Appendix E:
Specialist Studies

Appendix E1:
Agriculture

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SITE SENSITIVITY VERIFICATION
AND
AGRICULTURAL COMPLIANCE STATEMENT
FOR
PROPOSED 100MW PV PLANT AT SAMANCOR CHROME'S FERROCHROME SMELTER
STEELPOORT, LIMPOPO

Report by
Johann Lanz

15 September 2021

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EXECUTIVE SUMMARY

The key findings of this study are:

- The proposed site has high sensitivity for impacts on agricultural resources as a result of it having land capability values of 9 and 10 across much of its area. This land capability reflects the suitability of the climate, terrain and soils for the production of cultivated crops.
- However, factors related to the ownership and industrial activity on the site prevent it from being used for agriculture and so effectively limit its agricultural potential.
- The high sensitivity is therefore disputed and assessed to be low.
- One potential negative agricultural impact was identified – loss of agricultural potential by land degradation, but this was assessed as not being of high significance.
- The recommended mitigation measures are the implementation of an effective system of stormwater run-off control; maintenance of vegetation cover; and stripping, stockpiling and re-spreading of topsoil.
- The conclusion of this assessment is that the proposed development will not have an unacceptable negative impact on the agricultural production capability of the site. The proposed development is therefore acceptable. This is substantiated by the facts that the proposed development will occupy land that cannot currently be utilised for agriculture, that the proposed development poses a low risk in terms of causing soil degradation, and that the occupation is not permanent, allowing the land to be used for agriculture after the proposed activity ceases.
- From an agricultural impact point of view, it is recommended that the proposed development be approved.

1 INTRODUCTION

Environmental authorisation is being sought for the proposed 100MW PV plant at the Samancor Chrome's Ferrochrome Smelter operations in Steelpoort, Limpopo (see location in Figure 1). In terms of the National Environmental Management Act (NEMA), an application for environmental authorisation requires an agricultural assessment, in this case an Agricultural Compliance Statement (see terms of reference, below).

Johann Lanz was appointed as an independent agricultural specialist to provide the Agricultural Compliance Statement. The objective and focus of an Agricultural Compliance Statement is to assess whether or not the proposed development will have an unacceptable agricultural impact or not, and based on this, to make a recommendation on whether it should be approved or not.

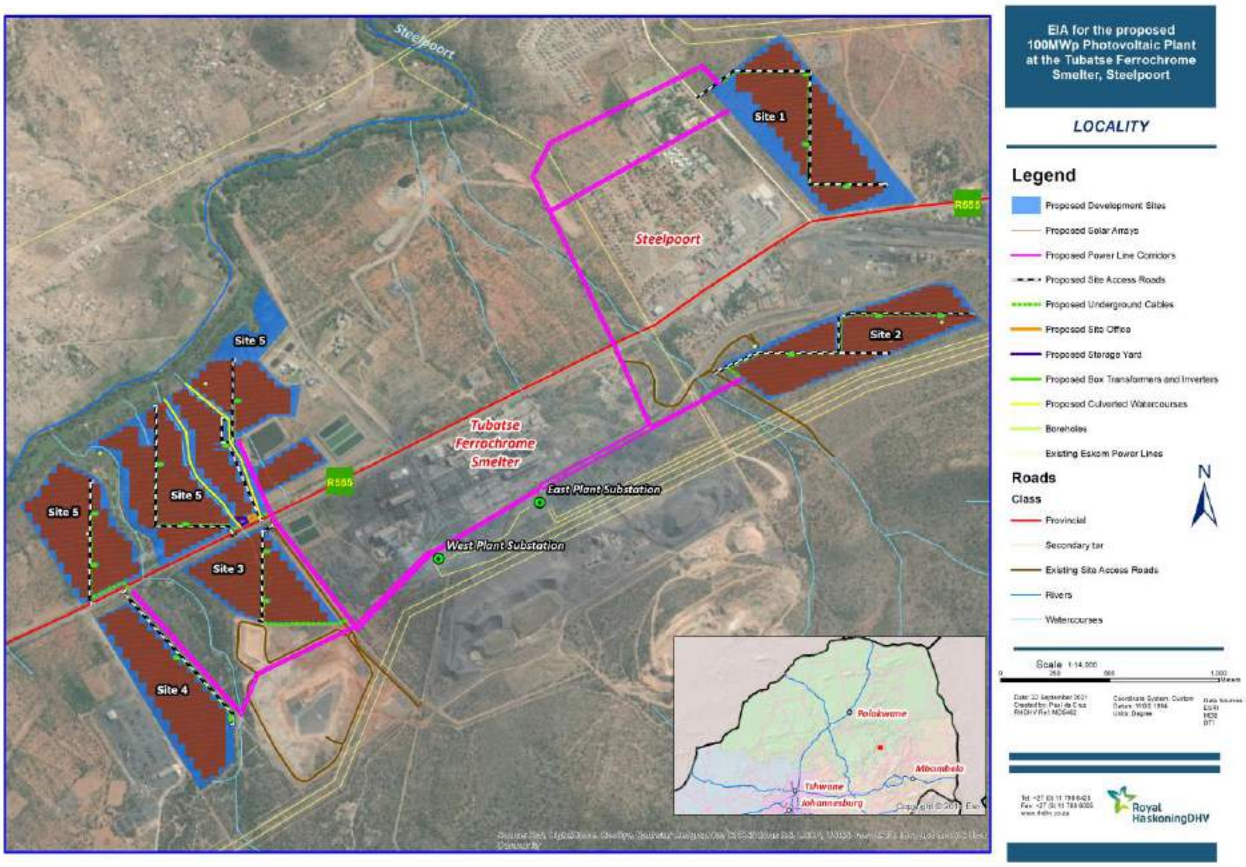

Figure 1. *Locality map of the proposed PV development at Steelpoort in Limpopo.*

2 PROJECT DESCRIPTION

The proposed facility will be spread over several sites and consist of the standard infrastructure of a PV facility including, but not limited to, PV array; inverters; on-site substation and grid connection; battery storage; auxiliary buildings; access roads and fencing.

For agricultural impacts, the exact nature of the different infrastructure within a development has very little bearing on the significance of impacts. What is of most relevance is simply the occupation of the land and whether it is being occupied by a solar panel, a road, a building or a substation makes no difference. What is of most relevance and addressed in this assessment, therefore, is simply the total footprint of the facility that excludes agricultural land use or impacts agricultural land.

3 TERMS OF REFERENCE

The terms of reference for this study is to fulfill the requirements of the *Protocol for the specialist assessment and minimum report content requirements of environmental impacts on agricultural resources by onshore wind and/or solar photovoltaic energy generation facilities where the electricity output is 20 megawatts or more*, gazetted on 20 March 2020 in GN 320 (in terms of Sections 24(5)(A) and (H) and 44 of NEMA, 1998).

The site includes land that is classified by the national web-based environmental screening tool as high sensitivity for impacts on agricultural resources. The level of agricultural assessment required in terms of the protocol (and hence in terms of NEMA) for sites that include high sensitivity is an Agricultural Agro-Ecosystem Specialist Assessment. The protocol also requires that a Site Sensitivity Verification be done.

The Site Sensitivity Verification has disputed the high sensitivity and found the entire site to be of maximum medium sensitivity (see Section 7). The agricultural protocol also states:

> Should the below apply, an Agricultural Compliance Statement must be submitted (rather than an Agricultural Agro-Ecosystem Specialist Assessment).
>
> Information gathered from the site sensitivity verification differs from the designation of “very high” or “high” agricultural sensitivity, and it is found to be of a “medium” or “low” sensitivity.

The above does apply in this case and therefore this assessment is an Agricultural Compliance Statement.

The terms of reference for such an assessment, as stipulated in the protocol, are listed below, and the section number of this report which fulfils each stipulation is given after it in brackets.

1. The Agricultural Compliance Statement must be prepared by a soil scientist or agricultural specialist registered with the South African Council for Natural Scientific Professions (SACNASP).

2. The compliance statement must:

   1. be applicable to the preferred site and proposed development footprint;
   2. confirm that the site is of “low” or “medium” sensitivity for agriculture (Section 6); and
   3. indicate whether or not the proposed development will have an unacceptable impact on the agricultural production capability of the site (Section 8.9).

3. The Agricultural Compliance Statement must contain, as a minimum, the following information:

   1. details and relevant experience as well as the SACNASP registration number of the soil scientist or agricultural specialist preparing the statement including a curriculum vitae (Appendix 1);
   2. a signed statement of independence by the specialist (Appendix 2);
   3. a map showing the proposed development footprint (including supporting infrastructure) with a 50 m buffered development envelope, overlaid on the agricultural sensitivity map generated by the screening tool (Figure 2);
   4. calculations of the physical development footprint area for each land parcel as well as the total physical development footprint area of the proposed development including supporting infrastructure (Section 8.8);
   5. confirmation that the development footprint is in line with the allowable development limits contained in Table 1 of the protocol (Section 8.8);
   6. confirmation from the specialist that all reasonable measures have been taken through micro-siting to avoid or minimize fragmentation and disturbance of agricultural activities (Section 8.6);
   7. a substantiated statement from the soil scientist or agricultural specialist on the acceptability, or not, of the proposed development and a recommendation on the approval, or not of the proposed development (Section 8.8);
   8. any conditions to which this statement is subjected (Section 10);
   9. in the case of a linear activity, confirmation from the agricultural specialist or soil scientist, that in their opinion, based on the mitigation and remedial measures proposed, the land can be returned to the current state within two years of completion of the construction phase (Section 8.7);
   10. where required, proposed impact management outcomes or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr) (Section 9); and
   11. a description of the assumptions made and any uncertainties or gaps in knowledge or data (Section 5).

4 METHODOLOGY OF STUDY

4.1 Methodology for assessing the agro-ecosystem

A field investigation was not deemed necessary for this assessment (see Section 6). The assessment was based on existing soil and agricultural potential data for the site. The following sources of existing information were used:

- Soil data was sourced from the land type data set, of the Department of Agriculture, Forestry and Fisheries (DAFF). This data set originates from the land type survey that was conducted from the 1970's until 2002. It is the most reliable and comprehensive national database of soil information in South Africa and although the data was collected some time ago, it is still entirely relevant as the soil characteristics included in the land type data do not change within time scales of hundreds of years.
- Land capability data was sourced from the 2017 National land capability evaluation raster data layer produced by the DAFF, Pretoria.
- Field crop boundaries were sourced from Crop Estimates Consortium, 2019. *Field Crop Boundary data layer, 2019*. Pretoria. Department of Agriculture, Forestry and Fisheries.
- Rainfall and evaporation data was sourced from the SA Atlas of Climatology and Agrohydrology (2009, R.E. Schulze) available on Cape Farm Mapper.
- Grazing capacity data was sourced from the 2018 DAFF long-term grazing capacity map for South Africa, available on Cape Farm Mapper.
- Satellite imagery of the site and surrounds was sourced from Google Earth.

5 ASSUMPTIONS, UNCERTAINTIES OR GAPS IN KNOWLEDGE OR DATA

There are no specific assumptions, uncertainties or gaps in knowledge or data that affect the findings of this study.

6 SITE SENSITIVITY VERIFICATION

In terms of the gazetted agricultural protocol, a site sensitivity verification must be submitted that:

1. confirms or disputes the current use of the land and the environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status etc.;
2. contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity.

Agricultural sensitivity, in terms of environmental impact, is a direct function of the capability of the land for agricultural production. This is because a negative impact, or exclusion of agriculture, on land of higher agricultural capability is more detrimental to agriculture than the same impact on land of low agricultural capability. The general assessment of agricultural sensitivity that is employed in the national web-based environmental screening tool, identifies all arable land that can support viable production of cultivated crops, as at least high sensitivity. This is because there is a scarcity of arable production land in South Africa.

The screening tool classifies agricultural sensitivity according to only two independent criteria – the land capability rating and whether the land is cultivated or not. All cultivated land is classified as at least high sensitivity, based on the logic that if it is under cultivation, it is indeed suitable for cultivation, irrespective of its land capability rating.

Uncultivated land is classified by the screening tool in terms of its land capability rating, as per the 2017 DAFF updated and refined land capability mapping for South Africa. Land capability is defined as the combination of soil, climate and terrain suitability factors for supporting rain fed agricultural production. It is an indication of what level and type of agricultural production can sustainably be achieved on any land. The higher land capability values (≥8 to 15) are likely to be suitable as arable land for the production of cultivated crops, while lower values are only likely to be suitable as non-arable, grazing land, or at the lowest extreme, not even suitable for grazing.

A map of the proposed development area overlaid on the screening tool sensitivity is given in Figure 2. Because there is no cultivation, agricultural sensitivity is purely a function of land capability. The land capability of the investigated site varies from 6 to 10. A map of the land capability of the site is given in Figure 3. Land capability values of 6 to 8 give medium agricultural sensitivity and values of 9 to 10 give high agricultural sensitivity. The small scale differences in land capability (pixels) across the project area are not very significant and are more a function of how the land capability data is generated by modelling, than actual meaningful differences in agricultural potential on the ground.

The land capability rating for the site is highly likely to be accurate. The terrain and climate are suitable for cultivation and the indications of soil potential from the land type data are that dominant soil types are deep, well-drained Hutton soils that are suitable for cultivation, although shallower soils do also occur.

However, there are other factors, apart from the natural agricultural resources, that limit the agricultural potential of the land on this site. Agriculture is not possible on the sites while Samancor and related industries are operating there. One of the restrictions to agricultural activities is that Samancor utilises boreholes on the sites for their water supplies and therefore have strict controls over land use. The current owners of the land (Samancor) are not interested in using it for agriculture and the land around the sites is broken up by mining and smelting related industry which makes it impractical to use as farmland.

Figure 2. *The proposed development site (blue outlines) overlaid on agricultural sensitivity, as given by the screening tool (green = low; yellow = medium; red = high; dark red = very high).*

The purpose of the NEMA agricultural protocol and the sensitivity rating of agricultural land by the screening tool is to conserve functional agricultural land, particularly arable land for agricultural use, within the context of a shortage of arable land that is suitable for crop production in South Africa. However if land cannot be used for agriculture and particularly the production of cultivated crops, then it does not make sense to conserve it for agricultural use, by preventing other land uses.

It is important to note that the need to conserve arable land is not only relevant to the present, but also to the future. The natural agricultural resources of this land must be conserved for a potential future time when the mining and smelting related industries no longer occupy the site and agricultural use may again become possible. The proposed development is associated with those industries and so if they cease to occupy the site, the proposed development will also cease to occupy the site. Its impact does not therefore prevent future agricultural use.

For the above reasons the site should be considered, at this point, and for the purposes of the impact of this proposed development, to be low rather than high sensitivity for impacts on agricultural resources. On this basis, the high sensitivity of the site for impacts on agricultural resources is disputed by this assessment.

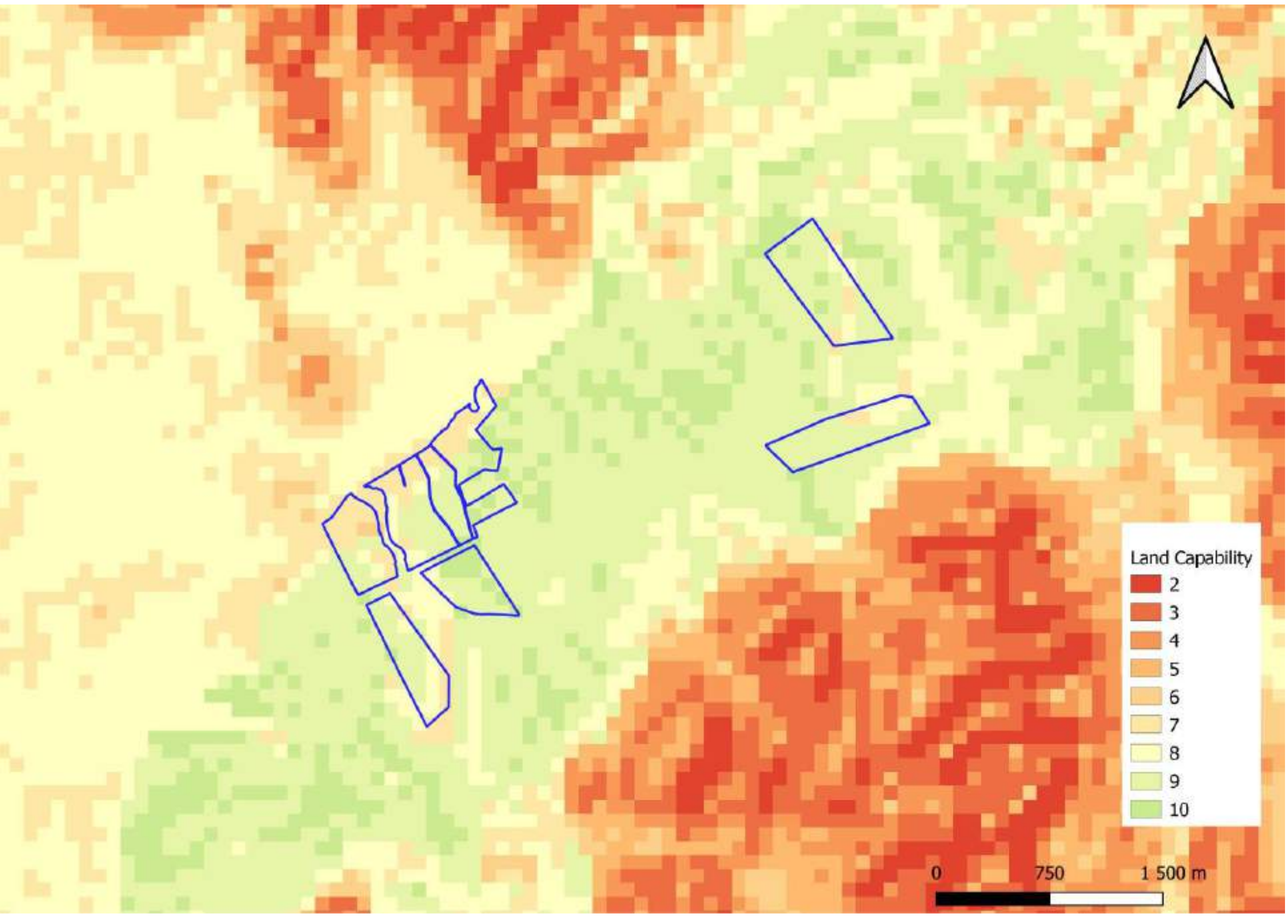

Figure 3. *The land capability of the proposed development site (blue outlines).*

7 LAND USE

The land across all sites is veld or bush that is not currently utilised for anything productive other than boreholes on some of the sites. Sites 3 and 4 are fenced in as part of a High-Hazard Facility.

8 ASSESSMENT OF AGRICULTURAL IMPACT

8.1 General

The focus and defining question of an agricultural impact assessment is to determine to what extent a proposed development will compromise (negative impacts) or enhance (positive impacts) current and/or potential future agricultural production. The significance of an impact is therefore a direct function of the degree to which that impact will affect current or potential future agricultural production. If there will be no impact on production, then there is no agricultural impact. Impacts that degrade the agricultural resource base, pose a threat to production and therefore are within the scope of an agricultural impact assessment.

8.2 Impact identification and discussion

The loss of agricultural potential by occupation of land is normally the most important agricultural impact of any development on agricultural land. However, in this case, because agricultural use of the land is not possible (see Section 6), this impact is not relevant. Therefore only one agricultural impact has been identified, which is a direct impact:

1. **Loss of agricultural potential by soil degradation –** This impact only becomes relevant once the land is returned to agricultural land use after decommissioning. Soil can be degraded by impacts in three different ways: erosion; topsoil loss; and contamination. Erosion can occur as a result of the alteration of the land surface run-off characteristics, which can be caused by construction related land surface disturbance, vegetation removal, and the establishment of hard surface areas like panels and roads. Loss of topsoil can result from poor topsoil management during construction related excavations. Hydrocarbon spillages from construction activities can contaminate soil. Soil degradation will reduce the ability of the soil to support vegetation growth. This impact only occurs during the construction and decommissioning phases.

8.3 Cumulative impacts

The cumulative impact of a development is the impact that development will have when its impact is added to the incremental impacts of other past, present or reasonably foreseeable future activities that will affect the same environment. It is important to note that the cumulative impact assessment for a particular project, like what is being done here, is not the same as an assessment of the impact of all surrounding projects. The cumulative assessment for this project is an assessment only of the impacts associated with this project, but seen in the context of all surrounding impacts. It is concerned with this project's contribution to the overall impact, within the context of the overall impact. But it is not simply the overall impact itself.

The most important concept related to a cumulative impact is that of an acceptable level of change to an environment. A cumulative impact only becomes relevant when the impact of the proposed development will lead directly to the sum of impacts of all developments causing an acceptable level of change to be exceeded in the surrounding area. If the impact of the development being assessed does not cause that level to be exceeded, then the cumulative impact associated with that development is not significant.

The potential cumulative agricultural impact of importance is a regional loss (including by degradation) of agricultural land, with a consequent decrease in agricultural production. The defining question for assessing the cumulative agricultural impact is this:

> What level of loss of agricultural land use and associated loss of agricultural production is acceptable in the area, and will the loss associated with the proposed development, when considered in the context of all past, present or reasonably foreseeable future impacts, cause that level in the area to be exceeded?

As identified above, this proposed development has zero impact on future agricultural production, as long as it does not degrade the agricultural resource base so that future agricultural production is compromised. If the project contributes zero impact to the cumulative impact then its cumulative impact must be assessed as insignificant. The proposed development is therefore acceptable in terms of cumulative impact, and from a cumulative impact perspective it is therefore recommended that it is approved.

8.4 Comparative assessment of alternatives

Due to the nature of the impacts and the effectively uniform agricultural potential conditions across the site, there will be absolutely no material difference between the agricultural impacts of any alternative layouts within the site boundaries and any technology alternatives. All possible alternatives are considered acceptable.

8.5 Impacts of the no-go alternative

The no-go alternative considers impacts that will occur to the agricultural environment in the absence of the proposed development. There are no agricultural impacts of the no-go alternative and no material difference between the agricultural impacts of the no-go alternative versus the development.

8.6 Micro-siting to minimize fragmentation and disturbance of agricultural activities

The agricultural protocol requires confirmation that all reasonable measures have been taken through micro-siting to minimize fragmentation and disturbance of agricultural activities. However, the agricultural uniformity, the fact that no agriculture is taking place on site, and the nature of the agricultural impact mean that the exact positions of all infrastructure will not make any material difference to agricultural impacts.

8.7 Confirmation of linear activity impact

Confirmation of the linear activity impact is not applicable in this case.

8.8 Impact footprint

The agricultural protocol stipulates allowable development limits for renewable energy developments of > 20 MW. Allowable development limits refer to the area of a particular agricultural sensitivity category that can be directly impacted (i.e. taken up by the physical footprint) by a renewable energy development. The agricultural footprint is defined in the protocol as the area that is directly occupied by all infrastructures, including roads, hard standing areas, buildings, substations etc., that are associated with the renewable energy facility during its operational phase, and that result in the exclusion of that land from potential cultivation or grazing. It excludes all areas that were already occupied by roads and other infrastructure prior to the establishment of the energy facility but includes the surface area required for expanding existing infrastructure (e.g. widening existing roads). It excludes the corridor underneath overhead power lines but includes the pylon footprints. It therefore represents the total land that is actually excluded from agricultural use as a result of the renewable energy facility.

The allowable development limit for land of low and medium sensitivity for impacts on agricultural resources, as this site has been shown above to be, is 2.5 ha per MW. This is the least stringent limit for renewable energy developments and is designed to allow solar PV (with its relatively large hectares per Megawatt requirement, compared to wind energy). The total facility footprint is 162 hectares for a 100 MW capacity and so it is well within the allowable limits.

8.9 Impact assessment and statement

An Agricultural Compliance Statement is not required to formally rate agricultural impacts. It is only required to indicate whether or not the proposed development will have an unacceptable impact on the agricultural production capability of the site. It must provide a substantiated statement on the acceptability, or not, of the proposed development and a recommendation on the approval, or not of the proposed development.

The conclusion of this assessment is that the proposed development will not have an unacceptable negative impact on the agricultural production capability of the site. The proposed development is therefore acceptable. This is substantiated by the following points:

- The proposed development will occupy land that cannot currently be utilised for agriculture.

- The proposed development poses a low risk in terms of causing soil degradation, which can be adequately and fairly easily managed by mitigation management actions.
- The occupation of land is not permanent. The land will potentially become available again for agricultural use once the proposed activity ceases, unless a decision at that time approves a different land use.

Therefore, from an agricultural impact point of view, it is recommended that the development be approved.

A formal rating of the identified impact, using the common methodology for the Environmental Impact Assessment for this project, is given in Table 1.

Table 1: Impact rating

Loss of agricultural potential by soil degradation		
	Without mitigation	**With mitigation**
Probability	Low (2)	Improbable (1)
Duration	Short term (2)	Short term (2)
Scale	Site only (1)	Site only (1)
Magnitude	Minor (2)	Minor (2)
Significance	**Low (10)**	**Low (5)**

9 ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

The environmental management programme inputs for the protection of soil resources are presented in the tables below for each phase of the development.

Table 2: Management plan for the planning and design phase

Impact	**Mitigation / management objectives and outcomes**	**Mitigation / management actions**	**Monitoring**		
			Methodology	**Frequency**	**Responsibility**
Aspect: Protection of soil resources					
Erosion	That disturbance and existence of hard surfaces causes no erosion on or downstream of the site.	Design an effective system of storm water run-off control, where it is required - that is at any points where run-off water might accumulate. The system must effectively collect and safely disseminate any run-off water from all accumulation points and it must prevent any potential down slope erosion.	Ensure that the storm water run-off control is included in the engineering design.	Once-off during the design phase.	Holder of the EA

Table 3: Management plan for the construction phase

Impact	**Mitigation / management objectives and outcomes**	**Mitigation / management actions**	**Monitoring**		
			Methodology	**Frequency**	**Responsibility**
Aspect: Protection of soil resources					
Erosion	That disturbance and existence of hard surfaces causes no erosion on or downstream of the site.	Implement an effective system of storm water run-off control, where it is required - that is at any points where run-off water might accumulate. The system must effectively collect and safely disseminate any run-off water from all accumulation points and it must prevent any potential down slope erosion.	Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	Every 2 months during the construction phase	Environmental Control Officer (ECO)
Erosion	That vegetation clearing does not pose a high erosion risk.	Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize disturbed soil against erosion.	Undertake a periodic site inspection to record the occurrence of and re-vegetation progress of all areas that require re-vegetation.	Every 4 months during the construction phase	Environmental Control Officer (ECO)

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	Frequency	Responsibility
Topsoil loss	That topsoil loss is minimised	If an activity will mechanically disturb the soil below surface in any way, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface.	Record GPS positions of all occurrences of below-surface soil disturbance (e.g. excavations) if it is an area of greater than 25 square metres. Record the date of topsoil stripping and replacement. Check that topsoil covers the entire disturbed area.	As required, whenever areas are disturbed.	Environmental Control Officer (ECO)

Table 4: Management plan for the operational phase

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	Frequency	Responsibility
Aspect: Protection of soil resources					
Erosion	That existence of hard surfaces causes no erosion on or downstream of the site.	Maintain the storm water run-off control system. Monitor erosion and remedy the	Undertake a periodic site inspection to verify and inspect the effectiveness	Bi-annually	Facility Environmental Manager

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	Frequency	Responsibility
		storm water control system in the event of any erosion occurring.	and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring		
Erosion	That denuded areas are re-vegetated to stabilise soil against erosion	Facilitate re-vegetation of denuded areas throughout the site	Undertake a periodic site inspection to record the progress of all areas that require re-vegetation.	Bi-annually	Facility Environmental Manager

Table 5: Management plan for the decommissioning phase

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	Frequency	Responsibility
Aspect: Protection of soil resources					
Erosion	That	Implement an	Undertake a	Every 2 months	Environmental

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	Frequency	Responsibility
	disturbance and existence of hard surfaces causes no erosion on or downstream of the site.	effective system of storm water run-off control, where it is required - that is at any points where run-off water might accumulate. The system must effectively collect and safely disseminate any run-off water from all accumulation points and it must prevent any potential down slope erosion.	periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	during the decommissioning phase, and then every 6 months after completion of decommissioning, until final sign-off is achieved.	Control Officer (ECO)
Erosion	That vegetation clearing does not pose a high erosion risk.	Maintain where possible all vegetation cover and facilitate re-vegetation of denuded areas throughout the site, to stabilize disturbed soil against erosion.	Undertake a periodic site inspection to record the occurrence of and re-vegetation progress of all areas that require re-vegetation.	Every 4 months during the decommissioning phase, and then every 6 months after completion of decommissioning, until final sign-off is achieved.	Environmental Control Officer (ECO)
Topsoil loss	That topsoil loss is minimised	If an activity will mechanically disturb the soil below surface in	Record GPS positions of all occurrences of below-surface	As required, whenever areas are disturbed.	Environmental Control Officer (ECO)

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	Frequency	Responsibility
		any way, then any available topsoil should first be stripped from the entire surface to be disturbed and stockpiled for re-spreading during rehabilitation. During rehabilitation, the stockpiled topsoil must be evenly spread over the entire disturbed surface.	soil disturbance (e.g. excavations) if it is an area of greater than 25 square metres. Record the date of topsoil stripping and replacement. Check that topsoil covers the entire disturbed area.		

10 CONCLUSIONS

The proposed site has high sensitivity for impacts on agricultural resources as a result of it having land capability values of 9 and 10 across much of its area. This land capability reflects the suitability of the climate, terrain and soils for the production of cultivated crops. However, factors related to the ownership and industrial activity on the site prevent it from being used for agriculture and so effectively limit its agricultural potential. The high sensitivity is therefore disputed and assessed, for the purposes of the impact of this proposed development, to be low.

It is however still important to protect the agricultural potential of the natural resource base. The recommended mitigation measures for this are implementation of an effective system of storm water run-off control; maintenance of vegetation cover; and stripping, stockpiling and re-spreading of topsoil.

The conclusion of this assessment is that the proposed development will not have an unacceptable negative impact on the agricultural production capability of the site. The proposed development is therefore acceptable. This is substantiated by the facts that the proposed development will occupy land that cannot currently be utilised for agriculture, that the proposed development poses a low risk in terms of causing soil degradation, and that the occupation is not permanent, allowing the land to potentially be used for agriculture after the proposed activity ceases.

From an agricultural impact point of view, it is recommended that the development be approved.

The conclusion of this assessment on the acceptability of the proposed development and the recommendation for its approval is not subject to any conditions.

11 REFERENCES

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Crop Estimates Consortium, 2019. *Field Crop Boundary data layer, 2019*. Pretoria. Department of Agriculture, Forestry and Fisheries.

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APPENDIX 1: SPECIALIST CURRICULUM VITAE

Johann Lanz
Curriculum Vitae

Education

M.Sc. (Environmental Geochemistry)	University of Cape Town	1996 - 1997
B.Sc. Agriculture (Soil Science, Chemistry)	University of Stellenbosch	1992 - 1995
BA (English, Environmental & Geographical Science)	University of Cape Town	1989 - 1991
Matric Exemption	Wynberg Boy's High School	1983

Professional work experience

I have been registered as a Professional Natural Scientist (Pri.Sci.Nat.) in the field of soil science since 2012 (registration number 400268/12) and am a member of the Soil Science Society of South Africa.

Soil & Agricultural Consulting **Self employed** **2002 - present**

In the past 5 years of running my soil and agricultural consulting business, I have completed more than 120 agricultural assessments (EIAs, SEAs, EMPRs) in all 9 provinces for renewable energy, mining, urban, and agricultural developments. My regular clients include: Aurecon; CSIR; SiVEST; Arcus; SRK; Environamics; Royal Haskoning DHV; Jeffares & Green; JG Afrika; Juwi; Mainstream; Redcap; G7; Mulilo; and Tiptrans. Recent agricultural clients for soil resource evaluations and mapping include Cederberg Wines; Western Cape Department of Agriculture; Vogelfontein Citrus; De Grendel Estate; Zewenwacht Wine Estate; and Goedgedacht Olives.

In 2018 I completed a ground-breaking case study that measured the agricultural impact of existing wind farms in the Eastern Cape.

Soil Science Consultant **Agricultural Consultors International (Tinie du Preez)** **1998 - 2001**

Responsible for providing all aspects of a soil science technical consulting service directly to clients in the wine, fruit and environmental industries all over South Africa, and in Chile, South America.

Contracting Soil Scientist **De Beers Namaqualand Mines** **July 1997 - Jan 1998**

Completed a contract to advise soil rehabilitation and re-vegetation of mined areas.

Publications

- Lanz, J. 2012. Soil health: sustaining Stellenbosch's roots. In: M Swilling, B Sebitosi & R Loots (eds). *Sustainable Stellenbosch: opening dialogues*. Stellenbosch: SunMedia.
- Lanz, J. 2010. Soil health indicators: physical and chemical. *South African Fruit Journal*, April / May 2010 issue.
- Lanz, J. 2009. Soil health constraints. *South African Fruit Journal*, August / September 2009 issue.
- Lanz, J. 2009. Soil carbon research. *AgriProbe*, Department of Agriculture.
- Lanz, J. 2005. Special Report: Soils and wine quality. *Wineland Magazine.*

I am a reviewing scientist for the *South African Journal of Plant and Soil*.

APPENDIX 2: DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

PROPOSED 100MW PV PLANT AT THE SAMANCOR CHROME'S TUBATSE FERROCHROME SMELTER OPERATIONS STEELPOORT, LIMPOPO

Kindly note the following:

- This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
- This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
- A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
- All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
- All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address: Department of Environmental Affairs, Attention: Chief Director: Integrated Environmental Authorisations, Private Bag X447, Pretoria, 0001 **Physical address:** Department of Environmental Affairs, Attention: Chief Director: Integrated Environmental Authorisations, Environment House, 473 Steve Biko Road, Arcadia Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at: Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Johann Lanz – Soil Scientist			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
Specialist name:	Johann Lanz			
Specialist Qualifications:	M.Sc. (Environmental Geochemistry)			
Professional affiliation/registration:	Registered Professional Natural Scientist Member of the Soil Science Society of South Africa			
Physical address:	1a Wolfe Street, Wynberg, Cape Town, 7800			
Postal address:	1a Wolfe Street, Wynberg, Cape Town, 7800			
Postal code:	7800	Cell:	082 927 9018	
Telephone:	082 927 9018	Fax:	Who still uses a fax? I don't	
E-mail:	johann@johannlanz.co.za			

2. DECLARATION BY THE SPECIALIST

I, **Johann Lanz**, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Johann Lanz – Soil Scientist (sole proprietor)

Name of Company:

26 August 2021

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, **Johann Lanz**, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Johann Lanz – Soil Scientist (sole proprietor)

Name of Company

26 August 2021

Date

7188602-4 CST
T.S Kolobe

Signature of the Commissioner of Oaths

2021-08-26

Date

SOUTH AFRICAN POLICE SERVICE
STATION COMMANDER
WYNBERG
2021 -08- 2 6
STASIEBEVELVOEDER
WYNBERG
SOUTH AFRICAN POLICE SERVICE

Appendix E2:
Hydrology

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED 100MWP PHOTOVOLTAIC PLANT ASSOCIATED WITH THE TUBATSE FERROCHROME SMELTER, STEELPOORT, FETAKGOMO TUBATSE LOCAL MUNICIPALITY, LIMPOPO.

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
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Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	GCS Water and Environment (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	Level 2	Percentage Procurement recognition	
Specialist name:	JENNIFER MENEGHELLI			
Specialist Qualifications:	BSC (CIVIL ENGINEERING)			
Professional affiliation/registration:	PROFESSIONAL ENGINEER WITH ECSA (20180332)			
Physical address:	83 WESSELS ROAD, RIVONIA, 2128			
Postal address:	PO BOX 2597, RIVONIA			
Postal code:	2128	Cell:	0765762470	
Telephone:	0118035726	Fax:	N/A	
E-mail:	JENNIFER@GCS-SA.BIZ			

2. DECLARATION BY THE SPECIALIST

I, JENNIFER MENEGHELLI, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Meneghelli

Signature of the Specialist

GCS WATER AND ENVIRONMENT (PTY) LTD

Name of Company:

Date 2021/010/01

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, JENNIFER MENEGHELLI, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Meneghelli

Signature of the Specialist

GCS WATER AND ENVIRONMENT (PTY) LTD

Name of Company

2021/10/01

Date

Signature of the Commissioner of Oaths

2021/10/01

Date

I certify that the DEPONENT has acknowledged that he/she knows and understands the contents of this affidavit, that he/she does not have any objection to taking the oath, and that he/she considers it to be binding on his/her conscience, and which was sworn to and signed before me

at Rivonia on this the 1 day of 10 2021 and that the administering oath complied with the regulations contained in Goverment Gazette No. R1258 of 21 July 1972, as amended.

COMMISSIONER OF OATHS (RS
Wendy Sherriff CA(SA
63 Wessel Road, Woodmea
Johannesburg

63 Wessel Road, Rivonia, 2128 PO Box 2597, Rivonia, 2128 South Africa
Tel: +27 (0) 11 803 5726 **Fax:** +27 (0) 11 803 5745 **Web:** www.gcs-sa.biz

Samancor Steelpoort / Burgersfort PV Plant Hydrological Assessment for an EIA and Water Use Authorisation Report

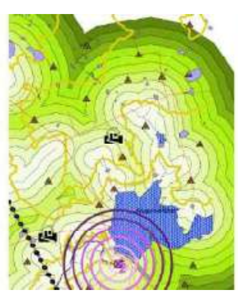
Version - 1

11 October 2021

GCS Project Number: 20-1181

Client Reference: Samancor Steelpoort / Burgersfort Hydrological Assessment




GCS (Pty) Ltd. **Reg No:** 2004/000765/07 Est. 1987
Offices: **Johannesburg** (Head Office) | Durban | Gaborone | Lusaka | Maseru | Windhoek | Ostrava
Directors: AC Johnstone (CEO) | A Gunn (COO) | A Wilke | M Van Rooyen | W Sherriff (Financial) | N Marday (HR)
Non-Executive Director: B Wilson-Jones

Samancor Steelpoort / Burgersfort PV Plant Hydrological Assessment for an EIA and Water Use Authorisation

Report
Version - 1

11 October 2021

DOCUMENT ISSUE STATUS

Report Issue	Version 1 – updated with Client comments and Steelpoort River analysis		
GCS Reference Number	20-1181		
Client Reference	Samancor Steelpoort / Burgersfort Hydrological Assessment		
Title	Samancor Steelpoort / Burgersfort PV Plant Hydrological Assessment for an EIA and Water Use Authorisation		
	Name	**Signature**	**Date**
Author	Jennifer Meneghelli	JMeneghelli	11 October 2021
Document Reviewer	Hendrik Botha		
Unit Manager	Andries Wilke		
Director	Andries Wilke		

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LIST OF FIGURES

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1 INTRODUCTION

Samancor Chrome wishes to construct a 100 MW photovoltaic (PV) project at their Tubatse FerroChrome operations in Steelpoort, Limpopo province. GCS Water and Environment (Pty) Ltd (GCS) was appointed by Royal HaskoningDHV (Pty) Ltd (RHDHV) to carry out a hydrological assessment in support of application for an Integrated Water Use License (IWUL) and Environmental Impact Assessment (EIA) for the proposed development on behalf of Samancor Chrome.

Five sites have been identified for the PV plants:

- Site 1: remaining extent of the farm Goudmyn 337, portion 10 and remaining extent of the farm Olifantspoortje 319 portion 5, 31.7 ha
- Site 2: remaining extent of the farm Goudmyn 337, portion 10 and remaining extent of the farm Olifantspoortje 319 portion 3, 30.1 ha
- Site 3: remaining extent of the farm Goudmyn 337, 13.7 ha
- Site 4: remaining extent of the farm Goudmyn 337, 15.6 ha
- Site 5: remaining extent of the farm Goudmyn 337 portion 10, 70.41 ha

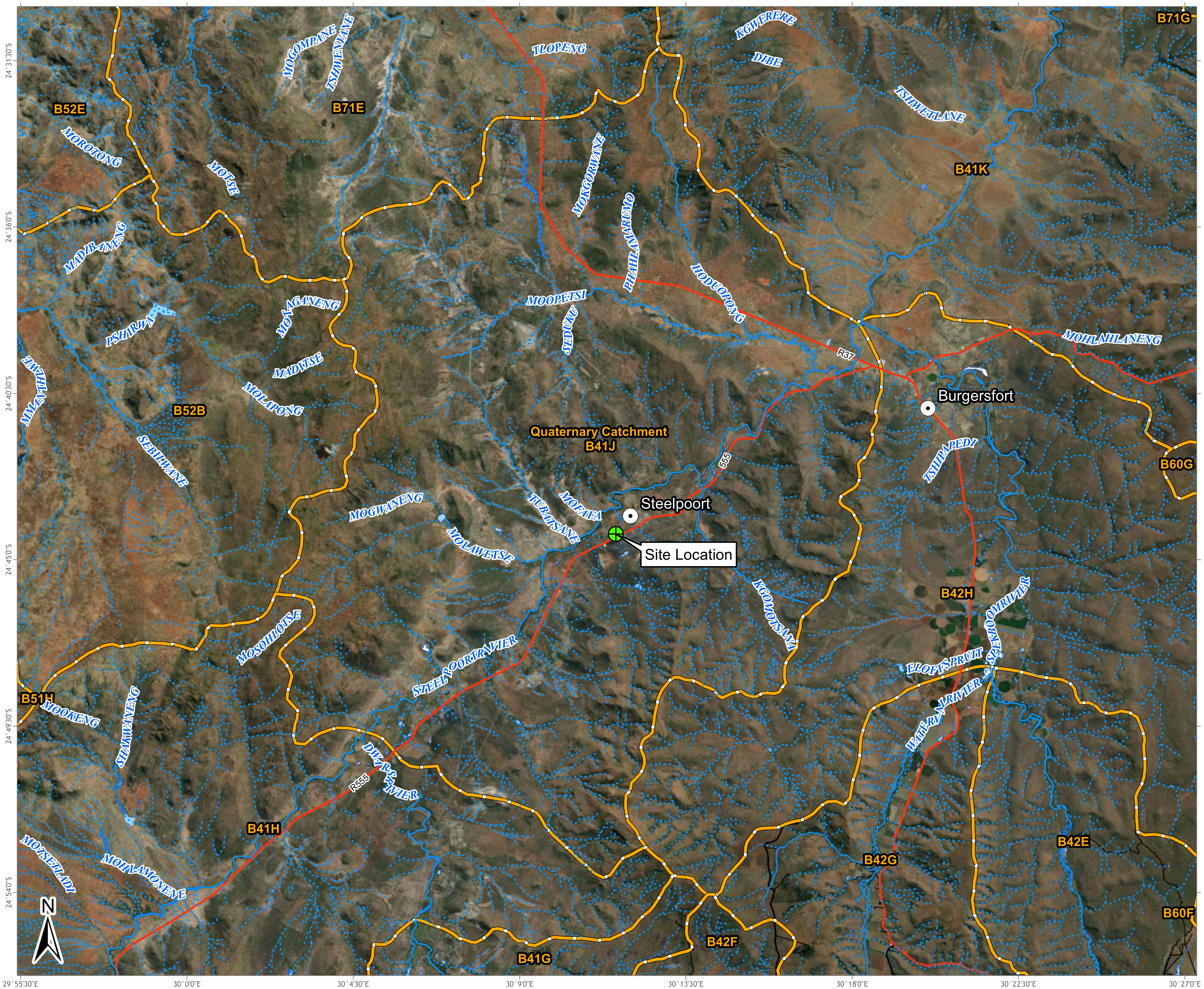
All five sites are required to achieve the 100 MW output and thus the project includes the construction of five PV plants. Each plant will have its own footprint and associated infrastructure including the PV cells, a battery and a substation and powerlines. Refer to Figure 1-1.

The area is located in the Olifants Water Management Area (WMA), quaternary catchment B41J (South Africa. Dept. of Water and Sanitation, 2016). The site is approximately 120 km south of Polokwane in the Greater Tubatse Local Municipality and the Sekhukhune District Municipality. The catchment is largely undeveloped with rural settlements and some agriculture. Steelpoort is an industrial town and the only town in the catchment. The Steelpoort River drains the catchment. Refer to Figure 1-2 for the locality plan and drainage information.

This report will cover the baseline climatic and hydrological description, the floodlines, a conceptual stormwater management plan, a water balance and a surface water impact assessment and monitoring program.

RHDHV SAMANCOR STEELPOORT: SITE LAYOUT MAP

RHDHV SAMANCOR STEELPOORT: LOCALITY MAP AND WATER MANAGEMENT AREA



LEGEND

Town

Site Location

Rivers and Streams

Non-Perennial

Perennial

Road Network

Main Road

Quaternary Catchment

Inland Water

Dams and lakes

Reservoirs and water tanks

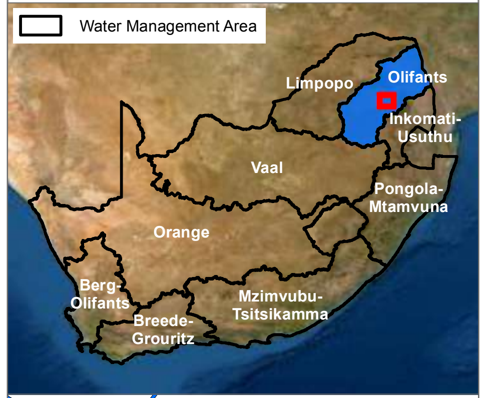
Marsh and swamps

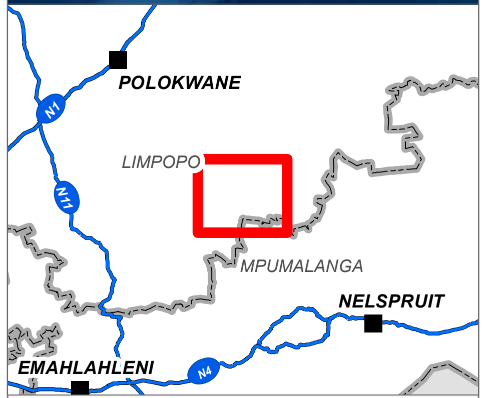
Non-perennial pans

River Area

Flood and non-perennial extent

Perennial extent





Data Sources:
Esri World Imagery Basemap
2011 DWAF Quaternary Catchments
2016 DWS Water Management Areas

0 3.5 7 Kilometers

SCALE: 1:180 000

FIGURE NO.:	-	MAP NUMBER:	20-1181-02
DRAWN BY:	N NAIDOO GIS TECHNICIAN	REVIEWED BY:	J MENEGHELLI WATER RESOURCE ENGINEER
DATUM: PROJECTION:	WGS84 GEOGRAPHIC	DATE:	21 MAY 2021
PROJECT: CLIENT:	SAMANCOR STEELPOORT HYDROLOGY ASSESSMENT ROYAL HASKONINGDHV		

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2 SCOPE OF WORK

This study will support Samancor's IWUL application and EIA by assessing the hydrology of the site in accordance with the minimum requirements set out in Government Notice No. R. 267 of the National Water Act (Act 36 of 1998) (as amended) *Regulations regarding the procedural requirements for water use licence applications and appeals* (South Africa. Dept. of Water and Sanitation, 2017). The Scope of Work (SoW) is comprised of the following tasks as per RHDHV's Terms of Reference (ToR) (2021):

- Data collection and literature review.
- Baseline hydrology investigation.
- Floodline delineation.
- Conceptual Stormwater Management Plan (SWMP).
- Conceptual water balance.
- Hydrological risk assessment including site walkover and application of the Department of Water and Sanitation's (DWS) Risk Assessment Matrix adapted for hydrological risks.
- Surface water monitoring plan.
- Compilation of a comprehensive hydrological report, to include the abovementioned components.

