

# Impact Assessment

## **Methodology for Impact Significance Scoring**

The significance (quantification) of potential environmental impacts identified during the Basic Assessment have been determined using a ranking scale, based on the following (terminology has been taken from the Guideline Documentation on EIA Regulations, of the Department of Environmental Affairs and Tourism, April 1998):

### **Occurrence**

- Probability of occurrence (how likely is it that the impact may occur?)
- Duration of occurrence (how long may it last?)

### **Severity**

- Magnitude (severity) of impact (will the impact be of high, moderate or low severity?)
- Scale/extent of impact (will the impact affect the national, regional or local environment, or only that of the site?)

Each of these factors has been assessed for each potential impact using the following ranking scales:

<b>Probability</b>	<b>Duration</b>
1 - very improbable (probably will not happen) 2 - improbable (some possibility, but low likelihood) 3 - probable (distinct possibility) 4 - highly probable (most likely) 5 - definite (impact will occur regardless of any prevention measures)	1 - of a very short duration (0–1 years) 2 - of a short duration (2-5 years) 3 - medium-term (5–15 years) 4 - long term (> 15 years) 5 - permanent
<b>Extent</b>	<b>Magnitude</b>
1 - limited to the site 2 - limited to the local area 3 - limited to the region 4 - will be national 5 - will be international	0 - small and will have no effect on the environment 2 - minor and will not result in an impact on processes 4 - low and will cause a slight impact on processes 6 - moderate and will result in processes continuing but in a modified way 8 - high (processes are altered to the extent that they temporarily cease) 10 - very high and results in complete destruction of patterns and permanent cessation of processes

The environmental significance of each potential impact is assessed using the following formula:

$$\text{Significance Points (SP)} = (\text{Magnitude} + \text{Duration} + \text{Extent}) \times \text{Probability}$$

The maximum value is 100 Significance Points (SP). Potential environmental impacts were rated as high, moderate or low significance on the following basis:

- < 30 significance points = **LOW** environmental significance.
- 31- 60 significance points = **MODERATE** environmental significance
- > 60 significance points = **HIGH** environmental significance

The table below summarises all the identified impacts and their significance ratings without and with mitigation, while detailed descriptions of each impact are provided there under.

*Note there are no feasible alternatives for the proposed development of the Cogeneration Facility **EXCEPT** the NO GO Alternative.*

**1. IMPACTS THAT MAY RESULT FROM THE PLANNING AND DESIGN, CONSTRUCTION, OPERATIONAL, DECOMMISSIONING AND CLOSURE PHASES AS WELL AS PROPOSED MANAGEMENT OF IDENTIFIED IMPACTS AND PROPOSED MITIGATION MEASURES**

Provide a summary and anticipated significance of the potential direct, indirect and cumulative impacts that are likely to occur as a result of the planning and design phase, construction phase, operational phase, decommissioning and closure phase, including impacts relating to the choice of site/activity/technology alternatives as well as the mitigation measures that may eliminate or reduce the potential impacts listed. This impact assessment must be applied to all the identified alternatives to the activities identified in Section A (2) of this report.

Note: There are no planning and design phase impacts associated with the proposed development. Refer below for the construction phase, operational phase, decommissioning phase impacts identified and assessed.

**CONSTRUCTION PHASE POTENTIAL IMPACTS**

Impact Summary	Significance	Proposed Mitigation															
<b>Alternative 1 (The Preferred Alternative)</b>																	
<b>Direct impacts</b>																	
<p><u><b>Health and Safety Impacts</b></u>                      During the assembly of the flare and the engines, there is potential for fire and explosions in extreme cases where management and expertise are inadequate. However the potential of this occurring is unlikely as the installation and operation is highly specialist skill requiring that specific people undertake the task.</p> <table border="1"> <thead> <tr> <th colspan="5">Significance Table: Safety at Beatrix Mine</th> </tr> <tr> <th>Duration</th> <th>Magnitude</th> <th>Extent</th> <th>Probability</th> <th>Significance</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>4</td> <td>1</td> <td>3</td> <td>18</td> </tr> </tbody> </table> <p>As a result the impact is of <b>Low significance impact (Negative)</b>.</p> <p>There are no Indirect or cumulative impacts during the construction phase for the proposed development.</p>	Significance Table: Safety at Beatrix Mine					Duration	Magnitude	Extent	Probability	Significance	1	4	1	3	18	<p><b>Low</b></p>	<p>Adhere to all health and safety standards as regulated by Beatrix mine.</p>
Significance Table: Safety at Beatrix Mine																	
Duration	Magnitude	Extent	Probability	Significance													
1	4	1	3	18													
<b>No - Go Alternative</b>																	
<p>There would be no impacts the status quo would stay the same.</p>	<p>N/a</p>	<p>N/a</p>															

