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Blast and Vibration Assessment Scoping Report Proposed Elandsfontein Colliery Project	
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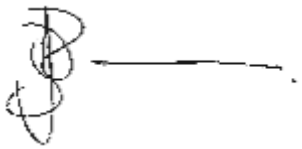
Signed:	
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ii. Study Team Qualifications and Background

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 result in a conflict of interest in undertaking this study.

iv. Document Control:

Name & Company	Responsibility	Action	Date	Signature
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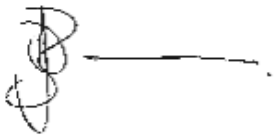
JD Zeeman Blast Management & Consulting	Consultant	Report Finalise	20/11/2019	

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1 Executive Summary

The proposed project is located on a portion of the remaining extent of portion 8; remaining extent of portion 1; a portion of the remaining extent of portion 6; portion 44; portion 14 and the remaining extent of portion 7 of the Farm Elandsfontein 309 JS, located in Emalahleni Local Municipality, Nkangala District Municipality, Mpumalanga Province. The site is approximately 4 km south of Kwa-Guqa and 16 km west of Emalahleni. The centre point of the site is 25°53'05.01"S and 29°05'36.57"E.

The Elandsfontein Colliery comprises of 2 distinct mining rights (MR314 and MR63). The applicant plans to consolidate the two mining right areas into a single mining right with associated consolidated EMPR. In addition, the applicant wishes to expand their existing mining operations to include additional mineral resource areas (i.e.: new open cast & underground areas within the consolidated mining right boundary).

The proposed project includes inter alia the following application processes with associated activities:

- New Integrated Environmental Authorisation and Waste Management Licence (Scoping and Environmental Impact Report (S&EIR));
- New Integrated Water Use Licence (IWUL);
- Section 102 consolidation of mining rights as well as consolidation of EMPR's into one holistic EMPR.

Elandsfontein Colliery is currently undertaking opencast mining of the No. 1 and No. 2 coal seam in Pit 1. Underground and Opencast mining is currently being done.

Roll over strip mining method is utilised to extract the coal from the No. 1 and No. 2 Coal Seam and rehabilitation is undertaken concurrently as the coal is extracted. A dozer, truck and shovel are used to remove the topsoil and subsoil material to expose the No 2 Coal Seam. Hard overburden material is blasted to expose the No 2 Coal Seam which is mined and placed on the ROM stockpile for dry processing.

The initial waste mining material will be placed on dumps to create space for the next cut material to be rolled into. This will form a continuous roll over method where the waste material will be placed in the previous mined out cut. The placement of material on the low wall side as part of the rehabilitation strategy will be in the same sequence as the material mined from bottom to top, i.e. hards at the bottom, then subsoil on top of the hards and then topsoil on top of the subsoil.

Drilling and blasting operations will for a critical part of mining the hards and the No 2 seam. Both material horizons will be drilled at specific patterns and blasted with the use of emulsion and pyrotechnics (shock tube).

The project area was reviewed on scoping level phase. Various installations were identified within 3500 m from the proposed opencast operations and 100 m from the Underground operations. Possible impacts at these points of interest associated with the planned operation was identified and considered. Three areas within a range of 0 to 3500 m from the pit boundaries were identified and indicated at different levels of possible influence. The possible influences and level of influence will be investigated and if required, mitigation measures will be recommended during the impact assessment phase.

Specific possible mitigations are addressed. Possible reduction of blasthole diameters and the use of electronic initiation will assist in reducing the levels on impact. Smaller diameter blastholes will reduce the charge mass per blasthole and electronic initiation can be used to reduce the number of blastholes firing to single blasthole detonation. The whole drilling and charging process can be reviewed in a detail blast design that considers the blast area distance to points of concern to manage to levels of influence.

2 Introduction

Blast Management & Consulting was contracted as part of the Environmental Impact Assessment (EIA) team to perform an initial review of possible impacts with regards to blasting operations in the proposed Elandsfontein Colliery Project. Blast Management & Consulting as a company concentrates on the monitoring, prediction, analysis, audit and consulting on all aspects of blasting operations. Specifically, are aspects such as ground vibration, air blast, fly rock, fumes and other influences evaluated.

3 Scope of Work

In presenting a scoping report the following scope of work is suggested and reported.

- Introduction
- Legislative Requirements
- Existing Status of project
- Source and receiving Environment
- Anticipated impacts
- Plan of environmental impact study

4 Legislative requirements

The following acts and guidelines contain references that will applicable to the study. There is currently no direct legislation with regards to ground vibration and air blast levels in South Africa. Aspects on control of blast impacts, vibration and air blast are not directly addressed in the Acts below but the legislation was considered as supporting documents in the process of evaluating the possible influences. The shortfall in direct legislation is supported by international standards and other guidelines as well as relevant project experience of the consultants.
The following acts and supporting detail are considered:

- Explosives Act No. 26 of 1956 and Amendments GNR.1604 of 8 September 1972
- Environment Conservation Act No. 73 of 1989
- Mineral and Petroleum Resources Development Act No. 28 of 2002 and Amendments GNR.527 of 23 April 2004
- Mine Health and Safety Act No. 29 of 1996 and Amendments GNR.93 of 15 January 1997
- Ground vibration and air blast is also evaluated according to the USBM (United States Bureau of Mines) guidelines for safe blasting
- Ground vibration and air blast is also evaluated according to guidelines as used by Blast Management & Consulting based on experience and knowledge.

