Blast Management & Consulting

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Addendum: Blast and Vibration Assessment Report

Proposed Development of an Underground Coal Mine and Associated Infrastructure near Hendrina, Mpumalanga

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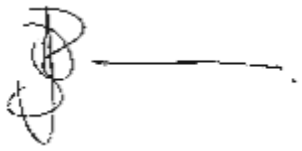
Signed:	
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ii. Study Team Qualifications And Background

The study team comprises J D Zeeman (as the member of Blast Management & Consulting) and Blast Management & Consulting employees. Blast Management & Consulting's main areas of concern are pre-blast consultation and monitoring, insitu monitoring, post-blast monitoring and consulting as well as specialised projects. Blast Management & Consulting has been active in the mining industry since 1997 and work has been done at various levels for mining companies in South Africa, Botswana, Namibia, Mozambique, Democratic Republic of Congo, Sierra Leone and Côte d'Ivoire.

J D Zeeman holds the following qualifications:

1985 - 1987	Diploma: Explosives Technology, Technikon Pretoria
1990 - 1992	BA Degree, University of Pretoria
1994	National Higher Diploma: Explosives Technology, Technikon Pretoria
1997	Project Management Certificate, Damelin College
2000	Advanced Certificate in Blasting, Technikon SA

Member: International Society of Explosive Engineers

iii. Independence Declaration

Blast Management & Consulting is an independent company. The work done for the report was performed in an objective manner and according to national and international standards, which means that the results and findings may not all be positive for the project applicant. Blast Management & Consulting has the required expertise to conduct such an investigation and draft

the specialist report relevant to the study. Blast Management & Consulting did not engage in any behaviour that could be result in a conflict of interest in undertaking this study.

iv. Document Control:

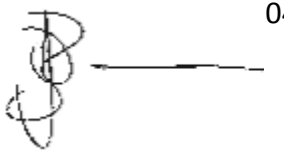
Name	Responsibility	Signature	Date
JD Zeeman Blast Management & Consulting	Consultant		04/09/2016

Table of Contents

List of Figures

1 Executive Summary

Blast Management & Consulting (BM&C) was contracted as part of the Environmental Impact Assessment (EIA) to perform an initial review of possible impacts with regards to blasting operations on the proposed Hendrina Reserve located in the Mpumalanga Province of South Africa. Ground vibration, air blast, fly rock and fumes are some of the aspects resulting from blasting operations.

The option of drilling and blasting after excavation of soft material was investigated. The possible ground vibration and air blast influence was calculated from a typical development end blast design.

The drilling and blasting of a development end only instead of a full scale box-cut will significantly reduce the possible influences associated with drilling and blasting to negligible at any surface infrastructure in the area. The development will start at a certain depth that will further contribute to reducing effects of blasting. The levels expected are low and may be perceived up to a distance 100 m.

There is no reason to believe that this operation cannot continue if the recommendations made are adhered to.

2 Introduction

The possible impact from drilling and blasting operations had to be reviewed due to a change in development of the decline shafts. The development of the decline shafts may be possible without establishing a box-cut. The development will consist of removing soft material to a level where a free face can be drilled and blasted for the declines only. This document thus serves as an addendum to the Blast and Vibration Assessment Report for the Proposed Development of an Underground Coal Mine and Associated Infrastructure near Hendrina (June 2016). The original report (June 2016) is considered a worst case scenario for the influences evaluated.