**OPERATIONAL PHASE POTENTIAL IMPACT**

Impact Summary	Significance	Proposed Mitigation															
<b>Alternative 1 (The Preferred Alternative)</b>																	
<b>Direct impacts</b>																	
<p><b>Noise Impacts</b>                      The four combustion engines proposed would create low level noise, however taking into consideration that that facility is within an industrial zone, with no noise receptors. The significance is low.</p> <table border="1"> <thead> <tr> <th colspan="5">Significance Table: Increase Safety at Beatrix Mine</th> </tr> <tr> <th>Duration</th> <th>Magnitude</th> <th>Extent</th> <th>Probability</th> <th>Significance</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>6</td> <td>2</td> <td>4</td> <td>44</td> </tr> </tbody> </table>	Significance Table: Increase Safety at Beatrix Mine					Duration	Magnitude	Extent	Probability	Significance	5	6	2	4	44	<p><b>Low</b> Significance</p>	<p>Ensure the noises are within the acceptable limits for Beatrix Mine</p>
Significance Table: Increase Safety at Beatrix Mine																	
Duration	Magnitude	Extent	Probability	Significance													
5	6	2	4	44													
<b>No - Go Alternative</b>																	
There would be no impacts the status quo would stay the same.	N/a	N/a															

## OPERATIONAL PHASE POTENTIAL IMPACT

Impact Summary	Significance	Proposed Mitigation															
<b>Alternative 1 (The Preferred Alternative)</b>																	
<b>Direct impacts</b>																	
<p><b><u>Health and Safety Impacts</u></b>            Underground (mine) methane is a hazardous gas as it has wide explosion limits in air and has the potential to cause explosions if not efficiently and safely managed through safe mine ventilation systems underground. Methane gas is a recognised, significant safety risks for underground mine workings. Although methane awareness and safety is improving, it is still a deadly and justifiably feared hazard of the mining industry. The problem is that methane is unavoidable and unlike coal mine methane, it is not a direct result of mining. In coal mines, the methane production is a function of the coal being mined. In gold mines, the methane is in geological faults and when these faults are intersected, this methane gas is released. Hence, methane emits continuously from certain areas in the mine. The properties of methane make it as difficult to detect. It is colourless, odourless and non-toxic, so there are no obvious physical signs such as coughing or streaming eyes to warn of its proximity (it will cause suffocation if it builds up in a badly ventilated space). Once present in the atmosphere of the mine, methane can easily ignite. Mine operators must ventilate or drain methane gas away from the face of the mine to keep levels well below the explosive range. It is a hazard to miners. The extraction of the methane will result in a safer working environment for the personnel at Beatrix Mine. Methane from both the underground working areas and from the boreholes will be destroyed either by flaring or by utilising it in power generation equipment or absorption chillers. The proposed development will have a moderate significance impact (Positive).</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr style="background-color: #d3d3d3;"> <th colspan="5">Significance Table: Increase Safety at Beatrix Mine</th> </tr> <tr> <th>Duration</th> <th>Magnitude</th> <th>Extent</th> <th>Probability</th> <th>Significance</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">6</td> <td style="text-align: center;">2</td> <td style="text-align: center;">4</td> <td style="text-align: center;">44</td> </tr> </tbody> </table>	Significance Table: Increase Safety at Beatrix Mine					Duration	Magnitude	Extent	Probability	Significance	5	6	2	4	44	<p><b>MODERATE</b> Significance</p>	<p>Adhere to all health and safety regulations for Beatrix Mine.</p>
Significance Table: Increase Safety at Beatrix Mine																	
Duration	Magnitude	Extent	Probability	Significance													
5	6	2	4	44													
<b>No - Go Alternative</b>																	
<b>There would be no impacts the status quo would stay the same.</b>	N/a	N/a															