This report was previously issued (Version B, May 2021) presenting the floodline delineation which informed the design and layout of the PV plants. This report has now been revised to include a conceptual SWMP and water balance based on the layouts. This report will support the IWUL and EIA.

3 METHODOLOGY

3.1 Data collection and literature review

The following information has been supplied by Samancor:

- Surface water monitoring data from 2018.
- Seasonal aquatic biomonitoring reports from 2018 by Nepid Consultants.
- Samancor Tubatse operations floodlines analysis technical memorandum by Golder, 2019. This report determined floodlines of the river course adjacent to the HH facility, the same river examined for Sites 3, 4 and 5.

The following national legislation will be referred to as guidance on best practices with regard to the hydrological assessment:

- South African Department of Water and Sanitation (formerly the department of Water Affairs – DWA) Best Practice Guidelines G1: Storm Water Management (DWA, 2006a) and Water and Salt Balances (DWA, 2006b).

The author went to Steelpoort to inspect all proposed sites on the 13th and 14th April 2021 and was accommodated by Mr Willem Den Heijer of Samancor. Observations made during the site visit are integral to the findings of this report.

3.2 Baseline climate and hydrology assessment

A desktop climate and hydrology assessment will be completed.

Climate data will be obtained from previous studies of the site and online sources.

Average monthly rainfall, evaporation, mean annual precipitation (MAP), mean annual evaporation (MAE) and mean annual runoff (MAR) are to be extracted from previous studies done on the site and the WR2012 database (WRC, 2012). Rainfall data for various sources will be analysed and cross-compared to select data estimated to be most representative of the site conditions.

The design rainfall depths will be determined using the Design Rainfall software for South Africa (Smithers and Schulze, 2000) for the selected rainfall station and will provid input into the necessary storm event calculations for the floodline determination and conceptual SWMP.

3.3 Floodline determination

Publicly available Advanced Land Observation Satellite data will be used to generate a digital elevation model (DEM) of the site. 1:10, 1:20, 1:50 and 1:100 return interval floodlines will then be determined:

- Catchment delineation and drainage lines will be calculated using Geographic Information Systems (GIS) software.
- Calculate peak flows:
    - Peak flood analysis will be undertaken for each sub-catchment contributing runoff to the rivers.
    - Peak runoff will be calculated using three of the SANRAL methods, namely the Rational Method Alternative 3, The Standard Design Flood method and the MIPI. The most acceptable method given the catchment characteristics will be selected.
- River system modelling:
    - A steady-state backwater GeoHEC-RAS model will be constructed that accurately represents the river system and existing infrastructure

It should be noted up-front that the floodline may not be suitable for engineering purposes and is intended for the water use authorization application process only. Should the Client require engineering quality floodlines for design purposes, GCS offers this service based on obtaining high resolution survey data of the river from the Client at an additional cost, this is not included in the scope.

3.4 Conceptual stormwater management plan

The conceptual SWMP will include the management of runoff on the site and the management of runoff from the upstream catchments draining towards the site. The design, sizing and placement of conceptual stormwater infrastructure will use relevant South African Best Practice Guidelines, described in the South African Drainage Manual (SANRAL, 2013). Sizing and modelling of the SWMP was undertaken using PCSWMM software (Chiwater, 2017).

The conceptual SWMP will be devised in accordance with the South African Department of Water and Sanitation (DWS) (formerly the department of Water Affairs - DWA) Best Practice Guidelines G1: Storm Water Management (DWA, 2006a).

Recommendations for management of stormwater flows during the construction phase in order to minimise detrimental impacts to the receiving environment will be presented.

3.5 Water balance

In this project, no water supply to the site is envisioned. Therefore, a high level discussion of water management during the construction and operational phases of the project will be presented.

3.6 Surface Water Impact Assessment

Surface water impacts resulting from the hydrology of the site will be predicted and quantified using a modified version of the DHSW&S Risk Assessment Matrix, adjusted for hydrological assessment. The same approach used to weight the impacts and assign value to the impacts will be used. Mitigations to reduce the predicted impacts will be suggested.

3.7 Surface Water Quality and Monitoring Program

Based on the water flows on the site, a surface water quality and monitoring program will be suggested to ensure that the water leaving the site is of acceptable quality to release to the environment with minimal detrimental effects.

4 BASELINE CLIMATE AND HYDROLOGY

4.1 General climate

The climate in the Limpopo province is classified as a hot semi-arid climate (BSh) by the Köppen-Geiger system (Climate-Data.org, 2021). The rainfall is the region is generally low, ranging from as little as 200 mm/yr to 560 mm/yr. Rainfall occurs during the summer months with the highest rainfall occurring in January while June and July are the driest months. Evaporation is estimated to range from 1 600 mm/yr in the mountainous regions to as high as 3 100 mm/yr for the Olifants WMA, which is much higher than rainfall resulting in a net loss of water meaning that the area is arid. The Limpopo province is one of the warmest areas in South Africa with predominantly sunny conditions prevailing. Summers are warm with temperatures getting as high as 40°C and winters are mild with frost, and temperatures dropping to 0°C at night. The climate is heavily influenced by eastern wind systems, particularly tropical cyclones from the Indian Ocean coming through Mozambique (Climate of the Limpopo Basin, 2010).

4.2 Site description

The Steelpoort River valley is steep with slopes of 2.5% in the plain and steep hills with slopes of 23% rising 1 000 m to altitudes of 1700 mamsl on the sides from approximately 700 mamsl along the river. The hills are rocky and the plains are densely vegetated with grasses, shrubs and trees. The Steelpoort River has major tributaries of the Tubatsane River which joins it from the north, downslope of the site. There are many small non-perennial drainage lines throughout the valley. There are two chrome smelters in the catchment. These are the main centres of development, otherwise the area is generally undeveloped.

4.3 Regional rainfall

The site falls in quaternary catchment B41J, in the B4D rainfall zone and has an MAP of 598 mm/yr characteristic of the arid north of the country (40% of South Africa's MAP of approximately 460 mm/yr, (World Bank Group, 2021)). The catchment has a gross area of 691 km^2 and drains to the Steelpoort River. Average monthly rainfall data for the catchment was extracted from WR2012 and is graphed in Figure 4-1.

Three South African Weather Service (SAWS) stations were identified in the vicinity: Ga-Sekhukhuneland, Maandagshoek and Rustplaats. These were compared to the quaternary catchment average monthly rainfall and MAP. Rustplaats was selected as being most representative of the site and was used to calculate peak flows.

Table 4-1 SAWS stations parameters

Station name	Number	Years	MAP (mm/yr)	Altitude (mamsl)	Distance (km)
Ga-Sekhukhuneland	0593015W	77	517	1282	16.9
Maandagshoek	0593126W	69	574	1033	17.9
Rustplaats	0594141W	75	545	1250	23.3

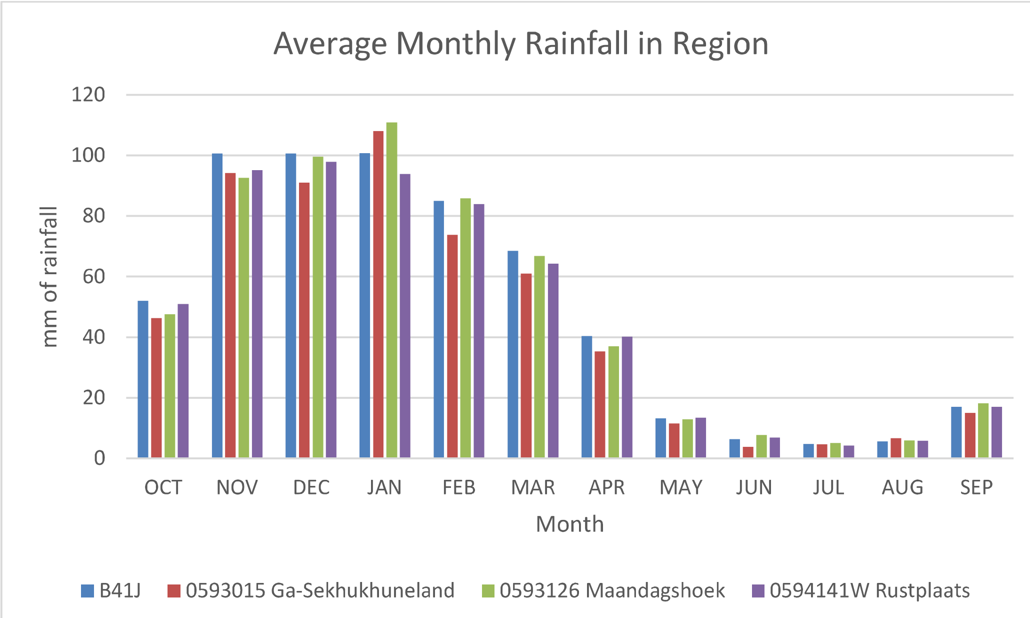


Figure 4-1 Average monthly rainfall

4.4 Evaporation

The Mean Annual Evaporation (MAE) for quaternary catchment B41J is 1550 mm/yr and the site falls within evaporation zone 4A. Monthly average evaporation calculated for the catchment (1920-2009) in shown in Figure 4-2.

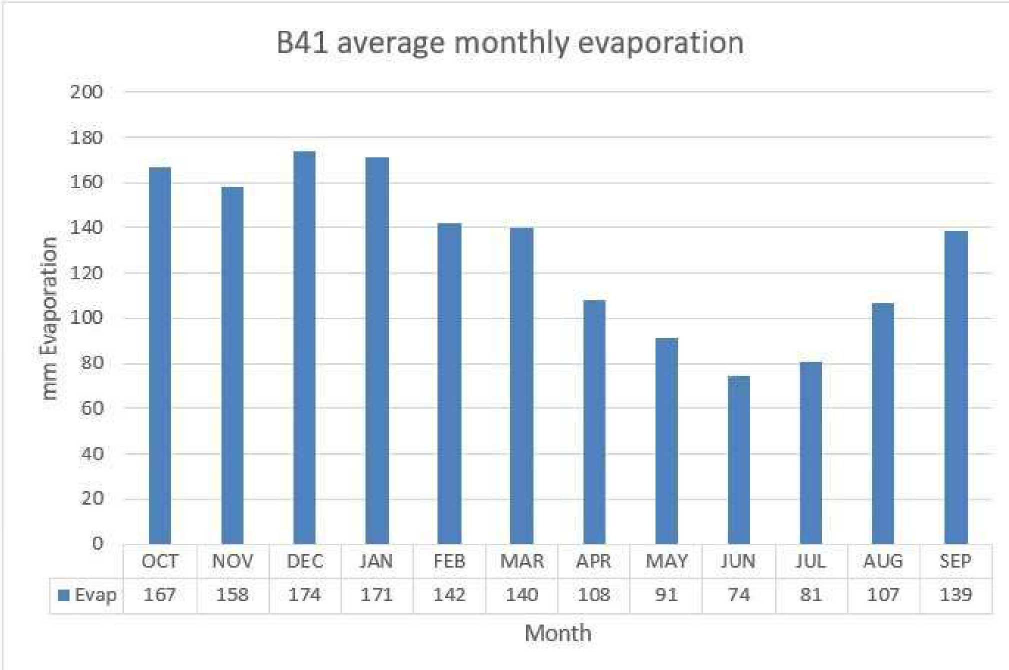


Figure 4-2 Quaternary catchment B41J average monthly evaporation

4.5 Runoff

The WRSM-Pitman model of the Olifants WMA was simulated to determine MAR for quaternary catchment B41J. It was found to be 13 120 000 m^3/yr. This is based on the assumptions of no subsurface flow at full moisture storage capacity, and 100 mm of soil moisture storage capacity.

4.6 Design rainfall depth

Design rainfall depths for the site were calculated using the Design Rainfall software for South Africa (Smithers and Schulze, 2000). The design rainfall depths for the 1:2-year to 1:200-year return periods can be seen in Table 4-2. These rainfall depths were used as input in calculating flood peak flows for the project site

Table 4-2 Design rainfall depths for Rustplaats SWAS station (mm)

Duration	Return Period (years)			
	10	20	50	100
24 hr	78.21	91.3	109.45	124.08
1 day	71.1	83	99.5	112.8
2 days	90.6	106.5	128.9	147.2
3 days	103.6	121.3	145.9	165.9

5 FLOODLINE DELINEATION

5.1 Catchment delineation

The site is in the valley, adjacent to the escarpment and therefore receives runoff from the hills. There are many drainage lines running through the valley. Two drainage catchments influencing the sites that drain to the Steelpoort River were identified. Refer to Figure 5-1 for the topography of the area and sub-catchments and drainage lines affecting the sites.

- Site 1: There are no drainage lines through Site 1. The site is just 800 m from the Steelpoort River and is bordered by the R555 to the south and an unnamed arterial road to the west. It is approximately 900 m long and 375 m wide and 37.1 ha in area. From site observations of scouring, it appears that runoff from the road flows alongside the road (no formal channel) to the river and therefore do not affect the site. There is a low point on the site at its south-west corner, where the two roads intersect, that has manholes and there is evidence of some flow here (gauged from flattened vegetation). However, no defined flow path could be identified from visual inspection or topographical modelling and it was therefore assumed that the flow volumes are not large and are dissipated into the area as overland flow. The area is densely vegetated with grasses and shrubs, on sandy soil. The is no existing infrastructure on the site.

  As there are not any drainage lines through Site 1, there will not be any floodlines to be considered in the planning and layout of the proposed PV plant. For the purposes of floodline determination, no sub-catchments were delineated for this site, although for the conceptual stormwater management plan an assessment of surface runoff over the area will be required.

- Site 2: There are no drainage lines through Site 2. The site is located behind the factory and railway line, at the foot of the hills. It is a long rectangular site, approximately 1 300 m long (east to west) by 250 m wide, with an area of 30.1 ha. The vegetation is dense and diverse, with grasses, shrubs and large trees. The soil is sandy and loose and will have a high drainage potential. There are two boreholes located on the site, and access roads leading to them. The site is otherwise undeveloped. The topography was observed to be gently sloping with no localized surface depressions or outcrops.

To the west of the site there is a significant watercourse that is channeled beneath the railway line through a square concrete culvert approximately 3 m wide by 2.5 m high, and 16 m long. The invert level of the culvert is approximately 5 m below the railway line, and the channel has steep slopes and falls steeply from the hills. This shape and slope would result in high velocity flows. No water was observed in the channel, indicating that it is a non-perennial river.

It was deemed necessary to investigate the floodline associated with this channel to determine if it will influence the site. The topography was examined and the sub-catchments contributing flow to this drainage line were delineated using GIS. The hills do not have a plateau, so the runoff is from their slopes only. The total sub-catchment area is approximately 227 ha with a slope of 20% on the hills and 5% on the plains and a flow length of 2 015 m.

- Site 3, Site 4 and Site 5: These three sites are located to the west of the factory and are all irregular in shape with areas of 13.7 15.6 ha and Site 5 being the largest site at 70.41 ha. There are no drainage lines through Site 3 and Site 4, but they lie adjacent to a significant drainage line that continues through Site 5. The R555 road lies between Site 3 and 4 and Site 5. The vegetation is extremely dense and varied on these sites. They are undeveloped and have no existing infrastructure on them. These sites have hilly topography and slope towards the drainage line.

  The drainage line is approximately 5 m deep with steep sides. It did not have water flowing in it at the time of the site visit, indicating that it is non-perennial. There is a rock feature protruding in it, which will have turbulent flow over its steep faces during rainfall events. The drainage lies passes below the R555 road through a bridge consisting of two concrete openings estimated to be 5 m by 5 in width and height.

  This drainage line receives runoff from a contributing sub-catchment that originates in the large hill formation lying to the south. The total area of the sub-catchment is 2 260 ha and is steep. This will result in high peak flows through the drainage channel. The floodline was determined from these observed catchment characteristics.

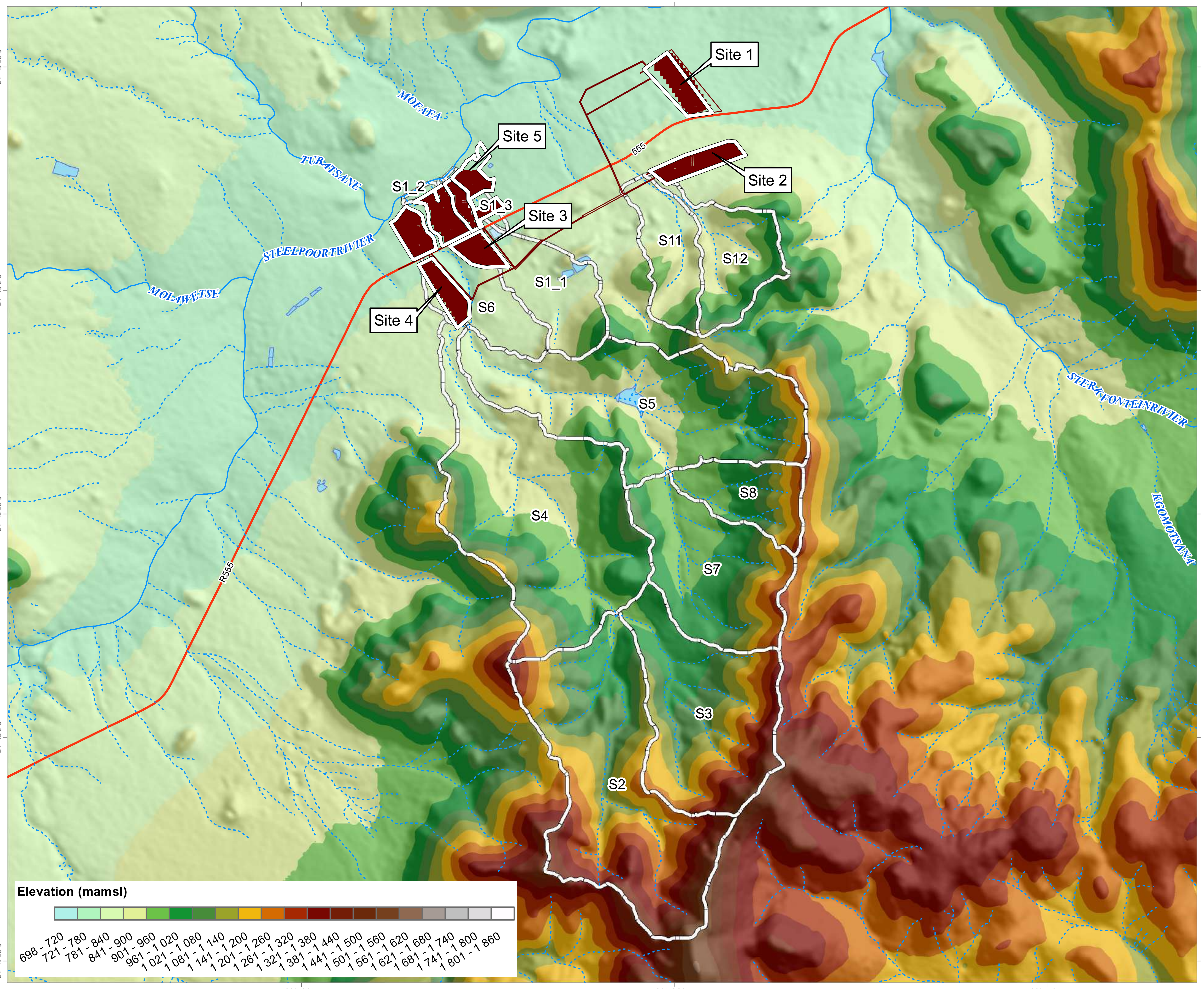
- Site 5: In addition to the major line passing through the site, there are three minor drainage lines that discharge into the site from under the road and drain to the Steelpoort River. These sub-catchments have areas of 0.15, 0.29 and 2.17 ha. It was not possible to delineate floodlines of these drainage lines as the DEM did not reflect their cross-sections. However, peak flows have been estimated and based on site measurements of the channel’s size their water surface levels on the site will be calculated.

All catchment characteristics are summarized in Table 5-1 for the sub-catchments delineated in Figure 5-1.

Table 5-1 Catchment attribute summary as per labelling in Figure 5-1

Catchment name	Area (ha)	Flow Length (km)	Slope (%)
S1_2	0.16	0.57	3.46
S1_1	2.17	2.94	6.08
S1_3	0.29	1.03	3.29
S2	482.97	4.35	11.30
S3	323.58	2.83	9.87
S4	517.27	5.26	6.13
S5	441.58	4.43	8.00
S6	135.64	1.93	2.09
S7	253.14	2.53	8.47
S8	106.11	1.73	20.30
S11	104.04	2.02	5.45
S12	122.91	2.02	12.10

RHDHV SAMANCOR STEELPOORT: SUB-CATCHMENT MAP



LEGEND

EIAR Plant Site
Power Corridor

Rivers and Streams

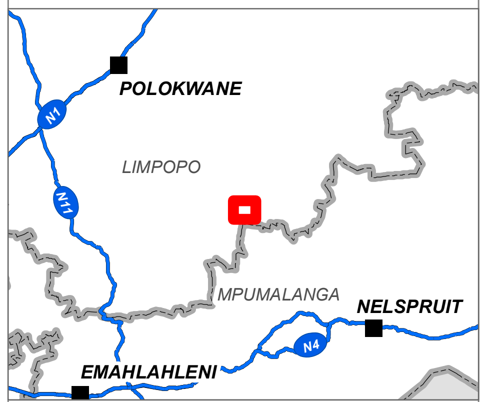
Non-Perennial
Perennial

Road Network

Main Road
Delineated Sub-catchments

Inland Water

Dams and lakes
Reservoirs and water tanks



Data Sources:
30 m ALOS DSM
Sub-catchments from specialist

0 | 1 | 2 Kilometers

SCALE: 1:45 000

FIGURE NO.:	-	MAP NUMBER:	20-1181-03-V2
DRAWN BY:	N MBOKAZI GIS INTERN	REVIEWED BY:	T DOMINY GIS ANALYST
DATUM: PROJECTION:	WGS84 GEOGRAPHIC	DATE:	30 SEPTEMBER 2021
PROJECT:	SAMANCOR STEELPOORT HYDROLOGY ASSESSMENT		
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5.2 Peak flow calculation

Peak flows were calculated for each sub-catchment for the 1:10, 1:20, 1:50 and 1:100 year design storm events.

Peak flows calculated using the SDF method were selected to be used for analysis for the large catchments, meaning that those peak flows calculated by the rational method may not be truly representative of the site. For the small catchments (S1_1, S1_2 and S1_3) values determined by the rational method were used.All peak flows calculated per delineated sub-catchment for each event are summarised in Table 5-2. Two of the drainage lines have large peak flows and floodlines will be generated based on these using GeoHECRAS. The three minor catchments through Site 5 have small flows and floodlines will not be calculated for these, water surface elevations will be calculated using PCSWMM.

- Site 2: The peak flows down the channel next to Site 2 are 21.40, 30.61, 44.28, 55.71 m^3/s for the events modelled.
- Site 3, 4 and 5: 53.52, 76.57, 110.77, 136.98 m^3/s for the events modelled.
- Site 5: Site 5 has three small drainage lines running through it.
    - S1_1: This is the largest of the three small sub-catchments. Its flow is directed under the R555 road via two 450 mm inner diameter concrete pipe culverts. The flows predicted to emanate from this small catchment of 2.17 ha are 0.36, 0.44, 0.56 and 0.67 m^3/s for the events modelled.

      It must be noted that this drainage line originates on Site 3. Site 3 was inspected, and the drainage line was identified as a slight depression, with no scour or defined channel observed. It is therefore predicted that this surface water can be managed with the overland flow by the stormwater management plan.
    - S1_2: One of these is very small (250 m) with a contributing catchment of 0.15 ha and has no culvert under the road. Flow is therefore assumed to be negligible in terms of planning and layout of the PV plant and can be managed with the stormwater management plan. Peak flows are minor at 0.07, 0.09, 0.12 and 0.14 m^3/s for the events modelled. There is an established drainage channel from the culvert to the river.

- S1_3: This drainage line also has a small catchment (0.29 ha) and is directed under the R555 road by a single PVC pipe culvert. There is a shallow drainage line visible through the catchment from the culvert to the Steelpoort River. Flows are minor at 0.08, 0.10, 0.13 and 0.16 m^3/s for the events modelled. It is likely that these flows can be managed by the stormwater management plan for the PV plant.

Table 5-2 Peak flows calculated for sub-catchments

Catchment name	Peak flows (m^3/s)			
	Return Period (years)			
	10	20	50	100
S1_1	0.36	0.44	0.56	0.67
S1_2	0.07	0.09	0.12	0.14
S1_3	0.08	0.10	0.13	0.16
S2	31.99	45.77	66.21	83.30
S3	25.89	37.04	53.58	67.41
S4	26.72	38.23	55.30	69.58
S5	26.80	38.34	55.46	69.78
S6	9.39	13.43	19.43	24.44
S7	20.84	29.82	43.14	54.27
S8	12.70	18.17	26.28	33.06
S11	8.94	12.79	18.50	23.27
S12	12.46	17.82	25.78	32.44

5.3 River system modelling results and analysis

The two major drainage lines identified were modelled in GeoHECRAS using the DEM from ALOS data as described in Section 3.3. The transects were inspected to ensure accurate representation of the channels, and the DEM was found to have sufficient elevation data to provide transects that agree with those observed and measured on site. Typical transects from the GeoHECRAS model are plotted in Figure 5-2 and Figure 5-3 below.

The first drainage line that passes Site 2 does not encroach on the site for any event and therefore does not exclude any area available for development. Key characteristics for each flood event are in Table 5-3. The maximum water surface elevation is 801.22 mamsl which is 2 m below the edge Site 2. The maximum surface width is 58.61 m from the drainage centreline which does not influence the site as the centreline is 130 m west of the site. Refer to Figure 5-4 for a map of the floodlines.

Table 5-3 Floodline attributes for a typical transect on the drainage line past Site 2

Return Interval (years)	Water Surface Elevation (mamsl)	Depth (m)	Velocity (m/s)	Surface width (m)	Total Volume (1 000 m^3)
10	800.97	0.47	1.63	48.52	1.17
20	801.05	0.54	1.82	51.46	1.52
50	801.15	0.64	2.00	55.36	1.95
100	801.22	0.71	2.12	58.61	2.29

Invert Elevation: 800.51 mamsl

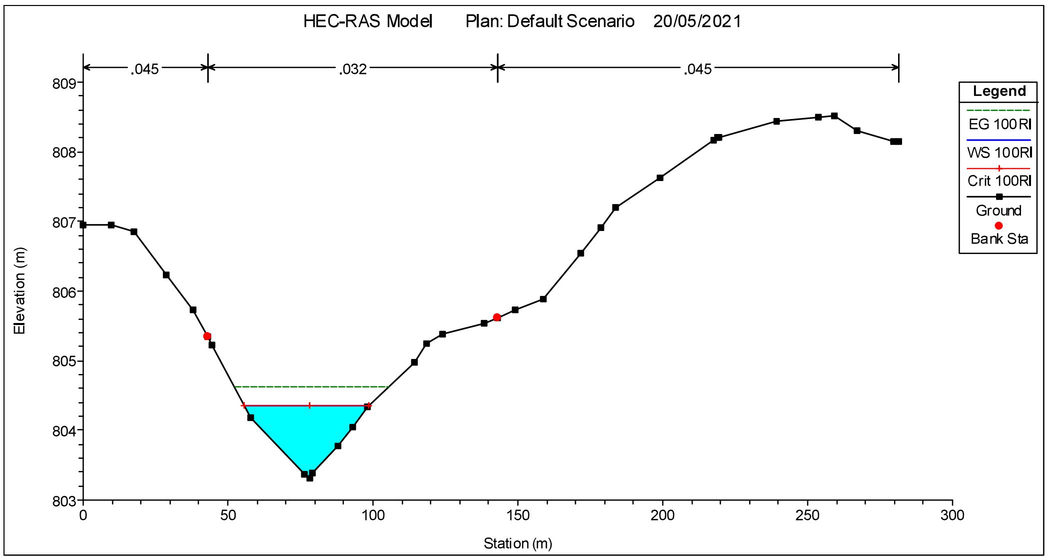


Figure 5-2 Drainage line past Site 2 transect with the 1:100 year return interval water surface elevation

The second major drainage line that passes between Sites 3 and 4 and through Site 5 experiences large volumes of flow (45 4300 m3 for the 1:100 year event). The floodlines encroach slightly on the south-east corner of Site 4 and do not affect Site 3. However, there is a significant impact on Site 5 as the flood will spread up to 88 m in width, rendering a large area of the site unsuitable for development. Refer to Figure 5-6 for the floodline map.

Table 5-4 Floodline attributes for a typical transect on the drainage line past Site 3 and 4 and through Site 5

Return Interval (years)	Water Surface Elevation (mamsl)	Depth (m)	Velocity (m/s)	Surface width (m)	Total Volume (1 000 m^3)
10	761.50	0.74	1.88	69.93	23.96
20	761.62	0.86	2.03	77.79	30.51
50	761.79	1.03	2.16	85.87	39.26
100	761.89	1.13	2.30	88.73	45.43

Invert Elevation: 760.76 mamsl

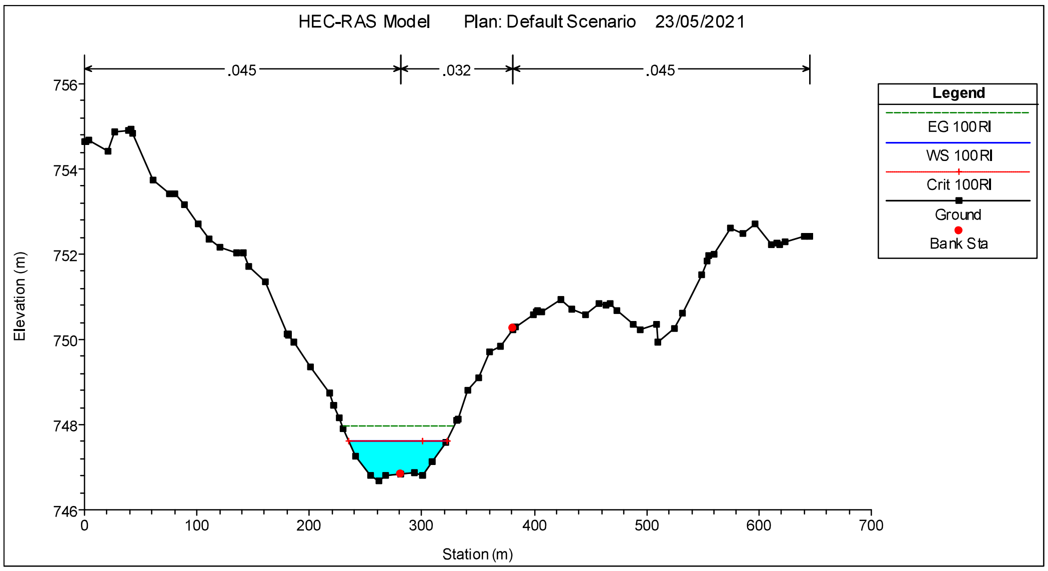


Figure 5-3 Drainage line past Sites 3 and 4, through Site 5 transect with the 1:100 year return interval water surface elevation

A limitation for this assessment is that there was not elevation data available for the smaller drainage lines through Site 5. The channel was simulated to be triangular with a width of 50 m and side slopes of 1:5 m/m. The design rainfall determined in Section 4.6 was applied to the channel. For the 1:100 year event, the surface width of flow was estimated to spread to 17 m. This indicates that a drainage channel with suitable hydraulic infrastrure is required as part of the stormwater management plan to canalise this flow, such that the maximum possible area of the site can still be used. It is recommended that topographical survey of the three minor drainage lines on the site be carried out in order to accurately model the floodlines and flows associated with these channels.

5.4 Steelpoort River analysis

The Steelpoort River falls within the Olifants Water Management Area. The Steelpoort River originates as the Grootspruit near Belfast in Mpumalanga from whence it flows in a northerly direction for approximately 180 km to confluence with the Olifants River near Ohrigstad in Limpopo province. The top of the catchment is at an elevation of 2 327 mamsl, falling to 581 mamsl at the confluence with the Olifants River (Limpopo River Awareness Kit, 2010). The total area of the catchment is 7 136 km^2 (DWS, 2018). The MAP for the catchment varies from 600 to 1 000 mm/yr. Land use is predominantly agricultural and pastoral with mining operators and small towns centres such as Steelpoort.

The proposed PV plant at Samancor lies along the Steelpoort River, between its two major tributaries being the Dwars Rivier 15 km upstream and the Spekboom 17 km downstream. The total sub-catchment area of the Steelpoort River upstream on the site is approximately 4 407 km^2, 61 % of the total catchment area and is made up of 9 quaternary catchments (Refer to Figure 5-5).

The De Hoop Dam lies approximately 39 km south-west of the proposed site. This dam was recently constructed by the DWS and was opened for operation in 2014. It is a concrete arch dam. The dam has a surface area of 1 690 ha, a height of 81 m, a length of 1 000 m, and the full supply capacity is 347 Mm^3 (DWS, 2020).

The methods of catchment runoff modelling employed for the other tributaries passing through the PV plant site are not suitable for determination of the peak flows in the Steelpoort River because it is such a long river with varying land uses, topography and climate. In addition, a rainfall event will have a spatial and temporal limitation and will occur within the catchment, not over the entire catchment. Conventional catchment runoff modelling assumes homogeneity across the catchment, a simplifying assumption that cannot be applied to this large and complex system. Therefore, floodline and corresponding peak flows for various recurrence intervals could not be determined by this method.

Publicly available data was then investigated for the river. No data was available regarding floodlines of the river.

The elements affecting flow volumes in the river were then investigated. The volume of water flowing in the Steelpoort River adjacent to the site will be controlled by a combination of the De Hoop Dam releases and inflow from the Dwars Rivier. Based on this premise, it was postulated that the maximum flows that could occur adjacent to the site would be comprised of the maximum release possible from the De Hoop Dam spillway summed with the peak inflow from the Dwars Rivier. In order to determine these values, stream flow data and dam spill data was obtained from the DWS and evaluated.

It was found that in February 2015, the De Hoop Dam was 101.4 % full and released a total volume of 23.8 mm^3 in the month (measuring station B4R007), corresponding to a flow of 29.4 Mm^3 for the month downstream of the dam (measuring station B4H023). In the same month, the Dwars Rivier experienced a monthly flow of 3.29 Mm^3 (measuring station B4H009).

The following assumptions were made:

- The 29.4 Mm^3 from the dam spilled over seven days at 4.2 Mm^3 per day.
- The Dwars Rivier experienced a flow of 3.29 Mm^3 at the peak of a 24 hour storm event.
- These two flows were superimposed to result in a total peak flow of 7.49 Mm^3 in 24 hours.

This flow was then input as the steady state flow to the GeoHECRAS model for backwater analysis and this resulted in the floodlines shown in Figure 5-6.

In order to estimate the recurrence interval associated with this flow, the rainfall event of February 2015 was investigated. The following information was retrieved from a newspaper article (Floodlist, 2015):

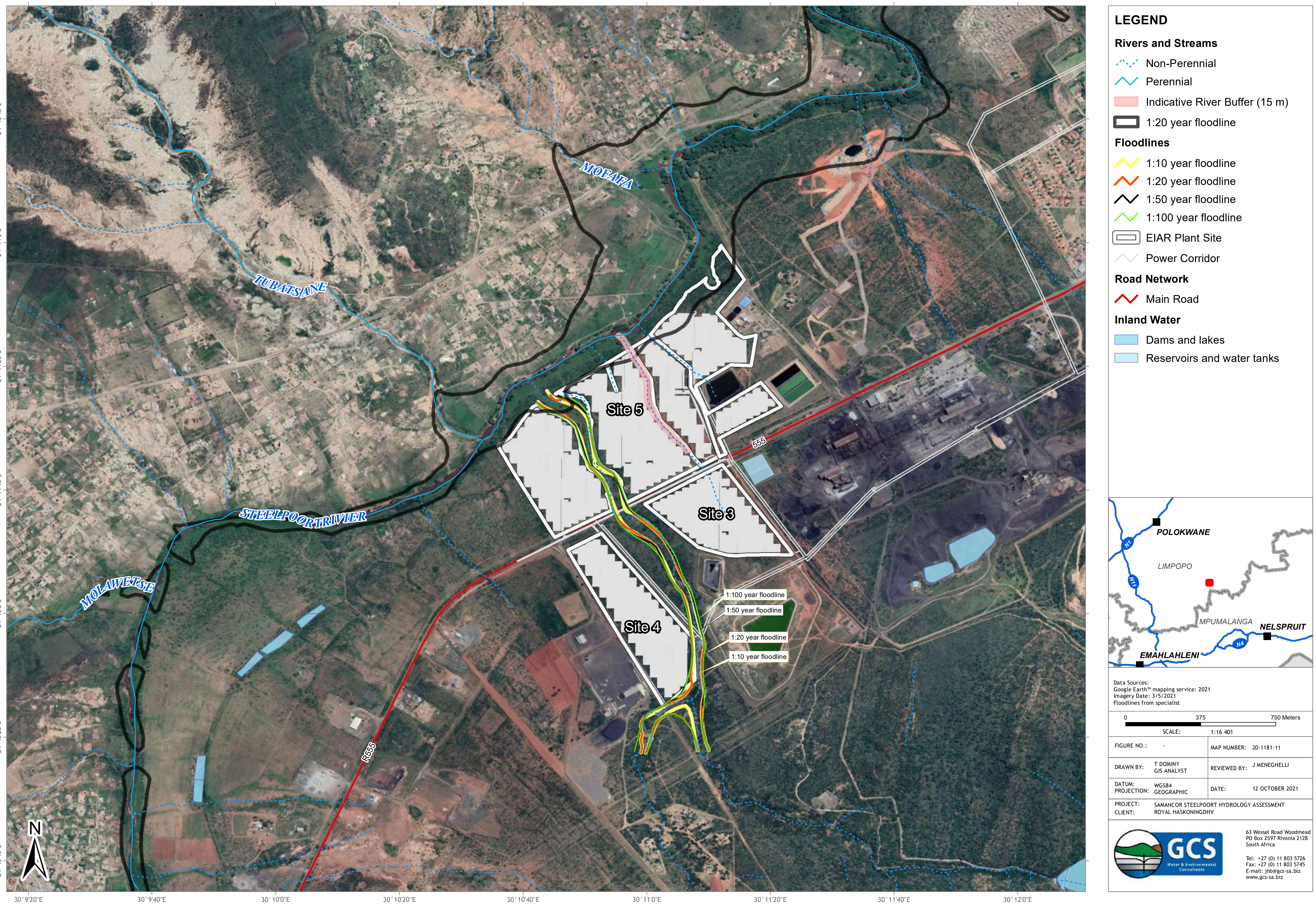
- Lydenburg recorded 93.0 mm of rainfall in 24 hours.
- Tzaneen recorded 124.0 mm of rainfall in 24 hours.

Comparing this to the design rainfalls of Lydenburg and Tzaneen, this corresponds to a 20 year 24 hour recurrence interval event. It is further assumed that the maximum spill from the De Hoop Dam is limited by the spillway capacity and therefore is unlikely to exceed the volumes released during this event.

It follows that the De Hoop Dam provides effective flood mitigation and protects downstream from flood hydrographs by tempering the releases. It is therefore unlikely that the maximum flow in the river would exceed the predicted flow of 7.49 Mm^3 as this flow is controlled by the dam spillway. It should also be noted that the dam was at full supply level when these releases were made (101.4 % capacity) (DWS, 2015). Therefore, downstream flooding will only occur if the spillway releases coincide with the dam being full.

It can therefore be concluded that the modelling of the floodlines based on dam spill data from the 2015 20 year recurrence interval represents the maximum extent of flooding that will be observed in the Steelpoort River adjacent to the proposed PV plant site.

RHDHV SAMANCOR STEELPOORT: STEELPOORT AND TRIBUTARY 1 FLOODLINE MAP



RHDHV SAMANCOR STEELPOORT: STEELPOORT QUATERNARY CATCHMENTS

LEGEND

- Site Location

Rivers and Streams

- Perennial

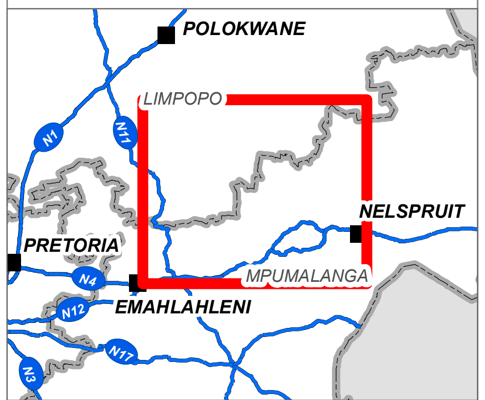
River_Line

Rivers and Streams

- Perennial
- Total catchment
- Quaternary catchments

Inland Water

- Dams and lakes
- Dry pans
- Reservoirs and water tanks
- Marsh and swamps
- Non-perennial pans



Data Sources:
ESRI Basemap Satellite Imagery 2021
WR2012 Quaternary catchments

0 12.5 25 Kilometers

SCALE: 1:600 000

FIGURE NO.:	-	MAP NUMBER:	20-1181-12
DRAWN BY:	T DOMINY GIS ANALYST	REVIEWED BY:	J MENEGHELLI
DATUM: PROJECTION:	WGS84 GEOGRAPHIC	DATE:	12 OCTOBER 2021
PROJECT: CLIENT:	SAMANCOR STEELPOORT HYDROLOGY ASSESSMENT ROYAL HASKONINGDHV		

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RHDHV SAMANCOR STEELPOORT: TRIBUTARY 2 FLOODLINE MAP

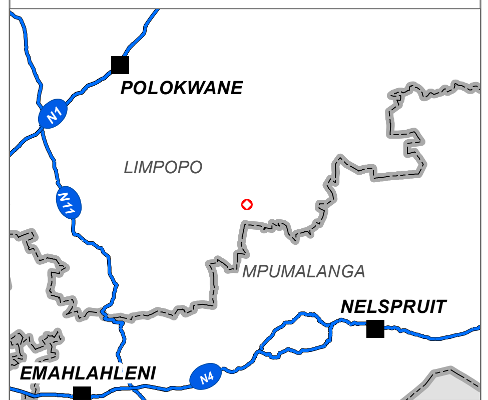
LEGEND

Rivers and Streams

Non-Perennial

Floodlines

1:10 year floodline
1:20 year floodline
1:50 year floodline
1:100 year floodline
Plant Sites



Data Sources:
Google Earth™ mapping service: 2021
Imagery Date: 3/5/2021
Floodlines from specialist

0 50 100 Meters

SCALE: 1:2 000

FIGURE NO.:	-	MAP NUMBER:	20-1181-05
DRAWN BY:	N NAIDOO GIS TECHNICIAN	REVIEWED BY:	J MENEGHELLI WATER RESOURCE ENGINEER
DATUM: PROJECTION:	WGS84 GEOGRAPHIC	DATE:	21 MAY 2021
PROJECT:	SAMANCOR STEELPOORT HYDROLOGY ASSESSMENT		
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6 CONCEPTUAL STORMWATER MANAGEMENT PLAN

6.1 Principles of the SWMP

In accordance with *Best Practice Guideline - G1: Stormwater Management* (2006) the SWMP for the site will seek to achieve certain objectives based on a philosophy of protecting the environment from impacts. This is of utmost importance as the proposed sites are undeveloped, and thus runoff hydrographs from them currently pose no threat to the receiving Steelpoort River. Therefore, impacts to the pristine environment should be minimised.

- Clean and dirty water should be separated, and it should be ensured that all stormwater structures are designed to keep dirty and clean water separate and can accommodate a defined precipitation event.
- The clean water catchment area should be maximised, and clean water should be routed to a natural watercourse with minimal damage to that watercourse in terms of quality, quantity and frequency of discharge.
- Dirty areas should be minimised, and runoff from these areas contained and treated for reuse. Natural watercourses and the environment should be protected from contamination by dirty areas by ensuring that the dirty water cannot enter the clean water system by spillage or seepage.

It should be noted that the PV plants are considered clean areas as they do not introduce any contaminants to the surface which may pollute surface runoff. Therefore, all areas are clean.

In addition to these aims, this SWMP has the following criteria:

- Stormwater should be directed such that no water flows in an unruly fashion that may jeopardize the safety of personnel or infrastructure, or such that it is a nuisance.
- Protection of the soils by preventing erosion is also a key requirement of the SWMP.
- Minimise modification of the natural topography of the area and avoid any modification of the natural watercourse as far as possible.

In terms of *SANRAL Drainage Manual* (2013) the area is rural, with low traffic volumes providing access to individual farms and is therefore considered a Class 5 area so stormwater management infrastructure should be sized for the 1 in 10-year recurrence interval.

These objectives have guided the planning of the proposed SWMP.

6.2 Existing Infrastructure

All five of the proposed sites are undeveloped and have no existing stormwater infrastructure on them.

There are boreholes on some of the sites, but these do not have any need for stormwater management infrastructure and therefore will not be factored into the design of the conceptual SWMP.

In terms of stormwater infrastructure in the surrounds of the project, the following has been noted:

- Site 1 is bordered by two roads which do not have formal drainage trenches.
- Site 2 is located next to a deep non-perennial watercourse that flows under the railway line via a single, rectangular concrete culvert.
- Site 3, Site 4 and Site 5 are intercepted by culverts and bridges draining the R555.

