Palaeontological desktop study of the proposed Lutzburg solar power plant (SPP) facility on the Remaining Extent of Portion 2 of the farm Ruby Vale 266, near Olifantshoek, Northern Cape Province.

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Summary

The proposed Lutzburg SPP development footprint, including both the preferred and alternative sites, is underlain by well-developed superficial deposits (surface gravels and aeolian sands) of low to very low palaeontological sensitivity. It is expected that the geologically recent overburden will largely buffer any impact on bedrock sediments that will result from the construction of the SPP. Potential impact on palaeontological heritage resources within the proposed Lutzburg SPP footprint (including both the preferred as well as alternative options) is considered low to very low. As far as the palaeontological heritage is concerned, the proposed Lutzburg SPP and associated transmission line development may proceed with no further palaeontological assessments required.

Introduction

The report provides a desktop assessment of potential palaeontological impact with regard to the proposed development of the Lutzburg solar power plant (SPP) facility on the Remaining Extent of Portion 2 of the farm Ruby Vale 266, located about 30 km south of Olifantshoek, Northern Cape Province (**Fig. 1**). The preferred site (general coordinates 28°13'30.29"S22°34'6.78"E) will cover an area of about 250 ha, while the alternative site will cover an area of about 300 ha (general coordinates 28°13'55.72"S 22°35'42.22"E) (**Fig. 2**).

The assessment is required as a prerequisite for new development in terms of the National Heritage Resources Act 25 of 1999. The Act identifies what is defined as a heritage resource, the criteria for establishing its significance and lists specific activities for which a heritage specialist study may be required. In this regard, categories of development relevant to the proposed development are listed in Section 34 (1), Section 35 (4), Section 36 (3) and Section 38 (1) of the Act, which also include the protection of geological and paleontological sites as well as palaeontological objects and material, meteorites and rare geological specimens. According to the SAHRIS Palaeo Sensitivity Map of South Africa (2016), the proposed Lutzburg SPP development footprint is located within an area considered to be of moderate palaeontological sensitivity and for that reason requires a palaeontological desktop assessment (**Fig 3**).

Methodology

The assessment was carried out with the aim to assess the potential impact on palaeontological heritage resources that may result from the proposed development. The palaeontological significance of the affected areas were evaluated through a desktop study and carried out on the basis of existing field data, database information and published literature. The assessment was carried out in March 2016.

Background

Assumptions and Limitations

The assessment provided within this report is based upon a desktop study without the benefit of a site visit. As such, the presentation of geological units present within the study area is derived from 1:250 000 geological maps that may vary in their accuracy. It is also assumed, for the sake of prudence, that fossil remains are always uniformly distributed in fossil-bearing rock units, although in reality their distribution may vary significantly.

Geology

According to the 1:250 000 scale geological map (2822 Postmasburg) of the area, the development area fall within the outcrop area of Olifantshoek Supergroup quartzites and metalavas that are most unlikely to contain any fossil material. The underlying bedrock within proposed development footprint is mantled by well-developed Kalahari Group aeolian sand deposits (*Qs*) and most likely alluvium along stream incisions and local watercourses (**Fig. 4**).

Palaeontology

The geologically recent aeolian sand overburden in the region is generally not considered to be fossiliferous, but Quaternary-age surface deposits in the central interior of the country can be highly fossiliferous in places, especially those that are directly related to fluvial environments along major river courses (Almond and Pether 2008; Brink *et al*. 1995, Broom 1909 a, b; Cooke 1955; Churchill *et al.* 2000; Rossouw 2006). Fossil assemblages (including an assortment of mammalian bones and teeth, coprolites, freshwater molluscs and plant microfossils), individual specimens and fossilized hyena burrows have been found preserved within Late Pleistocene alluvial sediments while intrusive features such as fossilized hyena lairs or fossilized bone accumulations are sometimes located outside the present river valleys along calcified pan dunes and localized spring deposits (Scott & Brink 1991; Horowitz *et al*. 1978; Scott and Klein 1981; Butzer 1984).

Impact Statement and Recommendations

Assessment of impacts, based on the assessment methodology provided by Environamics (see **Appendix 1),** is summarized in **Table 1.** A major limitation is the lack of knowledge of the depth of the superficial deposits covering the terrain, but is expected that the geologically recent overburden will largely buffer any impact on palaeontologically insignificant bedrock sediments. The desktop investigation indicates that the proposed development footprint, including both the preferred and alternative sites, is underlain by well-developed superficial deposits (surface gravels and aeolian sands) of low to very low palaeontological sensitivity.