5 Existing Status

The Elandsfontein Colliery is in the Witbank Coal Field on the farm Elandsfontein 309 JS. The property is approximately 16 km west of the town of Witbank in the Mpumalanga Province, South Africa. Elandsfontein Colliery's coal rights, which have been granted are:

MP 314 MR

- The Remaining Extent of Portion 7
- Portion of the Remaining Extent of Portion 8
- Portion 44
- Portion 14

of the farm ELANDSFONTEIN No. 309 JS and

MP 63 MR

- The Remaining Extent of Portion 1
- Portion of the Remaining Extent of Portion 8
- Portion of the Remaining Extent of Portion 6

of the farm ELANDSFONTEIN No. 309 JS.

Elandsfontein Colliery is located approximately 16 km west of the town of Witbank. The Elandsfontein Colliery can be accessed from the N4 National Road via the secondary provincial road (R547) through Clewer.

Elandsfontein Colliery is an existing mine with opencast and underground sections. It produces coal for the local and the export market, at a rate of 500 000 t/annum. Coal has been produced from the No. 1 Seam (underground bord and pillar operation) and an opencast operation on the No. 4 Seam and on the No. 2 Seam.

Figure 1 shows the planned mining layout of the underground and opencast mining.

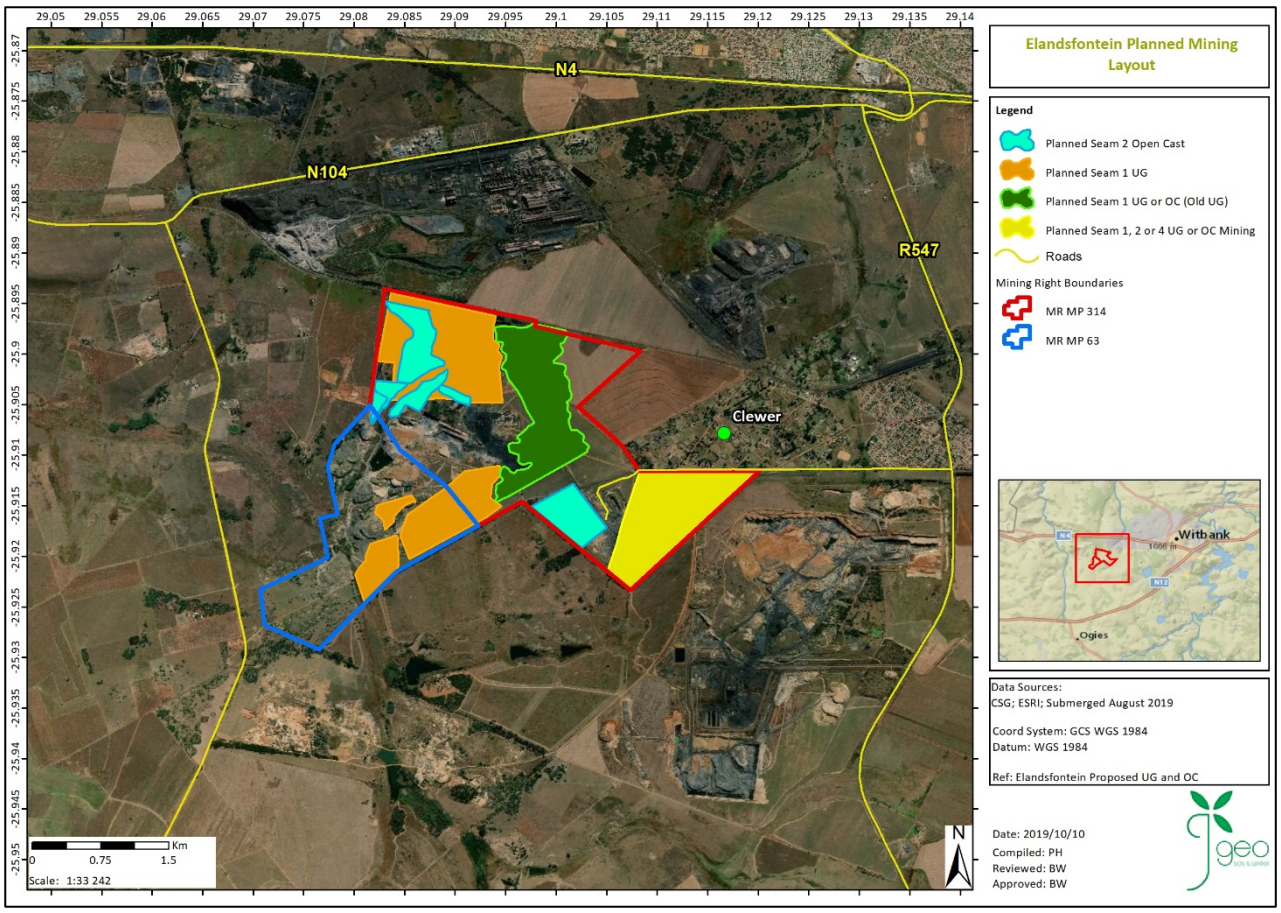

Figure 1: Mine Area with planned underground and opencast pits

6 Source Environment

The Elandsfontein Colliery comprises of 2 distinct mining rights (MR314 and MR63). The applicant plans to consolidate the two mining right areas into a single mining right with associated consolidated EMPR. In addition, the applicant wishes to expand their existing mining operations to include additional mineral resource areas (i.e.: new open cast & underground areas within the consolidated mining right boundary).

The proposed project includes *inter alia* the following application processes with associated activities:

- New Integrated Environmental Authorization and Waste Management License (Scoping and Environmental Impact Report (S&EIR));
- New Integrated Water Use License (IWUL);
- Section 102 consolidation of mining rights as well as consolidation of EMPR's into one holistic EMPR.

