ANNEXE I

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Our Reference: 02-0303
Your Reference

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Webber Wentzel
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2196

Attention Mr Garyn Rapson – (by email)

Dear Sirs

DCDM Voorspoed Mine Closure: Environmental Authorization FS 30/5/1/2/3/2/1(o12)EM

We refer to our instruction from Mr Garyn Rapson of Webber Wentzel to review the DeBeers Consolidated Mines Voorspoed Mine "Voorspoed Mine Basic Assessment Report and Environmental Management Programme and Closure Plan for Decommissioning" by Centre for Environmental Managing of the North West University.
We also refer to the Environmental Authorization by the Dept of Mineral Resources (Ref FS 30/5/1/2/3/2/1(012) EM, specifically Section 4 Findings, section 4(d) which states:
"The open pit walls is not stable and the materials from the walls are accumulating onto the pit. It was found that if the pit is not backfilled, the continuous failure of the pit walls will continue, and this may result severe degradation and public safety issues".
In addition, The Environmental Authorisation states in EA Site Specific Conditions 6
"Materials removed from the pit (mining residue) must be prioritised for the pit backfilling and any other materials to be used must not lead to any environmental pollution read with condition (d) of the amended Environmental Management Programme (EMPr) approval letter which states that *"all mine wastes (suitable for rehabilitation) must be taken back to the excavation area for backfilling purposes."*

GCS Findings:
GCS Has reviewed the CEM report and supporting specialist reports and is of the following opinion:
Failure of the pit wall is depended on the geology (structural and lithological) of the sidewall and the impact of weathering while being exposed to oxygen and water. The geotechnical findings are addressed in a DCDM internal geotechnical report which from personal communication Mr Philip De Graaf De Beers Geotechnical Engineer, states

- The failure of the Voorspoed mine open pit after closure was modelled by DCBM. The extent of the surface area expression of the failure was modelled and it will not extend beyond the location of the proposed security fence around the mine. In other words, the final surface

area of the open pit will not extend beyond the proposed safety fence and berms around the mine

GCS Reply to Section 4(d)
Environmental Issues.

- There are no significant environmental issues involved with the failure of the Voorspoed open pit sidewalls
- On failure, material from the sidewalls will collapse into the pit with a portion reaching the pitlake and a portion remaining as scree on the sidewalls
- DCDM geotechnical model indicates it is highly unlikely that the failure of the sidewalls will have any significant surface expression. In other words, the pit surface area will enlarge beyond the fence. This is due to the bench configuration and the geological material. As a result, this will not impact on any of the environmental mitigation measures proposed in the CEM Closure Environmental Management Program and Closure plan for decommissioning (fences, enviro-berms, etc)

Water Issues

- Material from the sidewall failure will have very limited water impact.
- There will be insignificant impact on the pitlake water quality due to the nature of the material that may fall into the pitlake.
- The rate of rise of water in the pitlake may increase due to material falling into the pitlake and effectively decreasing the void volumes of the pitlake.

Environmental Impact

The Environmental impact of the failure of the Voorspoed sidewall is therefore (according to CEM classification):

Extent – site specific: limited to the open pit
Duration –Medium: will continue randomly until the pit walls reach a stable state. Difficult to predict but will become less significant over time
Magnitude- Very low: Very local in extent and will have no impact on the surface area around the pit
Probability- Moderate: this will occur over time
Reversibility – Low: impossible to reverse
Avoidance – Low: impossible to avoid
Irreplaceable loss- Low: there is no loss of irreplaceable resources

Impact significance -very low. No mitigation or remedial activity will be needed. A low impact on the ecological system or any of its parts.

There is no need for any environmental mitigation as the significance is very low

GCS Opinion

GCS has reviewed the documentation and is of the opinion is that the proposed and Preferred Option 1 (detailed in the CEM EMPr, closure plan and Mineral Resource letter) offers an environmentally acceptable and sustainable option for the Voorspoed Open Pit Mine closure.

The Pitlake option does not result in any environmental liabilities that cannot be managed on site

GCS does not have the required expertise to comment on any of the health and safety issues related to Option 1

We have included some additional scientific data on pitlake for reference

Yours faithfully

Andrew Johnstone
Director

Background and Supporting Documentation for Voorspoed Mine Closure with a Pitlake

1. The Scientific Viability of Pitlakes

1.1. Recently, GCS authored a scientific study that was commissioned by the WRC to investigate whether pitlakes are an environmentally sustainable closure option for coal mines. The sustainability of pitlakes is a function of the mining method employed during operations and the relative size of the pitlake in comparison to the disturbed area. The study is entitled "*An Investigation to Determine if South African Coal Mine Pitlakes are a Viable Closure Option"* and is dated August 2019 ("**the WRC 2019 Pitlakes Study**"). However, the findings can be applied to a variety of mines, including diamond mines.

1.2. The WRC 2019 Pitlakes Study concludes as follows:
"The study concludes that pitlakes can be environmentally sustainable if they are designed correctly and that the potential surface discharge of water into the catchment area is managed. The organic and inorganic water quality in the pitlakes showed that the pitlakes are alkaline and have elevated total dissolved solid contents (mainly sodium sulphate) when compared to the natural surface and groundwater in the catchment. These water bodies can support life in terms of chlorophyll-a, phytoplankton and microbiology (bacteria).