Potential impact on palaeontological heritage resources within the preferred and alternative sites as well as along the associated transmission line is considered low to very low.

There are no areas within the preferred as well as along the alternative site footprint that need to be avoided and no mitigation measures or further monitoring are required. Potential for cumulative impacts of this project on paleontological resources is considered to be low locally and regionally.

If, in the unlikely event that localized fossil material is discovered within the sandy overburden during the construction phase of the project, it is recommended that a professional palaeontologist be called to assess the importance and rescue the fossils if necessary. As far as the palaeontological heritage is concerned, the proposed Lutzburg SPP may proceed with no further palaeontological assessments required.

References

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SAHRIS Palaeosensitivity map (2016) http://www.sahra.org.za/sahris/map/palaeo

Tables and Figures

Table 1. Paleontological Impact Rating for the Lutzburg SPP (see Appendix 1).

PHASE	Nature	Geographical Extent	Probability	Duration	Intensity/Magnitude	Reversibility	Irreplaceable loss	Cumulative Effect	Significance Rating	Significance
Planning	Planning for construction of SPP and associated transmission line	Site	Unlikely	Short term	Low	Completely reversible	No loss	Low	7	Negative low impact
Construction	Construction of SPP and associated transmission line	Site	Unlikely	Permanent	Low	Irreversable	Marginal loss	Low	14	Negative low impact
Operation	Overall function of the SPP	Site	Unlikely	Permanent	Low	Irreversable	Marginal loss	Low	14	Negative low impact
Decommissioning	Close of SPP facility	Site	Unlikely	Permanent	Low	Irreversable	Marginal loss	Low	14	Negative low impact