Drilling and blasting operations are to be done for the opencast and underground operations. The execution of blasting operations is considered the source of environmental influence in the form of possible ground vibration, air blast and fly rock. These are some of the main concerns regarding blasting operations. The opencast sections are expected to be the greatest source of possible influence. Underground operations do not yield effects such as air blast and fly rock on surface infrastructure. The level of impact or influence will be dependent on the blast charging layouts, location of the blast, type of blast and the location of the surrounding infrastructure with points of interest / concern. Various areas of operation are identified for this application and the location of these areas will determine the level of possible influence.

7 Receiving Environment

The receiving environment is considered the area expected to be influenced directly adjacent to the Elandsfontein Colliery Project area and specifically the area adjacent to the Open Pit areas. The area of influence is not expected to exceed a distance range of 3500m radius around the Open Pit Areas.

Figure 2 shows the location of the Elandsfontein Colliery Project Area and the anticipated receiving environment around the Open Pits, indicated as the Study area.

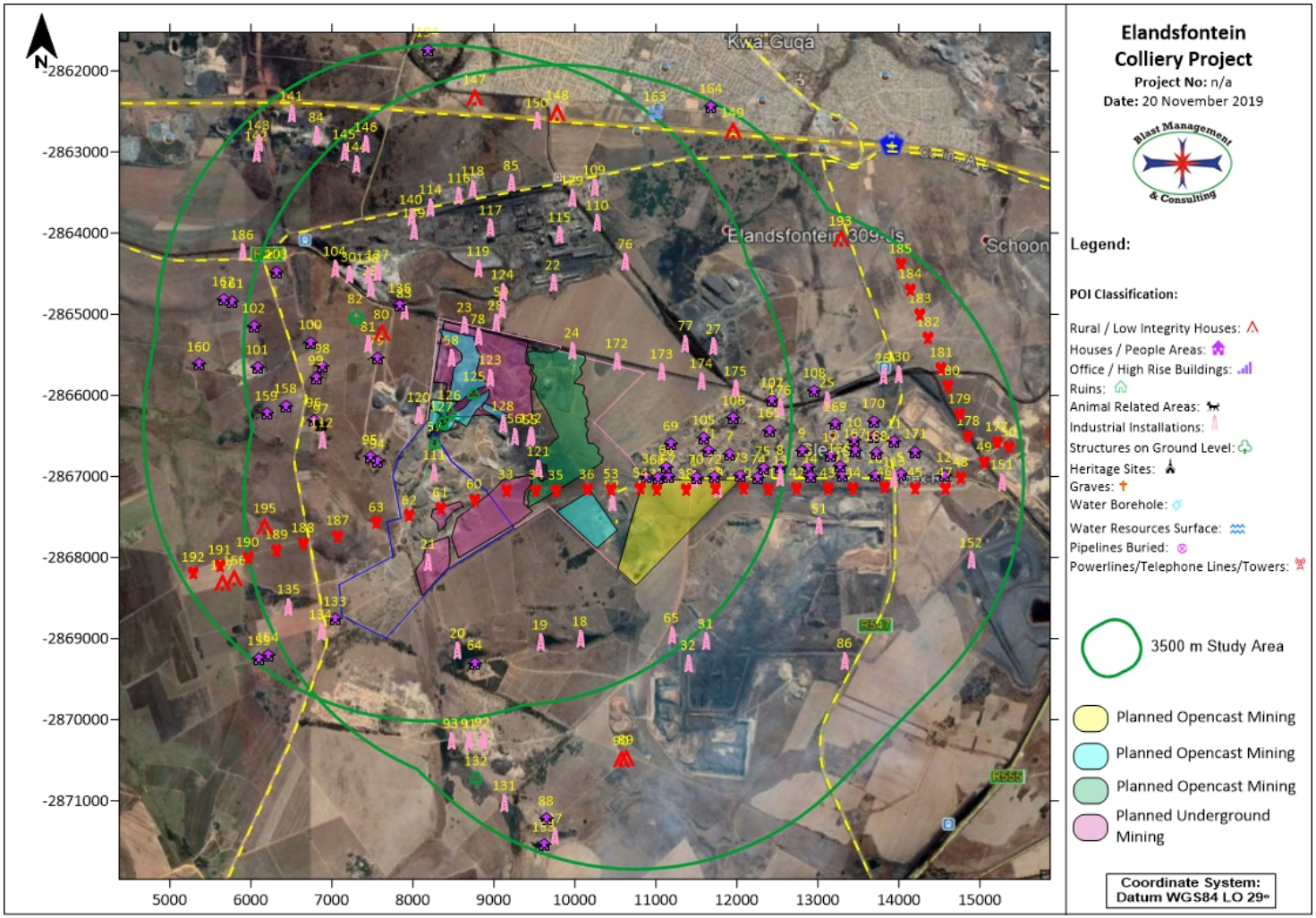

Figure 2: Study Area

8 Anticipated Impacts

The primary objective of blasting operations is producing rock for crushing to be used in construction. The blasting operation has the potential to yield secondary effects such as ground vibration, air blast, fly rock and fumes. These aspects may have a negative impact on the surrounding areas depending on the levels generated. The potential impacts considered can be described as follows:

Ground vibration: Levels greater than recommended limits may be damaging to structures. Different structures will also have different permitted levels. Ground vibration may cause damage if levels exceed the structures safe limit. People may also experience ground vibration as perceptible at very low levels and normally react negatively to the experience of ground vibration.

Air blast: In most cases the effect of air blast is underestimated. High levels of air blast could cause damage and normally windows are first to be damaged. Levels lower than required to induce damage may rattle windows and large roof surfaces. These effects are generally mistaken as ground vibration effect and leads to complaints. Rattling of doors and roofs causes concern and leads to people being upset.