Where possible, the drainage of the proposed conceptual SWMP will tie into this existing infrastructure.

6.3 Site 1 conceptual SWMP

6.3.1 Drainage characteristics of the site

Site 1 lies northeast of the Tubatse FerroChrome plant in Steelpoort town and is bordered on its southern perimeter by the R555 road, and along its western perimeter by an unnamed road that continues in a northerly direction to cross the Steelpoort River over a bridge. The topography of the site slopes gently and evenly in a northerly direction towards the valley bottom where the Steelpoort River runs. The southernmost boundary of the site on the R555 road is at an elevation of 775 mamsl, decreasing by 7 m over a distance of 845 m at a slope of 3.3 % to an elevation of 748 mamsl at the northernmost point of the site. This indicates that the natural drainage of the site will be towards the north. As noted in the floodline study, there are no drainage lines or permanent surface water features within the site itself. The site is vegetated with grasses and bushes, as shown in Figure 6-1 below.

Figure 6-1 Site 1 typical vegetation

6.3.2 Upstream catchments contributing runoff to site

During the site investigation, it was observed by studying the deposition of sediments, and patterns of scour, that the unnamed road drains along its informal side trenches and its surface to the Steelpoort River. In turn, the portion of the R555 that is adjacent to the site drains to the unnamed road. As the road is providing surface drainage paths to runoff from the upstream areas, no surface runoff reports to Site 1. Evidence of drainage can be seen below in Figure 6-2.

It can be concluded that no stormwater infrastructure is required for the management of flows from upstream catchments for Site 1.

Figure 6-2 Road drainage adjacent to Site 1

6.3.3 Runoff within the site boundary

Within Site 1, it is predicted that there is currently very little runoff due to the surface being pervious and densely vegetated with indigenous species. As it is, the site free drains to the surrounding environment overland in a northerly direction.

Once developed, the runoff from the site will be clean and can therefore be discharged to the environment. However, runoff volumes and frequency of occurrence is predicted to increase once the PV plant has been established as the vegetation will have been cleared, and sand on the site compacted resulting in lower infiltration rates. The roughness coefficient is estimated to decrease from 0.09 for dense grasses to 0.038 for mowed grass (adapted from Yen and Chow, 1985), which will also result in higher runoff volumes.

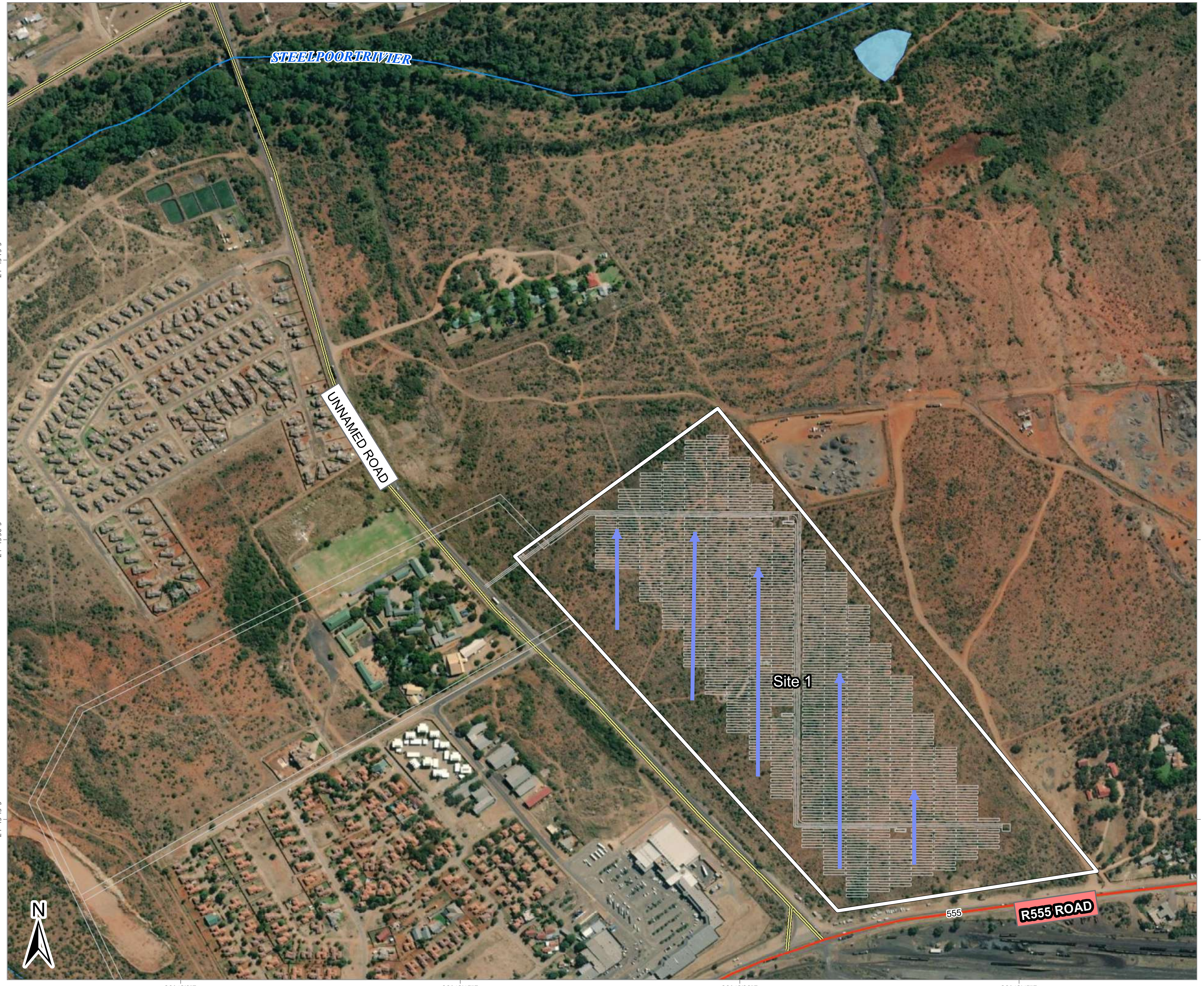
In order to keep the site as close to its pre-development runoff characteristics as possible, it is recommended that the ground is re-vegetated with grass once the PV plant has been established. It is not desirable to collect the resultant runoff and concentrate it, then releasing the total volume at a specific point as this introduces a risk of erosion. It is therefore recommended that the site remain free draining overland into the downstream environment. As there are no settlements nor any infrastructure immediately downslope of the site, the impact of the increased runoff volumes will be negligible.

6.3.4 Conceptual SWMP overview for the site

- No protection berms are required as there is no runoff from upstream catchments draining to the site.
- No stormwater management infrastructure is required within the site as it is free draining to the environment.

It can be concluded that no SWMP is needed for Site 1. Refer to Figure 6-3.

SITE 1 CONCEPTUAL SWMP (FREE DRAINING)



LEGEND

Site Boundary
Drainage Direction
PV Panel

Rivers and Streams

Non-Perennial
Perennial

Road Network

Main Road
Unnamed Road

Inland Water

Dams and lakes

Data Sources:
ESRI World Imagery Basemap
Drainage information provided by Specialist

0 150 300 Meters

SCALE: 1:6 000

FIGURE NO.:	-	MAP NUMBER:	20-1181-07
DRAWN BY:	N MBOKAZI GIS INTERN	REVIEWED BY:	T DOMINY GIS ANALYST
DATUM: PROJECTION:	WGS84 GEOGRAPHIC	DATE:	01 OCTOBER 2021
PROJECT: CLIENT:	SAMANCOR STEELPOORT HYDROLOGY ASSESSMENT ROYAL HASKONINGDHV		

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6.4 Site 2 conceptual SWMP

6.4.1 Drainage characteristics of the site

Site 2 lies behind the Tubatse FerroChrome plant, to the south. The railway line runs along the northern side of the proposed site. To the east is veld, and to the south are koppies (small hills, see Figure 6-4) and to the west is a deep watercourse, as investigated in the floodline section of this report. Similar to Site 1, the area of Site 2 drains in a north-easterly direction with the southwest corner being the highest point at 808 mamsl decreasing by 20 m over a distance of 935 m at a slope of 2.3 % to an elevation of 788 mamsl at the northeast corner. This indicates that the natural drainage of the site will be towards the north. As noted in the floodline study, there are no drainage lines or permanent surface water features within the site itself.

Figure 6-4 Site 2 vegetation and topography

6.4.2 Upstream catchments contributing runoff to site

The koppies to the south of Site 2 will drain towards the site. The majority of the koppies drain to the watercourse, so only a relatively small sub-catchment area of 45 ha is predicted to runoff directly to Site 2. The upper portion of the sub-catchment includes the steep slope of the koppie which is approximately 35 %, dropping by 45 m from 1 005 mamsl to 860 mamsl over a distance of 300 m. The overland texture of the koppie is densely vegetated with bushes. This part of the landscape will be modelled as a sub-catchment with a roughness of 0.120 (adapted from Yen and Chow, 1983). The lower portion of the contributing sub-catchment is veld, vegetated by mainly grasses interspersed with bushes and sloping more gently at 13 % towards Site 2 over a distance of 400 m. This area will be modelled as having a runoff coefficient of 0.09 for dense grass (adapted from Yen and Chow, 1983). As the contributing sub-catchment is undeveloped, the entire area is taken to be pervious. Refer to Figure 6-5 for the contributing sub-catchment delineation and Table 6-1 for the upstream sub-catchment parameters. The rainfall-runoff modelling was simulated in PCSWMM using an SCS Type 3 design storm and 24 hour design rainfall depths as determined in Section 4.6. The results of the simulation are summarized in Table 6-2.

Table 6-1 Site 2 upstream sub-catchment parameters

Name	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	N Perv
Site2_a	10.6359	355	300	35	0.12
Site2_b	34.7597	869	400	13	0.09

Table 6-2 Site 2 upstream runoff

Name	Rain Gage	Precipita-tion (mm)	Infiltration (mm)	Runoff (mm)	Runoff Volume (ML)	Peak Runoff (m^3/s)	Runoff Coefficient
Site2_a	10yr	78	50.65	27.65	2.94	1.95	0.355
	20yr	91	54.73	36.63	3.90	2.54	0.403
	50yr	109	60.19	49.25	5.24	3.51	0.452
	100yr	124	64.62	59.87	6.37	4.32	0.483
Site2_b	10yr	78	53.45	33.24	11.55	5.71	0.384
	20yr	91	57.56	44.93	15.62	7.83	0.440
	50yr	109	62.99	61.44	21.36	10.89	0.495
	100yr	124	67.36	75.39	26.20	13.50	0.530

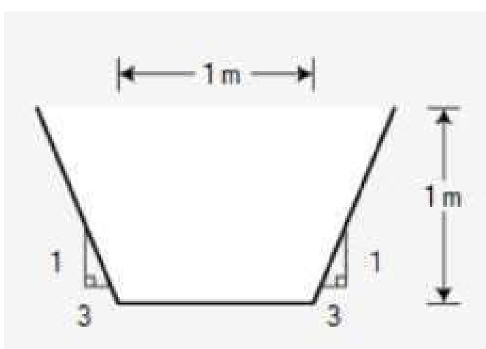
It is recommended that a vegetated trapezoidal protection berm and drain system be installed along the southern perimeter of Site 2 in order to receive runoff from the upstream catchment and divert it into the environment, away from the site via a suitably designed release structure.

6.4.3 Runoff within the site boundary

Site 2 currently drains overland into the environment. As for Site 1, maintaining a free-draining area will result in less impacts to the environment and reduce the risk of erosion. Site 2 will have a protection berm diverting runoff from the upstream catchment away from it. Therefore, even though the runoff will increase following the establishment of the PV plant, less runoff is present as the upstream runoff will be diverted. It follows that any increase from the natural runoff will be small. It is thus proposed that no stormwater infrastructure be installed on the site, and that it be left to drain freely into the environment. Refer to Figure 6-5.

6.4.4 Conceptual SWMP overview for the site

- Install a protection berm to the southern perimeter of the site.
- This protection berm and drain system will be trapezoidal and lined with vegetation.
- The channel will have the following attributes:
    - 560 m long
    - Slope of 0.009 m/m
    - Base width of 1 m
    - Side slopes of 1:3
    - Maximum depth of 1 m
    - For the 1:10 year event, the peak discharge will be 3.23 m^3/s, maximum velocity will be 1.18 m/s and maximum depth will be 0.8 m.



- A release structure will dissipate energy and prevent erosion.
- The release structure will consist of a drop box, a stilling basin and an exit apron lined with rip rap opening out into the veld.
- The drop box and stilling basin are recommended to be constructed of gabions.

SITE 2 CONCEPTUAL SWMP (FREE DRAINING)

LEGEND

- Site Boundary
- Release Structure
- Protection Berm and Drain
- Drainage Direction
- PV Panels

Subcatchment

- S11
- S12
- Site2 a
- Site2 b

Rivers and Streams

- Non-Perennial

Road Network

- Main Road
- Unnamed Road
- Railway Line

Data Sources:
ESRI World Imagery Basemap
Drainage and subcatchment information provided by Specialist

0 100 200 Meters

SCALE: 1:5 200

FIGURE NO.:	-	MAP NUMBER:	20-1181-08
DRAWN BY:	N MBOKAZI GIS INTERN	REVIEWED BY:	T DOMINY GIS ANALYST
DATUM: PROJECTION:	WGS84 GEOGRAPHIC	DATE:	01 OCTOBER 2021
PROJECT: CLIENT:	SAMANCOR STEELPOORT HYDROLOGY ASSESSMENT ROYAL HASKONINGDHV		

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6.5 Site 3 conceptual SWMP

6.5.1 Drainage characteristics of the site

Site 3 lies west of the Tubatse FerroChrome plant and north of the HH facility and leachate dam. Its northern boundary is defined by the R555 road (refer to Figure 6-7). The site is located on a ridge next to the non-perennial river identified in the floodline study and as such slopes towards the river, in a north-westerly direction at a gentle slope of 3 %, falling 21 m across the site from a maximum elevation of 787 mamsl to 766 mamsl over a distance of 680 m. On the site itself is a minor drainage line. During the site visit, no defined channel or surface water was observed, indicating that this is a small, non-perennial stream. As the site will lie over this drainage line, the SWMP must cater for it as it will naturally form a low point to which runoff will flow. As with the other sites, the site is undeveloped and densely vegetated as can be seen in Figure 6-6.

Figure 6-6 Site 3 typical vegetation, koppie visible in background

6.5.2 Upstream catchments contributing runoff to site

Site 3 has two upstream catchments draining to it, as per Figure 6-7, that include the HH facility. The first catchment drains to the north via the non-perennial drainage line originating in Site 3 (mentioned above) into the Steelpoort River. The second catchment drains into the large, non-perennial watercourse running adjacent to the site and passing under the R555 road through a bridge.

The first of the two sub-catchments, catchment S1_1 (subdivided into Site3_a, Site3_b and Site3_c) begins at the head of a koppie, and therefore shall be modelled as separate catchments – one representing the koppie face and the other representing the hill slope between the koppie and the site, as was done for Site 2 upstream catchments. The koppie has a steep slope of 38 %, falling 75 m from 1 030 mamsl at its top to 855 mamsl at its base over a distance of 485 m. The koppie is densely vegetated with bushes and will be modelled as having a runoff coefficient of 0.120 (adapted from Yen and Chow, 1985) and is assumed to be fully pervious. The rainfall will then run over the hill which slopes at 10 % over a distance of 565 m and is vegetated with grass and bushes which shall be modelled as having a runoff coefficient of 0.09 (adapted from Yen and Chow, 1985) and is assumed to be fully pervious. The area of the catchment with the HH facility shall be modelled as being 25 % impervious with runoff coefficient of 0.032 for compacted sand, and the remaining pervious area shall be assumed to have a runoff coefficient of 0.06 for dense grass (adapted from Yen and Chow, 1985). The HH facility itself acts as a sink for direct rainfall, but this has not been factored into the sub-catchment modelling as the total area of the HH facility is 4.10 ha, which is 2 % of the total contributing sub-catchment area of 151 ha. The effect on total runoff was therefore ignored as this is a more conservative approach. The sub-catchment slopes at 4 % over 615 m to the southern boundary of Site 3. All sub-catchment parameters are summarized in Table 6-3 below. The runoff results from simulating the sub-catchments in PCSWMM are summarized in Table 6-4.

Table 6-3 Site 3 upstream sub-catchment parameters

Name	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv
Site3_a	20	408	485	38	0	N/A	0.12
Site3_b	39	684	565	10	0	N/A	0.09
Site3_c	92	1499	615	4	25	0.032	0.06

Table 6-4 Site 3 upstream runoff

Name	Rain Gage	Precipi-tation (mm)	Infiltra-tion (mm)	Imperv Runoff (mm)	Perv Runoff (mm)	Runoff Volume (ML)	Peak Runoff (m^3/s)	Runoff Coeffi-cient
Site3_a	10yr	78	11.7	0	66.31	13.13	4.40	0.850
	20yr	91	11.92	0	78.94	15.63	5.31	0.868
	50yr	109	12.1	0	96.6	19.13	6.65	0.886
	100yr	124	12.22	0	111.38	22.06	7.88	0.898
Site3_b	10yr	78	11.7	0	99.82	38.58	9.10	0.891
	20yr	91	11.92	0	118.85	45.93	11.21	0.904
	50yr	109	12.1	0	145.44	56.21	14.36	0.918
	100yr	124	12.22	0	167.7	64.82	17.08	0.926
Site3_c	10yr	78	8.78	29.9	80.73	102.00	24.13	0.923
	20yr	91	8.94	35.14	96.14	121.04	29.43	0.932
	50yr	109	9.08	42.42	117.67	147.61	37.02	0.942
	100yr	124	9.16	48.51	135.7	169.84	43.52	0.948

As can be seen in Table 6-4, the volumes of runoff and the peak discharges coming from the upstream sub-catchments are significant. The total peak discharge that results from the upstream sub-catchments for the 1:10 year 24 hour storm event is 37.63 m^3/s and stormwater infrastructure will need to be designed for this flow. However, from the site inspection of visible watercourses, evidence of flow (sediments and scour) and the topography of the site, it is evident that this large catchment drains into the large watercourse and therefore will not directly influence the drainage of Site 3.

The second sub-catchment will not influence Site 3 as it will drain directly into the watercourse.

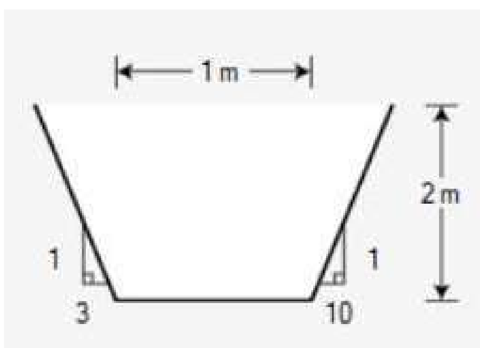
It is recommended that a vegetated trapezoidal protection berm and drain system be installed along the eastern perimeter of Site 3 in order to direct runoff from the upstream sub-catchment away from the site. The stormwater will then be required to flow via a culvert under the R555 road from where it shall be directed through Site 5 to the Steelpoort River for discharge.

6.5.3 Runoff within the site boundary

Site 3 currently drains overland into the watercourse. As for Site 1 and Site 2, maintaining a free-draining area will result in less impacts to the environment and reduce the risk of erosion. Site 3 will have a protection berm diverting runoff from the upstream catchment away from it. Therefore, even though the runoff will increase following the establishment of the PV plant, less runoff is present as the upstream runoff will be diverted. It follows that any increase from the natural runoff will be small. It is thus proposed that no stormwater infrastructure be installed on the site, and that it be left to drain freely into the environment. Refer to Figure 6-7.

6.5.4 Conceptual SWMP overview for the site

- Install a protection berm to the eastern perimeter of the site.
- This protection berm and drain system will be trapezoidal and lined with vegetation.
- On the side of the berm, next to the site, the slope of the trapezoid will be 1:3. On the other side, the trapezoid will be open to the slope of the hill, and runoff is predicted to flow by a combination of concentrated and overland flow. This side of the trapezoid has therefore been specified at 1:10 slope.
- The channel will have the following attributes:
    - 670 m long
    - Slope of 0.028 m/m
    - Base width of 1 m
    - Side slopes of 1:3 (downslope) and 1:10 (upslope)
    - Maximum depth of 2 m
    - For the 1:10 year event, the peak discharge will be 4.53 m^3/s, maximum velocity will be 0.36 m/s and maximum depth will be 1.6 m.



- The channel will discharge to the existing culvert running under the R555 road.
- The existing culvert is comprised of two 800 mm inner diameter concrete pipes (see photo in Figure 6-10). Based on the peak flows predicted for the 1:10 year event of 4.53 m^3/s, this culvert has sufficient capacity and an upgrade thereof is not required. However, it was observed that the pipes are silted up and it is recommended that they be cleared and maintained that way to ensure efficient performance during storm events.

SITE 3 AND SITE 4 CONCEPTUAL SWMP (FREE DRAINING)

LEGEND

- EIAR Plant Site
- Release Structure
- Protection Berm and Drain
- Drainage Direction
- PV Panel

Subcatchment

- S1
- S1 2
- S1 3
- S4
- S5
- S6
- Site3 c

Rivers and Streams

- Non-Perennial

Road Network

- Main Road

Inland Water

- Reservoirs and water tanks

Data Sources:
ESRI World Imagery Basemap
Drainage and subcatchment information provided by Specialist

0 100 200 Meters

SCALE: 1:5 000

FIGURE NO.:	-	MAP NUMBER:	20-1181-09
DRAWN BY:	N MBOKAZI GIS INTERN	REVIEWED BY:	T DOMINY GIS ANALYST
DATUM: PROJECTION:	WGS84 GEOGRAPHIC	DATE:	01 OCTOBER 2021
PROJECT: CLIENT:	SAMANCOR STEELPOORT HYDROLOGY ASSESSMENT ROYAL HASKONINGDHV		

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6.6 Site 4 conceptual SWMP

6.6.1 Drainage characteristics of the site

Site 4 lies west of the Tubatse FerroChrome plant and Site 3. Its northern boundary is defined by the R555 road (refer to Figure 6-7). The site is located on a ridge next to the non-perennial river identified in the floodline study and as such slopes towards the river, in an easterly direction at a gentle slope of 4 %, falling 4 m across the narrow site from a maximum elevation of 780 mamsl to 776 mamsl over a distance of 365 m. There are no drainage lines or surface water features within the site. As with the other sites, the site is undeveloped and densely vegetated.

6.6.2 Upstream catchments contributing runoff to site

As the site is located on a high point, there are no upstream catchments draining to it therefore no stormwater infrastructure for external flows is required.

6.6.3 Runoff within the site boundary

Site 4 currently drains overland into the watercourse. As for Site 1 and Site 2, maintaining a free-draining area will result in less impacts to the environment and reduce the risk of erosion. It is thus proposed that no stormwater infrastructure be installed on the site, and that it be left to drain freely into the environment. Refer to Figure 6-7.

- Site 4 currently drains overland into the watercourse. As for Site 1 and Site 2, maintaining a free-draining area will result in less impacts to the environment and reduce the risk of erosion. It is thus proposed that no stormwater infrastructure be installed on the site, and that it be left to drain freely into the environment. Refer to Figure 6-7.
- No protection berms are required as there is no runoff from upstream catchments draining to the site.
- No stormwater management infrastructure is required within the site as it is free draining to the environment.

It can be concluded that no SWMP is needed for Site 4. Refer to Figure 6-7.

6.7 Site 5 conceptual SWMP

6.7.1 Drainage characteristics of the site

Site 5 is located to the west of Tubatse FerroChrome and lies in between the R555 road to the south and the Steelpoort River to the north. As such, it drains in a northerly direction towards the Steelpoort River at a gentle slope of 3 %. On the southern perimeter of the site alongside the road, the elevation is 768 mamsl and decreases by 22 m to 744 mamsl on the northern side over a distance of 655 m.

Within the site boundaries, four drainage lines have been identified as can be seen in Figure 6-13.

- Moving from the west side to the east is firstly the watercourse identified in the floodlines. This is a significant feature that comes into the site through a bridge on the R555 road. See Figure 6-8 and Figure 6-9.
- Then there is a minor drainage line that is only visible from 250 m upslope from the Steelpoort River.
- There is then a third drainage line that originates in Site 3 and crosses the R555 via a culvert, and then flows through Site 5 to the Steelpoort River. See Figure 6-10, Figure 6-11 and Figure 6-12.
- Finally, there is a drainage line originating at the existing water treatment facility and again, running through the site to the river.

None of these drainage lines are perennial, all of them present with defined channels and the proposed conceptual SWMP will have to factor them into the design thereof.

Figure 6-8 R555 bridge over first and major channel through Site 5

Figure 6-9 First, major channel running through Site 5 (looking downstream)

Figure 6-10 Culvert under R555 for third drainage line through Site 5 (originating in Site 3)

Figure 6-11 Third drainage channel on Site 5 (looking downstream)

Figure 6-12 Third drainage channel on Site 5 (looking downstream)

6.7.2 Upstream catchments contributing runoff to site

The sub-catchment of the major watercourse is concentrated and channelled by the bridge on the R555 road. Therefore, this sub-catchment will not contribute any overland runoff to Site 5. The flow in the channel is large as demonstrated in the floodline study with peak flows of 53.52, 76.57, 110.77, 136.98 m^3/s for the events modelled. As an outcome of the floodline study, the PV layout has been modified to be outside the floodlines of this channel. It is recommended that this channel be preserved in its natural form as far as possible, and that riparian vegetation not be removed to ensure bank stabilisation of the natural channel.

The second, small drainage line has a small sub-catchment that flows into it, and this sub-catchment is located within the site boundary so there are no upstream flows to be managed.

The third drainage line is more significant and has the same upstream sub-catchment contributing runoff to it as Site 3. This runoff is concentrated and channelled through a culvert under the R555 from the protection berm around Site 3. The runoff will therefore enter Site 5 as a stream. It is proposed that this channel be augmented to receive runoff from the PV plant. This would involve enlarging and formalising the channel to dimensions determined in the conceptual SWMP design (to follow).

The final drainage line only has a small upstream catchment contributing to it with negligible flows. No protection of the PV plants from upstream runoff is necessary.

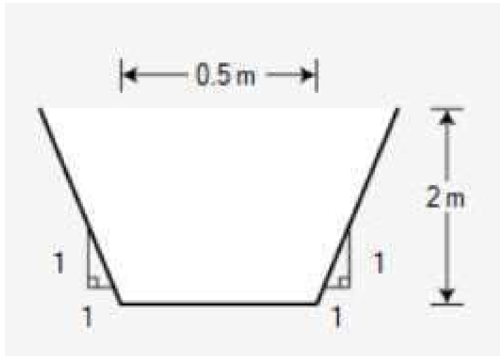
6.7.3 Runoff within the site boundary

Site 5 currently drains overland into the identified drainage lines and the Steelpoort River. As for the other sites, maintaining a free-draining area will result in less impacts to the environment and reduce the risk of erosion as the flows will not be concentrated to a single release point. It is thus proposed that no stormwater infrastructure be installed on the site between the PV panels, and that the area be left to drain freely into the nearest drainage line. As mentioned in the previous section, the main watercourse will be left as it is in its natural state, the second drainage line will not be modified but PV panels will be arranged so as to give it space, the third drainage line will be formalised into a canal and the fourth and final drainage line will be left as is with the PV panels placed so as to give it space.

Refer to Figure 6-13.

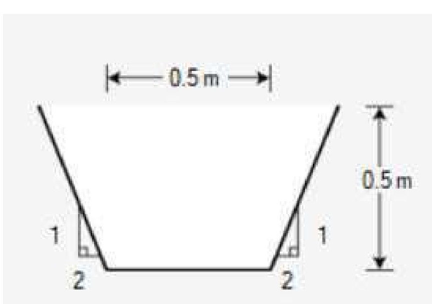
6.7.4 Conceptual SWMP overview for the site

- No protection berms are necessary.
- The third drainage line will need to be augmented and formalised. The following parameters are recommended:
    - Trapezoidal cross section, 2 m deep, 0.5 m bottom width, 1:1 side slopes



- Length of 750 m
- Slope of 3.8 %
- For the 1:10 year event, the peak discharge will be 4.7 m^3/s, maximum velocity will be 6.73 m/s and maximum depth will be 0.62 m.
- Due to the high velocity predicted, it is recommended that this channel be lined with concrete with energy dissipating concrete blocks installed at 3 m intervals along its length.

- The stormwater will discharge into the Steelpoort River via a suitably design release structure.
- The release structure will consist of a drop box, a stilling basin and an exit apron lined with rip rap opening out into the river.
- The drop box and stilling basin are recommended to be constructed of gabions.
- The fourth drainage line has a small catchment of only 0.3 ha and is therefore predicted to receive small flows, for example, 0.05 m^3/s for the 1:10 year event. This channel should be formalised into a trapezoidal shaped cross-section, lined with grass. The grass lining is essential to prevent erosion. The maximum velocity predicted for this channel is 0.33 m/s for the 1:10 year event, which will not scour the grass lining. The channel will be 0.5 m deep, 0.5 m bottom width, with 1:2 side slopes.



SITE 5 CONCEPTUAL SWMP

LEGEND

EIAR Plant Site
Release Structure
Formalised Channel
Drainage Direction
PV Panel

Subcatchment

S1
S1 2
S1 3
S6
Site3 c

Rivers and Streams

Non-Perennial
Perennial

Road Network

Main Road

Inland Water

Dams and lakes
Reservoirs and water tanks

Data Sources:
ESRI World Imagery Basemap
Drainage and subcatchment information provided by Specialist

0 100 200 Meters

SCALE: 1:5 430

FIGURE NO.:	-	MAP NUMBER:	20-1181-10
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DATUM: PROJECTION:	WGS84 GEOGRAPHIC	DATE:	01 OCTOBER 2021
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6.8 Stormwater management during construction

During the construction phase stormwater management interventions are required, particularly to manage sediments washing off the site. The sediments result from the removal of vegetation, disturbance of the soils, and stockpiling of materials. From all these sources, particles are transported during rainfall events and if not managed can cause a problem in receiving waterways.

Means of managing stormwater runoff during construction may be achieved by the following methods:

- Survey the site, remove large vegetation and then construct the SWMP infrastructure prior to continuing with the clearing and construction of the remainder of the site.
- Construct silt traps at the entrances to the SWMP infrastructure and at the outlet points. These silt traps will be in position for the duration of construction and will serve to trap the sediment. Sediment deposits should regularly be cleared and recompacted into the site or onto the stockpiles of material.
- Carry out dust suppression practices during construction to trap the dust particles and minimize their transport into water ways.
- Use silt-fences (strips of permeable geotextile) around the perimeter of the works.
- Although sediment is the primary pollutant arising from construction activities, cement from concrete mixing activities and paint can also enter stormwater. This can be minimized by working in a dedicated area and keeping the area clean.
- Divert stormwater away from construction activities by the use of temporary berms. The topography of the site is favorable in that it is situated on a slope so runoff will naturally drain away from the site, but diversion/protection berms can be constructed around concrete mixing areas and stockpiles to prevent rainwater from running through them and becoming contaminated.
- Protect stockpiles with waterproof coverings.
- Keep waste in covered bins or pits.
- Stage the works:
    - Reduce the risk of erosion by only working in specific areas and stripping the site as development progresses.
    - Complete one area before moving to the next. This will be especially beneficial due to the large area of the site.
    - Install geotextiles to cover surfaces where erosion is observed.

    - Attempt to schedule works that result in the destabilizing of soil for the dry season e.g. foundations.

- Ongoing inspection and maintenance of drainage management measures should be carried out throughout the construction period.
- As the site changes during the progression of construction, the drainage system may need to be reevaluated and altered.
- Re-establish natural grasses on the areas of site that remain exposed after the construction is complete.

7 WATER BALANCE

During both the construction and operation phases no permanent water supply by borehole or river abstraction will take place nor will wastewater removal be installed on the site.

- During construction, water will be brought in by tanker.
- During operation, panels will be cleaned by water brought in by tanker. The water will be supplied by the Reverse Osmosis plant at Tubatse FerroChrome. The runoff water from washing the panels will discharge to the ground and will either infiltrate, evaporate or runoff into the environment. This is acceptable as it is considered clean water.
- In terms of domestic use, portable toilets with a conservancy tank will be placed on site and will periodically be removed and emptied. There will be no sewage network installed on site.

As there are no permanent water supply or discharge activities being applied for in the WUL, no water balance is applicable.

8 HYDROLOGICAL RISK ASSESSMENT

8.1 Impact Assessment Methodology

Due to the hydrological assessment forming part of a larger risk assessment for the study area, the potential impacts and the determination of impact significance was assessed. The process of assessing the potential impacts of the project encompasses the following four activities:

1. Identification and assessment of potential impacts;
2. Prediction of the nature, magnitude, extent and duration of potentially significant impacts;

3. Identification of mitigation measures that could be implemented to reduce the severity or significance of the impacts of the activity; and
4. Evaluation of the significance of the impact after the mitigation measures have been implemented i.e. the significance of the residual impact.

Per GNR 982 of the EIA Regulations (2014), the significance of potential impacts was assessed in terms of the following criteria:

I. Cumulative impacts;
II. Nature of the impact;
III. Extent of the impact;
IV. Probability of the impact occurring;
V. The degree to which the impact can be reversed;
VI. The degree to which the impact may cause irreplaceable loss of resources; and
VII. The degree to which the impact can be mitigated.

Table 8-1 provides a summary of the criteria used to assess the significance of the potential impacts identified. An explanation of these impact criteria is provided in Table 8-2.

The net consequence is established by the following equation:

- Consequence = (Duration + Extent + Irreplaceability of resource) x Severity

And the environmental significance of an impact was determined by multiplying consequence with probability.

Note that the DHSW&S Risk Assessment Matrix is not applicable to the hydrological study, but to the aquatic ecology and wetlands study. The matrix has been adapted in the above methodology to reflect the same approach and principles of the DHSW&S Risk Assessment Matrix such that hydrological risks can be represented.

Table 8-1: Proposed Criteria and Rating Scales to be used in the Assessment of the Potential Impacts

Criteria	Rating Scales	Notes
Nature	Positive (+)	An evaluation of the effect of the impact related to the proposed development.
	Negative (-)	
Extent	Footprint (1)	The impact only affects the area in which the proposed activity will occur.
	Site (2)	The impact will affect only the development area.

Criteria	Rating Scales	Notes
	Local (3)	The impact affects the development area and adjacent properties.
	Regional (4)	The effect of the impact extends beyond municipal boundaries.
	National (5)	The effect of the impact extends beyond more than 2 regional/ provincial boundaries.
	International (6)	The effect of the impact extends beyond country borders.
Duration	Temporary (1)	The duration of the activity associated with the impact will last 0-6 months.
	Short term (2)	The duration of the activity associated with the impact will last 6-18 months.
	Medium-term (3)	The duration of the activity associated with the impact will last 18 months-5 years.
	Long term (4)	The duration of the activity associated with the impact will last more than 5 years.
Severity	Low (-1)	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected.
	Moderate (-2)	Where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive or vulnerable systems or communities are negatively affected.
	High (-3)	Where natural, cultural or social functions and processes are altered to the extent that the natural process will temporarily or permanently cease; and valued, important, sensitive or vulnerable systems or communities are substantially affected.
Potential for impact on irreplaceable resources	No (0)	No irreplaceable resources will be impacted.
	Yes (1)	Irreplaceable resources will be impacted.
Consequence	Extremely detrimental (-25 to -33)	A combination of extent, duration, intensity and the potential for impact on irreplaceable resources.
	Highly detrimental (-19 to -24)	
	Moderately detrimental (-13 to -18)	

Criteria	Rating Scales	Notes
	Slightly detrimental (-7 to -12)	
	Negligible (-6 to 0)	
	Slightly beneficial (0 to 6)	
	Moderately beneficial (13 to 18)	
	Highly beneficial (19 to 24)	
	Extremely beneficial (25 to 33)	
Probability (the likelihood of the impact occurring)	Improbable (0)	It is highly unlikely or less than 50 % likely that an impact will occur.
	Probable (1)	It is between 50 and 70 % certain that the impact will occur.
	Definite (2)	It is more than 75 % certain that the impact will occur or it is definite that the impact will occur.
Significance	Very high - negative (-49 to -66)	A function of Consequence and Probability.
	High - negative (-37 to -48)	
	Moderate - negative (-25 to -36)	
	Low - negative (-13 to -24)	
	Very low (0 to -12)	
	Low - positive (0 to 12)	
	Moderate - positive (13 to 24)	
	High - positive (37 to 48)	
	Very high - positive (49 to 66)	

Table 8-2: Explanation of Assessment Criteria

Criteria	Explanation
Nature	This is an evaluation of the type of effect the construction, operation and management of the proposed development would have on the affected environment. Will the impact change in the environment be positive, negative, or neutral?

Extent or Scale	This refers to the spatial scale at which the impact will occur. The extent of the impact is described as: footprint (affecting only the footprint of the development), site (limited to the site) and regional (limited to the immediate surroundings and closest towns to the site). Extent of scale refers to the actual physical footprint of the impact, not to the spatial significance. It is acknowledged that some impacts, even though they may be of small extent, are of very high importance, e.g. impacts on species of very restricted range. To avoid "double counting, specialists have been requested to indicate spatial significance under "intensity" or "impact on irreplaceable resources" but not under "extent" as well.
Duration	The lifespan of the impact is indicated as temporary, short, medium and long term.
Severity	This is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. Does the activity destroy the impacted environment, alter its functioning, or render it slightly altered?
Impact on irreplaceable resources	This refers to the potential for an environmental resource to be replaced, should it be impacted. A resource could be replaced by natural processes (e.g. by natural colonisation from surrounding areas), through artificial means (e.g. by reseeding disturbed areas or replanting rescued species) or by providing a substitute resource, in certain cases. In natural systems, providing substitute resources is usually not possible, but in social systems, substitutes are often possible (e.g. by constructing new social facilities for those that are lost). Should it not be possible to replace a resource, the resource is essentially irreplaceable e.g. red data species that are restricted to a particular site or habitat of very limited extent.
Consequence	The consequence of the potential impacts is a summation of the above criteria, namely the extent, duration, intensity and impact on irreplaceable resources.
Probability of occurrence	The probability of the impact occurring based on the professional experience of the specialist with environments of a similar nature to the site and/or with similar projects. It is important to distinguish between the probability of the impact occurring and the probability that the activity causing a potential impact will occur. Probability is defined as the probability of the impact occurring, not as the probability of the activities that may result in the impact.
Significance	Impact significance is defined to be a combination of the consequence (as described below) and the probability of the impact occurring. The relationship between consequence and probability highlights that the risk (or impact significance) must be evaluated in terms of the seriousness (consequence) of the impact, weighted by the probability of the impact occurring. In simple terms, if the consequence and probability of an impact is high, then the impact will have a high significance. The significance defines the level to which the impact will influence the proposed development and/or environment. It determines whether mitigation measures need to be identified and implemented and whether the impact is important for decision-making.

Degree of confidence in predictions	Specialists and the EIR team were required to indicate the degree of confidence (low, medium or high) that there is in the predictions made for each impact, based on the available information and their level of knowledge and expertise. Degree of confidence is not taken into account in the determination of consequence or probability.
Mitigation measures	Mitigation measures are designed to reduce the consequence or probability of an impact, or to reduce both consequence and probability. The significance of impacts has been assessed both with mitigation and without mitigation.

8.2 Risk Assessment Matrix

The predicted surface water impacts are listed in the tables below, with proposed mitigation measures and estimates of risk intensity. From the assessment, it was found that during both construction and operational phases, the risk of impact to surface water from the site is negligible if appropriate mitigation measures are put in place.

The risk assessment matrix finds the proposed activities to be slightly detrimental, reduced to negligible with the inclusion of mitigation measures.

Construction

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration	Extent	Potential for impact on irreplaceable resources	Severity	Consequence	Probability	Significance		Duration	Extent	Severity	Potential for impact on irreplaceable resources	Consequence	Probability	Significance	
Vadose zone soils	Disturbing vadose zone during soil excavations/activities.	Earthworks, terracing for installation of PV components, substations and battery units	Temporary (1)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6)	Definite (2)	Negligible (0 to -12)	• Only excavate areas applicable to the project area. • Cover excavated soils with a temporary liner to prevent contamination. • Keep the site clean of all general and domestic wastes. • Vegetation clearing to be limited to what is essential. • Retain as much indigenous vegetation as possible. • Exposed soils to be protected using a suitable covering. • Existing roads should be used as far as practical to gain access to the site and crossing the streams in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles.	Temporary (1)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6)	Definite (2)	Negligible (0 to -12)	Medium
Primary surface water Receivers -> Non-Perennial & Perennial Streams	Surface water contamination and sedimentation from the following activities: o Erosion and sedimentation of watercourses due to unforeseen circumstances (i.e. bad weather); and o Alteration of natural drainage lines which may lead to ponding or increased runoff patterns (i.e. may cause stagnant water levels or increase erosion).	Earthworks	Temporary (1)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6)	Definite (2)	Negligible (0 to -12)	• Install a temporary cut off trench to contain poor quality runoff (if observed). • Cover soil stockpiles with a temporary liner to prevent contamination. • Construct temporary silt traps at drainage points to allow sediment settlement from runoff.	Temporary (1)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6)	Definite (2)	Negligible (0 to -12)	Medium
	Water quality impacts due to: o Spillage of fuels and chemicals; and o Construction equipment and vehicles.	Plant on site during construction	Temporary (1)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6)	Definite (2)	Negligible (0 to -12)	• Clean up spillages immediately. • Keep chemicals in bunded areas. • Keep vehicles and equipment clean.	Temporary (1)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6)	Probable (1)	Negligible (0 to -12)	Medium
	Increased runoff altering flow regimes of receiving watercourses due to: o Vegetation removal; and o Compacting of soil.	Site clearing and preparation	Temporary (1)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6)	Definite (2)	Negligible (0 to -12)	• Vegetation clearing to be limited to what is essential. • Retain as much indigenous vegetation as possible. • Compact the site footprint only, minimise working area.	Temporary (1)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6)	Probable (1)	Negligible (0 to -12)	Medium

OPERATIONAL

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation Duration	Extent	Potential for impact on irreplaceable resources	Severity	Consequence	Probability	Significance	Recommended Mitigation Measures	Post Mitigation Duration	Extent	Severity	Potential for impact on irreplaceable resources	Consequence	Probability	Significance	Confidence
Primary surface water Receivers - > Non-Perennial & Perennial Streams	Increased runoff due to compacted surfaces from the proposed site onto the surrounding soils may cause higher velocities and frequency of occurrence and sediment transport to the nearby streams	Runoff	Long-term (4)	Local (3)	Yes (1)	Low (-1)	Slightly detrimental (-7 to -12)	Probable (1)	Negligible (0 to -12)	• Release structures for stormwater runoff from the site should dissipate energy and disperse flow to ensure minimal impact to the receiving emvironment.	Long-term (4)	Local (3)	Yes (1)	Negligible (0)	Negligible (0 to -6)	Improbable (0)	Negligible (0 to -12)	Medium
	Potential sedimentation several months after the site has been constructed. It is anticipated that the sediment load will decrease with time to pre-construction levels.	Net result of earthworks and development	Medium Term (3)	Local (3)	Yes (1)	Low (-1)	Slightly detrimental (-7 to -12)	Definite (2)	Low (-13 to -24)	• Release structures for stormwater runoff from the site should incorporate silt traps to allow for settlement of sediments. • Silt traps to be regularly cleaned.	Medium Term (3)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6)	Probable (1)	Negligible (0 to -12)	Medium
	Water quality impacts due to chemical spills, vehicle pollutants, fuel and oil spillages and leaks	Site operations	Long-term (4)	Site (2)	Yes (1)	Low (-1)	Slightly detrimental (-7 to -12)	Probable (1)	Negligible (0 to -12)	• Implementation of a SWMP to keep clean water away from dirty areas. • Demarcated dirty areas to be limited to roads, parking areas and chemical storage areas. • Spills to be cleaned up immediately. • Vehicles and equipment to be regularly maintained and cleaned.	Long-term (4)	Footprint (1)	Yes (1)	Low (-1)	Negligible (0 to -6)	Probable (1)	Negligible (0 to -12)	Medium
	Erosion due to change in topography, land use and vegetation removal.	Catchment modification	Long-term (4)	Local (3)	Yes (1)	Low (-1)	Slightly detrimental (-7 to -12)	Probable (1)	Negligible (0 to -12)	• Design the SWMP to ensure that the velocities of stormwater runoff flow are kept to a minimum • Design release structures to dissipate stream power • Include erosion protection measures such as rip rap in release structures.	Long-term (4)	Footprint (1)	Yes (1)	Low (-1)	Negligible (0 to -6)	Probable (1)	Negligible (0 to -12)	Medium

9 SURFACE WATER MONITORING PLAN

There are no permanent surface water features or flowing water on or nearby the proposed sites. The drainage lines are non-perennial and only have flow when there are storm events.

The Steelpoort River is a major watercourse downstream of the sites. Samancor currently has a surface water monitoring program, It is recommended that monitoring of the water quality take place at the beginning of construction of the sites through to their completion and operation in order to identify impacts to the river water quality resulting from them.

10 CONCLUSIONS

The sites were observed to be undeveloped; gently sloping towards the Steelpoort River; densely vegetated with loose, sandy soil and no flowing water or natural permanent surface water features.

The floodline analysis identified two major drainage lines and three minor ones. The hydrology affecting each proposed site is summarized below.

- There are no drainage lines in Site 1 and the entire area is suitable for development in terms of hydrology.
- There is a major drainage line with a large upstream contributing catchment adjacent to Site 2 and passing under the existing railway line. Floodline analysis indicated that flows from this channel will not encroach on the site or influence development thereof.
- Site 3 has a minor drainage line originating on it. There is no evidence of scour or a defined channel on the site and development of the entire site may go ahead with the stormwater management plan making provision for this natural drainage of the topography.
- Site 4 is adjacent to a major drainage line with an extremely large contributing catchment. During flood events, the flows will encroach on the south-east corner of the site. It is therefore recommended that the boundary of the site be modified to avoid this area. Otherwise, there are no local drainage lines on the site and the entire area is suitable for development.
- Site 5 has one major drainage line running through it and three minor drainage lines.
    - The major drainage line is a deep valley in the topography and divides the site. Flooding in this zone will be significant and it will not be possible to develop the area within the floodlines.
    - Two of the minor floodlines had small contributing catchments with negligible peak flows predicted for them. It is recommended that these drainage lines be formalized and managed by the SWMP. No floodlines were carried out for these drainage lines due to the DEM not having sufficient elevation data of the transects.
    - The third minor drainage line originates in Site 3 and passes under the R555 road via a culvert and then through the length of Site 5 to the Steelpoort River. It was not possible to carry out a floodline analysis due to the DEM not having adequate resolution of the transects. The flows are not large in this drainage line but it will divide the available area for development. It may be possible to formalize the channel as part of the stormwater management plan.