The surface area of a pitlake is vitally important to maximise evaporation which directly affects the water balance. In addition, surface runoff should be controlled to avoid excess runoff into the pitlake during storm events that may lead to a temporary positive water balance and uncontrolled discharge into the catchment. Should the pitlake be suitably designed, it forms a water sink to prevent uncontrolled discharge from the mining operations.

A fundamental change in thinking and South Africa legislative requirement is required to view pitlakes as an environmentally sustainable solution to prevent uncontrolled discharge from open cast mining operations to avoid the expense of ongoing water treatment. Correctly designed pitlakes offer an environmentally sustainable closure option for open cast coal mines in South Africa.

Enough data was collected in the study to allow for the development of a guideline for the design of coal mine pitlakes in the South African coal fields. The design manual considered the water balances of the pitlakes and the biological and chemical process that drive the water quality of pitlakes."

1.3. The WRC 2019 Pitlakes Study clearly concludes that pitlakes are an environmentally sustainable mine closure solution, provided they are correctly designed, and that certain other requirements and standards are met. The WRC 2019 Pitlakes Study suggests numerous design options to enhance water quality and ensure minimal environmental

degradation, if any. It is important to note that the principles and findings evident in the study can be applied to a variety of mines, including diamond, coal and gold mines. Considering the above, the existing legislation surrounding mine closure was examined, with a view to suggesting possible amendments or other avenues to explore. The objective is to ensure that pitlakes contribute to sustainable mine closure.

2. International Norms and Standards

2.1. Numerous international studies have been conducted regarding the viability of pitlakes as a mine closure option. An article in the journal "*Minerals*" explores the various uses that pitlakes have the potential to fulfil, by looking at existing uses around the world.[i]

2.2. This study highlights that the risks surrounding pitlakes can be mitigated by proper closure planning and associated technical measures during mining and closure or following relinquishment, the article notes that the following end uses have been realised in various locations around the world:
"Passive and active recreation, nature conservation, fishery and aquaculture, drinking and industrial water storage, greenhouse carbon fixation, flood protection and waterway remediation, disposal of mine and other waste, mine water treatment and containment, and education and research."

2.3. The International Council on Mining & Metals ("**IMMC**") published the *"Integrated Mine Closure Good Practice Guide, 2nd Edition"* ("**Good Practice Guide**") in 2019[ii], which echoes the sentiments of the above article. The Good Practice Guide further states that, while pitlakes may present residual certain risks at closure, they also offer substantial benefits (unlike many other mine closure options which ultimately sterilize the mining area). If proper management relating to the change in land type from terrestrial (pre-mining) to aquatic (post-mining), pitlakes can present numerous beneficial opportunities post-closure. By integrating social, environmental and economic viewpoints and factors, pitlakes can be used in a variety of activities, including the irrigation of agricultural land. Water management will need to be determined according to the characteristics of the pitlake and the surrounding area, in line with the over-arching notion of sustainability.

2.4. Diamond mines commonly produce deep pits and therefore have the potential to form pitlakes.[iii] The majority of open put kimberlite diamond mines are steep-sided and more or less circular, and the chemistry of groundwater associated with kimberlite deposits will have an impact on the quality of the pitlake. In Canada, pitlakes are used as post closure options in diamond mines. It has been shown that groundwater entering the mine will most likely have a chemistry similar to that of the nearby surface water body (if any), or will alternatively be a mixture of deeper groundwater and lake water.[iv] This same study states that *"groundwater associated with the kimberlite rock itself is unlikely to pose major*

problems from a water quality point of view", and *"water associated with kimberlite rock should have very low concentrations of trace metals."*[1]

2.5. Pitlakes are commonly used in Australia, largely due to the growth in open cut mining over the last few decades. There, they are often perceived as beneficial, depending on the quality of the water in the pitlake.[2] Significant effort has thus been expended on investigating and examining these pitlakes and their water quality, thereby promoting effective management.

2.6. Ultimately, and in line with the WRC 2019 Pitlakes Study, the use of pitlakes as a mine closure solution has been found to be scientifically defendable. However, South Africa's mining laws do not specifically recognise pitlakes as a sustainable closure option.

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[i] McCollough CD, Schultze M, Van den Berg J "Realizing Beneficial End Uses from Abandoned Pit Mine Lakes" *Minerals* (2020).

[ii] IMMC "Integrated Mine Closure Good Practice Guide" *2nd Edition* (2019).

[iii] Harris L *et al* "Creating Lakes from Open Pit Mines: Processes and Considerations, Emphasis on Northern Environments" *Canadian Technical Report of Fisheries and Aquatic Sciences* (2009).

[iv] Harris L *et al* "Creating Lakes from Open Pit Mines: Processes and Considerations, Emphasis on Northern Environments" *Canadian Technical Report of Fisheries and Aquatic Sciences* (2009)

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[1] Harris L *et al* "Creating Lakes from Open Pit Mines: Processes and Considerations, Emphasis on Northern Environments" *Canadian Technical Report of Fisheries and Aquatic Sciences* (2009).

[2] Kumar R *et al* "Water Resources in Australian Mine Pit Lakes" *Water in Mining Conference* (2009).