Fly Rock: Fly rock can be mitigated but possibility never eliminated. However, it can be managed properly with relative ease. Control of fly rock will also control the effects of air blast. Fly rock is a greater concern when an open pit is near houses or structures or installations. Wild fly rock could cause damage to structures and installations but also be lethal to people and animals.

Considering the possible impacts given above the study will define the level of anticipated impact. The level of impact will also give guideline to the level of mitigation or management of the impacts. Management of the impacts could include the following aspects as indicated in Table 1 below. Detail of management and mitigation will be discussed in the report where applicable:

Table 1: Anticipated impact and possible management

Anticipated Impact	Mitigation / Management
Ground Vibration	Blast Design
	Reduce charge mass per delay
	Change drilling configuration
	Alternative blasting
	Change initiation systems
Air Blast	Blast Design
	Stemming controls
	Stemming lengths

	Stemming materials
	Meteorological concerns
Fly rock	Blast Design
	Stemming controls
	Stemming lengths
	Stemming materials
	Geological concerns

Based on a 15 m bench height and basic blast possibilities, 165 mm diameter blast holes may be drilled. Considering standard rules, a 165 mm diameter blast hole, 15 m deep and 4.8 m stemming length; a charge mass of 251 kg will be loaded into such blast hole. Pending the initiation system six blast holes could be detonated simultaneously yielding 1505 kg charge mass per delay. The following tables shows expected vibration and air blast from these masses over distance.

Table 2: Prediction for minimum charge estimation

Distance (m)	Min Charge / Delay	Low Charge PPV (mm/s)	Structure Response @ 10Hz	Human Tolerance @ 30Hz	Min Charge / Delay	Possible Concern?
50.0	251	171.6	Problematic	Intolerable	134.3	Problematic
75.0	251	87.9	Problematic	Intolerable	131.5	Complaint
150.0	251	28.0	Problematic	Intolerable	126.8	Complaint
200.0	251	17.4	Problematic	Unpleasant	124.8	Complaint
250.0	251	12.1	Problematic	Unpleasant	123.3	Complaint
300.0	251	8.9	Problematic	Unpleasant	122.1	Complaint
400.0	251	5.6	Acceptable	Perceptible	120.1	Complaint
500.0	251	3.8	Acceptable	Perceptible	118.5	Acceptable
600.0	251	2.8	Acceptable	Perceptible	117.3	Acceptable
700.0	251	2.2	Acceptable	Perceptible	116.3	Acceptable
800.0	251	1.8	Acceptable	Perceptible	115.4	Acceptable
900.0	251	1.5	Acceptable	Perceptible	114.5	Acceptable
1000.0	251	1.2	Acceptable	Perceptible	113.8	Acceptable
1250.0	251	0.8	Acceptable	Perceptible	112.3	Acceptable
1500.0	251	0.6	Acceptable	Too Low	111.1	Acceptable
1750.0	251	0.5	Acceptable	Too Low	110.1	Acceptable
2000.0	251	0.4	Acceptable	Too Low	109	Acceptable
2500.0	251	0.3	Acceptable	Too Low	107.6	Acceptable
3000.0	251	0.2	Acceptable	Too Low	106.4	Acceptable
3500.0	251	0.2	Acceptable	Too Low	105.3	Acceptable

Table 3: Prediction for maximum charge estimation

Distance (m)	Max. Charge / Delay	Max Charge PPV (mm/s)	Structure Response @ 10Hz	Human Tolerance @ 30Hz	Max. Charge / Delay	Possible Concern?
50.0	1505	752.0	Problematic	Intolerable	138.4	Problematic
75.0	1505	385.2	Problematic	Intolerable	135.6	Problematic
150.0	1505	122.7	Problematic	Intolerable	130.9	Complaint
200.0	1505	76.4	Problematic	Intolerable	128.9	Complaint
250.0	1505	52.8	Problematic	Intolerable	127.4	Complaint
300.0	1505	39.1	Problematic	Intolerable	126.1	Complaint
400.0	1505	24.3	Acceptable	Intolerable	124.2	Complaint
500.0	1505	16.8	Acceptable	Unpleasant	122.6	Complaint
600.0	1505	12.5	Acceptable	Unpleasant	121.4	Complaint
700.0	1505	9.7	Acceptable	Unpleasant	120.3	Complaint
800.0	1505	7.8	Acceptable	Unpleasant	119.4	Acceptable
900.0	1505	6.4	Acceptable	Unpleasant	118.6	Acceptable
1000.0	1505	5.4	Acceptable	Perceptible	117.9	Acceptable
1250.0	1505	3.7	Acceptable	Perceptible	116.3	Acceptable
1500.0	1505	2.7	Acceptable	Perceptible	115.1	Acceptable
1750.0	1505	2.1	Acceptable	Perceptible	114.1	Acceptable
2000.0	1505	1.7	Acceptable	Perceptible	113.1	Acceptable
2500.0	1505	1.2	Acceptable	Perceptible	111.7	Acceptable
3000.0	1505	0.9	Acceptable	Perceptible	110.5	Acceptable
3500.0	1505	0.7	Acceptable	Too Low	109.3	Acceptable

The objective is to outline the expected environmental effects that blasting operations could have on the surrounding environment. The study will investigate the related levels and possible influences of expected ground vibration, air blast, fly rock and noxious fumes on the area of 3500m[1] surrounding the blast areas. The data clearly indicates specific concerns within the first 500 m radius therefore consideration of possible influence ranges given below is applied.

The receiving environment is classed into three areas.