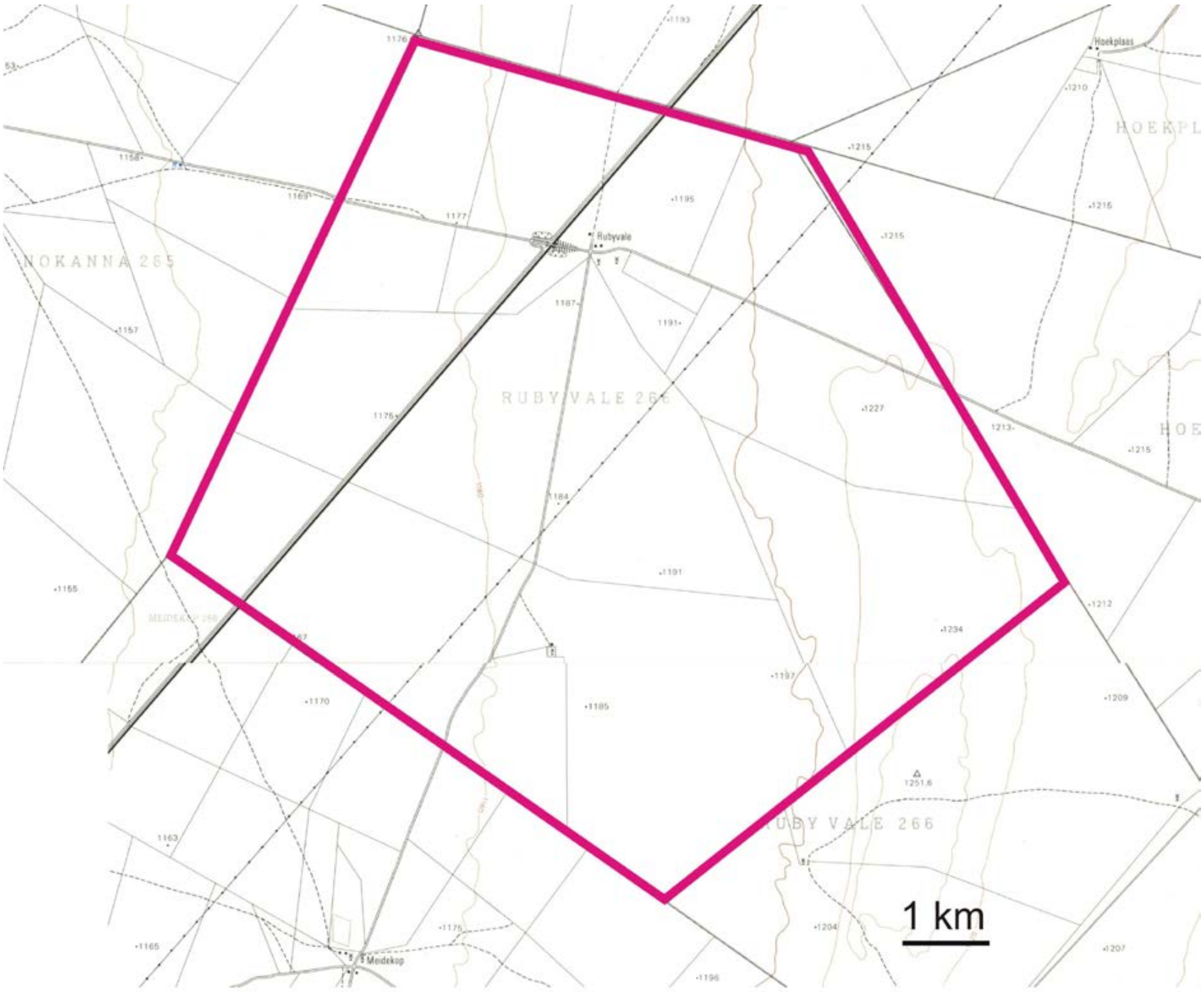

Figure1. Map of the Remaining Extent of Portion 2 of the farm Ruby Vale 266 (portion of 1:50 000 scale topographic maps 2822BA Mount Temple and 2822BC Bergenaarspad).