3 Objectives and background

The objectives of this document is to review the possible ground vibration and air blast impact associated with drilling and blasting of the decline shaft using the method below.
The process to be followed is as follows:

1. The topsoil will be removed and the area influenced will be less than 100mx100m
2. The softs will be removed from the same area and battered back to an acceptable standard, 3 to 1
3. The incline will be established in the centre of the one 100 m boundary towards the opposite side at the 6 degrees angle
4. As soon as the hards are encountered a brow will be established for the access into an incline shaft to be created for access
5. Blasting will then commence on the incline shaft or decline, the dimensions of which will be in the order of 6.6m in width and 3.5m in height
6. The blasting will be done in advance depth of a maximum of 3m per slice, thus approximately 68 cubic metres per blast. This process can be detailed as follows
    a. Drilling of a blasting pattern
    b. Charging up the basting pattern
    c. Remove all personnel and machinery
    d. Blast
    e. Support the roof
    f. Clear the area of material
    g. This process will run in 8 hour cycles, thus a blast at every 8 hours
    h. The process is repeated until the coal seam is reached

4 Blast design

A simplistic blast layout for the development end was laid out. Blast holes consisted of 45 mm diameter blast holes drilled 3 m deep in a set pattern with a 9 hole burn cut. The blast holes were loaded with cartridge explosives. The blast was timed to fire in the most likely sequence and the charge mass per delay predicted from this design. This design is a typical design and small changes may be applied in the development. Figure 1 shows the typical blast hole layout for the development end. Figure 2 shows the blast layout with expected charge mass per delay.