- 0 to 500 m which is considered the most critical. Ground vibration and air blast will be most significant within the 500 m radius. The levels of ground vibration will be very dependent on the drilling and blasting parameters applied. In most blasting operations this area is considered the unsafe zone and is normally cleared of all people and animals when blasting is done in a mining environment. Specific legal requirements from the Mine Health and Safety Act is also applicable for mining within 500 m from private infrastructure

[1] Determined by Blast Management & Consulting from Experience

- Lesser sensitive or medium sensitivity is the 500 m to 1500 m [2] reference area. The 1500m radius is considered by Blast Management & Consulting as a range where influence may be less but still requires active monitoring.
- The lowest critical or low sensitivity area is the 1500 m to approximately 3500 m radius. In this area the effects have more possibility of upsetting people than causing damage to structures.

Figure 3 indicates different ranges with various points of interest identified to date. These points are locations of possible receptors. At this stage this is not the final list of receptors or types of receptors as a site visit will confirm receptors and more detail review is required of the area during the EIA Phase. This is a basic indication of possible receptors. Receptors are classified based on the distance between the receptor and the open pit boundary. Receptors within 500 m are highly sensitive followed by medium sensitive and low sensitivity. Colours are also used to indicate sensitivity. Receptors located inside the open pit area are also indicated. It is assumed as indicated by the applicant that property belonging to receptors located inside the open pit area will be bought and these receptors will therefore move. Proceeding forward with detail evaluation specific attention will be required regarding high sensitivity areas.

[2] Estimated from experience by Blast Management & Consulting

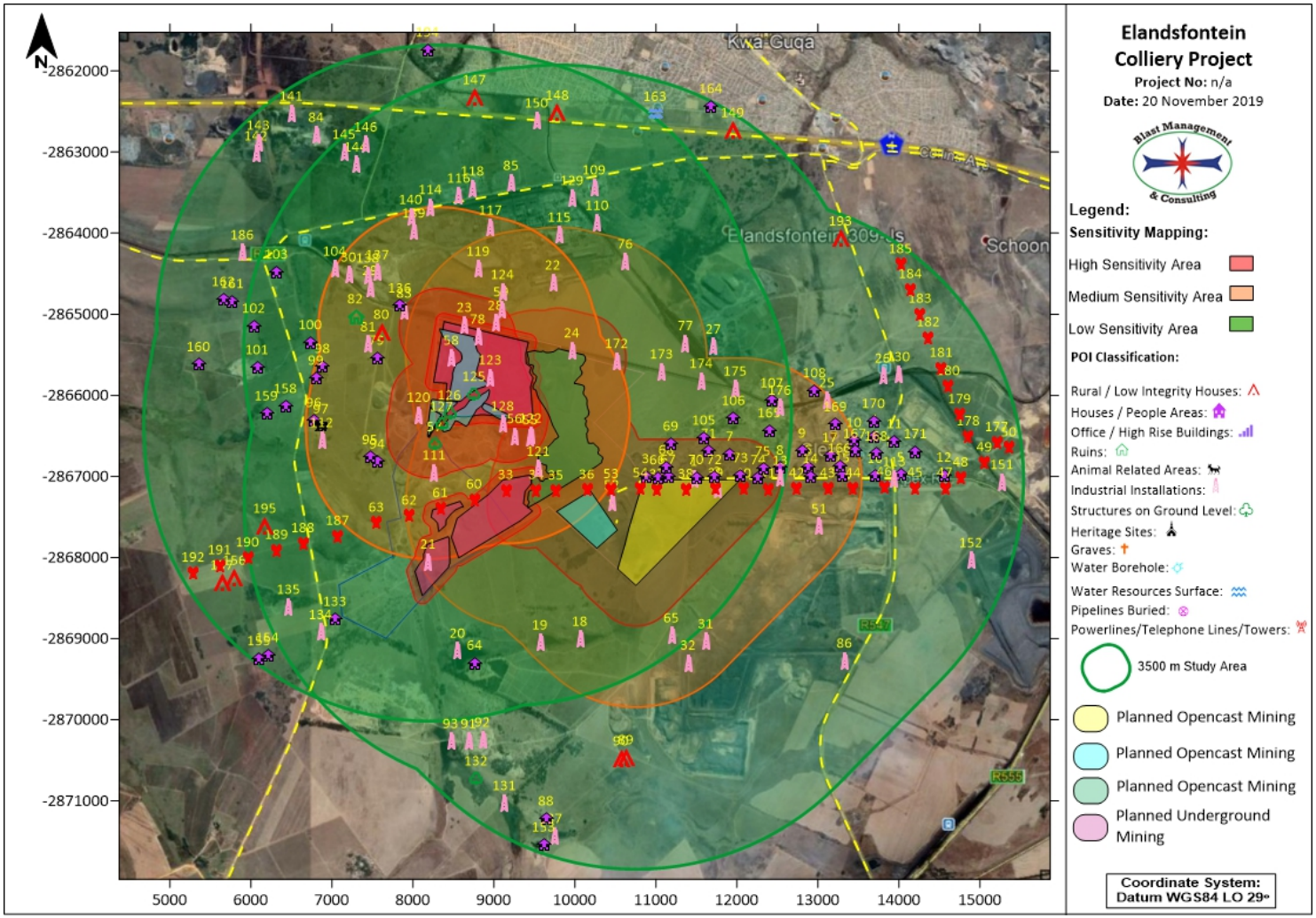

Figure 3: Study Area with POI and ranges from Open Pit Areas

Table 4 shows initial list of points identified with distances from the opencast areas. Indicated as well is the sensitivity rating indicated in colour for the various points. Olive Green = POI's found inside the pit area, Red = High, Mustard = Medium and Green = Low