- It is recommended that topographical survey of these three drainage lines be carried out for detailed engineering of the stormwater infrastructure.

In terms of the conceptual SWMP, all sites were allowed to free drain to the environment as far as possible as the runoff from the sites will be considered clean and by not concentrating the site flows, impacts to the receiving environment will be minimized. It is recommended that the sites be re-vegetated around and between the PV panels once construction is complete in order to encourage infiltration of rainfall into the soil, with the objective of reducing the runoff volume from the site. The following recommendations can be made per site:

- Site 1 will be free draining and does not require any stormwater infrastructure.
- Site 2 will be free draining and will not require any stormwater infrastructure within its footprint. Site 2 will require a protection berm and drain system along its southern perimeter to divert flows from the upstream sub-catchments draining towards it. This drain will discharge to the environment via a release structure.
- Site 3 will be free draining with a protection berm and drain system on its eastern perimeter to divert flows from the upstream sub-catchments around it.
- Site 4 will be free draining and will not require any stormwater infrastructure.
- Site 5:
    - Main watercourse to be preserved in its natural condition. This means no removal of riparian vegetation. This is critical in preventing erosion from developing.
    - The second minor drainage line will not require any infrastructure but panels should be placed away from it, as per design.
    - The third drainage line shall be formalized into a trapezoidal channel 0.5 m wide at the base by 2 m deep and lined with concrete, with 1:1 sides. It shall discharge via a release structure into the Steelpoort River.
    - The fourth drainage line will be formalized into a grass-lined trapezoidal channel with a depth of 0.5 m and a bottom width of 0.5 m, with side slopes of 1:2.
- The existing culvert under the R555 linking the protection berm flows from Site 3 to the third channel on Site 5 is of sufficient capacity to handle the predicted flows and is not required to be upgraded.

There is no water balance for the site as no water is being abstracted or discharged from it.

The hydrological impacts for the proposed development are small and can be mitigated with an effective stormwater management plan to handle increased runoff emanating from the sites and surface water as it flows through the areas.

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JENNIFER MENEGHELLI
Water Resource Engineer

CORE SKILLS

- Water Resource planning, management and optimisation
- Hydrological modelling and analysis
- Hydraulic engineering of water management systems
- Stormwater Management Plans
- Surface flood risk assessment
- Dam Break Analysis
- Floodline Determination
- Modelling of water systems

DETAILS

Qualifications

- B.Sc. – Civil Engineering
- Post Graduate Course Work – Civil Engineering
- M.Sc – Civil Engineering

Memberships

ECSA – Professional Engineer

SAICE – Associate Member

WISA – Associate Member

Languages

- English – fluent
- Afrikaans- fluent

PROFILE

Jennifer is a Professional Engineer committed to protecting and conserving freshwater systems by implementing sustainable surface water management practices. She applies water resource management principles to strategize optimal operation and site development of mining and industrial facilities. She effectively solves complex problems by proposing innovative, holistic solutions that come from a desire to learn. She is client focused and strives for technical excellence. She works independently and collaborates well with others.

Jennifer has experience in the following areas:

- Water resource planning, management, and optimisation from concept to detailed design
- Hydrological modelling and analysis
- Rainfall calculation
- Runoff modelling of sub catchments
- Peak flow analysis of rivers
- Floodline determination and flood mapping
- Hydraulic engineering of water management systems
- Stormwater Management Plans
- Surface flood risk assessment
- Dam break analyses
- Floodline determination
- Water balances
- River impact assessment
- Structural analysis and engineering
- Structural steel and concrete design
- Application of codes and specifications
- Site inspections and investigations
- Engineering coordination and technical direction
- Dam break analyses
- Environmental compliance and permitting
- River impact assessment
- Static and dynamic water balances

WORK EXPERIENCE

Year	Employer	Position	Role and Responsibility
2015 – 2018	**Jones & Wagener**	**Hydrological Engineer**	**Provided Surface water management consultancy to coal, diamond and gold mines, hazardous waste storage facilities and ash disposal facilities at power stations** • Multidisciplinary team in partnership with Specialists • Feasibility stage to construction, including tender phase • Site inspections • Preparation of proposals • Environmental compliance and permitting in accordance with national environmental and water bodies • Technical report writing • Holistic solution formulation and risk assessment of alternatives • Management of draughting services • Numerical modelling of surface water studies
2014	**Jacobs Engineering Group**	**Civil Structural Engineer**	**Civil and Structural resident engineer in the Front-End Loading (FEL) team at Sasol Synfeuls, as part of the alliance with Jacobs** • Multidisciplinary Front End Loading engineering team • Project scope definition • Problem identification and conceptual design • Tender evaluation • Consultant and contractor appointment • Liaison with the Department of Water and Sanitation and Environmental Affairs • Site supervision and quality management
2012 – 2013	**SNC-Lavalin Engineering Company**	**Civil and Structural Engineer**	**Complex structural engineering problems for large structures at gold and copper mine process plants and for the fertilizer industry.** • Multi-disciplinary team • BOQ development • Tender evaluation and ajudication • Dynamic structures • Composite concrete and steel structures • Foundations • Mining infrastructure civil design
2011 – 2012	**Roman Rock Consulting Engineers**	**Junior Civil and Structural Engineer**	**Static, dynamic and seismic structural analysis of heavy industrial steel and reinforced concrete structures. Designed light steel structures and mining civil infrastructure works.**

Eskom **South Africa**	**Medupi Ash Disposal Facility Stormwater Management Plan**	• Detailed dynamic water balance modelled in GoldSim. • Detailed stormwater management plans for all phases of the project from construction, to operational, to rehabilitated.
Sasol **South Africa**	**Consolidated Black Products Site Remediation Programme**	• Stormwater management plan to construction level of detail, including contractor management • Hydrologic assessment of the site • Dynamic SWMP that adapts to each phase of the project from construction to operation to rehabilitation
De Beers **South Africa**	**Venetia Stormwater Management Plan Feasibility Study**	• Stormwater infrastructure specification for various storm events • Mitigation measures • Dam break analyses
De Beers **South Africa**	**Venetia Surface Flood Risk Management Plan**	• Subcatchment delineation • Rainfall-runoff of subcatchments • Pit flooding and pumping strategy • 2D modelling of flooding of the site • Floodline determination
Newmont **Ghana**	**Ahafo Tailings Storage Facility Dam Breach Analysis**	• Modelling of alternative TSF locations • Modelling of displacement of inland lake by tailings • Dam break analysis in Flo2D
Debswana **Botswana**	**Jwaneng Slimes Dams Breach Analysis**	• Modeling of multiple dam breaches • Assessment of impacts • Emergency planning and preparedness plan
Sasol **South Africa**	**Sasolberg Water Dam Breach Analysis**	• Dam breach modelling • River flooding • Floodline modelling
AngloGold Ashanti **Guinea**	**Siguiri Gold Mine RWD Breach Analysis**	• Dam breach modelling • River flooding • Floodline modelling
EnviroServ **South Africa**	**Holfontein IWWMP Site Water Balance**	• Dynamic water balance, both operational and forecasting, in GoldSim
EnviroServ **South Africa**	**Shongweni IWWMP Site Water Balance**	• Dynamic water balance, both operational and forecasting, in GoldSim • Specification of dam management
AngloGold Ashanti **South Africa**	**Welverdiend Sinkhole Diversion**	• Detailed engineering design of stormwater management infrastructure
Rosema **South Africa**	**Era Stene Specialist Surface Water Study for EIA**	• Era Stene Specialist Surface Water Study for EIA
South 32 **South Africa**	**Middelburg Coal Mine Floodlines**	• Floodlines for EIA

DECLARATION

I, <u>JENNIFER MENEGHELLI</u> hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake to inform you of any changes therein, immediately. In case any of the above information is found to be false or untrue or misleading or misrepresenting, I am aware that I may be held liable for it.

Signature: JMeneghelli **Date: 2021/01/21**

Appendix E3: Freshwater

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED 100MWP PHOTOVOLTAIC PLANT ASSOCIATED WITH THE TUBATSE FERROCHROME SMELTER, STEELPOORT, FETAKGOMO TUBATSE LOCAL MUNICIPALITY, LIMPOPO.

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Scientific Aquatic Services			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
Specialist name:	Stephen van Staden			
Specialist Qualifications:	MSc Environmental Management			
Professional affiliation/registration:	SACNASP REG.NO: 400134/05			
Physical address:	29 Arterial Road West, Oriel. Bedfordview			
Postal address:	29 Arterial Road West, Oriel. Bedfordview			
Postal code:	2007		Cell:	083 415 2356
Telephone:	011 616 7893		Fax:	
E-mail:	leandra@sasenvgroup.co.za			

2. DECLARATION BY THE SPECIALIST

I, Stephen van Staden declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Scientific Aquatic Services

Name of Company:

12/10/2021

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Stephen van Staden, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Scientific Aquatic Services

Name of Company

12/10/2021

Date

Signature of the Commissioner of Oaths

2021/10/13

Date

SOUTH AFRICA POLICE SERVICE

13-10-2021

SOUTH AFRICA POLICE SERVICE

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

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Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
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473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	Scientific Aquatic Services			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
Specialist name:	Leandra Jonker			
Specialist Qualifications:	MSc Aquatic Health			
Professional affiliation/registration:	SACNASP REG.NO: 126391			
Physical address:	29 Arterial Road West, Oriel. Bedfordview			
Postal address:	29 Arterial Road West, Oriel. Bedfordview			
Postal code:	2007	Cell:	083 484 4022	
Telephone:	011 616 7893	Fax:		
E-mail:	leandra@sasenvgroup.co.za			

2. DECLARATION BY THE SPECIALIST

I, Leandra Jonker declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Jonker

Signature of the Specialist

Scientific Aquatic Services

Name of Company:

12/10/2021

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Leandra Jonker, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Scientific Aquatic Services

Name of Company

12/10/2021

Date

Signature of the Commissioner of Oaths

2021/10/13

Date

13-10-2021

SCIENTIFIC AQUATIC SERVICES

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FRESHWATER ECOLOGICAL ASSESSMENT IN SUPPORT OF THE ENVIRONMENTAL IMPACT ASSESSMENT AND WATER USE LICENSE AUTHORISATION PROCESSES FOR THE PROPOSED SAMANCOR CHROME OPERATIONS - TUBATSE FERROCHROME 100MW PHOTOVOLTAIC (PV) SOLAR PROJECT, NEAR STEELPOORT, LIMPOPO PROVINCE.

Prepared for

Royal Haskoning DHV (Pty) Ltd

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SAS Environmental Group of Companies

EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecological assessment in support of the Environmental Impact Assessment (EIA) and Water Use License (WUL) authorisation processes for the proposed Samancor Chrome Operations – Tubatse Ferrochrome 100MW Photovoltaic (PV) Solar Project, near Steelpoort, Limpopo Province.

The proposed PV plant will convert solar radiation into electric energy by using photovoltaic solar arrays. The name plate rating of the plant will be a minimum of 100 MWp. The proposed PV plant will be distributed over several sites along with its associated 33kV powerlines and the Tubatse East and West substation buildings, hereafter collectively referred to as the study area.

No wetlands were identified on site or within 500m of the planned infrastructure, with the freshwater ecosystems best defined as watercourses with associated riparian zones of varying degrees of development. These systems are associated with the proposed site 3,4 and 5 as such these watercourses will potentially be impacted upon, should the PV Plant be approved.

The aquatic ecological assessment included three sites located on the Steelpoort River, Site TS1 (upstream of the proposed construction), site TS2 (downstream of Sites 3, 4 and 5) and site TS3 (located downstream of the proposed construction).

Water quality of the Steelpoort River was considered good at all three sites, with largely natural Electrical Conductivity (EC), pH and Dissolved Oxygen (DO) concentrations observed during the site assessment.

Considering the Ecostatus Categories for both sites TS1 and TS2, the Macro-Invertebrate Response Assessment Index (MIRAI), Fish Response Assessment Index (FRAI), Riparian Vegetation Response Assessment Index (VEGRAI) and the Index of Habitat Integrity (IHI) classifications concur with the Resource Quality Objectives (RQO) of the Steelpoort River [Present Ecological State (PES) Category D (DWS, 2018)]. The MIRAI classification of site TS3 also concurred with the RQO (FRAI, VEGRAI and IHI not applied to site TS3). The Integrated Ecological Category (IEC) for both sites TS1 and TS2 have resulted in Ecostatus scores of 73.7% (Category C: Moderately Modified) at site TS1, and 75.2% (Category C: Moderately Modified) at site TS2, respectively. Overall, the Steelpoort River is considered moderately modified (Class C), of high Ecological Importance and Sensitivity (EIS) and also considered a fish support area (*Opsaridium peringueyi)*.

The outcome of the Risk Assessment proved that the proposed construction of the Solar PV plant would have a medium risk significance on the aquatic environment. The strict implementation of the stipulated mitigation measures as recommended in this report, with specific mention of limiting the potential of additional sediment to enter the watercourses, and limiting erosion from stormwater runoff, will enable the reduction of the perceived impacts.

Furthermore, with rehabilitation and long-term management of erosion and alien and invasive plant species the overall PES of the Steelpoort River and its associated watercourses will not be impacted by the Solar PV plant with the exception of the proposed canalisation of two drainage lines.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecological assessment in support of the Environmental Impact Assessment (EIA) and Water Use Licence (WUL) authorisation processes for the proposed Samancor Chrome Operations – Tubatse Ferrochrome 100MW Photovoltaic (PV) Solar Project, near Steelpoort, Limpopo Province. The existing and operational Samancor Chrome Operations – Tubatse Ferrochrome, hereafter referred to as Tubatse Ferrochrome is located approximately 700 m south west of the town of Steelpoort, directly south of the R555 roadway, and 1,5 km south east of the town of Pelaneng.

The proposed PV plant will be distributed over several sites along with its associated 33kV powerlines, ancillary infrastructure and Tubatse East and West substation buildings, hereafter collectively referred to as the study area, and consists of preferred layout sites 1 -5 (see Figure 1).

The purpose of this report is to define the ecology of the study area in terms of watercourse characteristics, mapping of the watercourses, defining areas of increased Ecological Importance and Sensitivity (EIS), and to define the Present Ecological State (PES) for the watercourses. It is a further objective of this report to establish aquatic ecological baseline conditions of the watercourse prior to the construction of the Solar PV plant. Finally, this report aims to provide detailed information to guide the management of the proposed construction activities specifically those which have a bearing on the receiving freshwater environment, to ensure the ongoing functioning of the ecosystem, such that local and regional conservation requirements and the provision of ecological services in the local area are supported.

Three non-perennial rivers with riparian vegetation [Systems 1, 2 and 5 (See Table 6)] and two ephemeral drainage lines without well defined riparian vegetation [Systems 4 and 5 (See Table 6)] were identified in the study area, an additional preferential flow path was also included [System 3 (See Table 6)]. Although these ephemeral drainage lines cannot be classified as rivers or streams in the traditional sense thereof due to the lack of saturated soils and riparian vegetation, they do still function as waterways, through episodic conveying of water. Based on the definition of a watercourse as per the National Water Act, 1998 (Act No. 36 of 1998), water does flow regularly or intermittently within these drainage lines, conveying water from the upgradient catchment area into the downgradient Steelpoort River. As such, they can be considered as watercourses due to their importance for hydrological functioning and therefore enjoy protection in terms of the National Water Act, 1998 (Act No. 36 of 1998). The results of the ecological assessment of the watercourses are discussed in Section 4 of this report is summarised in the table below.

Table A: Summary of results of the field assessment as discussed in Section 4.

Watercourse	Present Ecological State (PES)	Ecoservices	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS)
Steelpoort River	C (Moderately Modified)	Intermediate	High	REC: Category C BAS: Category C RMO: B/C (Maintain / Improve)
Non-perennial rivers with riparian vegetation	C (Moderately Modified)	Moderately Low	Moderate	REC: Category C BAS: Category C RMO: B/C (Maintain / Improve)
Ephemeral drainage lines without well-defined riparian vegetation	D (Largely modified)	Moderately Low	Moderate	REC: Category D BAS: Category D RMO: C/D (Maintain / Improve)

Limited areas of preferred layout site 5 are located within the 32m Zone of Regulation for both system 2 (Non-perennial river) and system 4 (Ephemeral drainage line). All other surface infrastructure is located at least 32m from the watercourses. However, it is proposed to construct new powerline corridors and new internal access roads from the R555.

Following the ecological assessment, the Risk Assessment Matrix as defined in Appendix A of Regulation GN509 of 2016 as it applies to the National Water Act, 1998 (Act No. 36 of 1998) was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the assessed watercourses. The results of the risk assessment are summarised in Table C below and presented in Section 7 of this report.

The results of the instream aquatic ecological assessment of the Steelpoort River are summarised in Table B below.

Table B: Summary of the results of the instream aquatic ecological assessment on the Steelpoort River.

Water Management Area: Olifants	
Quaternary Catchment: B41J	
Ecoregion: Eastern Bankenveld	
Weather Condition: Warm and clear	
Flows: Mixed flow	
Water Clarity: Discoloured to Clear	
Map: Locality of the Solar PV Plant. For a detailed layout map see Figure 1, Section 1.	
Site Coordinates:	
TS1 - 24°44'42.19"S	30°10'18.02"E
TS2 - 24°43'46.03"S	30°11'05.29"E
TS3 - 24°43'04.08"S	30°12'05.48"E

Site TS1 – Located on the Steelpoort River, upstream of the proposed PV plant.

Water quality:	
pH	8.51
EC (mS/m)	35.5
DO (mg/L)	9.61
DO saturation (%)	123.0
Temperature (ºC)	23.8
Aquatic Macro-invertebrates	
SASS5 Score	95
ASPT Score	7.3
IHAS	65 (Adequate)
MIRAI score	81.0 (Category B/C: Largely Natural to Moderately Modified)
Index of Habitat Integrity:	
Instream IHI: 76.8 (Category C: Moderately Modified) Riparian IHI: 75.0 (Category C: Moderately Modified)	
Riparian Vegetation Response Assessment Index	
VEGRAI score: 72.9 (Category C: Moderately Modified)	
Fish Response Assessment Index:	
FRAI score: 63.9 (Category C: Moderately Modified) **Species:** *Chiloglanis pretoriae, Enteromius neefi, Enteromius trimaculatus, Labeobarbus marequensis*	
Integrated Ecological Category (IEC)	
Ecostatus: 73.7 (Category C: Moderately Modified).	

Site TS2 – Located on the Steelpoort River, downstream of sites 3, 4 and 5 of the proposed PV plant.

Water quality:	
pH	8.56
EC (mS/m)	28.5
DO (mg/L)	6.1
DO saturation (%)	71.2
Temperature (ºC)	19.1
Aquatic Macro-invertebrates	
SASS5 Score	90
ASPT Score	6.0
IHAS	79 (Excellent)
MIRAI score	77.9 (Category C: Moderately Modified)
Index of Habitat Integrity:	
Instream IHI: 81.2 (Category B/C: Largely Natural to Moderately Modified) Riparian IHI: 75.0 (Category C: Moderately Modified)	
Riparian Vegetation Response Assessment Index	

VEGRAI score: 72.9 (Category C: Moderately Modified)		
Fish Response Assessment Index:		
FRAI Score: 75.1 (Category C. Moderately Modified) **Species:** *Chiloglanis pretoriae, Clarias gariepinus, Enteromius neefi, Enteromius trimaculatus, Enteromius paludinosus, Labeo cylindricus, Labeobarbus marequensis, Oreochromos mossambicus*		
Integrated Ecological Category (IEC)		
Ecostatus: 75.2 (Category C: Moderately Modified)		
Site TS3 – Located on the Steelpoort River, downstream of the proposed PV plant. Assessed December 2020.		
Water quality:		
pH EC (mS/m) DO (mg/L) DO saturation (%) Temperature (ºC)	7.55 37.2 7.52 100.4 25.8	
Aquatic Macro-invertebrates		
SASS5 Score ASPT Score IHAS MIRAI score	120 6.0 68 (Adequate) 80.2 (Category C: Moderately Modified)	
Index of Habitat Integrity:		
Not assessed in December 2020.		
Riparian Vegetation Response Assessment Index		
Not assessed in December 2020.		
Fish Response Assessment Index:		
Not assessed in December 2020.		
Ecostatus:		
Not assessed in December 2020.		

Table C: Summary of the results of the DWS Risk Assessment applied to the study area.

Impact and Aspect			Risk	Adjusted Risk Rating	Reversibility of Impact
Construction Phase	➢ Site preparation prior to construction activities of surface infrastructure components located outside the Steelpoort River and non-perennial rivers and associated floodlines or zones of regulation.	➢ Vehicular movement (transportation of construction materials)	**Low**	NA	Fully Reversible
		➢ Removal of vegetation and associated disturbances to soils.	**Medium**	Low	Moderate Residual Impacts
	➢ Site preparation prior to construction activities relating to the construction of new roads and installation of underground cables traversing non-perennial watercourses.		**Low**	NA	Partially Reversible
	➢ Construction of surface infrastructure outside the Steelpoort River and non-perennial rivers and associated floodlines or zones of regulation.		**Medium**	Low	Moderately Reversible
	➢ Construction of internal access road crossings and trenching through the watercourses (Impact on Steelpoort River)		**Low**	NA	Partially Reversible
	➢ Construction of internal access road crossings and trenching through the watercourses (Direct impact on drainage lines)		**Medium**	NA	Partially Reversible

Impact and Aspect		Risk	Adjusted Risk Rating	Reversibility of Impact
	➢ Canalisation of two ephemeral drainage lines located in Site 5 (Impact on Steelpoort River)	**Medium**	Low	Partially Reversible
	➢ Canalisation of two ephemeral drainage lines located in Site 5 (Direct impact on drainage lines)	**Medium**	NA	Non-reversible
Operational Phase	➢ Operation and maintenance of the surface infrastructure outside the Steelpoort River and non-perennial rivers and associated floodlines or zones of regulation.	**Medium**	Low	Fully Reversible
	➢ Operation and maintenance of roads traversing watercourses	**Low**	NA	Fully Reversible
Decommissioning Phase	➢ Removal of all surface infrastructure from the study area.	**Medium**	Low	Fully Reversible

The outcome of the Risk Assessment proved that the proposed construction of the Solar PV plant would have a medium risk significance on the aquatic environment. The strict implementation of the stipulated mitigation measures as recommended in this report, with specific mention of limiting the potential of additional sediment to enter the watercourses, and limiting erosion from stormwater runoff, will enable the reduction of the perceived impacts.

Based on the findings of the aquatic ecological assessment, several mitigation measure recommendations are made to minimise the impact on the aquatic ecology during the construction phase:

- ➢ All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential;
- ➢ All vegetation removed as part of the site clearing activities (specifically where large areas need to be cleared) should be transported from the construction site (may not be stockpiled) and disposed of at a registered waste disposal facility;
- ➢ During construction activities associated with surface infrastructure within close proximity to a watercourse, regular spraying of non-potable water or the use of chemical dust suppressants must be implemented to reduce dust and to ensure no smothering of vegetation within the watercourses occurs from excessive dust settling;
- ➢ All perennial and non- perennial rivers and associated floodlines must be considered no-go areas during construction and operation for all non-linear infrastructure;
- ➢ No vegetation may be removed from the 32 m ZoR surrounding the watercourse where no infrastructure is planned within 32 m thereof, as this provides a natural buffer zone around the watercourses which disperse surface runoff into the watercourses, and thus prevents sedimentation and erosion thereof.
- ➢ It is imperative that all construction works be undertaken during the dry, winter months when the flow is very low in the watercourses, and no diversion of flow would be necessary;
- ➢ The reaches of the watercourses where no activities are planned to occur must be considered no-go areas. These no-go areas for non-linear infrastructure can be marked at a maximum distance of 5 m upstream and downstream of the new road crossings. This 5 m buffer area would allow for construction personal, vehicles (if applicable) to enter the watercourse crossing where the new internal access roads are proposed;
- ➢ With regards to ground-breaking activities outside the 32 m NEMA ZoR:
  - o During excavation activities, the topsoil and vegetation should be stockpiled separately from other material outside of the 32 m NEMA ZoR;
  - o Excavated materials should not be contaminated, and it should be ensured that the minimum surface area is taken up. The mixture of the lower and upper layers of the excavated soil should be kept to a minimum, so as for later use as backfill material after construction has commenced;
  - o All exposed soils must be protected for the duration of the construction phase to prevent potential erosion and sedimentation of the watercourses;
  - o Construction of the proposed surface infrastructure may result in disturbance to the natural buffer zone surrounding the watercourses which may result in the reduction of surface roughness. This can be mitigated by ensuring that no concentrated runoff from the surface infrastructure construction area enters the watercourses. This can be

achieved by installing silt traps or placing haybales down gradient of the construction footprint to ensure no sediment laden or concentrated runoff generates from the construction footprint;
    - It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction.
- With regards to concrete mixing on site:
    - No mixed concrete may be deposited outside of the designated construction footprint;
    - Protective equipment should be provided, onto which any mixed concrete can be deposited while it awaits placing; and
    - Concrete spilt outside of the demarcated area must be promptly removed and taken to a suitably licensed waste disposal site.
- With regards to backfilling of excavated areas:
    - Stockpiled material should be used as backfill material;
    - All excavated areas should be backfilled to the natural ground level with excavated material;
    - Soil must be lightly recompacted to a depth of 450 mm, and all construction material must be removed from the site upon the completion of construction or used in the rehabilitation process.
- Rehabilitation of the construction footprint areas:
    - All footprint areas which have been compressed should be ripped and revegetated within indigenous vegetation as soon as the construction activities have ceased. This will prevent any soil erosion and the creation of gullies within the operational area;
    - The operational area should regularly be inspected for alien and invasive vegetation species which might have established due to the construction activity related disturbances.
    - Ensure that routine inspections and monitoring of any instream infrastructure are undertaken to monitor the establishment of indigenous vegetation and the presence of any alien or invasive plant species;
    - The surface infrastructure areas must be inspected to ensure that no concentrated runoff from these areas forms erosion gullies and eventually flow into the watercourses. Should this be noted, these gullies/preferential flow paths must be infilled with in situ material and appropriately revegetated;
    - Routine maintenance of the roads must be undertaken to ensure that no concentration of flow and subsequent erosion occurs due to the road crossings. Such maintenance activities must especially be undertaken after high rainfall events;
    - Stormwater runoff from the road crossings should be monitored (by the Operation and Maintenance (O&M) Manager), so it does not result in erosion of the watercourses. Stormwater should be allowed to diffusely spread across the landscape, by ensuring adequate surface roughness in the watercourse (through vegetation and rocky areas);
    - Should erosion be noted that was caused by the road crossings the area must be rehabilitated by infilling the erosion gully and revegetation thereof with suitable indigenous vegetation. Use can also be made of rocks obtained from the surrounding area to infill any area prone to erosion, as a natural dispersal mechanism.
- Installation of appropriately sized silt traps and attenuation facilities in the correct locations to minimize sediment laden runoff from entering the Steelpoort River.
- Aquatic biomonitoring of the Steelpoort River and habitat monitoring of the drainage channels must take place during construction and once the construction has been completed, when all rehabilitation activities have been implemented. Results obtained in this aquatic ecological baseline report should be used for temporal comparison. If any problematic trends are identified, the reason for impact must be identified and the appropriate mitigatory action initiated. All work must be completed by an SA RHP Accredited assessor and must take place on a minimum frequency of 6 months.

DOCUMENT GUIDE

The table below provides the specialist report requirements for the assessment and reporting of impacts on aquatic biodiversity in terms of Government Notice 320 as promulgated in Government Gazette 43110 of 20 March 2020 in line with the Department of Environmental Affairs screening tool requirements, as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998).

No.	Requirements	Section in report
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist	Front Page and Appendix I
2.2	Description of the preferred development site, including the following aspects-	
2.2.1	a. Aquatic ecosystem type b. Presence of aquatic species and composition of aquatic species communities, their habitat, distribution, and movement patterns	Section 3, 4 and 5
2.2.2	Threat status, according to the national web based environmental screening tool of the species and ecosystems, including listed ecosystems as well as locally important habitat types identified	Section 3, 4 and 5
2.2.3	National and Provincial priority status of the aquatic ecosystem (i.e. is this a wetland or river Freshwater Ecosystem Priority Area (FEPA), a FEPA sub- catchment, a Strategic Water Source Area (SWSA), a priority estuary, whether or not they are free-flowing rivers, wetland clusters, etc., a CBA or an ESA; including for all a description of the criteria for their given status	Section 3
2.2.4	A description of the Ecological Importance and Sensitivity of the aquatic ecosystem including: a. The description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); b. The historic ecological condition (reference) as well as Present Ecological State (PES) of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel, flow regime (surface and groundwater)	Section 3, 4 and 5
2.3	Identify any alternative development footprints within the preferred development site which would be of a “low” sensitivity as identified by the national web based environmental screening tool and verified through the Initial Site Sensitivity Verification	NA
2.4	Assessment of impacts - a detailed assessment of the potential impact(s) of the proposed development on the following very high sensitivity areas/ features:	Section 7
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Section 7
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	Section 7
2.4.3	How will the development impact on fixed and dynamic ecological processes that operate within or across the site, including: a. Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); b. Change in the sediment regime (e.g. sand movement, meandering river mouth/estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub-catchment; c. The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.). d. Assessment of the risks associated with water use/s and related activities.	Section 7
2.4.4	How will the development impact on the functionality of the aquatic feature including: a. Base flows (e.g. too little/too much water in terms of characteristics and requirements of system); b. Quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of overabstraction or instream or off-stream impoundment of a wetland or river); c. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland); d. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); and e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal).	Section 7
2.4.5	How will the development impact on key ecosystem regulating and supporting services especially Flood attenuation; Streamflow regulation; Sediment trapping; Phosphate assimilation; Nitrate assimilation; Toxicant assimilation; Erosion control; and Carbon storage.	Section 7

2.4.6	How will the development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	Section 7
2.4.7	In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: size of the estuary; availability of sediment; wave action in the mouth; protection of the mouth; beach slope; volume of mean annual runoff; and extent of saline intrusion (especially relevant to permanently open systems).	NA
3.	**The report must contain as a minimum the following information:**	
3.1	Contact details and curriculum vitae of the specialist including SACNASP registration number and field of expertise and their curriculum vitae;	Appendix I
3.2	A signed statement of independence by the specialist;	Appendix I
3.3	The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 1, 3 and 4
3.4	The methodology used to undertake the impact assessment and site inspection, including equipment and modelling used, where relevant;	Section 2 and Appendix C
3.5	A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	Section 1.3
3.6	Areas not suitable for development, to be avoided during construction and operation (where relevant);	Section 6
3.7	Additional environmental impacts expected from the proposed development based on those already evident on the site and a discussion on the cumulative impacts;	Section 7
3.8	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted protocol;	Section 6
3.9	Impact management actions and impact management outcomes proposed by the specialist for inclusion in the EMPr;	Section 7 and 8
3.10	A motivation where the development footprint identified as per 2.3 were not considered stating reasons why these were not being not considered; and	NA
3.11	A reasoned opinion, based on the finding of the specialist assessment, regarding the acceptability or not, of the development and if the development should receive approval, and any conditions to which the statement is subjected.	Section 8
3.12	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies.	Section 6
3.13	Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr).	Section 7 and 8
3.14	A motivation must be provided if there were development footprints identified as per paragraph 2.3 for reporting in terms of Section 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) that were identified as having a “low” aquatic biodiversity and sensitivity and that were not considered appropriate.	NA
3.15	A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not.	Section 7
3.16	Any conditions to which this statement is subjected.	Section 8

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GLOSSARY OF TERMS

% DO sat	In aquatic environments, oxygen saturation is a ratio of the concentration of dissolved oxygen in the water to the maximum amount of oxygen that will dissolve in the water at that temperature and pressure under stable equilibrium.
Alien vegetation	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Alluvial soil	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
ASPT	The average sensitivity of the aquatic community obtained by determining the sum of the sensitivity scores for each aquatic macro-invertebrate family observed and then dividing by the number of families present.
Biodiversity	The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Delineation (of a wetland)	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
DO	Dissolved Oxygen is the amount of oxygen that is present in the water. It is measured in milligrams per litre (mg/L).
EC	Electrical conductivity (EC) is a measure of the ability of water to conduct an electrical current. This ability is a result of the presence in water of ions such as carbonate, bicarbonate, chloride, sulphate, nitrate, sodium, potassium, calcium and magnesium, all of which carry an electrical charge.
Ecoregion	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region”.
EIS	Ecological importance refers to the diversity, rarity or uniqueness of the habitats and biota. Ecological sensitivity refers to the ability of the ecosystem to tolerate disturbances and to recover from certain impacts.
EWR	The flow patterns (magnitude, timing and duration) and water quality needed to maintain a riverine ecosystem in a particular condition. This term is used to refer to both the quantity and quality components.
FRAI	The FRAI is an assessment index based on the environmental intolerances and preferences of the reference fish assemblage and the response of the constituent species of the assemblage to particular groups of environmental determinants or drivers.
IHAS	An assessment index to determine the suitability of the habitat at any assessment point for colonisation by aquatic macro-invertebrates.
IHI	The habitat integrity of a river refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale that are comparable to the characteristics of natural habitats of the region.
Indigenous vegetation	Vegetation occurring naturally within a defined area.
Intermittent flow	Flows only for short periods.
MIRAI	MIRAI integrates the ecological requirements of the invertebrate taxa in a community or assemblage to their response to modified habitat conditions.
PES	The current state or condition of a water resource in terms of its biophysical components (drivers) such as hydrology, geomorphology and water quality and biological responses viz. fish, invertebrates, riparian vegetation). The degree to which ecological conditions of an area have been modified from natural (reference) conditions.
RQIS	RQIS provides national water resource managers with aquatic resource data, technical information, guidelines and procedures that support the strategic and operational requirements for assessment and protection of water resource quality.
RWQO	*Guidelines set by the South African Department of Water and Sanitation (DWS), formerly DWA or DWAF, for various physico-chemical and biological parameters for various uses as well as ecosystem functioning.

SA RHP	The RHP serves as a source of information regarding the overall ecological status of river ecosystems in South Africa. For this reason, the RHP primarily makes use of in-stream and riparian biological communities (e.g. fish, invertebrates, vegetation) to characterise the response of the aquatic environment to multiple disturbances.
SASS5	An index to determine the integrity of the aquatic macro-invertebrate community at any given assessment point.
SQR	A finer subdivision of the quaternary catchments (the catchment areas of tributaries of main stem rivers in quaternary catchments).
VEGRAI	VEGRAI is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results presented as Ecostatus Categories.
Watercourse	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soils, which may in turn have an influence on the ecological characteristics and functioning of wetlands.
WMS	WMS is a suite of computer programmes developed for the Department of Water and Sanitation to provide information for water resource monitoring and management in South Africa.
WULA	The National Water Act (Act 36 of 1998) gives the Department of Water and Sanitation the tools to gather the information that we need for the optimal management of our water resources. The registration of water use is one of these tools.

* South African water quality guidelines volume 7, Aquatic ecosystems (DWAF, 1996): This reference provides percentage change guidelines as follows:

- **Electrical conductivity (EC)/Total Dissolved Solids (TDS)** concentrations should not be changed by > 15 % from the normal cycles of the water body under unimpacted conditions at any time of the year, and the amplitude and frequency of natural cycles in EC/TDS concentrations should not be changed;
- **pH values** should not be allowed to vary from the range of the background pH values for a specific site and time of day, by > 0.5 of a pH unit, or by > 5 %, and should be assessed by whichever estimate is the more conservative.
- **Dissolved Oxygen (DO)** concentration should be 80% to 120% of saturation. In addition, for the purposes of this report, any spatial or temporal change exceeding 15% was considered significant.

Note that EC and pH comparisons refer to temporal comparisons. However, as no guidelines are available for spatial comparisons, the percentage change recommendations were applied to spatial comparisons. For the purpose of this report, a temporal or spatial change of 15% was considered significant with reference to DO.

Reserve Determination of Water Resources for the Catchments of the Olifants and Letaba, Department of Water and Sanitation (DWS, 2018). This publication provided updated classes and resource quality objectives of water resources for the Olifants catchment. The reserve for B41J (EWR Site – 9, Steelpoort River) applies. A summary of the relevant classes and resource quality objectives is provided below:

Summary of classes and resource quality objectives of the Dwars River (quaternary catchment B41J EWR Site – 9, Steelpoort River), based on DWS (2018).

Description	Parameter	Classification / Value
River name: Steelpoort River Biophysical node name: EWR site-9	Present Ecological Category (PES)	D
	Target Ecological Category (TEC)	C/D
	Ecological Importance and Sensitivity (EIS)	High
	Natural MAR (million m3/a)	23.3
	pH	5.0 – 10.0
	EC (mS/m)	≤ 85
	DO (mg/L)	≥ 5.0

ACRONYMS

°C	Degrees Celsius.
ASPT	Average Score Per Taxon
CBA	Critical Biodiversity Area
DO	Dissolved Oxygen
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EDL	Ephemeral Drainage Line
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMP	Environmental Management Program
ESA	Ecological Support Area
EWR	Ecological Water Requirements
FEPA	Freshwater Ecosystem Priority Areas
FRAI	Fish Response Assessment Index
GIS	Geographic Information System
GN	General Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IHAS	Invertebrate Habitat Assessment System
IHI	Index of Habitat Integrity
m	Meter
MAP	Mean Annual Precipitation
MC	Management Classes
MIRAI	Macro-Invertebrate Response Assessment Index
NA	Not Applicable
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NBA	National Biodiversity Assessment
NSBA	National Spatial Biodiversity Assessment
NWA	National Water Act
NWCS	National Wetland Classification System
PEMC	Present Ecological Management Class
PES	Present Ecological State
REC	Recommended Ecological Category
Ref	Reference

RHP	River Health Program
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SAS	Scientific Aquatic Services
SASS5	South African Scoring System version 5
subWMA	Sub-Water Management Area
SQR	Sub-Quaternary Reach
VEGRAI	Riparian Vegetation Response Assessment Index
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WRC	Water Research Commission
WMS	Water Management System
WULA	Water Use License Application

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecological assessment in support of the Environmental Impact Assessment (EIA) and Water Use Licence (WUL) authorisation process for the proposed Samancor Chrome Operations – Tubatse Ferrochrome 100MW Photovoltaic (PV) Solar Project, near Steelpoort, Limpopo Province.

The existing and operational Samancor Chrome Operations – Tubatse Ferrochrome, hereafter referred to as Tubatse Ferrochrome is located approximately 700 m south west of the town of Steelpoort, directly south of the R555 roadway, and 1,5 km south east of the town of Pelaneng (Figure 1 and 2).

The proposed PV plant will convert solar radiation into electric energy by using photovoltaic solar arrays. The name plate rating of the plant will be a minimum of 100 MWp. The proposed PV plant will be distributed over several sites and consists of preferred layout sites 1 -5 along with its associated 33kV powerlines and Tubatse East and West substation buildings, hereafter collectively referred to as the study area, as indicated in Figure 1.

Each of the PV plants will consist of the following infrastructure:

- Solar PV panels that will be able to deliver up to 100MWp to the Samancor grid;
- Inverters that convert direct current (DC) generated by the PV modules into alternating current (AC) to be exported to the electrical grid;
- Inverters that convert direct current (DC) generated by the PV modules into alternating current (AC) to be exported to the electrical grid;
- Inverter and transformer combination – each power block will have a centralised inverter which converts the DC power generated by the PV panels, to AC power and a transformer which transforms the power to a higher voltage of 33 kV to facilitate transmitting the power over longer distances to connect to the East and West Plant Substations; and
- Instrumentation and Control consisting of hardware and software for remote plant monitoring and operation of the facility.

Additional infrastructure associated with each PV plant site includes:

- Mounting structures for the solar panels in a fixed tilt or rotating tracking configuration;

- Cabling between the structures, to be lain underground where practical;
- New 33 kV powerlines (either overhead lines or underground cables) between the various sites and the Tubatse East and West substation buildings;
- Containerized switchgear substation at Tubatse East and west MV substations for connecting to the Tubasstse substation busbars;
- Water provision infrastructure (i.e. pipeline/s, storage tank/s, etc.) for PV panel cleaning;
- Battery Energy Storage System (BESS); and
- Internal access roads (4- 6 m wide roads will be constructed but existing roads will be used as far as possible), fencing (approximately 1.8m in height) and gates for access control.

Table 1: Technical details of the proposed PV plant/ s Facility Component Description/ Dimensions

Facility Component	Description
Height of PV panels	Approx. 0.8 m
Area of PV Arrays	Total area = 162 ha
Area occupied by inverter/ transformer stations/ substations	60 m^2
Capacity of on-site substation	Existing East & West: 62.5MW & 37.5MW, 33kV switchgear added to each SS
Area occupied by both permanent and construction laydown areas	Only 1 camp & laydown area. Laydown area = 6000 m^2 (Site 3,4,&5), 5000 m^2 - east region (Site 1&2). Construction camp – 2000 m^2

In order to identify all potential watercourses that may be impacted by the proposed PV plant, a 500 m “zone of investigation” around the study area, in accordance with Government Notice (GN) 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA), was used as a guide in which to assess possible sensitivities of the receiving watercourse environment. This area – i.e. the 500 m zone of investigation around the study area - will henceforth be referred to as the “investigation area”.

The Risk Assessment Matrix as defined in Appendix A of Regulation GN509 of 2016 as it applies to the National Water Act, 1998 (Act No. 36 of 1998) was applied to determine the significance of the perceived impacts associated with the proposed construction activities. In addition, mitigatory measures were developed which aim to minimise the perceived impacts associated with the activity, followed by an assessment of the significance of the impacts after mitigation, assuming that they are fully implemented.

This report, after consideration and a description of the ecological integrity of the development, must guide the professional team and inform the relevant authorities, by means of a reasoned opinion and recommendations, as to the impact of the proposed construction of the Solar PV plant on the Steelpoort River.

1.2 Scope of Work

Specific outcomes in terms of this report are outlined below:

Freshwater Ecological Assessment:

- A background study of relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA] 2011 database; the Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS], 2014 database and the Limpopo Conservation Plan V2, 2013 database) was undertaken to aid in defining the EIS of the watercourse;
- Watercourses were delineated according to "DWAF, 2008: A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". Aspects such as soil morphological characteristics, vegetation types and wetness were used to delineate the watercourses;
- The watercourse classification assessment was undertaken according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis et al., 2013);
- The EIS of the watercourse was determined according to the method described by Rountree and Kotze (2013);
- The services provided by the aquatic resources in the study area were assessed according to the method of Kotze et al. (2009) in which services to the ecology of the site as well as services to the people of the area were defined;
- The ecostatus of the riparian vegetation was assessed according to the method of Kleynhans et al (2007);
- Watercourses were mapped according to the ecological sensitivity of each hydrogeomorphic unit in relation to the proposed infrastructure. In addition to the extent of the riparian zone, the appropriate provincial recommended buffers and legislated zones of regulation were depicted.

Aquatic Ecological Assessment:

- To define the instream Ecostatus of the Steelpoort River associated with the study area;
- To delineate the watercourse associated with the study area;
- To define the instream EIS of the aquatic resource within the study area;

- To provide information to guide the project so as to maintain the Ecostatus of the system in support of the EIS of the aquatic ecosystem;
- To provide information to guide the project to ensure that connectivity of the aquatic resource is maintained both laterally and longitudinally along the watercourse;
- To provide recommendations to ensure that no further incision and erosion of the Steelpoort River takes place as a result of the proposed construction activities; and
- To provide recommendations to ensure that no significant persistent impact on water quality will take place.

DWS Risk Assessment:

- The DWS Risk Assessment Matrix (2016) was applied to identify potential impacts that may affect the watercourse as a result of the proposed activities and aim to quantify the significance thereof; and
- To present management and mitigation measures which should be implemented going forward to assist in minimising the impact on the receiving environment.

1.3 Assumptions and Limitations

The following points serve to indicate the assumptions and limitations with regard to the aquatic assessment:

- **Reference conditions are unknown:** The composition of aquatic biota in the study area, prior to major disturbance is unknown. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from limited data available such as the Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) PES/EIS database as discussed in Section 3.2.1.
- **Temporal variability:** The data presented in this report is based on a single site visit. Two points (Sites TS1 and TS2) were selected as representative points on the Steelpoort River during the April 2021 assessment. A third point (Site TS3) was considered in terms of water quality and macro-invertebrate community integrity, but no fish assessment was conducted at site TS3. The results from site TS3 were used from a previous aquatic ecological assessment of the Steelpoort River conducted in December 2020 and yielded similar results to sites TS1 and TS2 as conducted in April 2021. The effects of natural seasonal and long-term variation in the ecological conditions and aquatic biota found in the system is, therefore, unknown. Ideally aquatic assessments should be undertaken, as a minimum in the summer/high flow and winter/low flow seasons to account for and define seasonal variability.

- **Ecological assessment timing:** Aquatic and terrestrial ecosystems are dynamic and complex. It is possible that aspects, some of which may be important, could have been overlooked. A more reliable assessment of the biota would require seasonal sampling, with sampling being undertaken under both low flow and high flow conditions. However, the observations made in this study are deemed adequate to provide the information required to define the risk to the aquatic ecosystem in question, and to ensure that sufficient insight into management and mitigation measures is provided to adequately protect the system and to maintain the Ecostatus of the system.

