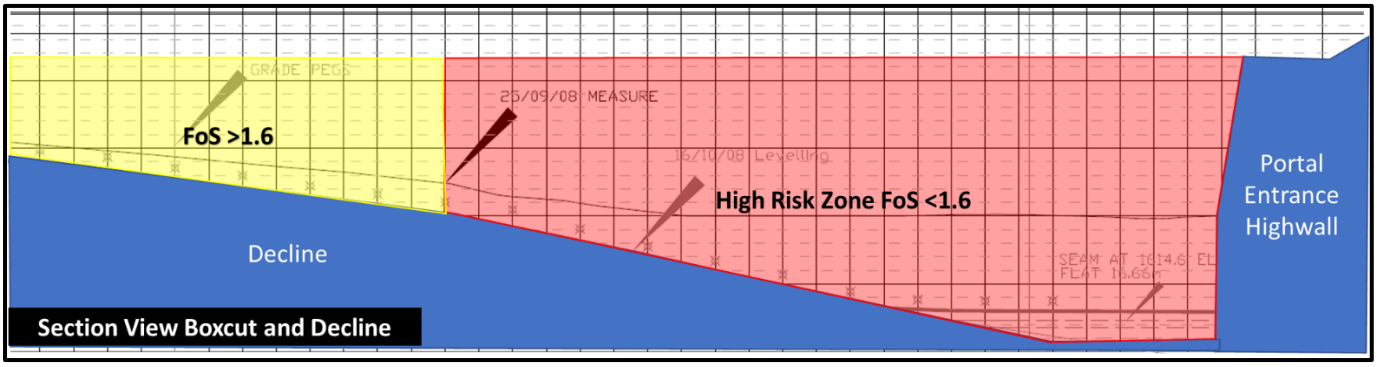

Figure 3: Section view – High Risk Areas

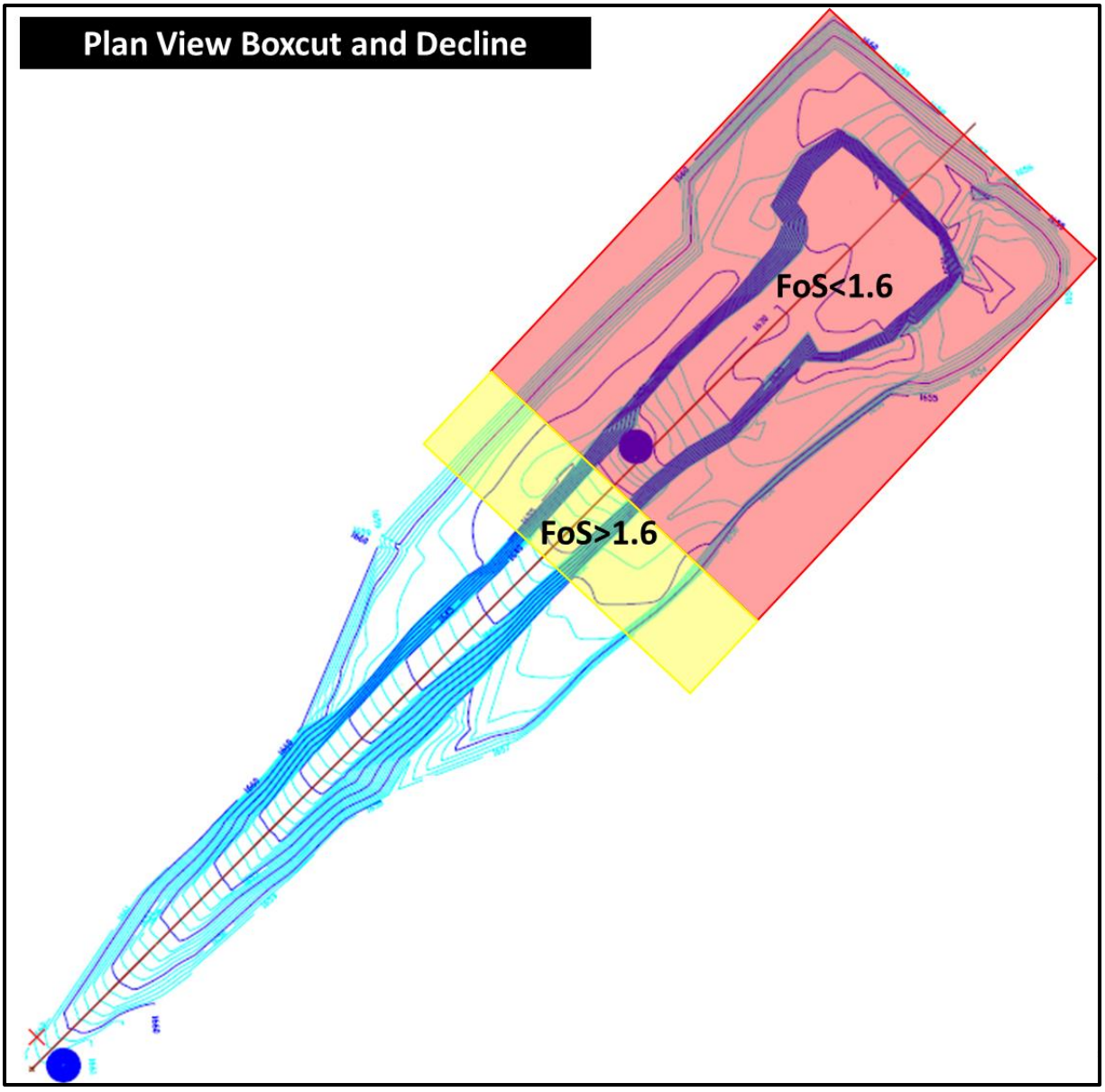

Figure 4: Plan view – High Risk Areas

The report was written without geological information of the Boxcut area. This information will be advantageous to the outcome of the investigation and should be made available to us as soon as the information is available.

Kind Regards

Big C Rock Engineering

Per Pierre Cronjé (Pr.Sci.Nat)

Rock Engineering Practitioner