Table 4: Initial identified points of interest

Tag	Description	Y	X	Distance (m)* to nearest Pit
2	Dam (Inside OC Pit Area)	-11760.49	2867157.80	-
34	Power lines/Pylons (Inside OC Area)	-9525.84	2867170.52	-
35	Power line/Pylons (Inside OC Area)	-9765.24	2867179.37	-
37	Power lines/Pylons (Inside OC Area)	-11014.25	2867166.12	-
38	Power lines/Pylons (Inside OC Area)	-11371.27	2867162.25	-
39	Power lines/Pylons (Inside OC Area)	-11738.85	2867148.57	-
1	Road	-11469.13	2867032.36	13
54	Power lines/Pylons	-10811.50	2867149.64	19
24	Railway Line	-9964.95	2865449.12	21
36	Power lines/Pylons	-10149.60	2867167.82	31
70	Houses	-11498.32	2867011.00	32
66	Houses	-11020.01	2867012.21	32
72	Houses	-11724.28	2867008.97	33
67	Houses	-11154.42	2867005.54	37
3	Buildings/Structures	-10875.61	2867000.12	43
78	Coal Yard	-8801.36	2865277.13	44
128	Mine Activity	-9109.77	2866351.15	49
73	Houses	-12046.99	2866986.32	55
127	Marsh	-8356.27	2866354.31	69
121	Coal Yard	-9551.62	2866907.23	75
123	Dam/Dam Wall	-8955.63	2865780.35	77
58	Mine Activity	-8475.54	2865538.43	98
57	Marsh	-8269.93	2866602.53	110
40	Power lines/Pylons	-12082.90	2867153.01	111
23	Railway Line	-8639.80	2865132.10	117
126	Marsh	-8455.05	2866217.42	123
120	Mine Activity	-8074.47	2866242.39	126
52	Mine Buildings/Structures	-10457.59	2867321.40	139
68	Houses	-11132.97	2866890.50	152
125	Marsh	-8757.44	2865985.70	159
56	Mine Buildings/Structures	-9257.65	2866506.73	214
53	Power lines/Pylons	-10452.09	2867161.63	226
55	Mine Activity	-9452.55	2866518.80	232
74	Houses	-12265.26	2867012.88	233
122	Mine Building	-9454.89	2866500.15	241
33	Power lines/Pylons	-9149.61	2867173.73	279
7	Houses	-11914.00	2866722.31	318
75	Houses	-12324.71	2866905.34	320
28	Sewer Works	-9024.05	2865106.65	321
71	Houses	-11654.74	2866686.08	354

41	Power lines/Pylons	-12383.53	2867155.46	368
172	Railway Line	-10517.81	2865580.48	390
69	Houses	-11186.05	2866596.82	445
111	Dam/Dam Wall	-8263.61	2866956.31	447
59	Industrial Structures	-9092.01	2864942.84	477
83	Railway line	-7896.88	2864960.78	490
13	Road	-12536.21	2867021.92	503
105	Houses	-11594.38	2866522.36	518
8	Houses	-12534.72	2866893.28	522
136	Building/Structure	-7841.06	2864894.09	571
124	Dam/Dam Wall	-9110.06	2864727.98	656
60	Power lines/Pylons	-8761.07	2867286.76	658
94	Farm Building	-7562.80	2866817.20	697
165	Houses	-12402.55	2866433.18	710
42	Power lines/Pylons	-12742.70	2867149.96	717
80	Informal Housing	-7615.25	2865220.58	718
95	Farm Building	-7473.61	2866762.99	756
106	Houses	-11959.36	2866283.28	756
65	Tailings Dam Active	-11193.34	2868962.82	759
22	Industrial Structure	-9730.00	2864611.45	819
119	Tailings Dam Old	-8807.00	2864440.13	829
79	Farmstead	-7557.26	2865537.80	846
9	Houses	-12808.24	2866682.76	853
6	Sport Terrain	-12880.27	2866887.69	860
14	Houses	-12911.68	2866998.92	879
61	Power lines/Pylons	-8344.03	2867394.97	893
81	Cement Dam	-7452.38	2865370.72	898
18	Dam/Dam Wall	-10062.72	2869004.05	952
173	Railway Line	-11070.91	2865708.91	955
29	Mining Activity	-7471.72	2864678.32	999
62	Power lines/Pylons	-7957.10	2867488.14	1002
176	Railway Line	-12532.65	2866153.90	1016
137	Mine Building	-7567.06	2864486.20	1036
82	Ruins	-7294.08	2865027.87	1050
107	Houses	-12432.36	2866062.79	1055
43	Power lines/Pylons	-13122.88	2867149.87	1095
31	Mine Activity	-11616.09	2869032.87	1098
138	Mine Buildings/Structure	-7445.63	2864523.74	1106
175	Railway Line	-11980.71	2865920.14	1119
51	Mine Activity	-13018.68	2867616.02	1141
32	Mine Building/Structures	-11399.98	2869300.58	1155
17	Building/Structure	-13149.61	2866736.96	1156
174	Railway Line	-11562.89	2865825.26	1216
63	Power lines/Pylons	-7554.12	2867573.86	1237
166	Houses	-13265.77	2866868.67	1244
77	Railway line	-11366.53	2865359.23	1251
139	Industrial Buildings	-8015.57	2863970.28	1254
76	Railway line	-10624.65	2864350.70	1264
15	Houses	-13300.68	2866986.35	1268