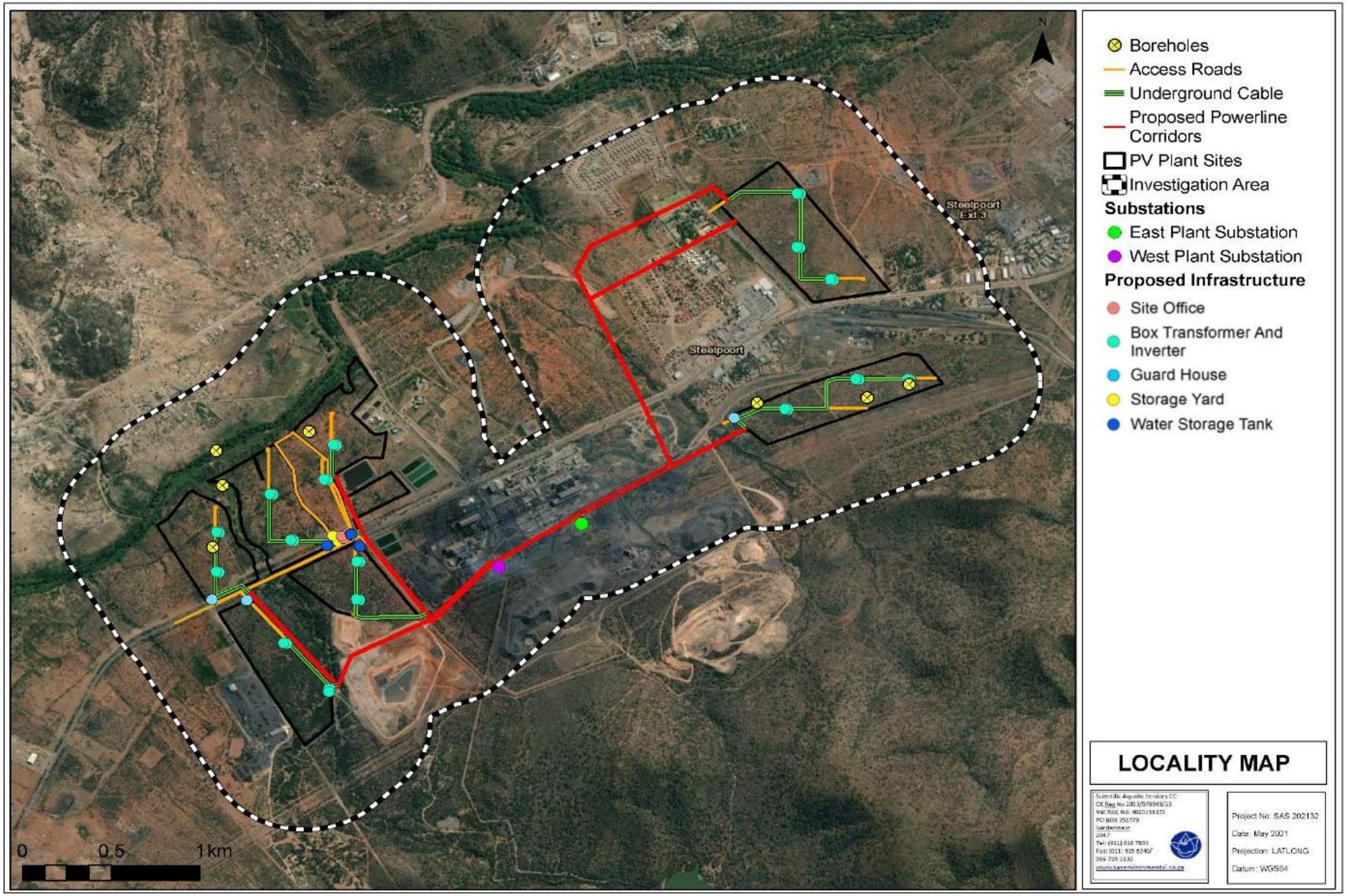


Figure 1: Digital satellite image depicting the location of the study and investigation areas in relation to surrounding areas.

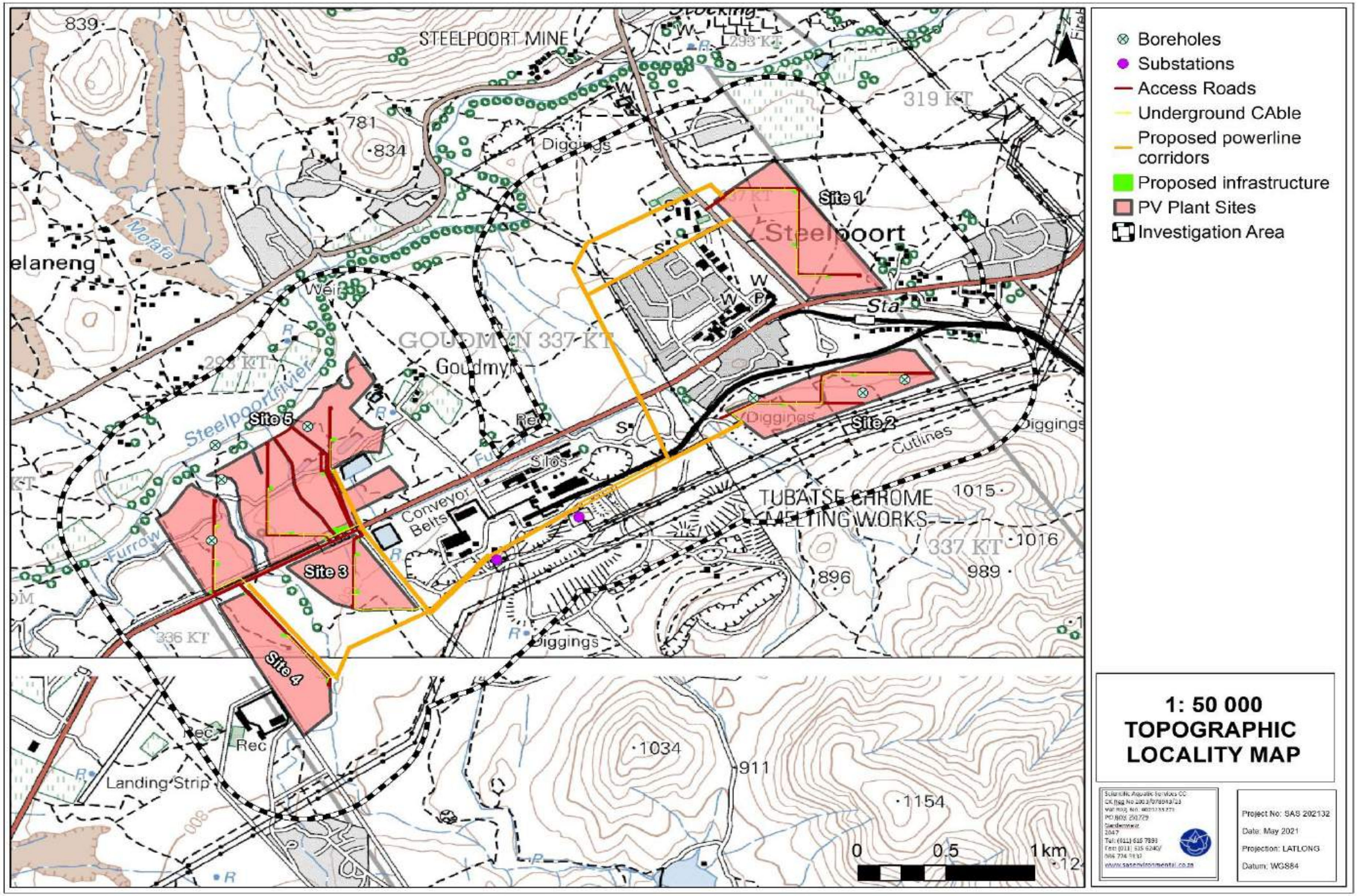


Figure 2: Location of the study and investigation areas depicted on a 1:50 000 topographical map in relation to surrounding area.

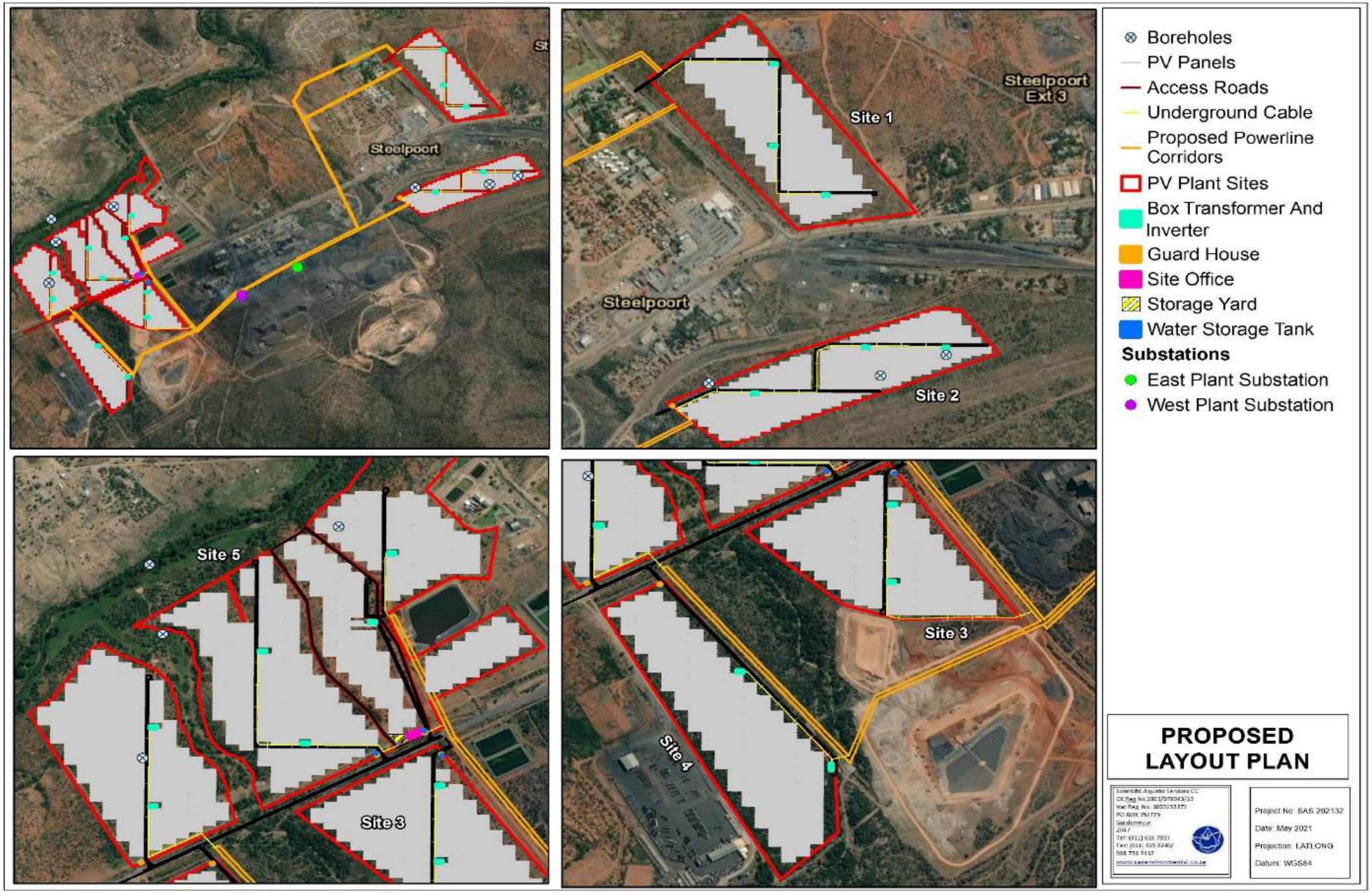


Figure 3: Proposed layout of the PV Plant Sites and the associated powerlines and their alternatives.

2 ASSESSMENT APPROACH

2.1 Watercourse Field Verification

As part of this assessment, the following definitions, as per the National Water Act, 1998 (Act No. 36 of 1998) are of relevance:

Watercourse means-

(a) A river or spring;
(b) A natural channel in which water flows regularly or intermittently;
(c) A wetland, lake or dam into which, or from which water flows; and
(d) Any collection of water, which the Minister may, by notice of the Gazette, declare a watercourse.

Wetland habitat is "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

Riparian habitat includes the physical structure and associated vegetation of areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

A field verification was undertaken on the 14^{th} and 15^{th} of April 2021, during which the presence of any watercourse characteristics as defined by DWAF (2008) or wetlands as defined by the NWA were noted (please refer to Sections 4 and 5 of this report). In addition to the delineation process, detailed assessment of the delineated watercourses was undertaken, at which time factors affecting the integrity of the watercourses were taken into consideration and aided in the determination of the functioning and the ecological and socio-cultural services provided by the watercourses. A detailed explanation of the methods of assessment undertaken is provided in Appendix C of this report.

The watercourse delineation took place according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" (DWAF, 2008). The foundation of the method is based on the fact that watercourses have several distinguishing factors including the following:

- Landscape position;

- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils; and
- The presence of alluvial soils in stream systems.

2.2 Sensitivity Mapping

All watercourses associated with the proposed development were delineated with the use of a Global Positioning System (GPS). Geographic Information System (GIS) was used to project these features onto aerial photographs and topographic maps. The sensitivity map presented in Section 6 should guide the design, layout and management of the proposed development.

2.3 Aquatic Ecological Assessment

Best practice methods of assessment (detailed methods of assessment provided in Appendix C) were used to assess the aquatic ecological integrity of the site based on water quality, instream and riparian habitat condition and biological impacts and integrity. All work was undertaken by a South African River Health Program (SA RHP) accredited assessor. Factors investigated included the following:

- Visual conditions of the site, including an assessment of impacts on the unnamed tributary;
- Water quality variables were measured *in-situ* using the Aquaread Aquameter (AP – 700 series) probe. Parameters included: Dissolved Oxygen (DO), pH, Electrical Conductivity (EC) and temperature. The results aid in the interpretation of the data obtained by the biomonitoring. Results are discussed against various guidelines as follows:
  - South African water quality guidelines volume 7, Aquatic ecosystems Target Water Quality Objectives (TWQR; DWAF, 1996);
  - The Resource Water Quality Objectives (RWQO) of the Steelpoort River (DWS, 2018).
- The general habitat integrity of the site was assessed based on the application of the Index of Habitat Integrity (IHI), based on the protocol of Kleynhans *et al*. (2008);
- Assessment of the riparian vegetation was performed using the Riparian Vegetation Response Assessment Index (VEGRAI), designed in such a way that qualitative ratings translate into quantitative and defensible results (Kleynhans et al., 2007b);
- The integrity of the aquatic macro-invertebrate community was assessed using the South African Scoring System version 5 (SASS5) as defined by Dickens &

Graham (2002), as well as through the application of the Macro-Invertebrate Response Assessment Index (MIRAI) Ecostatus tool as described by Thirion (2007). Aquatic macro-invertebrates expected within the system were derived from the DWS Resource Quality Information Services (RQIS) PES/EIS database;

- The integrity of the fish community was assessed using the Fish Response Assessment Index (FRAI) as described by Kleynhans (2007);
- The Ecological Importance and Sensitivity of the aquatic resources was determined according to the protocols of DWAF (1999).

2.4 Risk Assessment and Recommendations

Following the completion of the assessment, a risk assessment was conducted (please refer to Appendix C for the method of approach) and recommendations were developed to address and mitigate impacts associated with the proposed activities.

The recommendations provided also include general 'best practice' management measures, which apply to the activities associated with the proposed rehabilitation as a whole, and which are presented in Appendix D. Mitigation measures have been developed to address issues presented as a result of the proposed activities. The detailed site-specific mitigation measures are outlined in Section 6 of this report.

3 FRESHWATER ECOLOGICAL DESCRIPTION

3.1 Freshwater Systems Analysis: Results of Desktop Investigation

The following section contains data accessed as part of the desktop assessment and are presented as a "dashboard" report (Table 2). The dashboard reports aim to present concise summaries of the data on as few pages as possible in order to allow for integration of results by the reader to take place. Where required, further discussion and interpretation is provided. It is important to note that although all data sources used provide useful and often verifiable, high quality data, the various databases used do not always provide an entirely accurate indication of the focus areas' actual site characteristics at the scale required to inform the environmental authorisation and/or water use licensing processes. However, this information is considered to be useful as background information to the study. Thus, this data was used as a guideline to inform the assessment and to focus on areas and aspects of increased conservation importance.

Table 2: Desktop data relating to the character of watercourses associated with the study area and investigation area.

Aquatic ecoregion and sub-regions in which the study area is located	
Ecoregion	Eastern Bankenveld
Catchment	Olifants North
Quaternary Catchment	B41J
WMA	Olifants
subWMA	Steelpoort
Dominant characteristics of the Eastern Bankenveld Ecoregion Level 2 (9.03) (Kleynhans *et al.*, 2007)	
Dominant primary terrain morphology	Closed hills, mountains – moderate and high relief, low mountains
Dominant primary vegetation types	Mixed Bushveld
Altitude (m a.m.s.l)	500 to 2300
MAP (mm)	400 to 700
Coefficient of Variation (% of MAP)	20 to 34
Rainfall concentration index	55 to 64
Rainfall seasonality	Early summer
Mean annual temp. (°C)	14 to 22
Winter temperature (July)	2 – 20 °C
Summer temperature (Feb)	12 – 30 °C
Median annual simulated runoff (mm)	20 to 150

Detail of the study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The majority of the study area (95%) falls within a sub quaternary catchment considered an important fish support area, while a small western portion of the study area falls within a sub quaternary catchment not considered important in terms of watercourse conservation. Fish Support Areas include sub-quaternary catchments that are important for the migration of the fish species *Opsaridium peringueyi* (LC).
NFEPA Wetlands (Figure 4)	According to the NFEPA database, there are no natural or artificial wetlands situated within the study area however there are five artificial unchanneled valley bottom wetland features located within the investigation area. These wetlands are indicated by NFEPA to be heavily to critically modified. During the field assessment these were observed to be impoundments associated with the Tubatse Ferrochrome operations as well as impoundments associated with other operations within the study area.
Wetland Vegetation Type	The study area falls within the Central Bushveld Group 7 WetVeg group, considered Least Threatened, according to Mbona *et al.* (201).
NFEPA Rivers (Figure 4)	According to the NFEPA Database the Steelpoort River is located approximately 150 m north of the study area and the Tubatsane River confluences with the Steelpoort River approximately 150 m west of the study area. The Steelpoort River is considered moderately modified (Class C) and considered a fish support area, while the PES 1999 classification indicates that the Tubatsane River is moderated modified (Class C), however the NFEPA Database indicates the Tubatsane River as not intact (Class Z).
National Web Based Environmental Screening Tool (2020).	
The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.	
The aquatic sensitivity for the area is considered low, according to the screening tool.	

National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figure 5)
According to the NBA 2018: SAIIAE there are no natural wetland features associated with the study area or investigation area, however the artificial unchanneled valley bottom wetland features as identified by the NFEPA Database (2011) are classified as dams, open reservoirs and large reservoirs according to the NBA Dataset (2018). According to the NBA Dataset the Steelpoort River is largely modified (Class D), while the Tubatsane River is seriously modified (Class E). Both rivers are currently poorly protected (Ecosystem Protection Level (EPL) and therefore considered endangered (Ecosystem Threat Status (ETS).

Ecological Status of the most proximal sub-quaternary reach (DWS, 2014) (Figure 6)			
Sub-quaternary reach	B41J – 00563 (Steelpoort River)	B41J – 00562 (Tubatsane River)	B41J – 00576 (Steelpoort River)
Proximity to study area	150 m north of the study area	150 m north west of the study area	280 m west of the study area
Assessed by expert?	Yes	Yes	Yes
PES Category Median	Largely Modified (Class D)	Seriously Modified (Class E)	Largely Modified (Class D)
Mean Ecological Importance (EI) Class	High	Low	High
Mean Ecological Sensitivity (ES) Class	High	Very Low	High
Stream Order	3	1	3
Default Ecological Class (based on median PES and highest EI or ES mean)	High	Low to very-low	High

Detail of the study area in terms of the Limpopo Conservation Plan (C-Plan V2, 2013) (Figure 7)	
Critical Biodiversity Area (CBA) 1	The north eastern portion of site 5 and portions of the proposed powerlines, fall within a Category 1 CBA. These areas are considered **irreplaceable areas,** and areas required to meet biodiversity pattern and/or ecological processes targets. Land Management Recommendations: Obtain formal conservation protection where possible. Implement appropriate zoning to avoid net loss of intact habitat or intensification of land use. Incompatible Land-Use: Urban land-uses including Residential (including golf estates, rural residential, resorts), Business, Mining & Industrial; Infrastructure (roads, power lines, pipelines).
Critical Biodiversity Area (CBA) 2	The majority of the study area, comprising the entire site 1 and 4, and portions of site 2, 3 and 5, and large portions of the proposed powerline, falls within a Category 2 CBA. CBA 2's are considered "**optimal" best design selected sites**, areas selected to meet biodiversity pattern and/or ecological process targets. Alternative sites may be available to meet targets. Land Management Recommendations: Avoid conversion of agricultural land to more intensive land uses, which may have a negative impact on threatened species or ecological processes. Incompatible Land-Use: Urban land-uses including Residential (golf estates, rural residential, resorts), Business, mining & Industrial, Infrastructure (roads, power lines, pipelines). More intensive agricultural production than currently undertaken on site. Note: Certain elements of these activities could be allowed subject to detailed impact assessment to ensure that developments were designed to CBA2. Alternative areas may need to be identified to ensure the CBA network still meets the required targets.
Ecological Support Area (ESA) 1	Portions of site 5, site 3 and site 2 and portions of the proposed powerlines fall within Category 1 ESAs. Category 1 ESAs are **natural, near natural and degraded areas** supporting CBAs by maintaining ecological processes. Land Management Recommendations: Implement appropriate zoning and land management guidelines to avoid impacting on ecological processes. Avoid intensification of land use and fragmentation of natural landscapes. Incompatible Land-Use: Urban land-uses including Residential (including golf estates, rural residential, resorts), Business, Mining & Industrial; Infrastructure (roads, power lines, pipelines). **Note**: Certain elements of these activities could be allowed subject to detailed impact assessment to ensure that developments were designed to maintain the overall ecological functioning of ESAs.
Ecological Support Area (ESA) 2	The remaining portions of the proposed powerline falls within a Category 2 ESA. ESA2s are areas with **no natural habitat** that is important for supporting ecological processes. Land Management Recommendations: It is recommended to maintain current land-use and avoid intensification of land use, which may result in additional impact on ecological processes. Incompatible Land-Use: Any land use or activity that results in additional impacts on ecological functioning of land use in these areas.
Sekhukhune District Bioregional Plan (BRP, 2020) (Figure 8)	
The bioregional information source designated the remaining areas of natural habitat with the development footprints as ESA1 habitat. The remaining areas are mostly (and more accurately) appraised as "no natural habitat remaining". An appraisal of the Sekhukhune District Bioregional Conservation Plan categories, specifically in comparison with the Limpopo Province Conservation Plan (V2), provides a more accurate and appropriate categorisation of habitat within the proposed development footprints, although local discrepancies are still noted, specifically to the immediate east of Site 5 where CBA habitat is categorised, but habitat appears to be deteriorated (BEC, 2021). Whereas the C-Plan V2 indicates elevated conservation contribution and status, the BRP more accurately describes land transformation and habitat deterioration that is associated with the fragmented and isolated portions of woodland habitat in the immediate surrounds of Steelpoort (BEC, 2021).	

CBA = Critical Biodiversity Area; DWS = Department of Water and Sanitation; EI = Ecological Importance; EPL = Ecosystem Protection Level; ES = Ecological Sensitivity; ESA = Ecological Support Area; ETS = Ecosystem Threat Status; m.a.m.s.l = Metres Above Mean Sea Level; MAP = Mean Annual Precipitation; NBA = National Biodiversity Assessment; NFEPA = National Freshwater Ecosystem Priority Areas; NPAES = National Protected Areas Expansion Strategy; PES = Present Ecological State; SAIIAE = South African Inventory of Inland Aquatic Ecosystems; WMA = Water Management Area

Figure 4: The artificial wetlands, Steelpoort and Tubatsane Rivers associated with the study and investigation areas, according to NFEPA (2011).

Figure 5: The artifical features and Steelpoort and Tubatsane Rivers associated with the study and investigation areas, NBA (2018).

Figure 6: Relevant Sub-Quaternary Catchment Reaches (SQRs) of the Steelpoort and Tubatsane Rivers associated with the study area.

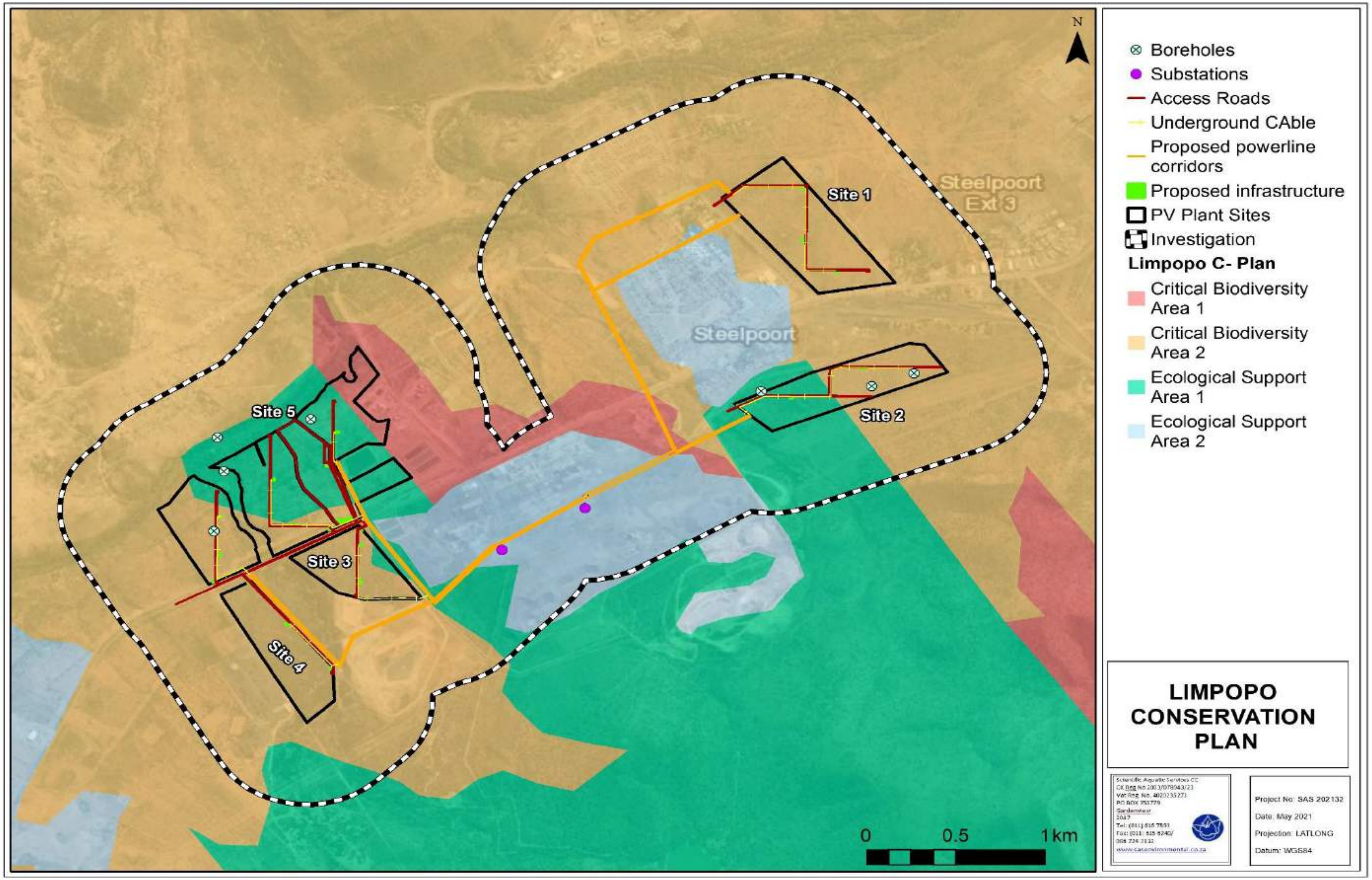


Figure 7: The sensitivity of the area associated with the study and investigation areas, according to the Limpopo Conservation Plant (2013).

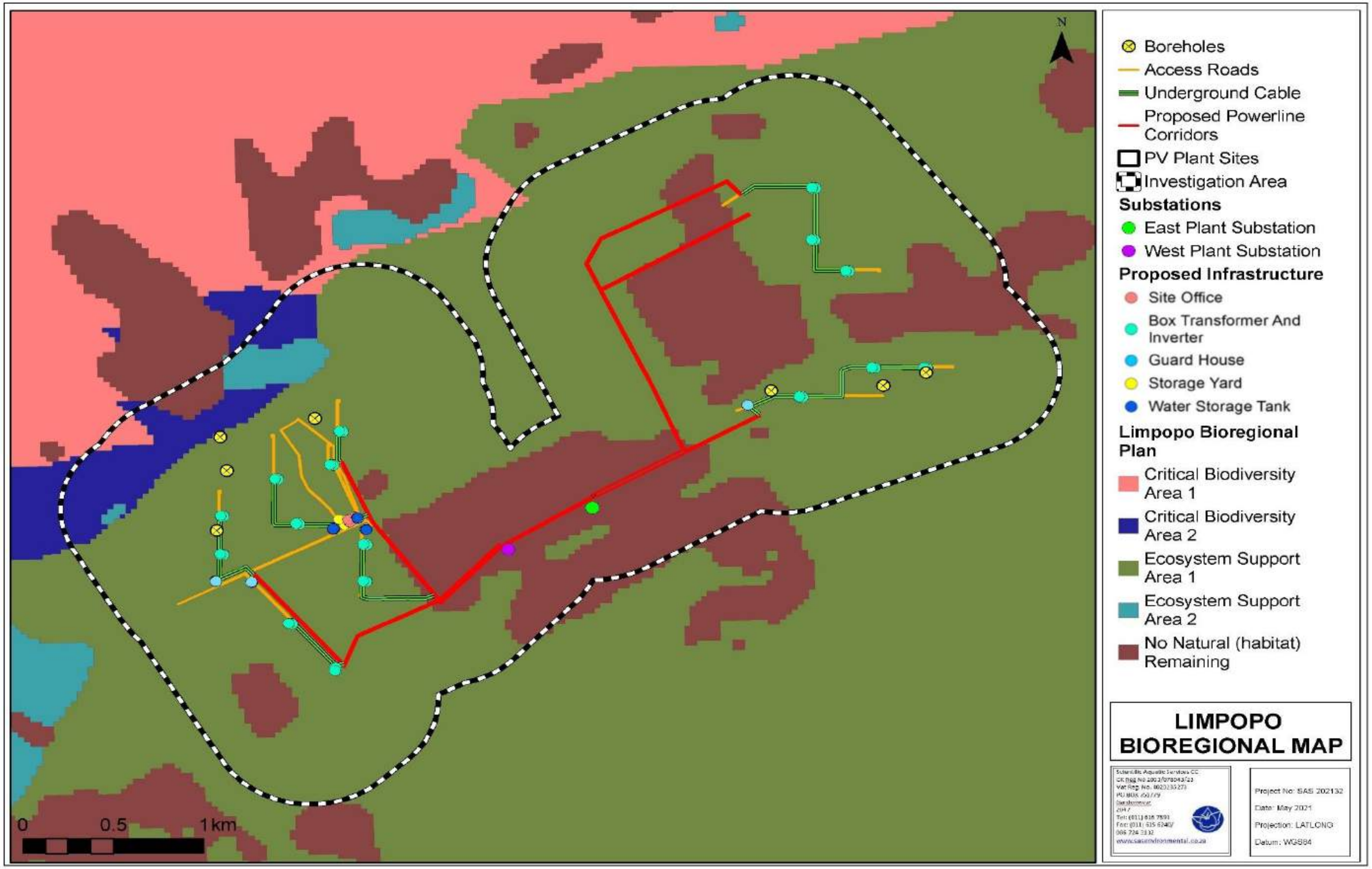


Figure 8: The sensitivity of the area associated with the study and investigation areas, according to the Limpopo Bioregional Map.

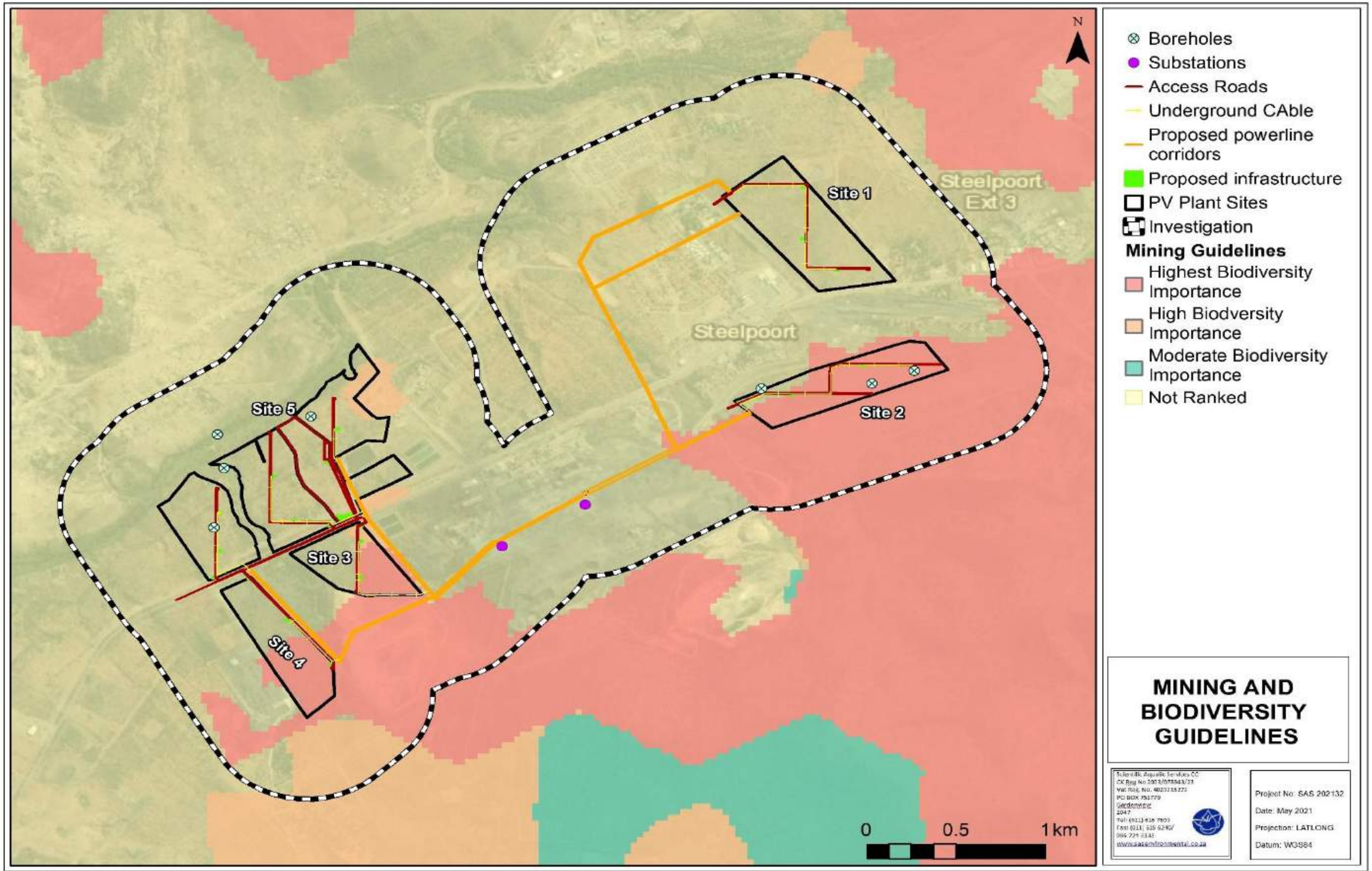


Figure 9: The sensitivity of the area associated with the study and investigation areas, according to the Mining and Biodiversity guidelines.

3.2 Ecostatus

3.2.1 Ecological Status of Sub-quaternary Catchments [Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) PES/EIS Database]

The PES/EIS database, as developed by the DWS RQIS department, was utilised to obtain additional background information on the focus area. The information from this database is based on information at a sub-quaternary catchment reach (SQR) level. Descriptions of the aquatic ecology is based on information collated by the DWS RQIS department from available sources of reliable information, such as SA RHP sites, Ecological Water Requirements (EWR) sites and Hydro Water Management system (WMS) sites.

In this regard, information for the SQRs of Rivers traversing the various assessment areas were obtained. The study area is associated with the Steelpoort and Tubatsane Rivers and their applicable SQR Points are as follows (Figure 6):

- B41J – 00563 (Steelpoort River);
- B41J – 00562 (Tubatsane River); and
- B41J – 00576 (Steelpoort River).

Key information on fish species, macro-invertebrates and background conditions, associated with the above listed SQRs as contained in this database and pertaining to the Present Ecological State (PES), ecological importance and ecological sensitivity for the Steelpoort and Tubatsane Rivers, are tabulated in Tables 3 to 5 below.

Table 3: Fish species previously collected from or expected in the various SQR monitoring points associated with the study area. B41J – 00632 (Tubatsane River) did not have any fish species at the time of the data collection.

	B41J – 00563 (Steelpoort River)	B41J – 00576 (Steelpoort River)
Amphilius uranoscopus	X	X
Barbus anoplus	X	X
Barbus neefi	X	X
Barbus paludinosus		X
Barbus trimaculatus	X	X
Barbus unitaeniatus	X	X
Chiloglanis paratus	X	X
Chiloglanis pretoriae	X	X
Chiloglanis swierstrai	X	X
Clarias gariepinus	X	X
Labeo cylindricus	X	X
Labeo molybdinus	X	X
Labeobarbus marequensis	X	X

Oreochromis mossambicus	X	X
Opsaridium peringueyi	X	X
Pseudocrenilabrus philander	X	X
Tilapia sparrmanii	X	X

Table 4: Invertebrates previously collected from or expected at the various SQR monitoring points associated with the various assessment areas. B41J – 00632 (Tubatsane River) did not have any macroinvertebrate species at the time of the data collection.

	B41J – 00563 (Steelpoort River)	B41J – 00576 (Steelpoort River)
Aeshnidae		X
Ancylidae	X	X
Baetidae > 2 sp	X	X
Belostomatidae	X	X
Caenidae	X	X
Ceratopogonidae	X	X
Chironomidae	X	X
Coenagrionidae	X	X
Corduliidae	X	X
Corixidae	X	X
Culicidae	X	X
Dytiscidae	X	X
Elmidae/dryopidae	X	X
Empididae	X	X
Gerridae	X	X
Gomphidae	X	X
Gyrinidae	X	X
Heptageniidae	X	X
Hirudinea	X	X
Hydracarina	X	X
Hydraenidae	X	
Hydrometridae	X	X
Hydrophilidae	X	X
Hydropsychidae 2 sp	X	X
Hydroptilidae	X	X
Leptoceridae	X	X
Leptophlebiidae	X	X
Libellulidae	X	X
Lymnaeidae	X	X
Muscidae	X	X
Naucoridae	X	X
Nepidae	X	X
Notonectidae	X	X
Oligochaeta	X	X
Perlidae	X	X
Philopotamidae	X	
Physidae		X
Pleidae	X	X
Potamonautidae	X	X
Prosopistomatidae		X
Simuliidae	X	X
Tabanidae	X	X
Thiaridae		X
Tipulidae	X	X
Tricorythidae	X	X
Turbellaria	X	X
Veliidae/mesoveliidae	X	X

Table 5: Summary of the ecological status of the sub-quaternary catchment reaches (SQRs) associated with the focus area based on the DWS RQS PES/EIS database (2014)

	B41J – 00563 (Steelpoort River)	B41J – 00562 (Tubatsane River)	B41J – 00576 (Steelpoort River)
Synopsis			
PES Category Median	Largely Modified (Class D)	Seriously Modified (Class E)	Largely Modified (Class D)
Mean EI class	High	Low	High
Mean ES class	High	Very Low	High
Length	19.54	12.05	17.08
Stream order	3	1	3
Default EC[4]	B (High)	D (Low to Very Low)	B (High)
PES Details			
Instream habitat continuity MOD	Moderate	Large	Small
RIP/wetland zone continuity MOD	Moderate	Serious	Moderate
Potential instream habitat MOD activities	Serious	Critical	Large
Riparian/wetland zone MOD	Moderate	Serious	Large
Potential flow MOD activities	Large	Small	Moderate
Potential physico-chemical MOD activities	Serious	Large	Large
EI Details			
Fish spp/SQ	16	NA	17
Fish average confidence	2.5	NA	4.41
Fish representivity per secondary class	High	NA	High
Fish rarity per secondary class	Very High	NA	Very High
Invertebrate taxa/SQ	43	NA	47
Invertebrate average confidence	4.12	NA	3.26
Invertebrate representivity per secondary class	High	NA	Very High
Invertebrate rarity per secondary class	High	NA	Very High
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating	High	Very Low	High
Habitat diversity class	Very Low	Low	Very Low
Habitat size (length) class	Low	Low	Low
Instream migration link class	High	Moderate	Very High
Riparian-wetland zone migration link	High	Moderate	High
Riparian-wetland zone habitat integrity class	High	Low	Moderate
Instream habitat integrity class	Low	Very Low	Moderate
Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m	Very High	Very High	High

	B41J – 00563 (Steelpoort River)	B41J – 00562 (Tubatsane River)	B41J – 00576 (Steelpoort River)
Riparian-wetland natural vegetation rating based on expert rating	High	Low	High
ES Details			
Fish physical-chemical sensitivity description	Very High	NA	Very High
Fish no-flow sensitivity	Very High	NA	Very High
Invertebrates physical-chemical sensitivity description	Very High	NA	Very High
Invertebrates velocity sensitivity	Very High	NA	Very High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	High	Very Low	High
Stream size sensitivity to modified flow/water level changes description	Low	Low	Low
Riparian-wetland vegetation intolerance to water level changes description	Low	Low	Low

[1] PES = Present Ecological State; confirmed in database that assessments were performed by expert assessors;
[2] EI = Ecological Importance;
[3] ES = Ecological Sensitivity
[4] EC = Ecological Category; default based on median PES and highest of EI or ES means.

3.3 Watercourse Delineation and Sensitivity Mapping

The Steelpoort River with its associated riparian habitat as well as the non-perennial rivers and ephemeral drainage lines were delineated using desktop methods with the use of aerial photographs, digital satellite imagery and topographical maps. These delineations were then ground-truthed during the field assessment undertaken in April 2021, according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" (DWAF, 2008).

The Steelpoort River has a well-developed riparian zone while the non -perennial tributaries have riparian zones which vary from moderately to weakly developed depending on the position in the landscape as well as the effects of geological characteristics and geomorphological processes at play.

In terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) any activities falling within 32 m of the delineated boundary will trigger a listed activity. Any activities proposed within the watercourse and the associated 1:100 year flood line of the watercourse or 100 m GN 509 Zone of Regulation (ZOR) (in the absence of the 1:100 year flood line), including rehabilitation, must be authorised by the DWS in terms of Section 21 (c) & (i) of the National Water Act, 1998 (Act No. 36 of 1998). Should this not be feasible, the proponent could undergo a Water Use License Application Process to attempt to obtain approval from the DWS in terms of Section 21 c and i of the National water Act. In addition, exemption from the requirements in terms of Regulation GN704 promulgated in 1999 will be required.

See Section 5 for the ZOR around the watercourses.

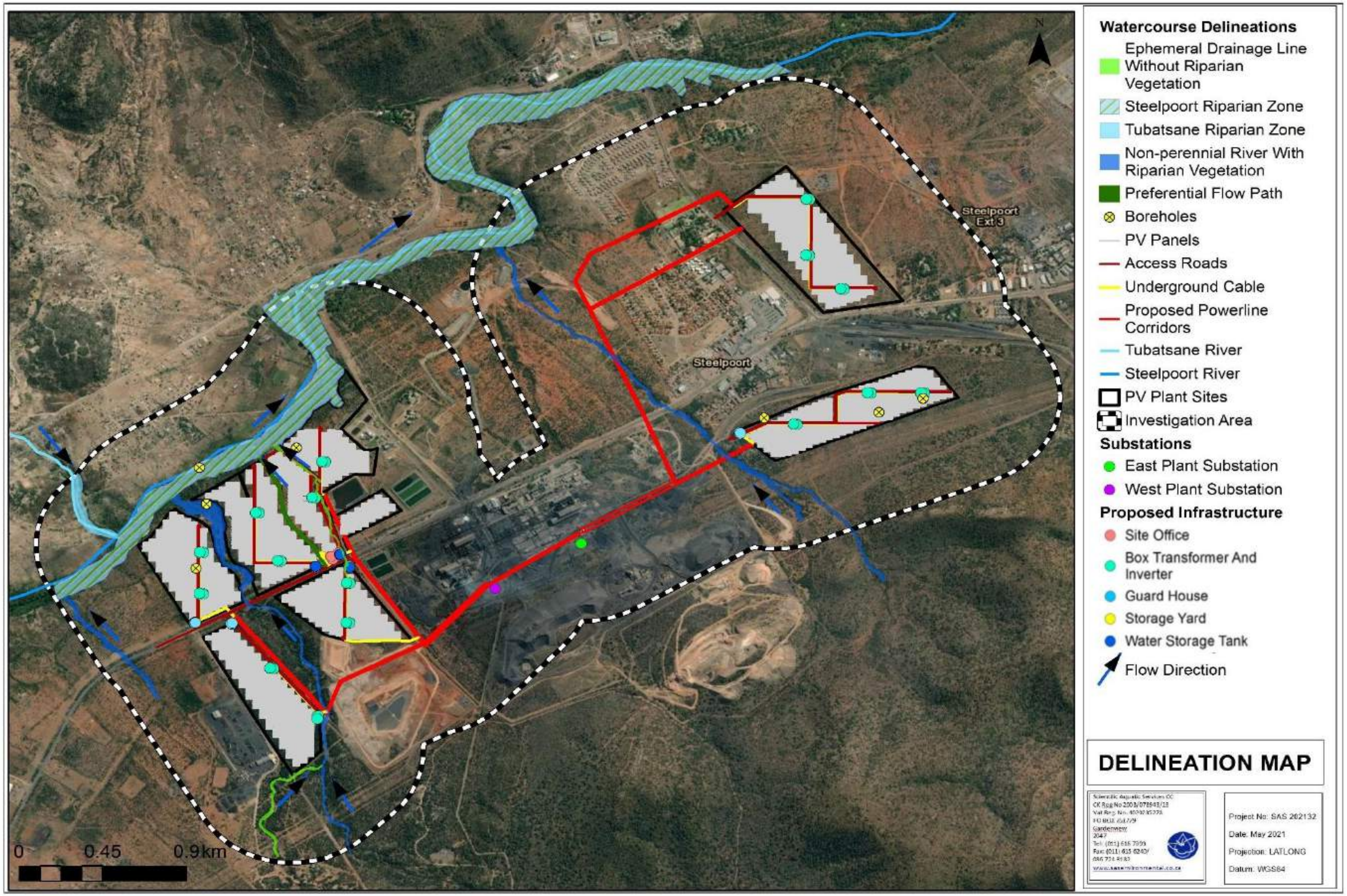


Figure 10: Watercourse delineation associated with the study area and investigation area.