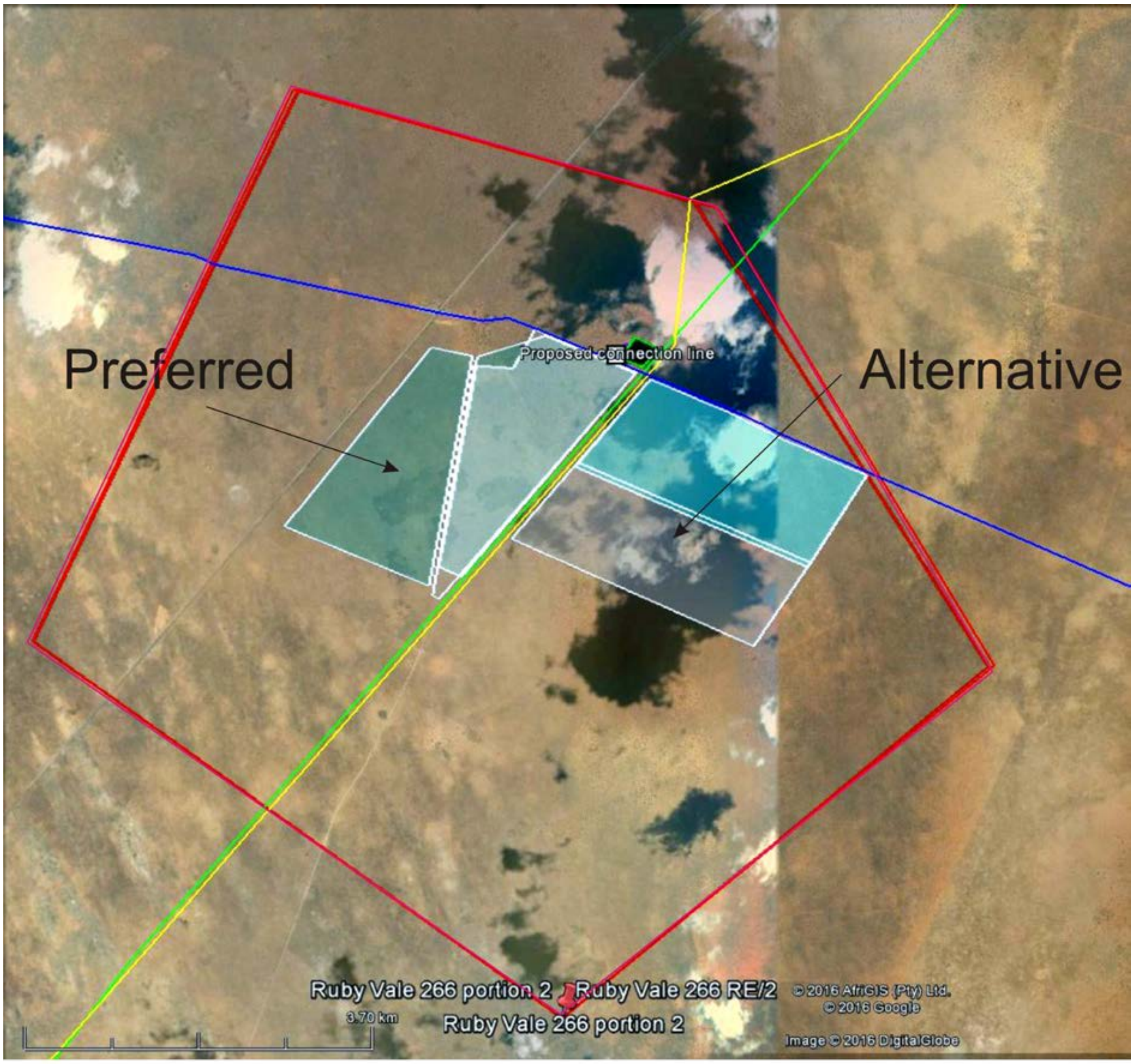

Figure 2. Aerial view of the preferred and alternative sites marked for the proposed Lutzburg SPP facility.

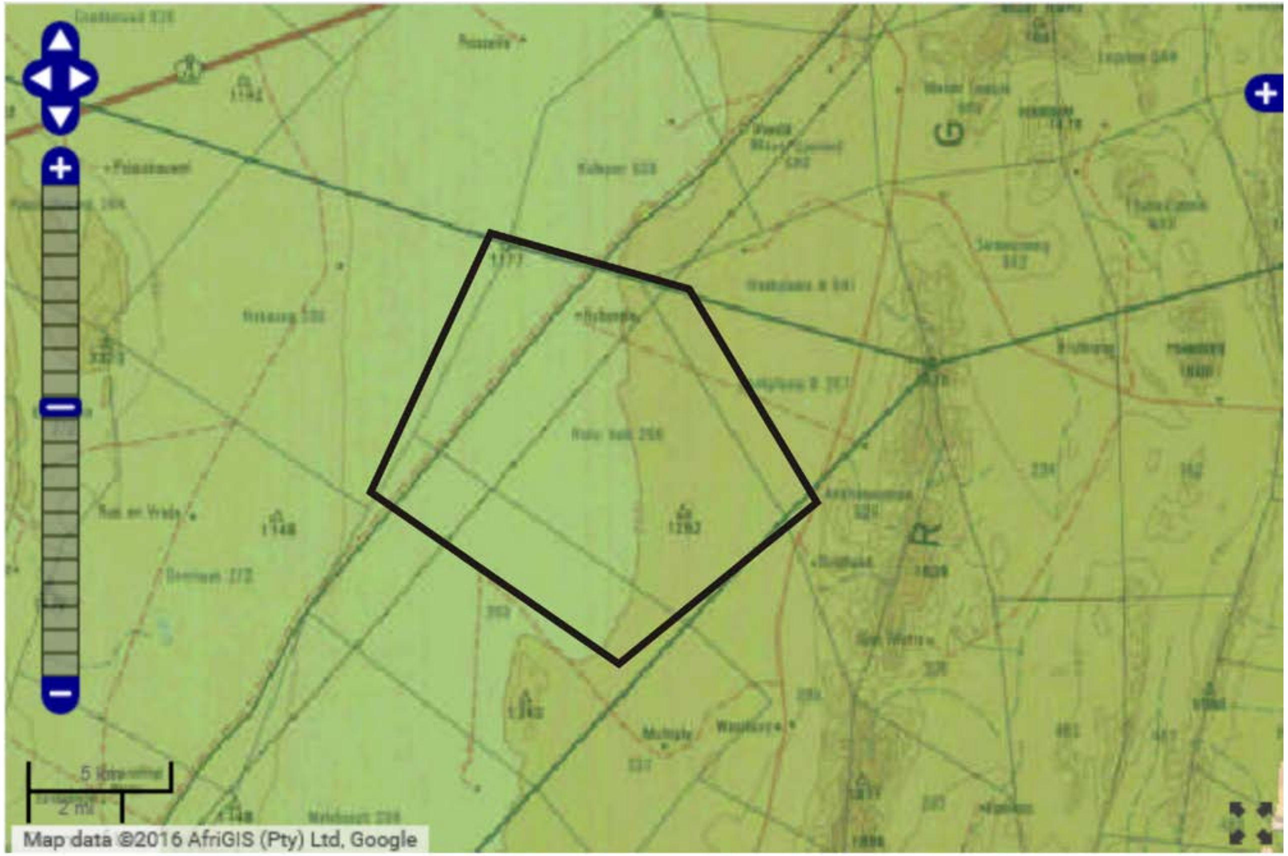

Figure 3. SAHRIS Palaeo Sensitivity Map of the area. The study area is considered to be of moderate palaeontological sensitivity.