112	Dam/Dam Wall	-6876.56	2866553.10	1307
97	Cattle Yard	-6866.90	2866382.17	1308
30	Mine Buildings	-7207.26	2864512.96	1310
19	Dam/Dam Wall	-9569.56	2869050.08	1320
117	Industrial Structures	-8959.97	2863933.39	1357
169	Houses	-13217.68	2866355.96	1367
96	Farmstead	-6780.80	2866305.04	1395
21	Dam/Dam Wall	-8191.74	2868054.54	1398
115	Industrial Structures	-9811.28	2864020.06	1407
98	Farm Buildings	-6885.12	2865639.89	1408
44	Power lines/Pylons	-13438.04	2867149.47	1408
140	Industrial Building/Structure	-7976.08	2863803.73	1426
108	Building Structures	-12959.93	2865939.77	1438
99	Farmhouse	-6806.98	2865785.93	1447
25	Railway Line	-13113.41	2866061.55	1457
167	Houses	-13454.41	2866686.69	1464
104	Railway line	-7036.75	2864443.10	1493
10	Houses	-13447.39	2866552.67	1495
114	Road (R104)	-8217.73	2863681.64	1507
27	Industrial Structures	-11711.17	2865400.14	1589
100	Farmstead	-6736.77	2865347.50	1604
110	Dam/Dam Wall	-10276.85	2863874.93	1620
187	Power lines/Pylons	-7074.12	2867737.45	1657
116	Industrial Structures	-8568.46	2863538.41	1660
16	Houses	-13708.24	2866995.26	1675
168	Houses	-13719.16	2866718.49	1716
4	School	-13694.62	2866514.64	1742
158	Farmstead	-6427.53	2866132.35	1761
118	Industrial Structures	-8738.96	2863452.26	1775
46	Power lines/Pylons	-13824.54	2867135.50	1793
170	Houses	-13686.14	2866318.31	1803
129	Road Bridge	-9966.97	2863567.80	1867
113	Road (R547)	-13943.23	2867033.85	1909
85	Power Station	-9214.73	2863383.70	1950
20	Dam/Dam Wall	-8552.03	2869149.80	1967
11	Houses	-13944.67	2866566.32	1968
159	Farmstead	-6194.38	2866223.76	1985
5	Church	-14023.50	2866977.38	1991
64	Game Lodge Buildings	-8767.12	2869300.01	2024
188	Power lines/Pylons	-6644.63	2867826.27	2029
109	Industrial Buildings	-10238.67	2863438.57	2036
89	Informal Housing	-10630.36	2870465.91	2125
103	Farm Building/Structures	-6319.29	2864475.95	2134
90	Informal Housing	-10571.09	2870478.77	2142
45	Power lines/Pylons	-14203.68	2867142.62	2172
26	Railway Substation	-13802.16	2865760.30	2182
101	Buildings/Structures	-6078.93	2865655.48	2187
171	Houses	-14205.20	2866692.44	2199
144	Industrial Building/Structure	-7296.96	2863154.11	2279

195	Informal Housing	-6173.30	2867609.36	2296
102	Farm Buildings	-6036.09	2865142.55	2297
189	Power lines/Pylons	-6318.45	2867911.93	2337
130	Bridge	-13995.26	2865741.00	2352
146	Mine Building/Structure	-7420.68	2862908.81	2451
145	Mine Building/Structure	-7153.20	2862999.33	2483
86	Power Substation	-13331.99	2869272.76	2489
133	Farmhouse	-7041.40	2868757.32	2521
12	Houses	-14559.13	2866982.17	2526
47	Power lines/Pylons	-14571.14	2867142.42	2539
161	Farmstead	-5771.70	2864839.64	2584
186	Sub Station	-5895.04	2864237.60	2615
92	Mine Activity	-8862.05	2870248.92	2681
190	Power lines/Pylons	-5961.38	2868006.81	2684
162	Farmstead	-5665.86	2864815.23	2692
135	Industrial Area	-6467.14	2868610.03	2714
48	Power lines/Pylons	-14766.03	2867014.64	2732
134	Industrial Area	-6863.66	2868922.53	2751
150	N4 Road	-9529.39	2862611.91	2777
91	Mine Building/Structures	-8690.61	2870266.15	2808
180	Power lines/Pylons	-14611.66	2865890.21	2822
179	Power lines/Pylons	-14750.63	2866238.14	2832
84	Mine Buildings	-6810.45	2862791.25	2836
181	Power lines/Pylons	-14524.74	2865665.01	2845
178	Power lines/Pylons	-14858.24	2866507.89	2874
147	Kwa-Guqa Houses	-8761.39	2862326.46	2887
160	Farmstead	-5354.98	2865617.58	2906
148	Kwa-Guqa Houses	-9785.01	2862516.89	2911
182	Power lines/Pylons	-14366.02	2865288.87	2916
156	Informal Houses	-5800.68	2868251.08	2955
93	Dam/Dam Wall	-8468.76	2870266.97	2960
183	Power lines/Pylons	-14264.54	2864999.82	3023
152	Tailings Dam	-14890.51	2868034.10	3025
191	Power lines/Pylons	-5616.16	2868101.06	3025
49	Power lines/Pylons	-15058.72	2866831.95	3032
88	Farmstead	-9648.46	2871218.45	3079
132	Marsh	-8782.45	2870727.51	3092
163	Reservoir	-10994.18	2862531.51	3100
157	Informal Houses	-5645.81	2868309.45	3115
142	Coal Yard	-6064.61	2863017.84	3136
131	Dam/Dam Wall	-9129.96	2871029.72	3137
184	Power lines/Pylons	-14144.89	2864695.48	3154
143	Industrial Building/Structure	-6096.23	2862888.79	3205
177	Power lines/Pylons	-15209.23	2866582.16	3208
193	Informal Housing	-13283.38	2864067.16	3224
141	Industrial Building/Structure	-6501.51	2862527.09	3227
151	Anglo Mining Operations	-15272.87	2867072.93	3239
87	Dam/Dam Wall	-9751.67	2871435.49	3249
185	Power lines/Pylons	-14021.87	2864385.50	3316

149	Kwa-Guqu Houses	-11949.41	2862730.84	3329
154	Farm Buildings	-6207.41	2869205.80	3344
50	Power lines/Pylons	-15358.00	2866646.97	3347
192	Power lines/Pylons	-5289.59	2868188.79	3350
153	Farmstead	-9617.14	2871541.27	3392
155	Farmstead	-6103.09	2869244.30	3438
164	Church	-11679.74	2862434.71	3449
194	Farm Buildings/Structures	-8182.59	2861737.38	3450

* Distance indicated is distance between pit edge and point of interest.