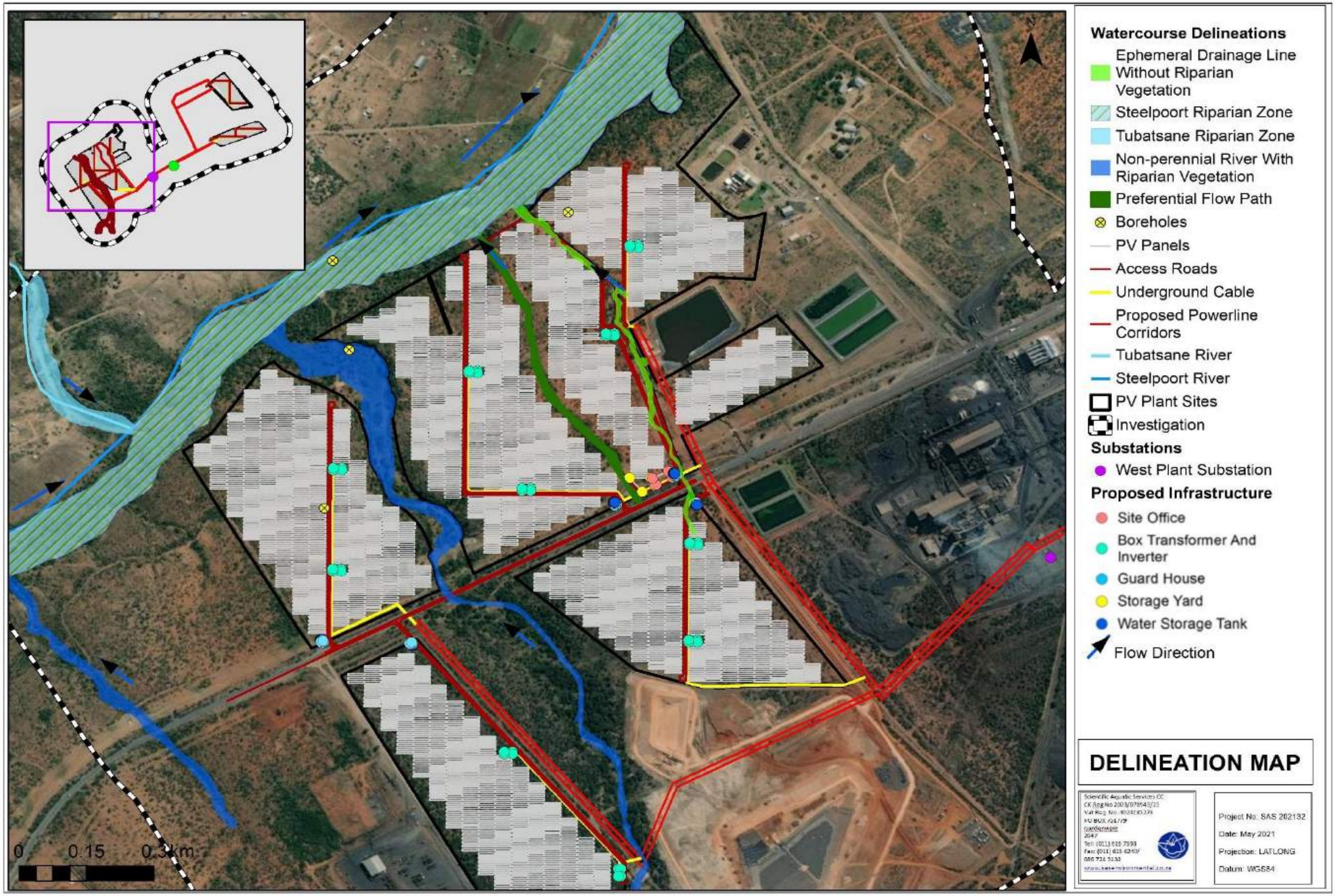


Figure 11: Watercourse delineation associated with the study area and investigation area zoomed in for detail.

4 RESULTS: WATERCOURSE CLASSIFICATION AND ASSESSMENT

4.1 Field verification and delineation

In preparation for the field assessment, aerial photographs, digital satellite imagery and provincial and national watercourse databases were used to identify points of interest associated with the proposed development at a desktop level. In this regard, specific mention is made of the following:

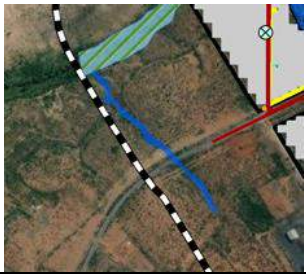
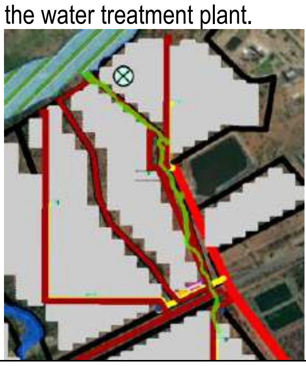
- Linear features: since water flows/moves through the landscape, watercourses often have a distinct linear element to their signature which makes them discernible on aerial photography or satellite imagery;
- Vegetation associated with watercourses: a distinct increase in density as well as shrub size near flow paths;
- Hue: with water flow paths often showing as white/grey or black and outcrops or bare soils displaying varying chroma created by varying vegetation cover, geology and soil conditions. Changes in the hue of vegetation with watercourse vegetation often indicated on black and white images as areas of darker hue (dark grey and black). In colour imagery these areas mostly show up as darker green and olive colours or brighter green colours in relation to adjacent areas where there is less soil moisture or surface water present; and
- Texture: with areas displaying various textures, created by varying vegetation cover and soil conditions.

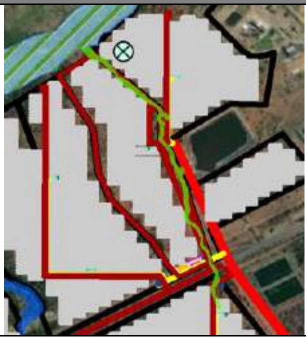
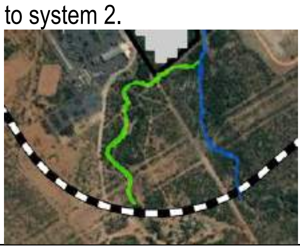
These points of interest were verified during the site assessment undertaken in April 2021.

Six (6) separate drainage systems were identified in the study area consisting of non-perennial rivers with riparian vegetation and ephemeral drainage lines without well defined riparian vegetation. A summary of the six (6) drainage systems identified in the study area relative to the proposed development infrastructure is provided in Table 6.

System 1 is a non-perennial river located west of the preferred site 5 and confluences with the Steelpoort River. System 2 bisects site 5 and originates from in between sites 3 and 4. This system also connects to the Steelpoort River. System 3 is a preferential flow path with no discernible riparian vegetation. System 4 is an ephemeral drainage line running from site 3 to site 5, west of the water treatment plant. This system also confluences with the Steelpoort River. System 5 is a non-perennial river located east of the Tubatse Ferrochrome plant with majority of the surface infrastructure located outside of the 32m ZOR. Only the powerline corridors traverses this system. System 6 is a small ephemeral drainage line draining to System 2 located south of preferred layout site 4. Although these episodic drainage lines cannot be classified as rivers resources in the traditional sense thereof due to the lack of saturated soils and riparian vegetation, they do still function as waterways, through episodic conveying of water. However, based on the definition of a watercourse, water flows regularly or intermittently within these drainage lines, conveying water from the upgradient catchment area into the downgradient Steelpoort River. As such, they can be defined as watercourses, and due to their importance for hydrological functioning as they do function as waterways and therefore enjoy protection in terms of the National Water Act, 1998 (Act No. 36 of 1998).

Table 6: Summary of the drainage systems identified in the study area, relative to the proposed infrastructure.

Drainage System	Locality	infrastructure proximity	General description
System 1	Located west of preferred layout site 5. 	No proposed surface infrastructure components are located within close proximity to this drainage system.	Non-perennial river with riparian vegetation. Confluences with the Steelpoort River.
System 2	Traverses site 5, located in between sites 3 and 4. 	Majority of the surface infrastructure components are located outside of the 32m ZOR*. New powerline corridors traverse the system.	Non-perennial river with riparian vegetation. Confluences with the Steelpoort River.
System 3 **(left)**	Runs from site 3 to site 5 west of the water treatment plant. 	Majority of the surface infrastructure components are located outside of the 32m ZOR. New powerline corridors and underground cables traverse the system.	Preferential flow path with no discernible riparian vegetation. Drains to the Steelpoort River. This system is proposed to be canalised. (See Section 7 for risk assessment and proposed mitigation measures)
System 4 **(right)**	Runs from site 3 to site 5 west of the water treatment plant.	Majority of the surface infrastructure components are located outside of the 32m ZOR. New powerline corridors and underground cables traverse the system.	Ephemeral drainage line without well defined riparian vegetation. Drains to the Steelpoort River.

Drainage System	Locality	infrastructure proximity	General description
			This system is proposed to be canalised. (See Section 7 for risk assessment and proposed mitigation measures)
System 5	Located east of the Tubatse Ferrochrome plant. 	No proposed surface infrastructure components are located within close proximity (outside of the 100m ZOR) to this drainage system. Only new powerline corridors traverse the system.	Non-perennial river with riparian vegetation. Confluences with the Steelpoort River.
System 6	Located south of site 4, connects to system 2. 	The majority of the surface infrastructure components are located outside of the 32m ZOR.	Ephemeral drainage line without well defined riparian vegetation. Drains to system 2.

*It is recommended that this surface infrastructure component be moved outside the watercourse and its 32 m NEMA Zone of Regulation.

The watercourses listed in Table 6 above were classified according to the Classification System outlined in Appendix C of this report as Inland Systems, located within the Eastern Bankenveld Ecoregion. Table 7 below presents the classification from level 3 to 4 of the Wetland Classification System (Ollis *et al.* 2013).

Table 7: Classification of the watercourses associated with the proposed development.

Watercourse	Level 3: Landscape Unit	Level 4: Hydrogeomorphic (HGM) Type
Steelpoort River	Valley Floor: the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	A linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
Non-perennial rivers with riparian vegetation	Valley Floor: the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	
Ephemeral drainage lines without riparian vegetation	Slope—an inclined stretch of ground typically located on the side of a mountain, hill or valley, not forming part of a valley floor. Includes scarp slopes, mid-slopes and foot-slopes.	

Tables 8 and 9 provides a summary of the field verification findings in terms of relevant aspects (hydrology, geomorphology and vegetation components) associated with the watercourses. Due to the similar watercourse characteristics of the non-perennial rivers and that of the ephemeral drainage lines, and each of these watercourse types having been subjected to the same anthropogenic impacts, the ecoservice provision, hydrological regime, geomorphological characteristics, water quality and habitat of these watercourses, all of the non-perennial rivers and all of the ephemeral drainage lines were assessed in a combined fashion. The details pertaining to the methodology used to assess the drainage systems is contained in Appendix C.

Table 8: Summary of results of the assessment of the non-pernnial rivers associated with the study area.

Ecological & socio-cultural service provision graph:

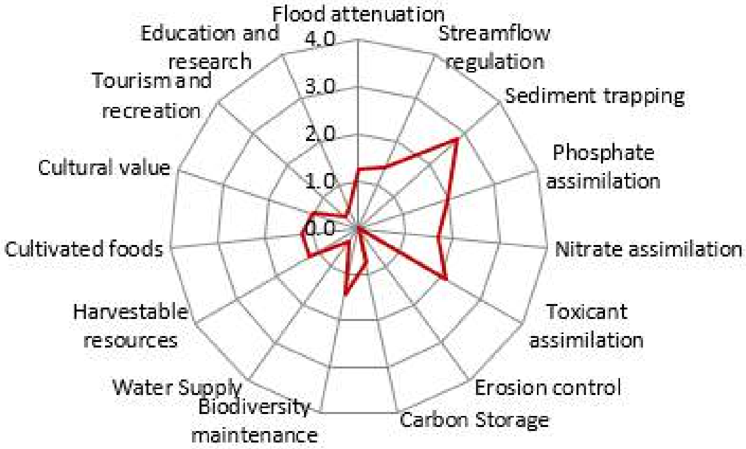


Figure 12: Representative photographs of the non-perennial rivers with riparian vegetation

VEGRAI discussion

VEGRAI Category:

System 1 and 2: Category B/C (Largely Natural to Moderately Modified)
System 4: Category C: Moderately Modified

Vegetation within/alongside the natural channels were considered to be moderately modified. Although categorised as a riparian habitat type, the dominant vegetation does not exhibit the typical riparian characteristics but is rather a reflection of the surrounding variable shrubland types, notably the woody (trees and shrubs) component, which may be locally slightly denser compared to the surrounding terrestrial areas (BEC, 2021). Few riparian indicator species, namely *Gymnosporia buxifolia* and *Senegalia* species were found on site. Grass species that typically occupy these parts are most often pioneer and poor-quality species, including *Aristida* species.

Ecoservice provision

Ecoservice Provisioning: 1.2 (Moderately Low)

Due to the non-perennial nature of these systems, their capacity to provide certain ecological services is considered reduced, although this is counteracted by the relative ecological integrity which increases overall functionality. Due to their high degree of connectivity to other natural areas, these systems are ecologically important in terms of providing migratory corridors and habitat for a variety of biota. These systems are not considered important for harvestable resources or cultivated foods, mainly due to it being located in a natural water scarce region and not located within an area utilised for recreational purposes.

EIS discussion

EIS Category: Moderate

The EIS of the watercourses falls within Category C, which are watercourses that are considered ecologically important and sensitive on a provincial or local scale. The watercourse is considered moderately sensitive due to the nature of the watercourse being moderately sensitive to changes in floods and low flows. The watercourse has experienced significant disturbances, although it is still representative of a riparian habitat.

<table>
<tr><th colspan="3">REC Category and RMO</th></tr>
<tr><td colspan="3">REC: Category C
BAS: Category C
RMO: B/C (Maintain / Improve)

Since these systems are considered of moderate Ecological Importance and Sensitivity, the Recommended Management Objective (RMO) is to, at minimum, maintain these systems in its present state, as any potential impacts my also impact cumulatively on the downstream Steelpoort River. Whilst some modifications to the overall drainage systems have occurred as a result of road crossings, further degradation of these drainage lines should not be permitted. It is recommended that small scale rehabilitation of areas which may potentially be impacted by the proposed development (such as road or powerline crossings) be undertaken. Additionally, it must be ensured no edge effects (such as sediment laden stormwater runoff) from surface infrastructure proposed as part of the proposed development that may be located within close proximity to the non-perennial rivers, enters these systems.</td></tr>
<tr><th colspan="3">Watercourse characteristics:</th></tr>
<tr><td colspan="2">a) Hydraulic regime

The watercourses associated with the proposed infrastructure are episodic watercourses with water flowing in the channel for a brief period of time after significant rainfall events. No historical information is available regarding whether the watercourses were previously perennial. When water does flow in the channel it appears it flows with significant velocity and thus leads to severe erosion of the naturally erodible soils.</td><td>b) Water quality

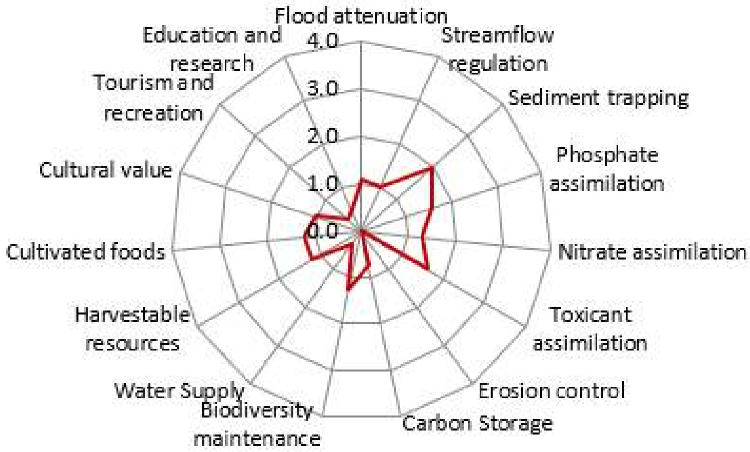
Due to the highly episodic nature of the watercourse, no surface water was present at the time of the assessment, and therefore no water quality readings could be taken.</td></tr>
<tr><td colspan="2">c) Geomorphology and sediment balance
The geomorphology of the upstream reaches of these systems are largely intact. Some erosion of the downstream reaches below the road crossings were noted, however, it is not considered significant. Despite erosion noted within isolated areas, no significant deposition of sediment was observed.</td><td>d) Habitat and biota
Limited riparian tree indicator species are found on site. The remainder of the tree species were terrestrial and, as such, the area bordering the channel can be classified, at best, as a weakly developed riparian zone. The presence of invasive plant species is indicative of a degree of disturbance within the habitat.

These drainage features strongly reflect the status of the surrounding variable shrubland, appearing locally deteriorated (BEC, 2021).

Due to the highly episodic nature of this system, it is unlikely to support aquatic macroinvertebrates. Amphibious species may, however, utilise episodic ponds that may form as a result of road crossings after significant rainfall events.</td></tr>
<tr><td>Extent of modification anticipated</td><td colspan="2">Minimal
Some modification is anticipated to the extent of the systems. This is attributed to the construction of new roads, upgrading of the existing road crossings and the installation of underground cables along these road crossings and new powerline corridors, changes to flow pattern and timing will need to be monitored to ensure that the hydrological connectivity are not adversely affected. Should construction take place only within the dry period and the recommended mitigation measures be applied, the impact significance can be reduced to a low negative impact.</td></tr>
<tr><td>Impact Significance:</td><td>Low
(with the implementation of mitigation measures)</td><td>System 1 - No proposed surface infrastructure components are located within close proximity to this drainage system.
System 2 - Majority of the surface infrastructure components are located outside of the 32m buffer. New powerline corridors and underground cables traverse the system.
System 4 - No proposed surface infrastructure components are located within close proximity to this drainage system. Only new powerline corridors traverse the system.</td></tr>
</table>

All comprehensive results calculated are available in **Appendix E**

Table 9: Summary of results of the assessment of the ephemeral drainage lines associated with the study area.

<table>
<tr><td>Ecological & socio-cultural service provision graph:
</td><td>
Figure 13: Representative photographs of the ephemeral drainage lines without well defined riparian vegetation</td></tr>
<tr><td>VEGRAI discussion</td><td>Ecoservice provision</td></tr>
<tr><td>VEGRAI Category:

System 3 and 5:Category D (Largely Modified)
Vegetation within/alongside these channels were considered to be largely modified. All species found bordering the watercourse were terrestrial species. The relative lack of riparian indicator species is most likely due to the episodic nature of the watercourse and thus the generally dry state of the channel.</td><td>Ecoservice Provisioning: 1.0 (Moderately Low)
Due to the ephemeral nature of these systems, their capacity to provide certain ecological services is considered reduced. Due to their high degree of connectivity to other natural areas, these systems are ecologically important in terms of providing migratory corridors and habitat for a variety of biota. These systems are not considered important for harvestable resources or cultivated foods, mainly due to it being located in a natural water scarce region and within an area utilised for recreational purposes.</td></tr>
<tr><td colspan="2">EIS discussion</td></tr>
<tr><td colspan="2">EIS Category: Moderate
The EIS of these drainage lines falls within Category C: Moderate. Systems that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.</td></tr>
<tr><td colspan="2">REC Category and RMO</td></tr>
<tr><td colspan="2">REC: Category D
BAS: Category D
RMO: C/D (Maintain / Improve)

Since these EDLs are considered of moderate Ecological Importance and Sensitivity, the Recommended Management Objective (RMO) is to, at minimum, maintain these EDLs in its current ecological state, as any potential impacts my also impact cumulatively on the downstream Steelpoort River. Whilst some modifications to the overall drainage system have occurred as a result of road crossings, further degradation of these drainage lines should not be permitted. It is recommended that small scale rehabilitation of areas which may potentially be impacted by the proposed development (such as road crossings and power lines) be undertaken. Additionally, it must be ensured no edge effects (such as sediment laden stormwater runoff) from surface infrastructure proposed as part of the proposed development that may be located within close proximity to the EDLs, enters these systems.</td></tr>
</table>

<table>
<tr><th colspan="3">Watercourse characteristics:</th><th></th></tr>
<tr><td colspan="3">a) Hydraulic regime
These watercourses are ephemeral drainage lines with water flowing in the channel for a brief period of time after significant rainfall events. When water does flow in the channel it appears it flows with significant velocity and thus leads to severe erosion of the naturally erodible soils.</td><td>b) Water quality
Due to the highly episodic nature of the watercourse, no surface water was present at the time of the assessment, and therefore no water quality readings could be taken.</td></tr>
<tr><td colspan="3">c) Geomorphology and sediment balance
The soils of the area are naturally prone to erosion, and this is apparent within these drainage lines. Incision was noted within all these drainage lines, and this may contribute to altered sediment balance of the Steelpoort River, as sediment is likely to be transported in stormwater runoff.</td><td>d) Habitat and biota
Species identified on site were terrestrial. The presence of invasive plant species is indicative of a degree of disturbance within the habitat.

Due to the highly episodic nature of these systems, it is unlikely to support aquatic macroinvertebrates. Amphibious species may, however, utilise episodic ponds that may form as a result of road crossings after significant rainfall events. The tracks small antelope were observed in the system indicating the system is used, to some degree as a migratory corridor.</td></tr>
<tr><td>Extent of modification anticipated</td><td colspan="3">Minimal
Some modification is anticipated to the extent of the systems This is attributed to the construction of new roads and the installation of underground cables along these road crossings and new powerline corridors, changes to flow pattern and timing will need to be monitored to ensure that the hydrological connectivity are not adversely affected. Should construction take place only within the dry period and the recommended mitigation measures be applied, the impact significance can be reduced to a low negative impact.</td></tr>
<tr><td>Impact Significance:</td><td>Low
(with the implementation of mitigation measures)</td><td colspan="2">System 3 - Majority of the surface infrastructure components are located outside of the 32m buffer. New powerline corridors and underground cables traverse the system.
System 5 - Majority of the surface infrastructure components are located outside of the 32m buffer.</td></tr>
</table>

All comprehensive results calculated are available in **Appendix E**

Table 10: Hydropedological considerations associated with the study area.

Figure 14:Rocky outcrops associated with the Mispah soils.

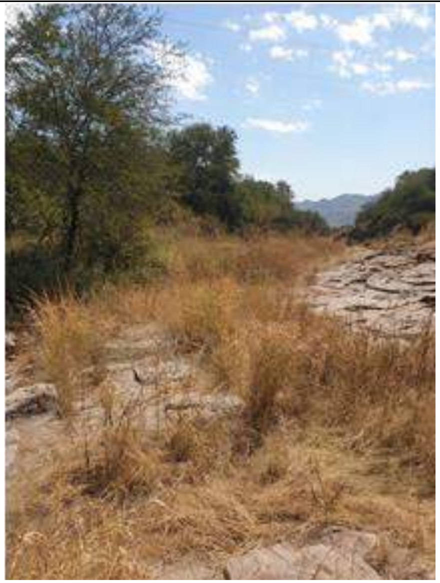


Figure 15: Underlying bedrock observed in the area.

Figure 16: Sandy eroded soils from rapid runoff.

Figure 17: Some deeper sandy soils observed on site.

The soils of the area are mostly characterised by shallow rocky soils (Mispah). Where soils are slightly deeper they are characterised by structured brown apedal or sandy soils. These soils, combined with the relatively steep slopes have limited storage capacity. The area is also known for having limited rainfall which reduces vadose zone recharge. This lack of storage combined with relatively rapid runoff means that the majority of rainfall reports to the Steelpoort River as surface runoff which occurs initially as surface sheet flow that reports to the non perennial preferential flow paths and non perennial streams, which are mostly underlain by impermeable bedrock, before recharging the Steelpoort River. Overall, therefore, the drainage of area can be defined as comprising of shallow responsive (surface runoff) soils with a small interflow (soil bedrock) component. Therefore the project area can be considered of limited importance from a hydropedological point of view. The limited hydropedological importance is further reduced due to the effect of the R555 which runs parallel to the Steelpoort river across the study area. This road would cut off interflow recharging the steelpoort river and would promote channelled flow in the non perennial drainage lines which are fitted with culverts under the road before confluencing with the Steelpoort River.

The proposed project will lead to some changes to the runoff characteristics of the footprint areas of the PV arrays which could potentially lead to increased runoff, although the magnitude of this change is limited. Since no separation of areas will take place and since the PV array area will not be sealed, no significant impact on hydropedological processes is deemed likely. Similarly the road network, as well as BESS and the cable crossings will not have a significant impact on hysdropedological processes. Although not a hydropedological impact, the canalising of the non- perennial watercourses will lead to altered runoff peaks reporting to the Steelpoort River. This runoff should be attenuated before being discharged to the Steelpoort River if formalisation of the drainage line is deemed unavoidable.

5 RESULTS: AQUATIC ECOLOGICAL ASSESSMENT

Instream integrity of the Steelpoort River associated with the Solar PV plant was assessed according to the appropriate instream aquatic indices.

5.1 Site characteristics

Two points (Sites TS1 and TS2) were selected as representative points on the Steelpoort River during the April 2021 assessment. A third point (Site TS3) was considered in terms of water quality and macro-invertebrate community integrity, but no fish assessment was conducted at site TS3. The results from site TS3 were used from a previous aquatic ecological assessment of the Steelpoort River conducted in December 2020 and yielded similar results to sites TS1 and TS2 as conducted in April 2021.

Table 11: Geographic co-ordinates for the assessment points associated with the Steelpoort River within the study area.

Site Name	Co-ordinates		Applied Indices / Analysis Conducted
	South	East	
TS1	24°44'42.19"S	30°10'18.02"E	In-situ water quality, SASS5, MIRAI, IHAS and IHI, VEGRAI and FRAI.
TS2	24°43'46.03"S	30°11'05.29"E	In-situ water quality, SASS5, MIRAI, IHAS and IHI, VEGRAI and FRAI.
TS3	24°43'04.08"S	30°12'05.48"E	In-situ water quality, SASS5, MIRAI, IHAS.

5.2 Results and Interpretation

Results are presented as “dashboard style” reports (Table 12 to 14). These dashboard reports aim to present concise summaries of the data on as few pages as possible, to allow for integration of results by the reader to take place. Where required, further discussion and interpretation is provided.

Table 12: Results of the assessment at Site TS1 (Located on the Steelpoort River, upstream of the proposed PV plant).

Site TS1

Figure 18: View of site TS1 at the time of the assessment.

Algal proliferation:	Slight proliferation on rocks.
Depth profiles:	Limited depth variation at the site under the current flow conditions. The site is dominated by shallow riffles and deeper pools.
Flow condition:	Moderately slow flow.
Riparian zone characteristics:	The riparian zone is considered relatively narrow due to the incised nature of the system. The site is dominated by trees, grasses and shrubs
Water clarity and odour:	Water was clear. No odours present.
Signs of pollution or impact.	Significant sand mining occurring in this section of the Steelpoort River, resulting in erosion, sedimentation and loss of instream habitat.

MIRAI	**Category B/C (Largely Natural to Moderately Modified)**
Instream IHI	**Category C (Moderately Modified)**
Riparian IHI	**Category C (Moderately Modified)**
VEGRAI	**Category C (Moderately Modified)**
FRAI	**Category C (Moderately Modified)**
Integrated Ecological Category: 73.7% (Category C: Moderately Modified)	

***In situ* physico-chemical water quality**

		RWQO EWR9 Steelpoort River (DWS, 2018)	
pH	8.51	**pH**	5.0 – 10.0
EC (mS/m)	35.5	**EC (mS/m)**	≤ 85
DO (mg/L)	9.61	**DO (mg/l)**	≥ 5.0
DO (% sat)	123.0		
Temp (℃)	23.8		

Water Quality Comments:

- The pH value measured during the assessment was largely natural and complied with the RWQO (DWS, 2018);
- The EC complied with the guideline limits required by the RWQO (DWS, 2018);
- The DO saturation was considered adequate and complied with the recommended the 5.0 mg/L requirement stated by the RWQO (DWS, 2018);
- Temperature was considered largely natural considering diurnal variation and the time of day of the assessment; and
- Overall, the water quality of this section of the Steelpoort River was considered good.

Aquatic macro-invertebrate community integrity

Invertebrate community assessment (SASS5 and IHAS)

SASS5 score	95
ASPT score	7.3
IHAS score	65 (Adequate)
MIRAI score	81.0 (Category B/C)

Macro-Invertebrate Community Integrity Comments:

- The aquatic macro-invertebrate community integrity was classified as a Category C (Moderately Modified) condition according to the MIRAI EcoStatus tool;
- Highly sensitive taxa observed on site was Heptageniidae and moderately sensitive taxa was Leptophlebiidae, Tricorythidae and Ecnomidae. The taxa observed on site had a diverse preference for stones, vegetation and GSM with airbreathers limited to Belostomatidae;
- The habitat suitability was considered adequate at the time of the assessment, however, significant sand mining of this section of the Steelpoort River has resulted in bank incision, erosion, increased sedimentation and some loss of instream habitat.

Index of Habitat Integrity

Instream IHI – 76.8 (Category C)	**Riparian IHI** – 75.0 (Category C)

Erosion evident at several points along the embankment. Alien vegetation encroachment is evident in the whole study area. Significant sedimentation and some algal proliferation observed on instream rocks.

Fish Community Assessment

FRAI Score	63.9 (Category C. Moderately Modified)

Species: *Chiloglanis pretoriae, Enteromius neefi, Enteromius trimaculatus, Labeobarbus marequensis*

Riparian Vegetation Response Assessment Index

VEGRAI score	
72.9 (Category C)	Some alien vegetation encroachment present in the study area, along with significant areas of vegetation clearing due to rural community settlements. Alien vegetation species include *Datura sp.* (Caster-oil plant), *Solanum mauritianum* (Bugweed), *Phragmites australis* (Common reed), *Lantana camara* (Common lantana) and *Amaranthus* sp. (Pigweed).

Key Drivers of System Change:

- Possible cumulative impacts on the water quality as a result of mining activities upstream of this point.
- Impacts on the hydraulic processes and geomorphological processes due to the effects of the De Hoop dam.
- Cumulative impacts from surrounding rural communities (subsistence farming, cattle watering, and washing of clothes).
- Significant areas of vegetation clearing and sand mining, leading to increased erosion and sedimentation.
- Due to upstream impoundments (De Hoop Dam) the natural flow of the Steelpoort River has been altered and results in significant variability in system flow rate (i.e. natural constraints). Bed-modification due to community sand mining has also resulted in significant instream habitat changes (deeper slow flowing pools, shallow runs) thus limiting the diversity and sensitivity of the aquatic community likely to occur.
- Bank erosion and instream sedimentation evident resulting from the sand mining activities as well as slight algal proliferation.

Table 13: Results of the assessment at Site TS2 (Located on the Steelpoort River, downstream of sites 3, 4 and 5 of the proposed PV plant).

Site TS2

Figure 19: View of site TS2 at the time of the assessment.

Algal proliferation:	Slight proliferation on rocks.
Depth profiles:	Some depth variation at the site under the current flow conditions. The site is dominated by shallow runs and riffles and deeper pools.
Flow condition:	Moderately slow flow.
Riparian zone characteristics:	The riparian zone is moderately wide. The site is dominated by trees, shrubs and grasses.
Water clarity and odour:	Water was clear. No odours present.
Signs of pollution or impact.	None observed.

MIRAI	**Category C (Moderately Modified)**
Instream IHI	**Category B/C (Largely Natural to Moderately Modified)**
Riparian IHI	**Category C (Moderately Modified)**
VEGRAI	**Category C (Moderately Modified)**
FRAI	**Category C (Moderately Modified)**

Integrated Ecological Category: 75.2% (Category C: Moderately Modified)

In situ physico-chemical water quality

		RWQO EWR9 Steelpoort River (DWS, 2018)	
pH	8.56	**pH**	5.0 – 10.0
EC (mS/m)	28.5	**EC (mS/m)**	≤ 85
DO (mg/L)	6.1	**DO (mg/l)**	≥ 5.0
DO (% sat)	71.2		
Temp (℃)	19.1		

Water Quality Comments:

- The pH value measured during the assessment was largely natural and complied with the RWQO (DWS, 2018);
- The EC complied with the guideline limits required by the RWQO (DWS, 2018);
- The DO saturation was considered adequate and complied with the recommended the 5.0 mg/L requirement stated by the RWQO (DWS, 2018);
- Temperature was considered largely natural considering diurnal variation and the time of day of the assessment; and
- Overall, the water quality of this section of the Steelpoort River was considered good.

Aquatic macro-invertebrate community integrity

Invertebrate community assessment (SASS5 and IHAS)

SASS5 score	90
ASPT score	6.0
IHAS score	79 (Excellent)
MIRAI score	77.9 (Category C)

Macro-Invertebrate Community Integrity Comments:

- The aquatic macro-invertebrate community integrity was classified as a Category C (Moderately Modified) condition according to the MIRAI EcoStatus tool;
- Highly sensitive taxa observed on site was Oligoneuridae and moderately sensitive taxa was Leptophlebiidae and Ecnomidae. The taxa observed on site had a diverse preference for stones, vegetation and GSM with airbreathers limited to Corixidae;
- The habitat suitability was considered excellent at the time of the assessment, with biotope diversity including stones in and out of current, marginal vegetation and GSM.

Index of Habitat Integrity

Instream IHI – 81.2 (CategoryB/C)	**Riparian IHI** – 75.0 (Category C)

Alien vegetation encroachment is evident in the whole study area. Slight sedimentation and some algal proliferation observed on instream rocks.

Fish Community Assessment

FRAI Score	75.1 (Category C. Moderately Modified)

Species: *Chiloglanis pretoriae, Clarias gariepinus, Enteromius neefi, Enteromius trimaculatus, Enteromius paludinosus, Labeo cylindricus, Labeobarbus marequensis, Oreochromos mossambicus*

Riparian Vegetation Response Assessment Index

VEGRAI score	Some alien vegetation encroachment present in the study area, along with significant areas of vegetation clearing due to rural community settlements. Alien vegetation species include *Datura sp,* (Caster-oil plant), *Solanum mauritianum* (Bugweed), *Phragmites australis* (Common reed), *Lantana camara* (Common lantana) and *Amaranthus* sp. (Pigweed).
72.9 (Category C)	

Key Drivers of System Change:

- Impacts on the hydraulic processes and geomorphological processes due to the effects of the De Hoop dam.
- Possible cumulative impacts on the water quality as a result of mining activities upstream of this point.
- Cumulative impacts from surrounding rural communities (subsistence farming, cattle watering, and washing of clothes).
- Significant areas of vegetation clearing and sand mining, leading to increased erosion and sedimentation.

Table 14: Results of the assessment at Site TS3 (Located on the Steelpoort River, downstream of the proposed PV plant). Assessed December 2020.

Site TS3

Figure 20: View of site TS3 at the time of the assessment.

Algal proliferation:	Slight proliferation on rocks.
Depth profiles:	Some depth variation at the site under the current flow conditions. The site is dominated by shallow runs and riffles and deeper pools.
Flow condition:	Moderately slow flow.
Riparian zone characteristics:	The riparian zone is moderately wide. The site is dominated by trees, shrubs and grasses.
Water clarity and odour:	Water was clear. No odours present.
Signs of pollution or impact.	None observed.

MIRAI	**Category B/C (Largely Natural to Moderately Modified)**
Instream IHI	**NA**
Riparian IHI	**NA**
VEGRAI	**NA**
FRAI	**NA**

NA= Not Assessed during the December 2020 assessment.

***In situ* physico-chemical water quality**

pH	7.55	**RWQO EWR9 Steelpoort River (DWS, 2018)**	
EC (mS/m)	37.2	**pH**	5.0 – 10.0
DO (mg/L)	7.52	**EC (mS/m)**	≤ 85
DO (% sat)	100.4	**DO (mg/l)**	≥ 5.0
Temp (℃)	25.8		

Water Quality Comments:

- The pH value measured during the December 2020 assessment was largely natural and complied with the RWQO (DWS, 2018);
- The EC complied with the guideline limits required by the RWQO (DWS, 2018);
- The DO saturation was considered adequate and complied with the recommended 80 – 120% saturation range as stipulated by the guidelines (DWAF, 1996), as well as the 5.0 mg/L requirement stated by the RWQO (DWS, 2018);
- Temperature was considered largely natural considering diurnal variation and the time of day of the assessment; and
- Overall, the water quality of this section of the Steelpoort River was considered good.

Aquatic macro-invertebrate community integrity

Invertebrate community assessment (SASS5 and IHAS)

SASS5 score	120
ASPT score	6.0
IHAS score	68 (Adequate)
MIRAI score	80.2 (Category B/C)

Macro-Invertebrate Community Integrity Comments:

- The aquatic macro-invertebrate community integrity was classified as a Category B/C (Largely Natural to Moderately Modifiedl) condition according to the MIRAI EcoStatus tool;
- Highly sensitive taxa observed on site was Pyralidae and moderately sensitive taxa was Leptophlebiidae, Tricorythidae Chlorocyphidae and Elmidae. The taxa observed on site had a diverse preference for stones, vegetation and GSM with multiple airbreathers (five taxa) ranging from low to moderate sensitivity;
- The habitat suitability was considered as adequate at the time of the assessment, with biotope diversity including stones in and out of current, marginal vegetation and GSM.

Key Drivers of System Change:

- Impacts on the hydraulic processes and geomorphological processes due to the effects of the De Hoop dam.
- Possible cumulative impacts on the water quality as a result of mining activities upstream of this point.
- Cumulative impacts from surrounding rural communities (subsistence farming, cattle watering, and washing of clothes).
- Significant areas of vegetation clearing and sand mining, leading to increased erosion and sedimentation.

5.3 Ecological Importance and Sensitivity Assessment

As with the derived aquatic ecological category, the Ecological Importance and Sensitivity (EIS) method (DWAF, 1999) was applied to the section of the Steelpoort River to ascertain the sensitivity and importance of the system taking into account the instream component. The results of the assessment are presented in the table below:

Table 15. Results of the EIS assessment for the Steelpoort River within the study area.

Biotic Determinants	Score
Rare and endangered biota	4
Unique biota	1
Intolerant biota	4
Species/taxon richness	3
Aquatic Habitat Determinants	
Diversity of aquatic habitat types or features	3
Refuge value of habitat type	3
Sensitivity of habitat to flow changes	2
Sensitivity of flow-related water quality changes	2
Migration route/corridor for instream and riparian biota	3
Nature Reserves, Natural Heritage sites, Natural areas, PNEs	2
RATINGS	**2.7**
EIS CATEGORY	**High**

The Ecological Importance and Sensitivity Assessment analysis of the Steelpoort River provided a score of 2.7 which is considered of **high importance and sensitivity**. Quaternaries/delineations that are considered to be unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use. The Steelpoort River was considered of high sensitivity with regards to diversity of aquatic habitat types (rapids, riffles and riparian vegetation), biota intolerant to changes in flow (*Chiloglanis swierstrai, Enteromius lineomaculatus, Opsaridium peringueyi* and *Chiloglanis pretoriae*) and rare and endangered species (*Enteromius lineomaculatus* and *Opsaridium peringueyi).*

6 LEGISLATIVE REQUIREMENTS, NATIONAL AND PROVINCIAL GUIDELINES PERTAINING TO THE APPLICATION OF BUFFER ZONES

The following legislative requirements and relevant provincial guidelines were taken into consideration during the desktop assessment. A description of some of these legislative requirements is presented in Appendix D:

- Constitution of the Republic of South Africa, 1996[1];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Government Notice 509 (GN 509) as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);
- The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA);
- Government Notice 598 Alien and Invasive Species Regulations (2014), including the Government Notice 864 Alien Invasive Species List as published in the Government Gazette 40166 of 2016, as it relates to the National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004);
- National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEMPAA);
- Limpopo Environmental Management Act, 2003 (Act No. 7 of 2003) (LEMA); and
- Sekhukhune District Bioregional Plan in terms of Section 40(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).

According to Macfarlane *et al.* (2015) the definition of a buffer zone is variable, depending on the purpose of the buffer zone, however in summary, it is considered to be “a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another”. Buffer zones are considered important to provide protection of basic ecosystem processes (in this case, the protection of aquatic and wetland ecological services), reduce impacts on water resources arising from upstream activities (e.g. by removing or filtering sediment and pollutants), provision of habitat for aquatic and wetland species as well as for certain terrestrial species, and a range of ancillary societal benefits (Macfarlane *et. al,* 2015). It should be noted, however, that buffer zones are not considered to be effective mitigation against impacts such as hydrological changes arising from stream flow reduction, impoundments or abstraction, nor are they considered to be effective in the management of point-source discharges or contamination of groundwater, both of which require site-specific mitigation measures (Macfarlane *et. al,* 2015).

The definition and motivation for a regulated zone of activity for the protection of the watercourses can be summarised as follows:

[1] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the ‘Constitution of the Republic of South Africa, 19996”. It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it nor the acts amending it are allocated act numbers.

Table 16: Articles of Legislation and the relevant zones of regulation applicable to each article.

<table>
<tr><th>Regulatory authorisation required</th><th>Zone of applicability</th></tr>
<tr><td>Water Use License Application for water uses as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998).</td><td>Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)
In accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21c and 21i is defined as:
the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or
a 500 m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation.</td></tr>
<tr><td>Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended.
Department of Environment, Forestry and Fisheries</td><td><u>Activities of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended)</u>

Activity 12:
The development of:
(xii) Infrastructure or structures with a physical footprint of <u>100 square meters</u> or more;
Where such development occurs—
a) Within a watercourse;
b) In front of a development setback; or
c) If no development setback has been adopted, within 32 meters of a watercourse, measured from the edge of a watercourse.