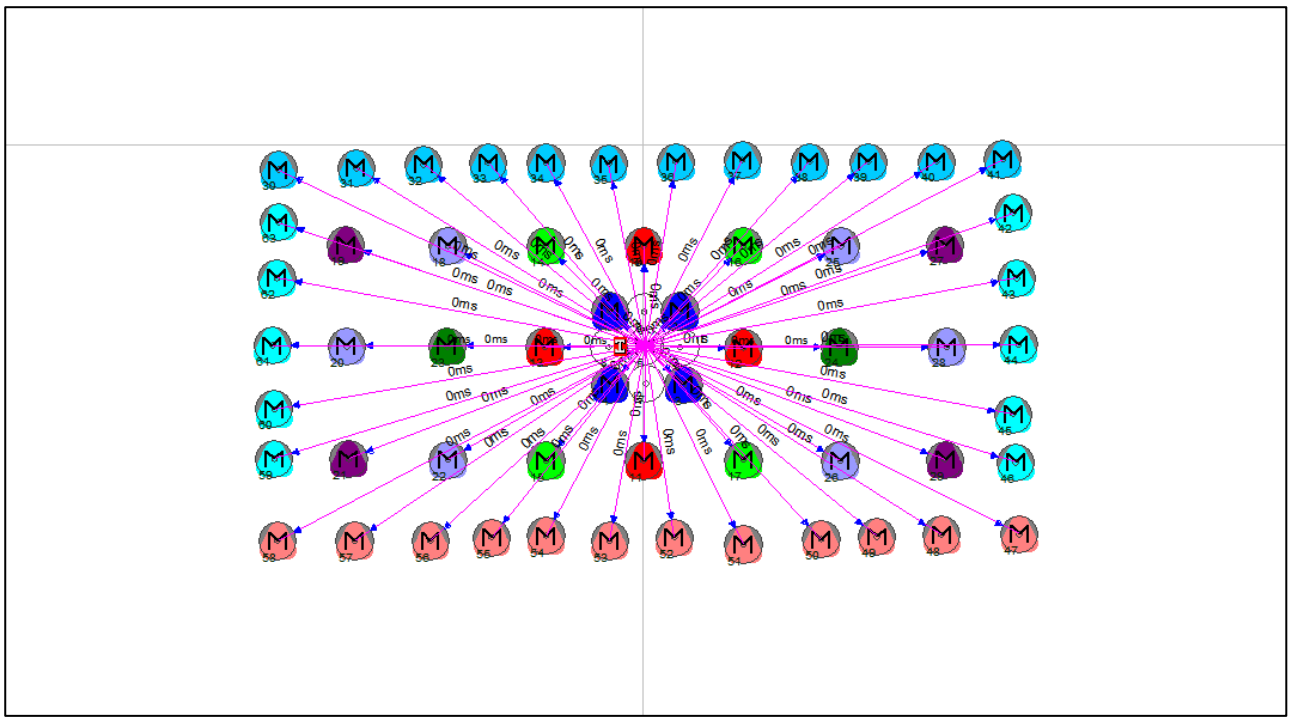


Figure 1: Typical blast hole layout

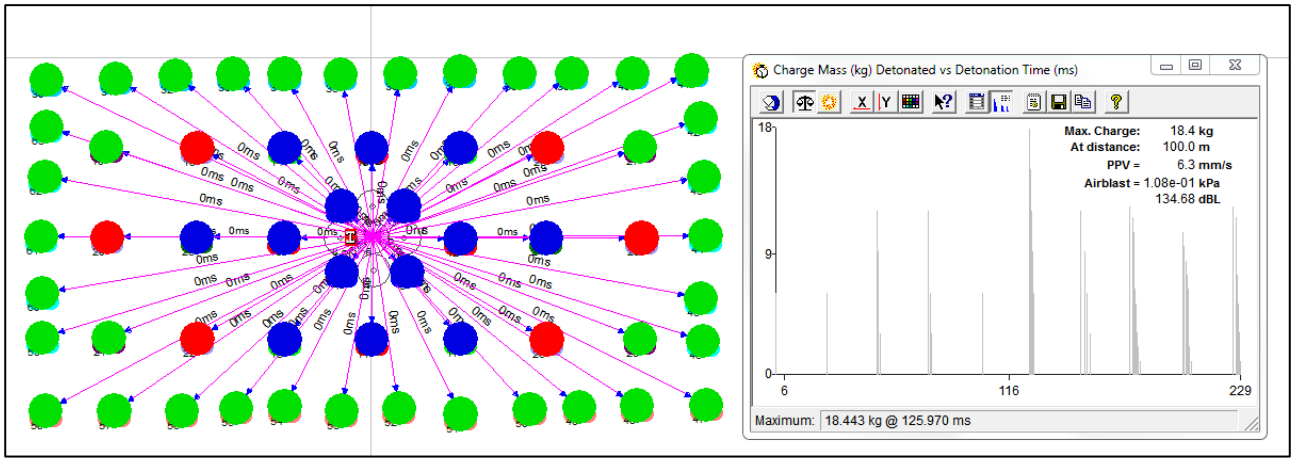


Figure 2: Blast layout with expected charge mass per delay

5 Results of analysis

The blasting operation uses significantly less charge than the original assessment. An estimate of maximum 18 kg charge per delay is anticipated for this design. The ground vibration and air blast result from this blast is estimated to be 6.3 mm/s and 135 dBL at 100 m direct distance from the blast. Air blast will be less due to the depth at which blasting will be done. The specific reduction is difficult to calculate and only a direct distance value is presented. The levels of ground vibration and air blast are significantly lower than the levels expected from a full box-cut. The depth at which the first blast will be done will add further reduction of the blast effects to the point that the possible effects may be negligible. It is also certain that for each blast developed the effects will be further reduced with progress of the decline. The first 5 to 10 blasts are expected to still have some effect from sound, ground vibration and air blast within the immediate vicinity of the shaft but will start subsiding thereafter. Further assessment will not be required.

6 Recommendations

The blasting will need to be undertaken within the normal safety and control measures as per the regulatory requirements. At Mooivley West (Shaft No. 1) there are 2 points of interest observed within 500 m from the shaft area. All other points of interest observed are located at distances greater than 500 m. There are no surface infrastructures closer than 250 m from the shaft areas.
There will not be a specific requirement for monitoring of blasting operations but can still be undertaken for confirmation of ground vibration and air blast levels. No other specific management measures are recommended.

7 Conclusion

The drilling and blasting of a development end only instead of a full scale box-cut will significantly reduce the possible influences associated with drilling and blasting to be negligible at any surface infrastructure in the area. The development will start at a certain depth that will further contribute to reducing effects of blasting.