The specific levels of influence to be considered contributing to damage of structures / installations in the area cannot be determined at this stage. A detail analysis of drilling and blasting operations will be required to determine spheres of influence from planning blasting operations. Such an investigation or analysis is generally conducted during the EIA phase of the environmental impact assessment. The geology and expected drilling and blasting operations to be done, with the possible influence with regards to the human perceptions of ground vibration and air blast, will be considered. Humans are sensitive to even very low-level effects of ground vibration and air blast. In order to take this into consideration an area with a radius of 3500m around the open pit is identified as an area that could observe influence. This is with the view that people will experience ground vibration levels as low as 0.75mm/s[3].

The objective is to outline the expected environmental effects that blasting operations could have on the surrounding environment. The EIA phase of the study will investigate the related levels and possible influences of expected ground vibration, air blast, fly rock on the surrounding area.

Review of the area clearly shows that various infrastructure is found within and around the proposed open pit area. The infrastructure is considered private property and not mine owned. This will require careful planning regarding drilling and blasting operations. There are various legal requirements that will need to be considered in the process going forward. A detailed plan of possible influence will be required with specific mitigation measures to be implemented.

[3] Chiapetta F, A Van Vreden, 2000, Vibration/Air blast Controls, Damage Criteria, Record Keeping and Dealing with Complaints. 9th Annual BME Conference on Explosives, Drilling and Blasting Technology, CSIR Conference Centre, Pretoria, 2000.

9 Scoping Phase Impact Assessment

The scoping phase impact is based on review of the planned project area with the surrounding infrastructure. Evaluation is done based on the three areas of sensitivity and the type of infrastructure observed in the areas of 0 to 500 m, 0 to 1500 m and beyond 1500 m.

Table 5: Scoping Phase Impact Assessment

IMPACT DESCRIPTION				Pre-Mitigation							Post Mitigation								Priority Factor Criteria			
Identifier	Impact	Alternative	Phase	Nature	Extent	Duration	Magnitude	Reversibility	Probability	Pre-mitigation ER	Nature	Extent	Duration	Magnitude	Reversibility	Probability	Post-mitigation ER	Confidence	Cumulative Impact	Irreplaceable loss	Priority Factor	Final score
8.1	Ground Vibration	Alternative 1	Operation	-1	3	4	4	3	4	-14	-1	3	4	2	3	3	-9	High	2	2	1.25	-11.25
8.2	Air Blast	Alternative 1	Operation	-1	3	4	4	3	4	-14	-1	3	4	2	3	3	-9	High	2	2	1.25	-11.25
8.3	Fly Rock	Alternative 1	Operation	-1	3	4	4	3	4	-14	-1	3	4	2	3	3	-9	High	2	2	1.25	-11.25

10 Possible mitigations

Review of ground vibration and air blast levels and method applied above it is certain that specific areas will be influenced negatively. There are options of considering different processes that can help mitigate these influences. Drilling designs can be altered to smaller diameters which provides that less charge per blasthole charged. Different initiation systems can be used – electronic initiation instead of normal shock tube systems. Electronic initiation provides opportunity to manage the delay periods of blastholes detonating – so single blasthole detonation can be achieved. This will reduce the effective charge contributing to ground vibration to the charge per blasthole and assist in managing the level of ground vibration. Regarding air blast and fly rock there is options to manage the stemming length, stemming material and stemming procedures. All these factors could be employed in facilitating a reduced external effect with regards to ground vibration, air blast and fly rock. Detail specific blast design for each specific block blasted should be used. This design should consider all the factors of influence and the distance relationship between blast and the point/s of concern.

11 Plan of future study

In order to complete the impact assessment, the following will be required:

- Conduct a site visit to determine location of structures and structure profiles: Determine typical structures and installations that are found within the influence radius from the blasting operations.
- Obtain all relevant data and information on proposed blasting methods and methodology.
- The process then consists of modelling the expected impact based on planned drilling and blasting information for the operation. Various accepted mathematical equations[4] are applied to determine the attenuation of ground vibration, air blast and fly rock. These values are then calculated over distance from site and shown as amplitude level contours. Overlay of these contours with the location of the various receptors gives an indication of the possible impact and expected result of potential impact. Evaluation of each receptor according to the predicted levels will indicate the level of possible influence and required mitigation if necessary. The possible environmental or social impacts are then addressed in the detailed EIA phase investigation.
- Prepare a report that provides the discussion and outcomes of all evaluations.
- Present the outcomes to interested and affected parties if required.

[4] Persson, P. A., R. Holmberg and J. Lee, 1994, Rock Blasting and Explosives Engineering, Boca Raton, Florida: CRC Press.

12 Conclusion and Recommendations

The Elandsfontein Colliery Project was reviewed on scoping level phase. Points of interest were identified for possible influence. Various installations were identified within the 3500 m radius from the proposed new open pit. Three areas ranging from 0 to 3500 m was identified with different levels of possible influence indicated. The possible influences and level of influence will be investigated and if required mitigation measures will be recommended during the impact assessment phase. Upon review of the location of the proposed open pit areas careful consideration will be required for drilling and blasting operations in the pit areas. Consideration must be given to various legal requirements that will be applicable.