Activity 19:
The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from –
(a) a watercourse

<u>Activities of Listing Notice 3 (GN 985) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended)</u>

Activity 14:
The development of –
(ii) infrastructure or structures with a physical footprint of 10 square metres or more;
Where such development occurs-
a) Within a watercourse;
b) In front of a development setback; or
c) If no development setback has been adopted, within 32 meters of a watercourse, measured from the edge of a watercourse

Activity 23:
The expansion of –
(ii) infrastructure or structures with a physical footprint of 10 square metres or more;
Where such development occurs-
a) Within a watercourse;
b) In front of a development setback; or
c) If no development setback has been adopted, within 32 meters of a watercourse, measured from the edge of a watercourse

Activity 48:
“The expansion of
(i)infrastructure or structures where the physical footprint is expanded by 100 square metres or more;
Where such expansion occurs-</td></tr>
</table>

Regulatory authorisation required	Zone of applicability
	a) Within a watercourse; *b) In front of a development setback; or* *c) If no development setback has been adopted, within* ***32 meters of a watercourse****, measured from the edge of a watercourse*

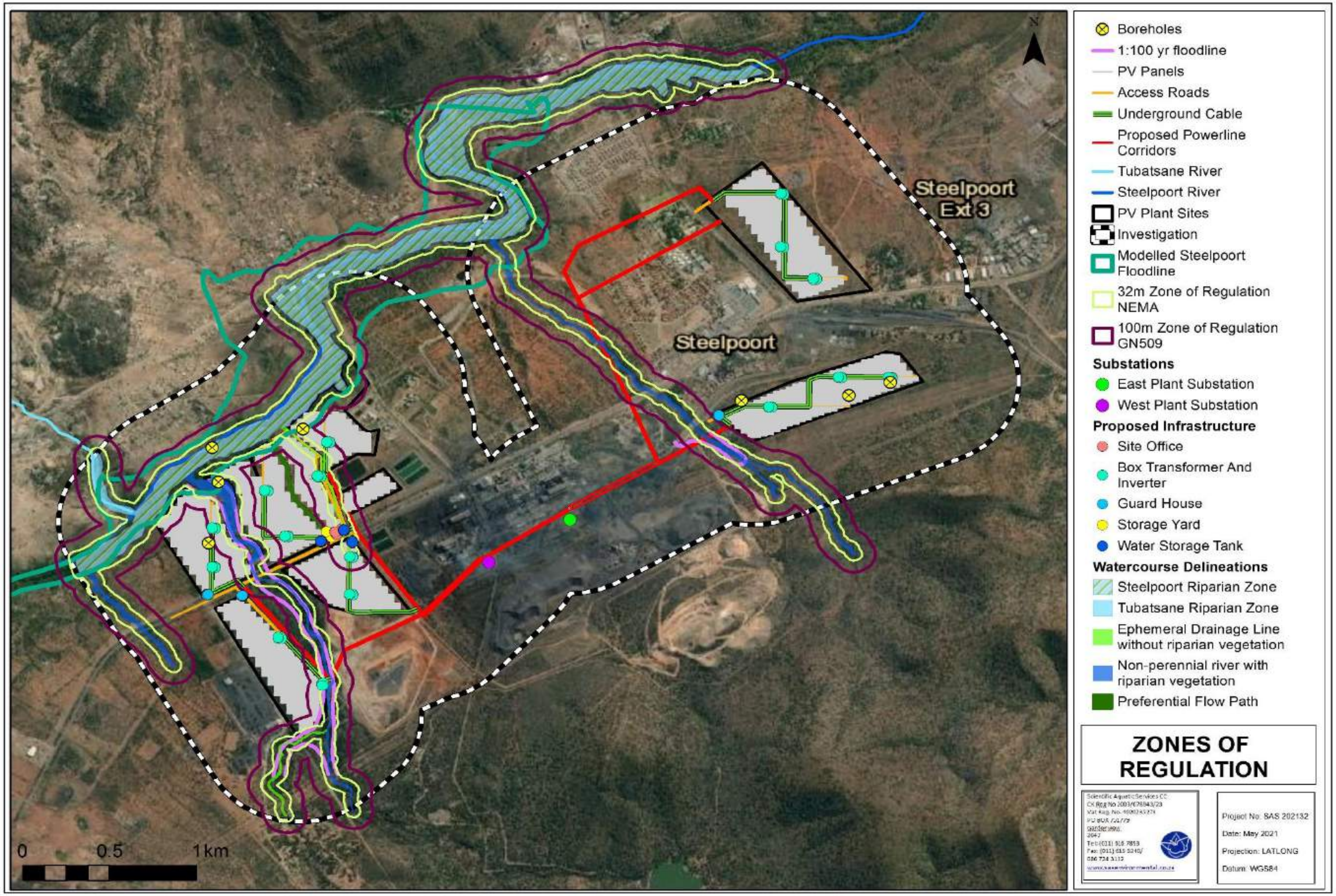


Figure 21: Watercourse delineation and associated zones of regulation. * *Modelled Steelpoort floodline based on 2015 20 year 24-hr occurrence.*

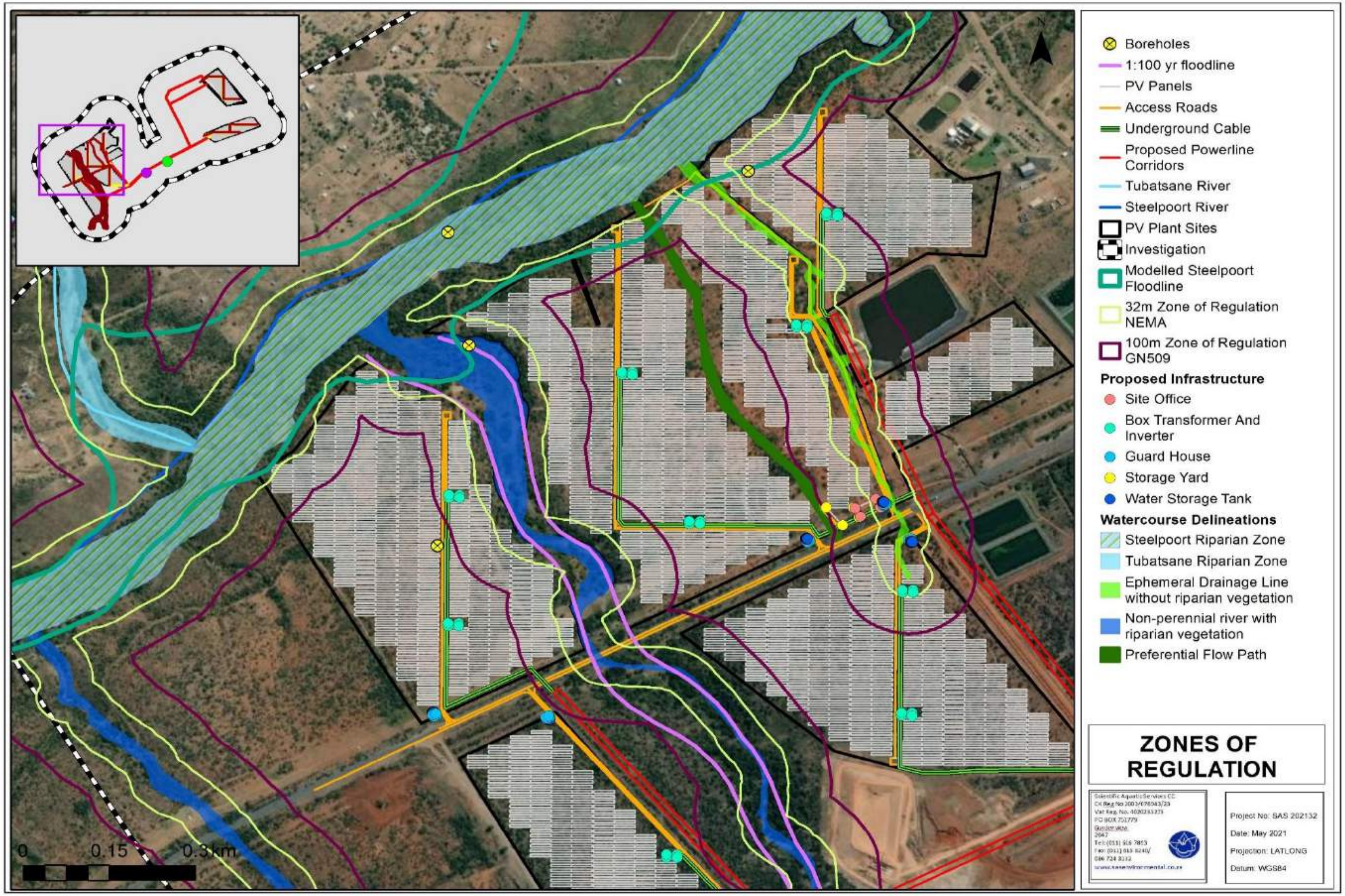


Figure 22: Watercourse delineation and associated zones of regulation zoomed in for detail (West). * *Modelled Steelpoort floodline based on 2015 20 year 24-hr occurrence.*

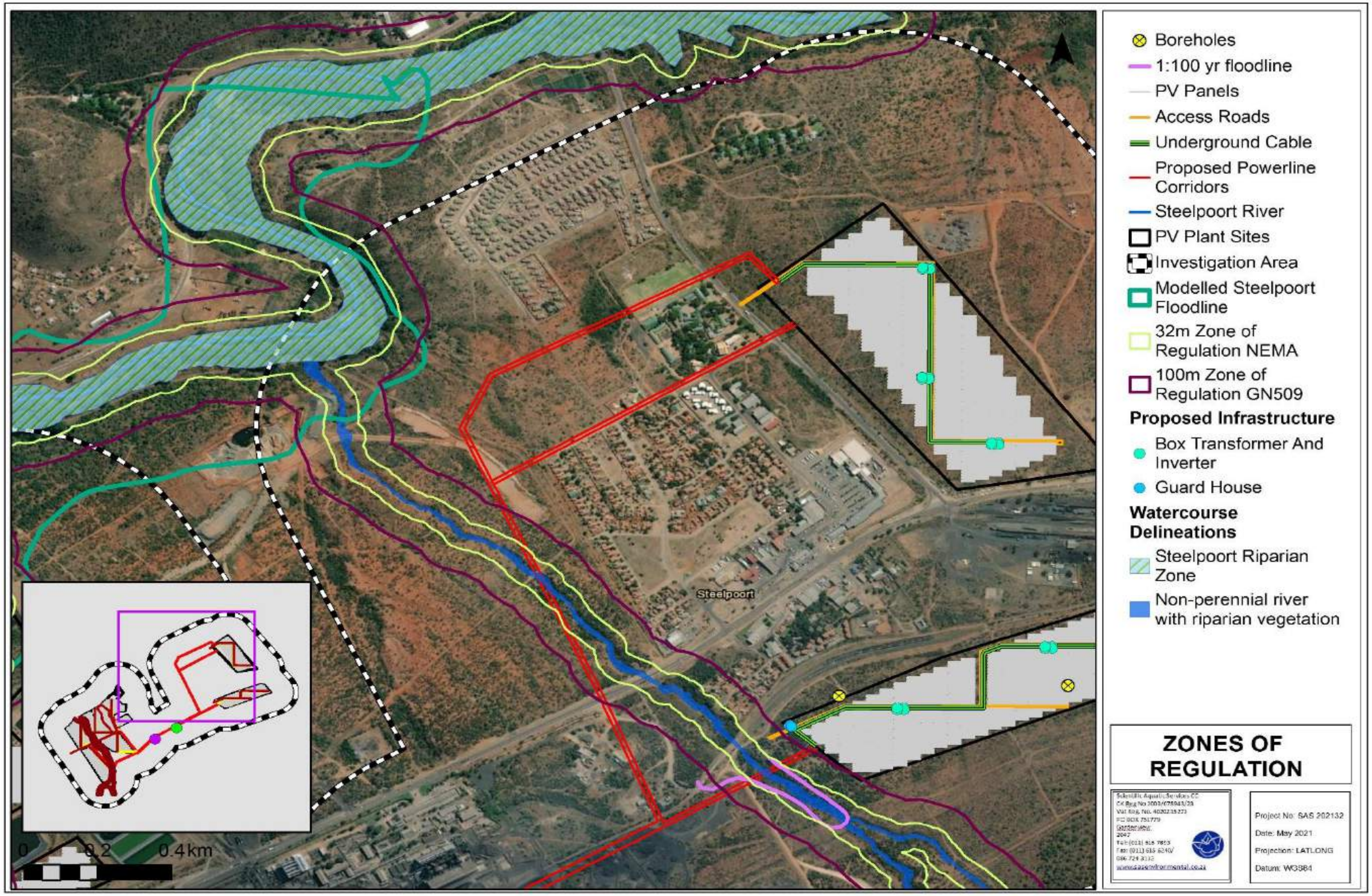


Figure 23: Watercourse delineation and associated zones of regulation zoomed in for detail (East). **** Modelled Steelpoort floodline based on 2015 20 year 24-hr occurrence.***

7 RISK ASSESSMENT

This section presents the significance of potential impacts on the ecology of the watercourse associated with the proposed construction of the Solar PV plant. In addition, it indicates the required mitigatory measures needed to minimise the perceived impacts of these proposed activities and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures and assuming that they are fully implemented.

Risk Analyses

7.1 Consideration of impacts and application of mitigation measures

This section provides a description of the activities and aspects during the construction of the Solar PV plant which may lead to impacts on the Steelpoort River and watercourses identified during the assessment. The activities requiring authorisation in terms of Section 21 of the National Water Act, 1998 (Act No. 36 of 1998).

The DWS approved Risk Assessment Matrix as promulgated in Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the assessed watercourses.

The results of the outcome of the risk assessment are summarised in Table 17. The points below summarise the considerations undertaken as part of the risk assessment:

- The risk associated with the construction activities and the current onsite factors were considered;
- The risk assessment was applied assuming that a high level of mitigation is implemented, thus the results of the risk assessment provided in this report presents the perceived impact significance *post-mitigation;*
- Based on the assessment, the Steelpoort River is in a moderately modified ecological state, and of high importance and sensitivity;
- Three non-perennial rivers with riparian vegetation and two ephemeral drainage lines without well defined riparian vegetation were identified in the study area. The non-

perennial rivers were classified as being in a moderately modified ecological state of moderate importance and sensitivity, while the EDL's were classified as being in a largely modified condition of moderate importance and sensitivity;

- The construction of the Solar PV plant will possibly continue over a period of months to a year and the activities will operate daily and is envisaged to be 'permanent', the frequency of impacts are likely to be daily for the foreseeable future;
- Most impacts are considered easily detectable; however, impacts such as surface and/or groundwater contamination would entail specific monitoring to ascertain the occurrence and severity of impacts.

7.2 Impact discussion and essential mitigation measures

Multiple impacts and aspects were considered in the risk assessment and are described in detail in Table 17. However, it is considered important to note the latent and cumulative impacts considered, and these are listed below:

Cumulative and Latent Impacts:

- The soils of this area are particularly prone to erosion. With site clearing for the PV arrays there is a risk of reduced surface roughness, which will increase the risk of erosion and sedimentation of the non-perennial watercourses and the Steelpoort River;
- Alterations to stormwater run-off within the area, altering the hydrological processes of the systems and increased sedimentation;
- Sediment laden stormwater runoff entering the Steelpoort River, leading to smothering of biota and potentially altering surface water quality is a potential impact that might occur during the operational phase of the PV Plant;
- Proliferation of alien and weed species in disturbed areas will lead to altered vegetation communities within the riparian zone and adjacent areas.

These impacts have the potential to be adequately minimized or avoided provided the mitigation measures provided in this report for impacts are implemented and adhered to.

According to the DWS Risk Assessment Matrix guidelines, for sensitivity ratings within the Moderate Risk range (56-80) a manual adjustment can be made to allow for a low risk. This is to be done subject to the listing of additional mitigation measures which are highlighted in red below (Table 17).

Table 17: Summary of the Risk Assessment applied to ascertain the significance of risk posed to the Steelpoort River by the proposed Solar PV plant construction activities.

<table>
<tr><th>No.</th><th>Phases</th><th>Activity</th><th>Aspect</th><th>Impact</th><th>Severity</th><th>Consequence</th><th>Likelihood</th><th>Significance</th><th>Risk Rating</th><th>Confidence level</th><th>Control Measures</th><th>Borderline LOW MODERATE Rating Classes</th><th>Reversibility of the impact</th></tr>
<tr><td>1</td><td rowspan="2">Construction Phase</td><td rowspan="2">Site preparation prior to construction activities of surface infrastructure components located outside of the Steelpoort River and non-perennial rivers and associated floodlines (but within the 32m and 100m zones of regulation).</td><td>➢ Vehicular movement (transportation of construction materials)</td><td>➢ Loss of watercourse vegetation, associated habitat and ecosystem services;
➢ Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; and
➢ Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles.</td><td>1</td><td>3</td><td>12</td><td>36</td><td>L</td><td>70</td><td rowspan="2">➢ All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential;
➢ Retain as much indigenous freshwater vegetation as possible;
➢ All vegetation removed as part of the site clearing activities (specifically where large areas need to be cleared) should be transported from the construction site (may not be stockpiled) and disposed of at a registered waste disposal facility;
➢ During construction activities associated with surface infrastructure within close proximity to a watercourse, regular spraying of non-potable water or the use of chemical dust suppressants must be implemented to reduce dust and to ensure no smothering of vegetation within the watercourses occurs from excessive dust settling;
➢ The watercourses must be considered as no-go areas. No construction vehicles, nor construction personnel or vehicles may traverse through these watercourses;
➢ Contractor laydown areas, and material storage facilities to remain outside of the 32 m ZoR;
➢ All vehicle re-fuelling is to take place outside of the 32 m ZoR;
➢ No vegetation may be removed from the 32 m ZoR surrounding the watercourse where no infrastructure is planned within 32 m thereof, as this provides a natural buffer zone around the watercourses which disperse surface runoff into the watercourses, and thus prevents sedimentation and erosion thereof.
A manual amendment to a Low risk is deemed feasible should the following additional mitigation measures be applied:
➢ **Installation of appropriately sized silt traps and attenuation facilities in the correct locations to minimize sediment laden runoff from entering the Steelpoort River.**</td><td>NA</td><td>Fully reversible</td></tr>
<tr><td>2</td><td>➢ Removal of vegetation and associated disturbances to soils.</td><td>➢ Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream watercourse areas;
➢ Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the watercourses;
➢ Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; and
➢ Proliferation of alien and/or invasive vegetation as a result of disturbances.</td><td>2</td><td>5.75</td><td>14</td><td>80.5</td><td>M</td><td>85</td><td>55
L
(-25)</td><td>Moderate Residual Impacts</td></tr>
</table>

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	Reversibility of the impact
3		Site preparation prior to construction activities relating to the construction of new roads and installation of underground cables traversing through watercourses.	➢ Removal of vegetation and associated disturbances to soils.	➢ Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream watercourse areas; ➢ Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the watercourses; ➢ Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; and ➢ Proliferation of alien and/or invasive vegetation as a result of disturbances.	1.8	3.75	14	52.5	L	70	➢ It is imperative that all construction works be undertaken during the dry, summer months when the flow is very low in the watercourses, and no diversion of flow would be necessary; ➢ The reaches of the watercourses where no activities are planned to occur must be considered no-go areas. These no-go areas can be marked at a maximum distance of 5 m upstream and downstream of the proposed road upgrade crossing. This 5 m buffer area would allow for construction personal, vehicles (if applicable) to enter the watercourse crossing where the road is proposed to be upgraded; ➢ Contractor laydown areas, vehicle re-fuelling areas and material storage facilities to remain outside of the watercourses and their associated 32 m NEMA ZoR; ➢ The removed vegetation must be stockpiled outside of the delineated boundary of the watercourse. The footprint areas of these stockpiles should be kept to a minimum, and may not exceed a height of 2 m. Should the vegetation not be suitable for reinstatement after the construction phase or be alien/invasive vegetation species, all material must be disposed of at a registered garden refuse site and may not be burned or mulched on site.	NA	Partially reversible

4		Construction of surface infrastructure outside of the Steelpoort River and non-perennial rivers and associated floodlines (but within the 32m and 100m zones of regulation).	➢ Removal of vegetation and topsoil and associated stockpiling; ➢ Ground-breaking and earthworks relating to foundations and trenches; ➢ Mixing and casting of concrete for construction purposes; ➢ Backfilling of excavated and disturbed areas; and ➢ Miscellaneous activities by construction personnel.	➢ Disturbances of soils leading to increased alien vegetation proliferation within the terrestrial buffer zone surrounding the watercourses, with the potential to affect the watercourse habitat; ➢ Altered runoff patterns within the local catchment of the watercourses, potentially leading to increased erosion and sedimentation of the watercourses; ➢ Potential impacts on the water quality of surface runoff (when present) which may potentially enter the watercourses and contamination of soils due to concrete being cast; and ➢ Potential of backfill material to enter the watercourses, increasing the sediment load of the watercourses.	**1.5**	**5.5**	**14**	**77**	**M**	**85**	With regards to ground-breaking activities outside the 32 m NEMA ZoR: ➢ During excavation activities, the topsoil and vegetation should be stockpiled separately from other material outside of the 32 m NEMA ZoR; ➢ Excavated materials should not be contaminated, and it should be ensured that the minimum surface area is taken up. The mixture of the lower and upper layers of the excavated soil should be kept to a minimum, so as for later use as backfill material after construction has commenced; ➢ All exposed soils must be protected for the duration of the construction phase to prevent potential erosion and sedimentation of the watercourses; ➢ Construction of the proposed surface infrastructure may result in disturbance to the natural buffer zone surrounding the watercourses which may result in the reduction of surface roughness. This can be mitigated by ensuring that no concentrated runoff from the surface infrastructure construction area enters the watercourses. This can be achieved by installing silt traps or placing haybales down gradient of the construction footprint to ensure no sediment laden or concentrated runoff generates from the construction footprint; ➢ It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction. **A manual amendment to a Low risk is deemed feasible should the following additional mitigation measures be applied:** ➢ **Installation of appropriately sized silt traps and attenuation facilities in the correct locations to minimize sediment laden runoff from entering the Steelpoort River.** With regards to concrete mixing on site: ➢ No mixed concrete may be deposited outside of the designated construction footprint; ➢ Protective equipment should be provided, onto which any mixed concrete can be deposited while it awaits placing; and ➢ Concrete spilt outside of the demarcated area must be promptly removed and taken to a suitably licensed waste disposal site.	55 L (-22)	Moderately reversible

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	Reversibility of the impact
											With regards to backfilling of excavated areas: ➢ Stockpiled material should be used as backfill material; ➢ All excavated areas should be backfilled to the natural ground level with excavated material; ➢ Soil must be lightly recompacted to a depth of 450 mm, and all construction material must be removed from the site upon the completion of construction or used in the rehabilitation process. Rehabilitation of the construction footprint areas: ➢ All footprint areas which have been compressed should be ripped and revegetated within indigenous vegetation as soon as the construction activities have ceased. This will prevent any soil erosion and the creation of gullies within the operational area; ➢ The operational area should regularly be inspected for alien and invasive vegetation species which might have established due to the construction activity related disturbances.		

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	Reversibility of the impact
5		Construction of new road crossings and trenching through the watercourses (Impact on the Steelpoort River)	➢ Compaction of soil in the existing road reserve to increase the width of the roads; ➢ Importation of materials to construct the roads.	➢ Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream reach of the watercourse; ➢ Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the downstream reach of the watercourse; ➢ Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; and ➢ Proliferation of alien and/or invasive vegetation as a result of disturbances.	1.8	3.75	14	52.5	L	70	➢ During the construction of internal roads and associate cable installation that may potentially traverse watercourses, a buffer of no more than 5 m on either side of the proposed road reserve through the watercourses may be impacted. This area must be cordoned off, and no vehicles or personnel are permitted outside of the authorised construction area; ➢ Material to be used (gravel) as part of the roads construction must be stockpiled outside the 32 m NEMA ZoR of the watercourses to prevent sedimentation thereof and to avoid any other vegetation to be impacted by the construction activities. These stockpiles may not exceed a height of 2 m and should be protected from wind using tarpaulins; ➢ Any remaining soils following the completion of backfilling of the trenches are to be spread out thinly in an area within the watercourses to aid in the natural reclamation process; ➢ After construction of roads traversing watercourses, the area surrounding the road must be revegetated with suitable indigenous vegetation to prevent the establishment of alien vegetation species and to prevent erosion from occurring; ➢ It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction; ➢ All alien and invasive vegetation should be removed. All material must be disposed of at a registered garden refuse site and may not be burned or mulched on site.	NA	Partially reversible

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	Reversibility of the impact
6		Construction of new road crossings and trenching through the watercourses (Direct impact on the drainage lines)	➢ Compaction of soil in the existing road reserve to increase the width of the roads; ➢ Importation of materials to construct the roads.	➢ Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream reach of the watercourse; ➢ Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the downstream reach of the watercourse; ➢ Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; and ➢ Proliferation of alien and/or invasive vegetation as a result of disturbances.	2.5	5.5	14	77	M	85	➢ During the construction of new roads and associate cable installation that may potentially traverse watercourses, a buffer of no more than 5 m on either side of the proposed road reserve through the watercourses may be impac (ted. This area must be cordoned off, and no vehicles or personnel are permitted outside of the authorised construction area; ➢ Material to be used (gravel) as part of the road construction must be stockpiled outside the 32 m NEMA ZoR of the watercourses to prevent sedimentation thereof and to avoid any other vegetation to be impacted by the construction activities. These stockpiles may not exceed a height of 2 m and should be protected from wind using tarpaulins; ➢ Any remaining soils following the completion of backfilling of the trenches are to be spread out thinly in an area within the watercourses to aid in the natural reclamation process; ➢ After construction of roads traversing watercourses, the area surrounding the road must be revegetated with suitable indigenous vegetation to prevent the establishment of alien vegetation species and to prevent erosion from occurring; ➢ It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction; ➢ All alien and invasive vegetation should be removed. All material must be disposed of at a registered garden refuse site and may not be burned or mulched on site.	NA	Partially Reversible

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	Reversibility of the impact
7		Canalisation of two ephemeral drainage lines located in Site 5 (Impact on the Steelpoort River)	➢ Removal of vegetation and topsoil and associated stockpiling; ➢ Ground-breaking and earthworks relating to the installation of concrete slabs and terrafix blocks or similar approved construction material.	➢ Disturbances of soils leading to increased alien vegetation proliferation within the terrestrial buffer zone surrounding the watercourse, with the potential to affect the watercourse habitat; ➢ Altered runoff patterns within the local catchment of the watercourses, potentially leading to increased erosion and sedimentation of the watercourses; ➢ Potential impacts on the water quality of surface runoff (when present) which may potentially enter the watercourses and contamination of soils due to concrete being cast.	2.3	4.25	14	59.5	M	80	➢ It is imperative that all construction works be undertaken during the dry winter months; ➢ Erosion control measures should be installed; ➢ No mixed concrete may be deposited outside of the designated construction footprint; ➢ Protective equipment should be provided, onto which any mixed concrete can be deposited while it awaits placing. **A manual amendment to a Low risk is deemed feasible should the following additional mitigation measures be applied:** ➢ **Installation of appropriately sized silt traps and attenuation facilities in the correct locations to minimize sediment laden runoff from entering the Steelpoort River.** ➢ **The stormwater outlet should be constructed from energy dissipating structures (such as Armorflex or reno mattresses) to slow down the velocity of water inflow to the Steelpoort River;** ➢ **After installation of stormwater outlets, the area surrounding the outlets should be re-seeded with indigenous riparian vegetation;** ➢ **Adequate stormwater management plan to be incorporated into the design;** ➢ **Release of the stormwater into the riparian area of the Steelpoort River must not result in further erosion, sedimentation and bank incision.**	55 L (-5)	Partially Reversible

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	Reversibility of the impact
8		Canalisation of two ephemeral drainage lines located in Site 5 (Direct impact on the drainage lines)	➢ Removal of vegetation and topsoil and associated stockpiling; ➢ Ground-breaking and earthworks relating to the installation of concrete slabs and terrafix blocks or similar approved construction material.	➢ Disturbances of soils leading to increased alien vegetation proliferation within the terrestrial buffer zone surrounding the watercourse, with the potential to affect the watercourse habitat; ➢ Altered runoff patterns within the local catchment of the watercourses, potentially leading to increased erosion and sedimentation of the watercourses; ➢ Potential impacts on the water quality of surface runoff (when present) which may potentially enter the watercourses and contamination of soils due to concrete being cast.	**2.5**	**6.5**	**14**	**91**	**M**	**85**	➢ It is recommended that these drainage lines are not canalised unless it is absolutely unavoidable; ➢ Use soft engineering techniques (swales and other attenuation devises such as cobble beds) must be used to appropriately manage water in the landscape with appropriate buffers; ➢ It is imperative that all construction works be undertaken during the dry winter months; ➢ Erosion control measures should be installed; ➢ No mixed concrete may be deposited outside of the designated construction footprint; ➢ Protective equipment should be provided, onto which any mixed concrete can be deposited while it awaits placing.	NA	Non-reversible

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	Reversibility of the impact
9	**Operational Phase**	Operation and maintenance of the surface infrastructure outside the Steelpoort River and non-perennial rivers and associated floodlines (but within the 32m and 100m zones of regulation).	➢ Potential indiscriminate movement of maintenance vehicles within the watercourses or within close proximity to the watercourses; ➢ Increased risk of sedimentation and/or hydrocarbons entering the watercourses via stormwater runoff from the surface infrastructure (specifically during the cleaning of the solar PV arrays).	➢ Disturbance to soils and ongoing erosion as a result of periodic maintenance activities; ➢ Altered water quality (if surface water is present) as a result of increased availability of pollutants.	**1.8**	**4.75**	**12**	**57**	**M**	**85**	➢ No indiscriminate driving through the watercourses may be permitted during standard operational activities or maintenance activities. Use must be made of the existing watercourse crossings only; ➢ Unnecessary disturbances surrounding the perimeter of the surface infrastructure must be avoided; ➢ Vehicles used in the development site must be regularly washed to avoid the dispersal of seeds on any alien or invasive species into the watercourses; ➢ Ensure that routine inspections and monitoring of any instream infrastructure are undertaken to monitor the establishment of indigenous vegetation and the presence of any alien or invasive plant species; ➢ The surface infrastructure areas must be inspected to ensure that no concentrated runoff from these areas forms erosion gullies and eventually flow into the watercourses. Should this be noted, these gullies/preferential flow paths must be infilled with in situ material and appropriately revegetated; ➢ Monitoring for the establishment for alien and invasive vegetation species must be undertaken, specifically at the road crossings and surface infrastructures. Should alien and invasive plant species be identified, they must be removed and disposed of as per an alien and invasive species control plan and the area must be revegetated with suitable indigenous vegetation. **A manual amendment to a Low risk is deemed feasible should the following additional mitigation measures be applied:** ➢ **Installation of appropriately sized silt traps and attenuation facilities in the correct locations to minimize sediment laden runoff from entering the Steelpoort River.**	55 L (-2)	Fully reversible

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	Reversibility of the impact
10		Operation and maintenance of roads traversing watercourses	➢ Concentrated runoff entering the watercourses; ➢ Disturbance to the watercourse vegetation.	➢ Concentrated runoff from the road crossing leading to erosion and subsequent sedimentation of the watercourses (increase in the sediment load) and turbulent flows when surface water is present; ➢ Higher flood peaks into the watercourses due to reduced surface roughness in the watercourses.	2.3	4.25	12	51	L	70	➢ Routine maintenance of the roads must be undertaken to ensure that no concentration of flow and subsequent erosion occurs due to the road crossings. Such maintenance activities must especially be undertaken after high rainfall events; ➢ Stormwater runoff from the road crossings should be monitored (by the Operation and Maintenance (O&M) Manager), so it does not result in erosion of the watercourses. Stormwater should be allowed to diffusely spread across the landscape, by ensuring adequate surface roughness in the watercourse (through vegetation and rocky areas); ➢ Maintenance vehicles must make use of dedicated access roads and no indiscriminate movement in the watercourses may be permitted; ➢ During periodic maintenance activities of the roads, monitoring for erosion should be undertaken; ➢ Should erosion be noted that was caused by the road crossings the area must be rehabilitated by infilling the erosion gully and revegetation thereof with suitable indigenous vegetation. Use can also be made of rocks obtained from the surrounding area to infill any area prone to erosion, as a natural dispersal mechanism.	NA	Fully reversible

11	**Decommissioning Phase**	Removal of all surface infrastructure from the study area	➢ Movement of construction vehicles and personnel; ➢ Disturbance to the buffer zone surrounding the watercourses	➢ Disturbance of soil and established vegetation in the operational area	**1.8**	**4.75**	**13**	**61.8**	**M**	**85**	➢ No indiscriminate driving in the watercourses and buffer zones surrounding the watercourses may be permitted. Use must be made of the existing roads during the decommissioning phase; ➢ All surface infrastructure within the watercourses and that within its 100 m ZoR must be decommissioned. All materials must be removed from the watercourses (where appliable) and may temporarily be stockpiled outside the GN509 ZoR, where after is must be removed from site and disposed of at a registered disposal facility; ➢ High flood peaks from the decommissioning footprint areas can be mitigated by ensuring that no concentrated runoff from the surface infrastructure area and subsequent cleared area enters the watercourses. The velocity of surface water flow from these areas must be reduced by entering that the vegetation in the buffer area surrounding the watercourses are intact or by the strategic placement of silt traps of haybales as a means to obstruct flow but still allow flow to percolate at a reduced velocity and encourages a diffuse flow pattern; ➢ Areas where surface infrastructure have been decommissioned and removed must be suitably compacted and revegetated to ensure that no erosion occurs which may contribute to the sediment load of the watercourses; ➢ Should erosion gullies be noted, these areas must be rehabilitated by infilling them with suitable soil and ensuring the area is vegetated. The increased surface roughness will discourage concentrated flow paths to develop and ensure diffuse flow patterns. ➢ Should road crossings be decommissioned, road footprint area in the watercourse must be levelled to the same level and shape as that of the upstream and downstream reaches. This will ensure a continuous bed level and prevent any concentration of surface flow from occurring; ➢ Watercourse embankments must be suitably rehabilitated (shaped end revegetated) to prevent any erosion from occurring; ➢ All bare areas in the study area, specifically where vegetation was initially cleared for surface infrastructure components) must be ripped and be revegetated within suitable indigenous vegetation species; ➢ Follow up revegetation should take place in areas where initial revegetation is not successful; ➢ It is recommended that a Watercourse Rehabilitation and Management Plan must be compiled and implemented.	55 L (-7)	Fully reversible

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	Reversibility of the impact
											Implementation must be overseen by a suitably qualified Environmental Site Officer (ESO) and the ESO must sign off the rehabilitation before the relevant contractors leave site; ➢ Post-closure monitoring of the watercourses (for a period of 3 years), with specific mention of the erosion and invasion of alien vegetation species) is recommended to be undertaken. **A manual amendment to a Low risk is deemed feasible should the following additional mitigation measures be applied:** ➢ Installation of appropriately sized silt traps and attenuation facilities in the correct locations to minimize sediment laden runoff from entering the Steelpoort River.		

The outcome of the Risk Assessment proved that the proposed construction of the Solar PV plant would have a medium risk significance on the aquatic environment. The strict implementation of the stipulated mitigation measures as recommended in this report, with specific mention of limiting the potential of additional sediment to enter the watercourses, and limiting erosion from stormwater runoff, will enable the reduction of the perceived impacts, however, some impact on the aquatic system is inevitable.

Additional "good practice" mitigation measures applicable to a project of this nature are provided in Appendix D of this report.

7.3 Aftercare and monitoring

Prudent monitoring of the Steelpoort River will be required for the duration of the proposed project and into the operational phases, as this will ensure a continual flow of data, enabling all parties involved to accurately assess and manage any potential impacts which may arise from the proposed construction activities. To ensure the accurate gathering of data, the following techniques and guidelines should be followed:

- Site walk through surveys should be applied as the preferred method of monitoring (at specified frequencies) with specific focus on:
    - Erosion monitoring (for the duration of the construction and operational phase);
    - Sedimentation (for the duration of the construction and operational phase);
    - Alien and invasive vegetation proliferation (at the start and end of the growing season);
    - Surface water monitoring; and
    - Waste and litter problems.
- Aquatic biomonitoring of the Steelpoort River. Biomonitoring should continue biannually for a period of at least three years to determine if any impacts to the Steelpoort River as a result of the proposed Solar PV Plant have stabilised.
- Habitat monitoring of the non-perennial watercourses should be conducted in conjunction with the biomonitoring programme.
- All data gathered should be measurable (qualitative and quantitative);
- Monitoring actions should be repeatable;
- Data should be auditable; and
- Reports should present and interpret the data obtained.

The monitoring plan, as indicated in Table 18 below, comprises but is not limited to the following:

- Identification of areas of concern. These are areas that are affected by disturbances such as:
  - Erosion;
  - Alien vegetation species encroachment; and
  - Revegetation.
- Ensuring that the control measures as stipulated in this report are adhered to;
- Gathering all equipment required for the monitoring process; and
- Compiling a monitoring report.

Table 18: Monitoring actions required to be implemented as part of the proposed construction activities of the Tubatse Solar PV Plant.

Aspect	Monitoring Location	Frequency of sampling	Method of Assessment and Performance Indicators (where applicable)	Reporting Requirement
Water Quality	Refer to the monitoring points as per Table 10 and Section 5.1.	**Construction Phase:** Monitoring should take place monthly for the duration of the construction phase (this should include monthly visual and water quality assessments and biannual biomonitoring assessments during the low-flow winter period and during the high-flow summer period). **Operational Phase:** The monitoring programme must commence as soon as the construction and rehabilitation has been completed. Biomonitoring should continue biannually for a period of at least three years to determine if any impacts to the Steelpoort River as a result of the proposed Solar PV Plant have stabilised. Further action will depend on the results of the monitoring programme.	Monitor water quality (with a handheld water quality probe) for the physical water quality conditions during the construction and operational phases for the following parameters: • *In-situ* water quality (pH, EC; TDS and DO). **As per the DWAF (1996) Target Water Quality Range:** • **pH values should not be allowed to vary from the range of the background pH values for a specific site and time of day, by > 0.5 of a pH unit, or by > 5 %;** • **EC/TDS concentrations should not be changed by > 15% from the normal cycles of the water body under unimpacted conditions at any time of the year; and** • **DO should range from 80% - 120% saturation.** Biomonitoring should be conducted bi-annually, the following indices should be applied: • Aquatic macro-invertebrate community integrity (SASS5 and MIRAI); • Fish community integrity (FRAI) and • General habitat integrity (VEGRAI, IHI and IHAS). Monitoring of the non-perennial watercourses: • General habitat integrity (VEGRAI and IHI). **Results should comply with the RQOs for the Steelpoort River (PES Category D) (DWS, 2018).**	Reporting to be included as part of the annual ECO monitoring report to be submitted to the competent authority.
Erosion	The areas affected by construction activities along the Steelpoort River and its watercourses.	• Visual inspections must take place after rainfall events for the first year. • Annual erosion monitoring to be undertaken for the first year post-rehabilitation.	To monitor the extent of erosion in the river and watercourses. Provide a report addressing the following: 1. Brief indication of the method of assessment; 2. Assumptions and Limitations must be listed; 3. Photographs and GPS point locations taken of existing erosion in the watercourses prior to and post during the construction phase must be incorporated into the report. 4. Any erosion observed must be discussed in detail; 5. Map indicating where erosion is present; and 6. Recommended mitigation and remediation actions should be presented.	Reporting to be included as part of the annual ECO monitoring report to be submitted to the competent authority.

Aspect	Monitoring Location	Frequency of sampling	Method of Assessment and Performance Indicators (where applicable)	Reporting Requirement
Alien Invasive Plant (AIP) species control.	The areas affected by construction activities along the Steelpoort River and its watercourses	• Monitoring should be done during and after growing season; • Regrowth of alien vegetation should be monitored monthly during the construction phase; and • Monitoring must be done annually during the operational phase, for three consecutive years.	To monitor the AIP control undertaken in the study area. Provide a report addressing the following: 1. A list of AIP species occurring within the watercourse; 2. Discuss the density of species; 3. Fixed point photo (Taking photo at specific point within the watercourse to identify the extent of invasion); and 4. Focus areas requiring remedial action and proposed corrective actions.	Reporting to be included as part of the annual ECO monitoring report to be submitted to the competent authority.

Note: This monitoring plan must be implemented by a competent person and submit the findings to the responsible authority for evaluation

8 CONCLUSION

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecological assessment in support of the Environmental Impact Assessment (EIA) and Water Use License (WUL) authorisation processes for the proposed Samancor Chrome Operations – Tubatse Ferrochrome 100MW Photovoltaic (PV) Solar Project, near Steelpoort, Limpopo Province.

The proposed PV plant will convert solar radiation into electric energy by using photovoltaic solar arrays. The name plate rating of the plant will be a minimum of 100 MWp. The proposed PV plant will be distributed over several sites along with its associated 33kV powerlines and the Tubatse East and West substation buildings, hereafter collectively referred to as the study area.

No wetlands were identified on site or within 500m of the planned infrastructure, with the freshwater ecosystems best defined as watercourses with associated riparian zones of varying degrees of development. These systems are associated with the proposed site 3,4 and 5 as such these watercourses will potentially be impacted upon, should the PV Plant be approved.

The aquatic ecological assessment included three sites located on the Steelpoort River, Site TS1 (upstream of the proposed construction), site TS2 (downstream of Sites 3, 4 and 5) and site TS3 (located downstream of the proposed construction).

Water quality of the Steelpoort River was considered good at all three sites, with largely natural Electrical Conductivity (EC), pH and Dissolved Oxygen (DO) concentrations observed during the site assessment.

Considering the Ecostatus Categories for both sites TS1 and TS2, the Macro-Invertebrate Response Assessment Index (MIRAI), Fish Response Assessment Index (FRAI), Riparian Vegetation Response Assessment Index (VEGRAI) and the Index of Habitat Integrity (IHI) classifications concur with the Resource Quality Objectives (RQO) of the Steelpoort River [Present Ecological State (PES) Category D (DWS, 2018)]. The MIRAI classification of site TS3 also concurred with the RQO (FRAI, VEGRAI and IHI not applied to site TS3). The Integrated Ecological Category (IEC) for both sites TS1 and TS2 have resulted in Ecostatus scores of 73.7% (Category C: Moderately Modified) at site TS1, and 75.2% (Category C: Moderately Modified) at site TS2, respectively. Overall, the Steelpoort River is considered moderately modified (Class C), of high Ecological Importance and Sensitivity (EIS) and also considered a fish support area (Opsaridium peringueyi).

The outcome of the Risk Assessment proved that the proposed construction of the Solar PV plant would have a medium risk significance on the aquatic environment. The strict implementation of the stipulated mitigation measures as recommended in this report, with specific mention of limiting the potential of additional sediment to enter the watercourses, and limiting erosion from stormwater runoff, will enable the reduction of the perceived impacts.

Furthermore, with rehabilitation and long-term management of erosion and alien and invasive plant species the overall PES of the Steelpoort River and its associated watercourses will not be impacted by the Solar PV plant.

9 RECOMMENDATIONS

- All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential;
- All vegetation removed as part of the site clearing activities (specifically where large areas need to be cleared) should be transported from the construction site (may not be stockpiled) and disposed of at a registered waste disposal facility;
- During construction activities associated with surface infrastructure within close proximity to a watercourse, regular spraying of non-potable water or the use of chemical dust suppressants must be implemented to reduce dust and to ensure no smothering of vegetation within the watercourses occurs from excessive dust settling;
- All perennial and non- perennial rivers and associated floodlines must be considered no-go areas during construction and operation for all non-linear infrastructure;
- No vegetation may be removed from the 32 m ZoR surrounding the watercourse where no infrastructure is planned within 32 m thereof, as this provides a natural buffer zone around the watercourses which disperse surface runoff into the watercourses, and thus prevents sedimentation and erosion thereof.
- It is imperative that all construction works be undertaken during the dry, winter months when the flow is very low in the watercourses, and no diversion of flow would be necessary;
- The reaches of the watercourses where no activities are planned to occur must be considered no-go areas. These no-go areas for non-linear infrastructure can be marked at a maximum distance of 5 m upstream and downstream of the new road

crossings. This 5 m buffer area would allow for construction personal, vehicles (if applicable) to enter the watercourse crossing where the new internal access roads are proposed;

- With regards to ground-breaking activities outside the 32 m NEMA ZoR:
  - During excavation activities, the topsoil and vegetation should be stockpiled separately from other material outside of the 32 m NEMA ZoR;
  - Excavated materials should not be contaminated, and it should be ensured that the minimum surface area is taken up. The mixture of the lower and upper layers of the excavated soil should be kept to a minimum, so as for later use as backfill material after construction has commenced;
  - All exposed soils must be protected for the duration of the construction phase to prevent potential erosion and sedimentation of the watercourses;
  - Construction of the proposed surface infrastructure may result in disturbance to the natural buffer zone surrounding the watercourses which may result in the reduction of surface roughness. This can be mitigated by ensuring that no concentrated runoff from the surface infrastructure construction area enters the watercourses. This can be achieved by installing silt traps or placing haybales down gradient of the construction footprint to ensure no sediment laden or concentrated runoff generates from the construction footprint;
  - It is highly recommended that an alien vegetation management plan be compiled during the planning phase and implemented concurrently with the commencement of construction.
- With regards to concrete mixing on site:
  - No mixed concrete may be deposited outside of the designated construction footprint;
  - Protective equipment should be provided, onto which any mixed concrete can be deposited while it awaits placing; and
  - Concrete spilt outside of the demarcated area must be promptly removed and taken to a suitably licensed waste disposal site.
- With regards to backfilling of excavated areas:
  - Stockpiled material should be used as backfill material;
  - All excavated areas should be backfilled to the natural ground level with excavated material;
  - Soil must be lightly recompacted to a depth of 450 mm, and all construction material must be removed from the site upon the completion of construction or used in the rehabilitation process.
- Rehabilitation of the construction footprint areas:

  - All footprint areas which have been compressed should be ripped and revegetated within indigenous vegetation as soon as the construction activities have ceased. This will prevent any soil erosion and the creation of gullies within the operational area;
  - The operational area should regularly be inspected for alien and invasive vegetation species which might have established due to the construction activity related disturbances.
  - Ensure that routine inspections and monitoring of any instream infrastructure are undertaken to monitor the establishment of indigenous vegetation and the presence of any alien or invasive plant species;
  - The surface infrastructure areas must be inspected to ensure that no concentrated runoff from these areas forms erosion gullies and eventually flow into the watercourses. Should this be noted, these gullies/preferential flow paths must be infilled with in situ material and appropriately revegetated;
  - Routine maintenance of the roads must be undertaken to ensure that no concentration of flow and subsequent erosion occurs due to the road crossings. Such maintenance activities must especially be undertaken after high rainfall events;
  - Stormwater runoff from the road crossings should be monitored (by the Operation and Maintenance (O&M) Manager), so it does not result in erosion of the watercourses. Stormwater should be allowed to diffusely spread across the landscape, by ensuring adequate surface roughness in the watercourse (through vegetation and rocky areas);
  - Should erosion be noted that was caused by the road crossings the area must be rehabilitated by infilling the erosion gully and revegetation thereof with suitable indigenous vegetation. Use can also be made of rocks obtained from the surrounding area to infill any area prone to erosion, as a natural dispersal mechanism.
- Installation of appropriately sized silt traps and attenuation facilities in the correct locations to minimize sediment laden runoff from entering the Steelpoort River.
- Aquatic biomonitoring of the Steelpoort River and habitat monitoring of the drainage channels must take place during construction and once the construction has been completed, when all rehabilitation activities have been implemented. Results obtained in this aquatic ecological baseline report should be used for temporal comparison. If any problematic trends are identified, the reason for impact must be identified and the appropriate mitigatory action initiated. All work must be completed by an SA RHP Accredited assessor and must take place on a minimum frequency of 6 months.

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APPENDIX A – Terms of Use and Indemnity

INDEMNITY AND TERMS OF USE OF THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and SAS CC and its staff reserve the right to, at their sole discretion, modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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APPENDIX B – Legislation

LEGISLATIVE REQUIREMENTS

The Constitution of the Republic of South Africa, 1996	The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 by way of section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive normalization of this right. Section 27 is defined as a socio-economic right and not an environmental right. However, read with section 24 it requires of the state to ensure that water is conserved and protected and that sufficient access to the resource is provided. Water regulation in South Africa places a great emphasis on protecting the resource and on providing access to water for everyone.
National Environmental Management Act (NEMA) (Act No. 107 of 1998)	The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
National Water Act (NWA) (Act No. 36 of 1998)	The National Water Act (NWA) (Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i).
National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA)	The objectives of this act are (within the framework of NEMA) to provide for: ➢ The management and conservation of biological diversity within the Republic of South Africa and of the components of such diversity; ➢ The use of indigenous biological resources in a sustainable manner; ➢ The fair and equitable sharing among stakeholders of the benefits arising from bio prospecting involving indigenous biological resources; ➢ To give effect to ratify international agreements relating to biodiversity which are binding to the Republic; ➢ To provide for cooperative governance in biodiversity management and conservation; and ➢ To provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act. This act alludes to the fact that management of biodiversity must take place to ensure that the biodiversity of the surrounding areas are not negatively impacted upon, by any activity being undertaken, in order to ensure the fair and equitable sharing among stakeholders of the benefits arising from indigenous biological resources. Furthermore, a person may not carry out a restricted activity involving either: a) A specimen of a listed threatened or protected species; b) Specimens of an alien species; or A specimen of a listed invasive species without a permit.
General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA (Act 36 of 1998)	In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: c) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;

	d) In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or e) A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and stormwater management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.

APPENDIX C – Method of Assessment

APPENDIX D - Freshwater Assessment

1. Desktop Study

Prior to the commencement of the field assessment, a background study, including a literature review, was conducted in order to determine the ecoregion and ecostatus of the larger aquatic system within which the watercourses and drainage line features present in close proximity of the development are located. Aspects considered as part of the literature review are discussed in the sections that follow.

1.1 National Freshwater Ecosystem Priority Areas (NFEPA; 2011)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), South African National Biodiversity Institute (SANBI), DWA, South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa’s freshwater biodiversity, within the context of equitable social and economic development.

The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable, natural resource with economic, aesthetic, spiritual, cultural and recreational value. However, the integrity of freshwater ecosystems in South Africa is declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).

The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland feature present in the vicinity of the development.

1.2 *Department of Water and Sanitation (DWS) Resource Quality Information Services Present Ecological State / Ecological Importance and Sensitivity (PES/EIS) Database (2014)*

The PES/EIS database as developed by the DWS RQIS department was utilised to obtain background information on the project area. The PES/EIS database has been made available to consultants since mid-August 2014. The information from this database is based on information at a sub-quaternary catchment reach (subquat reach) level with the descriptions of the aquatic ecology based on the information collated by the DWS RQIS department from all reliable sources of reliable information such as SA RHP sites, EWR sites and Hydro WMS sites. The results obtained serve to summarise this information as a background to the conditions of the watercourse traversed by the proposed linear development.