## OPERATIONAL PHASE POTENTIAL IMPACT

Impact Summary	Significance	Proposed Mitigation													
<b>Alternative 1 (The Preferred Alternative)</b>															
<b>Direct impacts</b>															
<p><b><u>Air Emissions</u></b>            Aspects may contribute to potential air pollution include:</p> <ul style="list-style-type: none"> <li>- Diesel emissions from mechanically driven equipment. (Minimal qualities)</li> <li>- Methane and other natural gas.</li> </ul>	<p><b>MODERATE</b> Significance (Positive)</p>	<p>No Mitigation Required.</p>													
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #d3d3d3;"> <th colspan="5">Significance Table: Increase air quality at Beatrix Mine</th> </tr> <tr> <th>Duration</th> <th>Magnitude</th> <th>Extent</th> <th>Probability</th> <th>Significance</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">6</td> <td style="text-align: center;">2</td> <td style="text-align: center;">4</td> <td style="text-align: center;">44</td> </tr> </tbody> </table> <p>The operation of the flare would reduce the amount of air pollution as the flare would destroy methane that entering the atmosphere.</p>			Significance Table: Increase air quality at Beatrix Mine					Duration	Magnitude	Extent	Probability	Significance	5	6	2
Significance Table: Increase air quality at Beatrix Mine															
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5	6	2	4	44											
<b>No - Go Alternative</b>															
There would be no impacts the status quo would stay the same.	N/a	N/a													
<b>Indirect impacts</b>															
There are no Indirect or cumulative impacts during the operational phase for the proposed development.															

## OPERATIONAL PHASE POTENTIAL IMPACT

Impact Summary	Significance	Proposed Mitigation															
<b>Alternative 1 (The Preferred Alternative)</b>																	
<b>Direct impacts</b>																	
<p><b>Social Impact:</b> The proposed facility would create thirty five (35) temporary and two permanent additional employments. The local community has a large number unemployed people. Job creation by strengthening the mining sector in this area is crucial as stated in the IDP as the area is highly dependent on the mining industry.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #cccccc;"> <th colspan="5" style="text-align: left; padding: 2px;">Significance Table: Increase air quality at Beatrix Mine</th> </tr> <tr> <th style="width: 20%;">Duration</th> <th style="width: 20%;">Magnitude</th> <th style="width: 20%;">Extent</th> <th style="width: 20%;">Probability</th> <th style="width: 20%;">Significance</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">6</td> <td style="text-align: center;">2</td> <td style="text-align: center;">4</td> <td style="text-align: center;">44</td> </tr> </tbody> </table>	Significance Table: Increase air quality at Beatrix Mine					Duration	Magnitude	Extent	Probability	Significance	3	6	2	4	44	<p><b>MODERATE</b> environmental significance (Positive)</p>	<p>No mitigation required.</p>
Significance Table: Increase air quality at Beatrix Mine																	
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3	6	2	4	44													
<b>No - Go Alternative</b>																	
There would be no impacts the status quo would stay the same.	N/a	N/a															