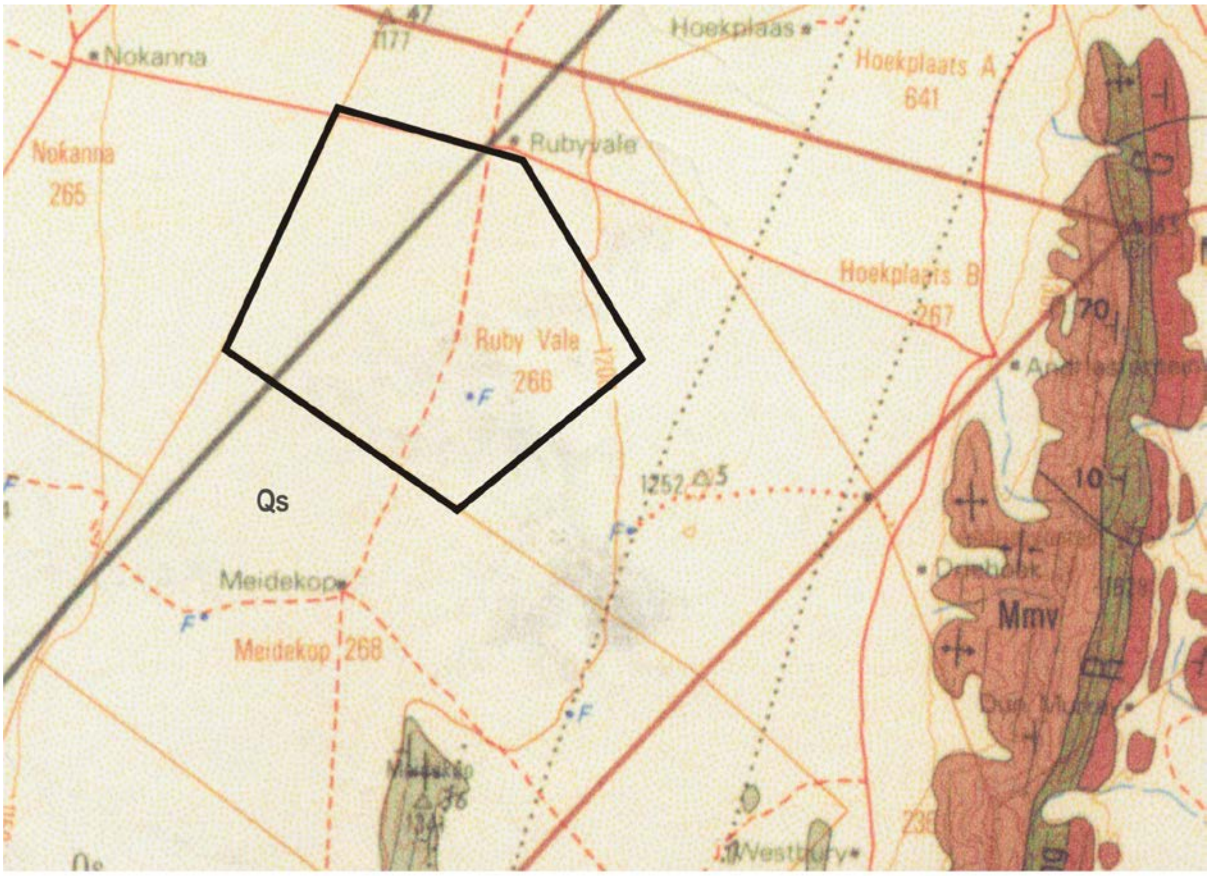

Figure 4. Portion of 1:250 000 scale geological map of the study area (2822 Postmasburg).

Appendix 1: Environmental Assessment Methodology

The environmental assessment aims to identify the various possible environmental impacts that could results from the proposed activity. Different impacts need to be evaluated in terms of its significance and in doing so highlight the most critical issues to be addressed.

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in the Table below.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System

Impact assessment must take account of the nature, scale and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the project phases:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact the following criteria is used:

Table 1: The rating system

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes

		in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).

3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any

		resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity. The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a		

weighted characteristic which can be measured and assigned a significance rating.		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive effects.