## OPERATIONAL & CONSTRUCTION PHASE POTENTIAL IMPACTS

Impact Summary	Significance	Proposed Mitigation															
<b>No - Go Alternative</b>																	
<p>The <b>No Go Alternative</b> refers to the proposed development not occurring. As such the following positive benefits would not come to light:</p> <ul style="list-style-type: none"> <li>- <b>The destruction of methane:</b> The proposed project will destroy both the underground mine methane and the borehole methane. The destruction of this methane will result in the elimination of methane released directly into the atmosphere. Since methane has 21 times the global warming potential of carbon dioxide, the project will result in a significant reduction of greenhouse gas emissions from the mine.</li> <li>- <b>The displacement of grid electricity:</b> Methane will be extracted from underground and piped up from Shaft 4 to the surface. This methane will fuel internal combustion engines to produce electricity. The electricity will be used on the mine; reducing the amount of electricity that Beatrix Mine needs to import from the national grid. The methane and the waste heat from the engines will be used to generate chilled water. This chilled water would otherwise have been generated using electricity in conventional electric chillers. Hence, the production of chilled water in this project will further displace grid electricity.</li> <li>- <b>Social Impact:</b> The project will create jobs in both the construction and operations phase. The project will contribute to foreign reserve earnings for South Africa via the carbon credit sales revenue. The carbon credits obtained from the destruction of methane will be owned by Gold Fields. The current earning profile of the mine changes with the fluctuating gold price and the cyclical changes associated with the South African currency. The revenue from the carbon credits will decrease the volatility of the normal earnings profile of the mine.</li> </ul>	<p><b>HIGH</b> environmental significance (Negative)</p>	<p>No Mitigation Required.</p>															
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #cccccc;"> <th colspan="5">Significance Table: Increase air quality at Beatrix Mine</th> </tr> <tr> <th>Duration</th> <th>Magnitude</th> <th>Extent</th> <th>Probability</th> <th>Significance</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">8</td> <td style="text-align: center;">5</td> <td style="text-align: center;">5</td> <td style="text-align: center;">90</td> </tr> </tbody> </table>			Significance Table: Increase air quality at Beatrix Mine					Duration	Magnitude	Extent	Probability	Significance	5	8	5	5	90
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Duration	Magnitude	Extent	Probability	Significance													
5	8	5	5	90													
<p>As noted, the above benefits would not come to light if the project does not go ahead. As such the overall cumulative impact of not developing the Co - generation Facility is negative, with a high environmental significance.</p>																	

## 2. ENVIRONMENTAL IMPACT STATEMENT

Taking the assessment of potential impacts into account, please provide an environmental impact statement that summarises the impact that the proposed activity and its alternatives may have on the environment after the management and mitigation of impacts have been taken into account, with specific reference to types of impact, duration of impacts, likelihood of potential impacts actually occurring and the significance of impacts.

It is evident from this document that a major concern with regards to the existing operations of Beatrix Mine, is their current methane emissions into the atmosphere. This assessment illustrates that there are various potential negative and positive impacts that may result from the proposed Co-Generation facility and associated infrastructure.

From an environmental perspective and with the consideration of the potential impacts detailed above, the EAP is of the view that the preferred alternative A will result in Moderate Positive impacts with mitigation.

The Impact Summary Report in **Table 1** below indicates that with the implementation of mitigation measures, all impacts will be of low significance to the receiving environment. However, given the degraded environment and considering the proposed site is currently a working mining operation, the impacts associated with the proposed installation of the Co-Generation facility is minimal. Construction of the Co-Generation facility would not be labour intensive, as the facility would be containerised and equipment assembled.

Health and Safety Impacts is an important environmental aspect requiring careful mitigation and control. The danger of working with highly flammable gases must be recognised. The mitigation measures recommended is to ensure that the National Health and Safety Regulations must be adhered to with appropriate measures included into the Environmental Management Programme (See Appendix G).

Several mitigation measures have been proposed to minimise the anticipated environmental impacts together with an environmental management programme report to monitor the effectiveness of these mitigation measures.

**Table 1: Potential Impact Summary Report.**

ALTERNATIVES	A1 (Preferred Alternative)		No-Go	
CONSTRUCTION PHASE IMPACTS				
POTENTIAL IMPACT	Without mitigation	With mitigation	Without mitigation	With mitigation
Health and Safety (Direct Impact)	Low (-)	Low (-)	-	-
OPERATIONAL PHASE IMPACTS				
POTENTIAL IMPACT	Without mitigation/ enhancement	With mitigation/ enhancement	Without mitigation	With mitigation
Health and safety (Indirect Impact)	Moderate (-)	Low (-)	-	-
Noise Impacts (Direct Impact)	Low (-)	Low (-)	-	-
Air Emissions	Moderate (+)	N/A	-	-
Social Impact (Indirect Impact)	Moderate (+)	N/A	High (-)	-

Key:

	High negative impact	(-)	Negative Impact
	Moderate negative impact	(+)	Negative Impact
	Moderate positive impact	(-)	Positive Impact
	Low	(-)	Negative Impact

### Alternative A (preferred alternative)

On the basis of the findings in this report, it is suggested that **Alternative A** be approved for the construction of the proposed Co-Generation Facility.

### No-go alternative (compulsory)

The “No-Go” alternative was briefly assessed and compared as shown above.

The proposed Co-Generation Facility has positive environmental and social impacts. The purpose of the proposed facility is to increase the sustainability of the mine, reduce methane emissions and create an alternative energy supply.