2. Classification System for Wetlands and other Aquatic Ecosystems in South Africa (2013)

All wetland or riparian features encountered within the study area was assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems, hereafter referred to as the “Classification System” (Ollis et. al., 2013). A summary on Levels 1 to 4 of the classification system are presented in the tables below.

Table C1: Classification System for Inland Systems, up to Level 3.

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	**LEVEL 2: REGIONAL SETTING**	**LEVEL 3:LANDSCAPE UNIT**
Inland Systems	DWA Level 1 Ecoregions OR NFEPA WetVeg Groups OR Other special framework	Valley Floor
		Slope
		Plain
		Bench (Hilltop / Saddle / Shelf)

Table C2: Hydrogeomorphic (HGM) Units for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4:HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

Level 1: Inland systems

From the classification system, Inland Systems are defined as **aquatic ecosystems that have no existing connection to the ocean**[2] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but **which are inundated or saturated with water, either permanently or periodically.** It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that has been included in Level 2 of the classification system is that of the DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et. al.,* 2005). There is a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) groups' vegetation types across the country, according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the NFEPA project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting Bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

Level 3: Landscape Setting

At Level 3 of the classification system for Inland Systems, a distinction is made between four Landscape Units (Table C1) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis *et. al.,* 2013):

- **Slope:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley;
- **Valley floor:** The base of a valley, situated between two distinct valley side-slopes;
- **Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land; and
- **Bench (hilltop/saddle/shelf):** an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

Level 4: Hydrogeomorphic Units

Seven primary HGM Types are recognised for Inland Systems at Level 4A of the classification system (Table C2), on the basis of hydrology and geomorphology (Ollis *et. al*., 2013), namely:

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland:** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;
- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;
- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and

[2] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley, but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et. al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et. al*., 2009).

3. Wet-Ecoservices (2009)

"The importance of a water resource, in ecological, social or economic terms, acts as a modifying or motivating determinant in the selection of the management class" (DWA, 1999). The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze *et al.* (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;
- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Carbon storage;
- Maintenance of biodiversity;
- Water supply for human use;
- Natural resources;
- Cultivated foods;
- Cultural significance;
- Tourism and recreation; and
- Education and research.

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland.

Table C3: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

APPENDIX E - Aquatic Assessment

The sections below describe the methodology used to assess the aquatic ecological integrity based on water quality, instream and riparian habitat condition and biological impacts and integrity.

Visual Assessment

The site was investigated in order to identify visible impacts on the site, with specific reference to impacts from surrounding activities. Both natural constraints placed on ecosystem structure and function, as well as anthropogenic alterations to the system, were identified by observing conditions and relating them to professional experience. Photographs were taken to provide visual indications of the conditions at the time of assessment. Factors which were noted in the site-specific visual assessments included the following:

- Stream morphology;
- Instream and riparian habitat diversity;
- Stream continuity;
- Erosion potential;
- Depth flow and substrate characteristics;
- Signs of physical disturbance of the area; and
- Other life forms reliant on or associated with aquatic ecosystems.

Physico Chemical Water Quality Data

Biota specific water quality parameters included pH, Electrical Conductivity (EC), Dissolved Oxygen concentration (DO) and temperature. Where applicable, results are discussed against the guideline water quality values for aquatic ecosystems developed by the Department of Water and Sanitation (DWS), formerly known as the Department of Water Affairs and Forestry (DWAF 1996 vol. 7).

General Habitat Integrity

The general habitat integrity of the site was discussed based on the application of the Index of Habitat Integrity (Kleynhans *et al.* 2008). It is important to assess the habitat at the site in order to aid in the interpretation of the results of the community integrity assessments, by taking habitat conditions and impacts into consideration. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitat at the site. The method classifies habitat integrity into one of six classes, ranging from unmodified/natural (Class A) to critically modified (Class F), as indicated in Table C1 below.

Table C1: Classification of Present State Classes in terms of Habitat Integrity [Kleynhans *et al.* 2008]

Class	Description	Score (% of total)
A	Unmodified, natural.	90 - 100
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 - 89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 - 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 - 19

Habitat for aquatic macro-invertebrates

The Integrated Habitat Assessment System (IHAS), according to the protocol of McMillan (1998), is used to determine specific habitat suitability for aquatic macro-invertebrates as well as to aid in the interpretation of the results of the South African Scoring System version 5 (SASS5) scores. However, according to a study conducted within the Mpumalanga and Western Cape regions, the IHAS method does not produce reliable scores with regard to the suitability of habitat at sampling sites for aquatic macroinvertebrates (Ollis *et al*., 2006). Furthermore, the performance of the IHAS seems to vary between geomorphologic zones and between biotope groups (Ollis *et al*., 2006). It has, however; become clear that IHAS requires further validation and testing, although the basic data remains of value (Thirion, 2007).

Table C2: IHAS Scores and their corresponding description of overall condition (quality and quantity) of available aquatic macroinvertebrate habitat (McMillan, 1998)

IHAS Score (%)	Description
>75	Excellent
65 – 74	Good

55 – 64	Adequate / Fair
<55	Poor

Aquatic Macro-Invertebrates: South African Scoring System version 5 (SASS5)
Sampling was performed using the qualitative kick sampling method called SASS5 (South African Scoring System version 5) (Dickens and Graham, 2002). The SASS5 method has been specifically designed to comply with international accreditation protocols. This method is based on the British Biological Monitoring Working Party (BMWP) method and has been adapted for South African conditions by Dr. F. M. Chutter (1998).

The SASS5 method was designed to incorporate all available biotypes at a given site and to provide an indication of the integrity of the of the aquatic macro-invertebrate community through recording the presence of various macro-invertebrate families at each site, as well as consideration of abundance of various populations, community diversity and community sensitivity. Each taxon is allocated a score according to its level of tolerance to river health degradation (Dallas 2007).

Fish biota: Fish Response Assessment Index (FRAI)
The FRAI (Kleynhans, 2007) is based on the premise that "drivers" (environmental conditions) may cause fish stress which shall then manifest as changes in fish species assemblage. The index employs preferences and intolerances of the reference fish assemblage, as well as the response of the actual (present) fish assemblage to particular drivers to indicate a change from reference conditions. Intolerances and preferences are divided into metric groups relating to preferences and requirements of individual species. This allows cause-effect relationships to be understood, i.e. between drivers and responses of the fish assemblage to changes in drivers. These metric groups are subsequently ranked, rated and finally integrated as a fish Ecological Category.

The fish community could not be sampled using an electro-shock method due to rain at the time of assessment. However, fish species expected to occur were derived from the Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) PES/EIS database.

The Riparian Vegetation Response Assessment Index (VEGRAI)
VEGRAI is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results (Kleynhans *et al.*, 2007b). Results are defensible because their generation can be traced through an outlined process (a suite of rules that convert assessor estimates into ratings and convert multiple ratings into an Ecological Category).

Riparian vegetation is described in the National Water Act (NWA; Act 36 of 1998) as follows: 'riparian habitat' includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

Table C3: Descriptions of the A-F ecological categories.

Ecological category	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitat and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat have occurred, but the basic ecosystem functions are still predominately unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39

F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances, the basic ecosystem functions have been destroyed and the changes are irreversible	0-19

Ecological Importance and Sensitivity (EIS) Method of assessment
The EIS method considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale (Table C4). The median of the resultant score is calculated to derive the EIS category (Table C5).

Table C4: Definition of the four-point scale used to assess biotic and habitat determinants presumed to indicate either importance or sensitivity

Four point scale	Definition
1	One species/taxon judged as rare or endangered at a local scale.
2	More than one species/taxon judged to be rare or endangered on a local scale.
3	One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.
4	One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books)

Table C5: Ecological importance and sensitivity categories (DWAF, 1999)

EISC	General Description	Range of median
Very high	Quaternaries/delineations that are considered to be unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3-4
High	Quaternaries/delineations that are considered to be unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use.	>1-≤2
Low/ marginal	Quaternaries/delineations that are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

RISK ASSESSMENT METHOD
In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of the risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[3]. The interaction of an aspect with the environment may result in an impact.

[3] The definition has been aligned with that used in the ISO 14001 Standard.

- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as freshwater features, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[4].

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

"RISK ASSESSMENT KEY" (Based on DWS 2015 publication: Section 21 c and i water use Risk Assessment Protocol)

Table C6: Severity (How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

Table C7: Spatial Scale (How big is the area that the aspect is impacting on)

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

[4] Some risks/impacts that have low significance will however still require mitigation

Table C8: Duration (How long does the aspect impact on the resource quality)

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5
PES and EIS (sensitivity) must be considered.	

Table C9: Frequency of the activity (How often do you do the specific activity)

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table C10: The frequency of the incident or impact (How often does the activity impact on the resource quality)

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table C11: Legal issues (How is the activity governed by legislation)

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

Table C12: Detection (How quickly or easily can the impacts/risks of the activity be observed on the resource quality, people and resource)

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table C13: Rating Classes

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Licence required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.

A low risk class must be obtained for all activities to be considered for a GA

Table C14: Calculations

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance\Risk = Consequence X Likelihood

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:

   - Primary project site and related facilities that the client and its contractors develops or controls;
   - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
   - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for construction phase and operational phase; and
- Individuals or groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status were assessed.

Control Measure Development
The following points presents the key concepts considered in the development of mitigation measures for the proposed construction:

- Mitigation and performance improvement measures and actions that address the risks and impacts[5] are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
   - Avoidance or prevention of impact;
   - Minimisation of impact;
   - Rehabilitation; and
   - Offsetting.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and
- Desired outcomes are defined and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

Recommendations
Recommendations were developed to address and mitigate potential impacts on the aquatic ecology of the resources in traversed or in close proximity of the proposed water use activities.

[5] Mitigation measures should address both positive and negative impacts

APPENDIX F – Risk Assessment Mitigation Measures

Good Housekeeping

The following essential mitigation measures are considered to be standard best practice measures applicable to activities of this nature and must be implemented during the life of the project, in conjunction with those stipulated in the project specific risk assessment, which define the mitigatory measures specific to the minimisation of impacts on the watercourses within the study area.

Activities footprint

- The footprint of all activity areas should remain as small as possible and not encroach into the riparian feature, except where absolutely essential or where authorised activities are to take place.
- It must be ensured that the freshwater feature is off-limits to non-essential personnel;
- Access to the remainder of the freshwater feature should be prohibited to prevent compaction of soils, loss of vegetation and increased erosion;
- A specified area for washing, cutting, etc. must be allocated outside of the freshwater feature zone and adequate measures should be taken to prevent contamination of any surfaces in this area, as well as in the freshwater feature, which may contribute to sedimentation and degradation of water quality at this point;
- Appropriate sanitary facilities must be provided for the life of the construction and all waste removed to an appropriate waste facility; and
- No fires should be permitted in or near the riparian area.

Freshwater habitat

- Flow continuity within the freshwater feature must be maintained as far as possible. It is considered essential therefore that disturbances within the freshwater features must be minimised as far as possible;
- All areas where soils are exposed or destabilised need to be stabilised, taking into account the following:
  - As far as possible soft engineering and earthworks should be used, with special mention of re-sloping of banks, revegetation of banks and stabilisation using products such as hessian sheets and socks; and
  - Hard engineering techniques should only be implemented in areas where engineering and hydraulic constraints require such interventions. In particular mention is made of gabions, reno mattresses and reinforced walls.
- The duration of impacts on the freshwater features should be minimised as far as possible by ensuring that the duration of time in which flow alteration will take place, is minimised;
- Permit only essential construction personnel within 100m of all riparian systems;
- Keep all demarcated sensitive zones outside of the construction area off limits during the construction phase of the development.

Vegetation

- Proliferation of alien and invasive species is expected within any disturbed areas, and these species should be eradicated and controlled to prevent their spread beyond the project footprint. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled;
- Removal of the alien and weed species encountered within the study area must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 1998). Removal of species should take place throughout the life of the dam structure;
- Species specific and area specific eradication recommendations:
  - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
  - Footprint areas should be kept as small as possible when removing alien plant species*;* and
  - No vehicles should be allowed to drive through the freshwater feature during the eradication of alien and weed species.

Soils

- All soils compacted as a result of the construction activities as well as maintenance activities should be ripped and profiled; and
- A monitoring plan for the operational phase of the project should be implemented to prevent erosion and incision.

General

- All vehicles must be regularly inspected for leaks;
- Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage;
- All hazardous chemicals must be stored on specified surfaces;
- All spills should be immediately cleaned up and treated accordingly;
- Appropriate sanitary facilities must be provided for the duration of the construction activities and all waste must be removed to an appropriate waste facility;
- No dumping of waste should take place. If any spills occur, they should be immediately cleaned up.

APPENDIX G – Results of the Aquatic Assessment

IHAS Scoresheets

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name:
Site Name: TS1
Date: 14/04/21

SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			18		
VEGETATION	0	1	2	3	4	5
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none		1-25	26-50	51-75	>75
	Vegetation Score (max 15):				10	
OTHER HABITAT/GENERAL	0	1	2	3	4	5
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				10	
	HABITAT TOTAL (MAX 55):				38	
STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>1	1	>½-1	½	<½-¼	<¼
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	fl/dr	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	50-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX				27	
	TOTAL IHAS SCORE (%):				65	

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name:

Site Name: **TS2** — **Date**: **14/04/21**

SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(*NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			18		
VEGETATION	0	1	2	3	4	5
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none		1-25	26-50	51-75	>75
	Vegetation Score (max 15):				11	
OTHER HABITAT/GENERAL	0	1	2	3	4	5
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				13	
	HABITAT TOTAL (MAX 55):				42	
STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>1	1	>½-1	½	<½-¼	<¼
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	fl/dr	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	50-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX 45):					37
	TOTAL IHAS SCORE (%):				79	

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name:
Site Name: **TS3**
Date: 01/12/2020

SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
SIC Score (max 20): 17						
VEGETATION	0	1	2	3	4	5
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none		1-25	26-50	51-75	>75
Vegetation Score (max 15): 13						
OTHER HABITAT/GENERAL	0	1	2	3	4	5
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
Other Habitat Score (max 20): 10						
HABITAT TOTAL (MAX 55): 40						

STREAM CONDITION	0	1	2	3	4	5
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>1	1	>½-1	½	<½-¼	<¼
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	fl/dr	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	50-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
STREAM CONDITIONS TOTAL (MAX 28						
TOTAL IHAS SCORE (%): 68						

SASS5 Scoresheets

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: 14/04/21	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT
GRID REFERENCE:	PORIFERA	5					HEMIPTERA:						DIPTERA:					
S:°	COELENTERATA	1					Belostomatidae*	3		1		1	Athericidae	10				
E:°	TURBELLARIA	3					Corixidae*	3					Blepharoceridae	15				
SITE CODE: TS1	ANNELIDA:						Gerridae*	5					Ceratopogonidae	5				
RIVER:	Oligochaeta	1					Hydrometridae*	6					Chironomidae	2	A	A	A	A
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7					Culicidae*	1				
WEATHER CONDITION:	CRUSTACEA:						Nepidae*	3					Dixidae*	10				
TEMP: 23.8 °C	Amphipoda	13					Notonectidae*	3					Empididae	6				
Ph: 8.51	Potamonautidae*	3					Pleidae*	4					Ephydridae	3				
DO: 9.61mg/l	Atyidae	8					Veliidae/M..veliidae*	5					Muscidae	1				
Cond: 35.5 mS/m	Palaemonidae	10					MEGALOPTERA:						Psychodidae	1				
BIOTOPES SAMPLED:	HYDRACARINA	8					Cordalidae	8					Simuliidae	5				
SIC: TIME: minutes	PLECOPTERA:						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					TRICHOPTERA						Tabanidae	5				
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	EPHEMEROPTERA						Ecnomidae	8	A			A	GASTROPODA					
M VEG IC: DOM SP:	Baetidae 1sp	4					Hydropsychidae 1sp	4	A			A	Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	A	B	B	B	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6	A	A		A	Philopotamidae	10					Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13	1			1	Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW:	Leptophlebiidae	9	A			A	CASED CADDIS:						Thiaridae*	3				
TURBIDITY:	Oligoneuridae	15			1	1	Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					PELECYPODA					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9	1			1	Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					SASS SCORE:		73	31	35	95
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6					NO OF TAXA:		10	6	4	13
	Chlorocyphidae	10					Petrothrincidae SWC	11					ASPT:		7.30	5.17	8.75	7.31
	Chlorolestidae	8					Pisuliidae	10					IHAS:		65%			
	Coenagrionidae	4		A		A	Sericostomatidae SWC	13					OTHER BIOTA:					
	Lestidae	8					COLEOPTERA:											
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					COMMENTS:					
	Protoneuridae	8					Elmidae/Dryopidae*	8					* = airbreathers					
	Zygoptera juvs.	6					Gyrinidae*	5					SWC = South Western Cape					
	Aeshnidae	8					Halipidae*	5					T = Tropical					
	Corduliidae	8					Helodidae	12					ST = Sub-tropical					
OTHER OBSERVATIONS:	Gomphidae	6	A		A	A	Hydraenidae*	8					S = Stone & rock					
	Libellulidae	4	B	A		B	Hydrophilidae*	5					VG = all vegetation					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud					
	Pyralidae	12					Psephenidae	10					1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: 15/04/21	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10				
E: °	**TURBELLARIA**	3					Corixidae*	3			1	1	Blepharoceridae	15				
SITE CODE: TS2	**ANNELIDA:**						Gerridae*	5					Ceratopogonidae	5		1		1
RIVER:	Oligochaeta	1	1			1	Hydrometridae*	6					Chironomidae	2		B	A	B
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7					Culicidae*	1				
WEATHER CONDITION:	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP: 19.1°C	Amphipoda	13					Notonectidae*	3					Empididae	6				
Ph: 8.56	Potamonautidae*	3					Pleidae*	4					Ephydridae	3				
DO: 6.1 mg/l	Atyidae	8					Veliidae/M..veliidae*	5					Muscidae	1				
Cond: 28.5 mS/m	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5				
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5	A			A
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8	A			A	**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4			1		Hydropsychidae 1sp	4	A	A	1	B	Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6		B			Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	B			B	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6	A	A	1	A	Philopotamidae	10					Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13					Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW:	Leptophlebiidae	9	A			A	**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY:	Oligoneuridae	15	A	A		A	Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9					Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		76	52	29	90
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6	1			1	**NO OF TAXA:**		11	9	7	15
	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		6.91	5.78	4.14	6.00
	Chlorolestidae	8					Pisuliidae	10					**IHAS:**	79%				
	Coenagrionidae	4		A		A	Sericostomatidae SWC	13					**OTHER BIOTA:**					
	Lestidae	8					**COLEOPTERA:**											
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS:**					
	Protoneuridae	8					Elmidae/Dryopidae*	8					* = airbreathers					
	Zygoptera juvs.	6					Gyrinidae*	5					SWC = South Western Cape					
	Aeshnidae	8					Halipidae*	5					T = Tropical					
	Corduliidae	8					Helodidae	12					ST = Sub-tropical					
OTHER OBSERVATIONS:	Gomphidae	6	A	A	1	A	Hydraenidae*	8					S = Stone & rock					
	Libellulidae	4	B	A	1	B	Hydrophilidae*	5					VG = all vegetation					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud					
	Pyralidae	12					Psephenidae	10					1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: TS3	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S:°	**COELENTERATA**	1					Belostomatidae*	3		1		1	Athericidae	10				
E:°	**TURBELLARIA**	3					Corixidae*	3					Blepharoceridae	15				
SITE CODE: 01/12/2020	**ANNELIDA:**						Gerridae*	5					Ceratopogonidae	5				
RIVER:	Oligochaeta	1	A		1	A	Hydrometridae*	6		1		1	Chironomidae	2	B			B
SITE DESCRIPTION:	Leeches	3					Naucoridae*	7					Culicidae*	1				
WEATHER CONDITION:	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP: 25.8 °C	Amphipoda	13					Notonectidae*	3					Empididae	6				
Ph: 7.55	Potamonautidae*	3					Pleidae*	4					Ephydridae	3				
DO: 7.52 mg/l	Atyidae	8					Veliidae/M..veliidae*	5		A		A	Muscidae	1				
Cond: 37.2 mS/m	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5		A		A
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5	1			1
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1sp	4			A		Hydropsychidae 1sp	4	A	A		A	Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12	B	B		B	Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6	A		1	A	Philopotamidae	10					Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13					Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW:	Leptophlebiidae	9	A		1	A	**CASED CADDIS:**						Thiaridae*	3	A	A	1	A
TURBIDITY:	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9	1			1	Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		79	60	29	120
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6		1		1	**NO OF TAXA:**		13	10	6	20
	Chlorocyphidae	10	1			1	Petrothrincidae SWC	11					**ASPT:**		6.08	6.00	4.83	6.00
	Chlorolestidae	8					Pisuliidae	10					**IHAS:**	68%				
	Coenagrionidae	4		A		A	Sericostomatidae SWC	13					**OTHER BIOTA:**					
	Lestidae	8					**COLEOPTERA:**											
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS:**					
	Protoneuridae	8					Elmidae/Dryopidae*	8	1			1	* = airbreathers					
	Zygoptera juvs.	6					Gyrinidae*	5					SWC = South Western Cape					
	Aeshnidae	8					Halipidae*	5					T = Tropical					
	Corduliidae	8					Helodidae	12					ST = Sub-tropical					
OTHER OBSERVATIONS:	Gomphidae	6	A		1	A	Hydraenidae*	8					S = Stone & rock					
	Libellulidae	4	A			A	Hydrophilidae*	5					VG = all vegetation					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud					
	Pyralidae	12		1		1	Psephenidae	10					1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

MIRAI

Site TS1

			INVERTEBRATE EC: BASED ON WEIGI			
INVERTEBRATE EC METRIC GROUP		METRIC GROUP CALCULATED SCORE	CALCULATED WEIGHT	WEIGHTED SCORE OF GROUP	RANK OF METRIC GROUP	%WEIGHT FOR METRIC GROUP
FLOW MODIFICATION	FM	86.9	0.192	16.716	3	50
HABITAT	H	74.2	0.385	28.5503	1	100
WATER QUALITY	WQ	78.7	0.308	24.2051	2	80
CONNECTIVITY & SEASONALITY	CS	100.0	0.115	11.5385	4	30
						260
INVERTEBRATE EC				81.0099		
INVERTEBRATE EC CATEGORY				C/B		
>89=A; 80-89=B; 60-79=C; 40-59=D; 20-39=E; <20=F						

Site TS2

INVERTEBRATE EC METRIC GROUP		METRIC GROUP CALCULATED SCORE	CALCULATED WEIGHT	WEIGHTED SCORE OF GROUP	RANK OF METRIC GROUP	%WEIGHT FOR METRIC GROUP
FLOW MODIFICATION	FM	85.0	0.192	16.3462	3	50
HABITAT	H	74.2	0.308	22.8402	2	80
WATER QUALITY	WQ	70.7	0.385	27.1795	1	100
CONNECTIVITY & SEASONALITY	CS	100.0	0.115	11.5385	4	30
						260
INVERTEBRATE EC				77.9043		
INVERTEBRATE EC CATEGORY				C		
>89=A; 80-89=B; 60-79=C; 40-59=D; 20-39=E; <20=F						

Site TS3

			INVERTEBRATE EC: BASED ON WEIGI			
INVERTEBRATE EC METRIC GROUP		METRIC GROUP CALCULATED SCORE	CALCULATED WEIGHT	WEIGHTED SCORE OF GROUP	RANK OF METRIC GROUP	%WEIGHT FOR METRIC GROUP
FLOW MODIFICATION	FM	84.2	0.192	16.1982	3	50
HABITAT	H	80.4	0.308	24.7337	2	80
WATER QUALITY	WQ	72.0	0.385	27.6923	1	100
CONNECTIVITY & SEASONALITY	CS	100.0	0.115	11.5385	4	30
						260
INVERTEBRATE EC				80.1627		
INVERTEBRATE EC CATEGORY				C/B		
>89=A; 80-89=B; 60-79=C; 40-59=D; 20-39=E; <20=F						

IHI

Site TS1

INSTREAM IHI	
Base Flows	-1.0
Zero Flows	0.0
Floods	1.0
HYDROLOGY RATING	0.5
pH	0.0
Salts	-0.5
Nutrients	-1.0
Water Temperature	0.0
Water clarity	-1.0
Oxygen	-1.0
Toxics	0.0
PC RATING	1.0
Sediment	-2.0
Benthic Growth	-2.0
BED RATING	2.0
Marginal	-2.0
Non-marginal	-1.0
BANK RATING	1.6
Longitudinal Connectivity	-1.0
Lateral Connectivity	-1.0
CONNECTIVITY RATING	1.0
INSTREAM IHI %	76.8
INSTREAM IHI EC	C
INSTREAM CONFIDENCE	3.0

RIPARIAN IHI	
Base Flows	-1.0
Zero Flows	0.0
Moderate Floods	1.5
Large Floods	1.5
HYDROLOGY RATING	0.9
Substrate Exposure (marginal)	2.0
Substrate Exposure (non-marginal)	1.0
Invasive Alien Vegetation (marginal)	1.0
Invasive Alien Vegetation (non-marginal)	1.0
Erosion (marginal)	2.0
Erosion (non-marginal)	1.0
Physico-Chemical (marginal)	0.0
Physico-Chemical (non-marginal)	0.0
Marginal	2.0
Non-marginal	1.0
BANK STRUCTURE RATING	1.6
Longitudinal Connectivity	1.0
Lateral Connectivity	1.0
CONNECTIVITY RATING	1.0
RIPARIAN IHI %	75.0
RIPARIAN IHI EC	C
RIPARIAN CONFIDENCE	3.0

Site TS2

INSTREAM IHI	
Base Flows	-1.0
Zero Flows	0.0
Floods	1.0
HYDROLOGY RATING	0.5
pH	0.0
Salts	0.0
Nutrients	-0.5
Water Temperature	0.0
Water clarity	-1.0
Oxygen	-0.5
Toxics	0.0
PC RATING	0.5
Sediment	-1.5
Benthic Growth	-1.5
BED RATING	1.5
Marginal	-2.0
Non-marginal	-1.0
BANK RATING	1.6
Longitudinal Connectivity	-1.0
Lateral Connectivity	-1.0
CONNECTIVITY RATING	1.0
INSTREAM IHI %	81.2
INSTREAM IHI EC	B/C
INSTREAM CONFIDENCE	3.0

RIPARIAN IHI	
Base Flows	-1.0
Zero Flows	0.0
Moderate Floods	1.5
Large Floods	1.5
HYDROLOGY RATING	0.9
Substrate Exposure (marginal)	2.0
Substrate Exposure (non-marginal)	1.0
Invasive Alien Vegetation (marginal)	1.0
Invasive Alien Vegetation (non-marginal)	1.0
Erosion (marginal)	2.0
Erosion (non-marginal)	1.0
Physico-Chemical (marginal)	0.0
Physico-Chemical (non-marginal)	0.0
Marginal	2.0
Non-marginal	1.0
BANK STRUCTURE RATING	1.6
Longitudinal Connectivity	1.0
Lateral Connectivity	1.0
CONNECTIVITY RATING	1.0
RIPARIAN IHI %	75.0
RIPARIAN IHI EC	C
RIPARIAN CONFIDENCE	3.0

VEGRAI

Steelpoort River

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	71.4	44.6	2.8	1.0	100.0
NON MARGINAL	75.2	28.2	0.0	2.0	60.0
	2.0				160.0
LEVEL 3 VEGRAI (%)				72.9	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				1.4	

FRAI

Site TS1

AUTOMATED	
FRAI (%)	**31.7**
EC: FRAI	**E**
ADJUSTED	
FRAI (%)	**66.3**
EC: FRAI	**C**

Site TS2

AUTOMATED	
FRAI (%)	**52.9**
EC: FRAI	**D**
ADJUSTED	
FRAI (%)	**75.1**
EC: FRAI	**C**

Results of the Freshwater Assessment

VEGRAI

System 1 and 2:

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	80.0	66.7	2.8	1.0	100.0
NON MARGINAL	80.0	13.3	0.0	2.0	20.0
	2.0				120.0
LEVEL 3 VEGRAI (%)				80.0	
VEGRAI EC				**B/C**	
AVERAGE CONFIDENCE				1.4	

System 3 and 5:

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	58.5	48.7	2.8	1.0	100.0
NON MARGINAL	40.0	6.7	0.0	2.0	20.0
	2.0				120.0
LEVEL 3 VEGRAI (%)				55.4	
VEGRAI EC				**D**	
AVERAGE CONFIDENCE				1.4	

System 4:

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	73.3	56.4	2.8	1.0	100.0
NON MARGINAL	66.7	15.4	0.0	2.0	30.0
	2.0				130.0
LEVEL 3 VEGRAI (%)				71.8	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				1.4	

ECOSERVICES

Ecosystem service	Steelpoort River
Flood attenuation	1.8
Streamflow regulation	1.2
Sediment trapping	2.2
Phosphate assimilation	1.7
Nitrate assimilation	1.7
Toxicant assimilation	1.9
Erosion control	2.3
Carbon Storage	1.0
Biodiversity maintenance	1.6
Water Supply	2.5
Harvestable resources	2.2
Cultivated foods	2.4
Cultural value	1.5
Tourism and recreation	1.6
Education and research	1.3
SUM	**26.8**
Average score	**1.8**

Ecosystem service	Non-perennial rivers
Flood attenuation	1.3
Streamflow regulation	1.4
Sediment trapping	2.8
Phosphate assimilation	2.0
Nitrate assimilation	1.7
Toxicant assimilation	2.1
Erosion control	0.0
Carbon Storage	0.8
Biodiversity maintenance	1.4
Water Supply	0.3
Harvestable resources	1.2
Cultivated foods	1.2
Cultural value	1.0
Tourism and recreation	0.4
Education and research	0.5
SUM	**18.1**
Average score	**1.2**

Ecosystem service	Ephemeral Drainage Lines
Flood attenuation	1.1
Streamflow regulation	1.0
Sediment trapping	2.0
Phosphate assimilation	1.6
Nitrate assimilation	1.3
Toxicant assimilation	1.6
Erosion control	0.0
Carbon Storage	0.8
Biodiversity maintenance	1.3
Water Supply	0.3
Harvestable resources	1.2
Cultivated foods	1.2
Cultural value	1.0
Tourism and recreation	0.4
Education and research	0.5
SUM	**15.2**
Average score	**1.0**

APPENDIX H – Risk Analysis

Table F1: Outcome of the Risk Assessment applied to ascertain the significance of risk posed to the Steelpoort River and study area.

No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Adjusted Risk Rating	Confidence level
1	Construction Phase	Site preparation prior to construction activities of surface infrastructure components located outside of the Steelpoort River and non-perennial rivers and associated floodlines	Vehicular movement (transportation of construction materials)	*Loss of watercourse vegetation, associated habitat and ecosystem services; *Transportation of construction materials can result in disturbances to soils, and increased risk of sedimentation/erosion; and *Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles.	1	1	1	1	1	1	1	3	5	1	5	1	12	36	L	NA	70
2			Removal of vegetation and associated disturbances to soils.	*Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream watercourse areas; *Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the watercourses;	2	1	2	2	1.8	2	2	5.75	5	3	5	1	14	80.5	M	-25 L	85

No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Adjusted Risk Rating	Confidence level
				*Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; and *Proliferation of alien and/or invasive vegetation as a result of disturbances.																	
3		Site preparation prior to construction activities relating to the construction of new roads and installation of underground cables traversing through watercourses.	Removal of vegetation and associated disturbances to soils.	*Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream watercourse areas; *Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the watercourses; *Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; and *Proliferation of alien and/or invasive vegetation as a result of disturbances.	2	1	2	2	1.8	1	1	3.75	5	3	5	1	14	52.5	L	NA	70
4		Construction of surface infrastructure outside of the Steelpoort River and non-perennial	*Removal of vegetation and topsoil and associated stockpiling; *Ground-breaking and earthworks relating to foundations and trenches; *Mixing and	*Disturbances of soils leading to increased alien vegetation proliferation within the terrestrial buffer zone surrounding the watercourses, with the	2	1	2	1	1.5	2	2	5.5	5	3	5	1	14	77	M	-22 L	85

No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Adjusted Risk Rating	Confidence level
		rivers and associated floodlines.	casting of concrete for construction purposes; *Backfilling of excavated and disturbed areas; and *Miscellaneous activities by construction personnel.	potential to affect the watercourse habitat; *Altered runoff patterns within the local catchment of the watercourses, potentially leading to increased erosion and sedimentation of the watercourses; *Potential impacts on the water quality of surface runoff (when present) which may potentially enter the watercourses and contamination of soils due to concrete being cast; and *Potential of backfill material to enter the watercourses, increasing the sediment load of the watercourses.																	
5		Construction of new road crossings and trenching through the watercourses (Impact on the Steelpoort River)	➢ Compaction of soil in the existing road reserve to increase the width of the roads; Importation of materials to construct the roads.	➢ Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream reach of the watercourse; ➢ Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the	2	1	2	2	1.8	1	1	3.75	5	3	5	1	14	52.5	L	NA	70

No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Adjusted Risk Rating	Confidence level
				downstream reach of the watercourse; ➢ Increased sedimentation of the watercourses, leading to smothering of vegetation associated in the watercourses; and ➢ Proliferation of alien and/or invasive vegetation as a result of disturbances.																	
6		Construction of new road crossings and trenching through the watercourses (Direct impact on the drainage lines)	➢ Compaction of soil in the existing road reserve to increase the width of the roads; Importation of materials to construct the roads.	➢ Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream reach of the watercourse; ➢ Exposure of soils, leading to increased runoff, and erosion, and thus increased sedimentation of the downstream reach of the watercourse; ➢ Increased sedimentation of the watercourses, leading to smothering of vegetation associated	3	2	3	2	2.5	2	1	5.5	5	3	5	1	14	77	M	NA	85

No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Adjusted Risk Rating	Confidence level
				in the watercourses; and i ➢ Proliferation of alien and/or invasive vegetation as a result of disturbances.																	
7		Canalisation of two ephemeral drainage lines located in Site 5 (Impact on the Steelpoort River)	➢ Removal of vegetation and topsoil and associated stockpiling; Ground-breaking and earthworks relating to the installation of concrete slabs and terrafix blocks or similar approved construction material.	➢ Disturbances of soils leading to increased alien vegetation proliferation within the terrestrial buffer zone surrounding the watercourse, with the potential to affect the watercourse habitat; ➢ Altered runoff patterns within the local catchment of the watercourses, potentially leading to increased erosion and sedimentation of the watercourses; Potential impacts on the water quality of surface runoff (when present) which may potentially enter the watercourses and contamination of soils due to concrete being cast.	3	2	2	2	2.3	1	1	4.25	5	3	5	1	14	59.5	M	-5 L	85

No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Adjusted Risk Rating	Confidence level
8		Canalisation of two ephemeral drainage lines located in Site 5 (Direct impact on the drainage lines)	➢ Removal of vegetation and topsoil and associated stockpiling; Ground-breaking and earthworks relating to the installation of concrete slabs and terrafix blocks or similar approved construction material.	➢ Disturbances of soils leading to increased alien vegetation proliferation within the terrestrial buffer zone surrounding the watercourse, with the potential to affect the watercourse habitat; ➢ Altered runoff patterns within the local catchment of the watercourses, potentially leading to increased erosion and sedimentation of the watercourses; ➢ Potential impacts on the water quality of surface runoff (when present) which may potentially enter the watercourses and contamination of soils due to concrete being cast.	3	2	3	2	2.5	1	3	6.5	5	3	5	1	14	91	M	NA	85
9	Operational Phase	Operation and maintenance of the surface infrastructure outside the watercourses and the 32 m NEMA ZoR	*Potential indiscriminate movement of maintenance vehicles within the watercourses or within close proximity to the watercourses; *Increased risk of sedimentation and/or	*Disturbance to soils and ongoing erosion as a result of periodic maintenance activities; *Altered water quality (if surface water is present) as a result of increased availability of pollutants	2	1	2	2	1.8	2	1	4.75	5	1	5	1	12	57	M	-2 L	

No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Adjusted Risk Rating	Confidence level
			hydrocarbons entering the watercourses via stormwater runoff from the surface infrastructure (specifically during the cleaning of the solar PV arrays).																		
10		Operation and maintenance of roads traversing watercourses	*Concentrated runoff entering the watercourses; *Disturbance to the watercourse vegetation.	• Concentrated runoff from the road crossing leading to erosion and subsequent sedimentation of the watercourses (increase in the sediment load) and turbulent flows when surface water is present; • Higher flood peaks into the watercourses due to reduced surface roughness in the watercourses.	2	2	3	2	2.3	1	1	4.25	5	1	5	1	12	51	L	NA	70
11	Decommissioning Phase	Removal of all surface infrastructure from the study area	*Movement of construction vehicles and personnel; *Disturbance to the buffer zone surrounding the watercourses	*Disturbance of soil and established vegetation in the operational area	1	1	3	2	1.8	2	1	4.75	5	2	5	1	13	61.8	M	-7 L	85

APPENDIX I – Specialist information

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Stephen van Staden MSc (Environmental Management) (University of Johannesburg)

Leandra Jonker MSc (Aquatic Health) (University of Johannesburg)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Physical address:	29 Arterial Road West, Oriel		
Postal code:	2007	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc Environmental Management (University of Johannesburg) BSc (Hons) Zoology (Aquatic ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct.

Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource Discipline Lead, Managing Member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health Practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
Member of the Gauteng Wetland Forum
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000

Short Courses

Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Tools for Wetland Assessment (Rhodes University)	2017
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2018
Wetland Management: Introduction and Delineation (WLID1502S) (University of the Free State)	2018
Hydropedology and Wetland Functioning (TerraSoil Science and Water Business Academy)	2018

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona
Central Africa – Democratic Republic of the Congo

DEVELOPMENT SECTORS OF EXPERIENCE

1. Mining: Coal, chrome, Platinum Group Metals (PGMs), mineral sands, gold, phosphate, river
2. Linear developments (energy transmission, telecommunication, pipelines, roads)
3. Minerals beneficiation
4. Renewable energy (Hydro, wind and solar)
5. Commercial development
6. Residential development
7. Agriculture
8. Industrial/chemical

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Offset Plans
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Biodiversity Assessments

- ➢ Floral Assessments
- ➢ Biodiversity Actions Plan (BAP)
- ➢ Biodiversity Management Plan (BMP)
- ➢ Alien and Invasive Control Plan (AICP)
- ➢ Ecological Scan
- ➢ Terrestrial Monitoring
- ➢ Biodiversity Offset Plan

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF LEANDRA JONKER

PERSONAL DETAILS

Position in Company	Aquatic Ecologist
Joined SAS Environmental Group of Companies	2012

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health practitioner by the South African River Health Program (RHP)
Southern African Society of Aquatic Scientists

EDUCATION

Qualifications

MSc Aquatic Health (University of Johannesburg)	2015
BSc Environmental Management (Hons) (University of South Africa)	2011
BSc Botany and Zoology (North-West University)	2009

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Free State

KEY SPECIALIST DISCIPLINES

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA, IHI & RHAM)
- Aquatic Macro-Invertebrate Community Integrity Assessments (SASS5 & MIRAI)
- Fish Community Integrity Assessments (FRAI)
- Fish Health Assessments
- Diatom Community Assessments
- Riparian Vegetation Integrity Assessments (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Sediment Chemical Analysis
- Riverine Rehabilitation Plans

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

Appendix E4:
Biodiversity

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

ENVIRONMENTAL AUTHORISATION FOR THE PROPOSED 100MWP PHOTOVOLTAIC PLANT ASSOCIATED WITH THE TUBATSE FERROCHROME SMELTER, STEELPOORT, FETAKGOMO TUBATSE LOCAL MUNICIPALITY, LIMPOPO.

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

MV 18

1. SPECIALIST INFORMATION

Specialist Company Name:	Bathusi Environmental Consulting cc (CK99/052182/52)			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
Specialist name:	Riaan A. J. Robbeson			
Specialist Qualifications:	M.Sc. (Plant Ecology)			
Professional affiliation/registration:	South African Council of Natural Scientific Professions (SACNASP) Pri.Sci.Nat (Botany, Ecology), Cand.Nat.Sci (Zoology), Reg No: 400005/03			
Physical address:	Balboa Place 9, Eldoglen, 0157			
Postal address:	PO Box 77448, Eldoglen			
Postal code:	0171	Cell:	082 3765 933	
Telephone:	012 658 5579	Fax:	086 636 5455	
E-mail:	riaan@bathusi.org			

2. DECLARATION BY THE SPECIALIST

I, Riaan A. J. Robbeson (Pr.Sci.Nat.), declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has, or may have, the potential of influencing any decision to be taken with respect to the application by the competent authority, and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Bathusi Environmental Consulting (CK99/052182/52)

Name of Company:

20th September 2021

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Riaan A. J. Robbeson (Pr.Sci.Nat.), swear under oath/ affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Bathusi Environmental Consulting (CK99/052182/52)

Name of Company

20th September 2021

Date

SOUTH AFRICAN POLICE SERVICE
COMMUNITY SERVICE CENTRE
2021 -09- 20
WIERDABRUG SAPS
SUID-AFRIKAANSE POLISIEDIENS

M. M.. M.O. MBHEWSE

Signature of the Commissioner of Oaths

2021-09-20

Date

TERRESTRIAL BIODIVERSITY EIA ASSESSMENT FOR THE PROPOSED 100 MW PHOTOVOLTAIC PLANT AT THE TUBATSE FERROCHROME PLANT, SITUATED NEAR STEELPOORT IN THE LIMPOPO PROVINCE

Compiled by:

BATHUSI ENVIRONMENTAL CONSULTING CC

&

PACHNODA CONSULTING CC

Riaan A. J. Robbeson (Pr.Sci.Nat.)
SACNASP 400005/03, Botanical Science

Lukas J. Niemand (Pr.Sci.Nat.)
SACNASP 400095/06, Zoological Science

Prepared for:

Royal HaskoningDHV

BEC Report Reference:	RHD - SPV – 2021/16
Report Version:	2021.10.10.02
Royal HaskoningDHV Reference:	MD5462-101-101
Botanical Section Compiled by:	Riaan A. J. Robbeson (Pr.Sci.Nat.)
Faunal Section Compiled by:	Lukas J. Niemand (Pr.Sci.Nat.)
Status:	FINAL REPORT
Date released:	10th October 2021

DOCUMENT STRUCTURE

DOCUMENT NAVIGATION

LIST OF FIGURES

LIST OF TABLES

LIST OF GRAPHS

SECTION A: EXECUTIVE SUMMARIES

1 BACKGROUND

The client is planning to develop and operate a Photovoltaic (PV) Solar Plant (100 MW) at the Samancor Tubatse Ferrochrome Smelter in Steelpoort in the Limpopo Province. The development will be spread over 5 sites with a collective surface area of approximately 161.4 ha, and will comprise of the following infrastructure (inter alia):

⇒ Solar PV panels that will be able to deliver up to 100 MW to the Samancor grid;
⇒ Inverters that convert direct current (DC) generated by the PV modules into alternating current (AC) to be exported to the electrical grid;
⇒ Inverter and transformer combination – each power block will have a centralised inverter which converts the DC power generated by the PV panels, to AC power and a transformer which transforms the power to a higher voltage of 33 kV to facilitate transmitting the power over longer distances to connect to the East and West Plant Substations; and
⇒ Instrumentation and Control consisting of hardware and software for remote plant monitoring and operation of the facility.

Appurtenant infrastructure will also include:

⇒ Mounting structures for the solar panels in a fixed tilt of rotating tracking configuration;
⇒ Cabling between the structures, to be lain underground where practical;
⇒ New 33 kV powerlines (either overhead lines or underground cables) between the various sites and the Tubatse East and West substation buildings;
⇒ Containerized switchgear substation at Tubatse East and West MV substations for connecting to the Tubatse substation busbars;
⇒ Water provision infrastructure (i.e. pipeline/s, storage tank/s, etc.) for PV panel cleaning;
⇒ Battery Energy Storage System (BESS); and
⇒ Internal access roads (4- 6 m wide) will be constructed (existing roads will be used as far as possible), fencing (approximately 1.8 m in height), gates and access control.

To establish the ecological importance and potential impacts on the terrestrial ecological receiving environment, BEC was requested to compile an EIA assessment. Towards this objective, suitable site inspections were conducted on 28th April to 2nd May 2021, and 7th to 8th September 2021. No survey limitations were identified, although no nocturnal surveys were conducted for the faunal surveys. Climatic, seasonal and environmental conditions were regarded optimal to establish the nature and sensitivity of the site and inform the project accordingly.

2 BIOPHYSICAL ENVIRONMENT

The following biophysical aspects have a determining effect on the status and nature of remaining natural habitat and flora and fauna species of the receiving environment:

⇒ Land use, on a regional scale, is decidedly rural with commercial livestock and agricultural land uses dominating, while mining and associated commercial activities concentrated within the consolidated urban nodes, such as Steelpoort. Numerous small villages are sprawled across the landscape, notably along the Steelpoort River and major roads, characterised by deteriorated and transformed areas in the immediate surrounds.
⇒ Extensive areas of natural habitat remain in the larger region; these areas are typically associated with land uses that are conducive to the preservation of natural habitat, including wildlife farming and livestock grazing activities.
⇒ Mining and associated commercial beneficiation industries account for the major industrial type of land uses of the immediate region, which is particularly prevalent in the Steelpoort area.

- ⇒ Land use within the immediate region (<2 km) is largely determined by industrial, commercial and residential land uses associated with Steelpoort town, and the sites conform to disjunct, fragmented and isolated pockets of remaining natural (woodland) habitat that has been subjected to (subsistence) livestock farming practices.
- ⇒ Disruptive land uses from the surrounding properties/ areas that have had an adverse effect on the status of the land include mining and industrial activities, mining infrastructure (ponds, artificial impoundments, spoils heaps, etc.), roads and railway lines, informal and illegal sand mining activities and residential areas and rural townships.
- ⇒ The proposed sites comprise mostly natural woodland habitat, but because of proximity to the Steelpoort town, exhibiting varying (moderate to significant) levels of habitat deterioration that stems from typical and surrounding land use activities, including severe and persistent grazing pressure and inappropriate fire regimes. However, most of the remaining natural woodland correlates to the regional ecological type.
- ⇒ The site is located in the Eastern limb of the Bushveld Igneous Complex and is underlain by the rocks of the Rustenburg Layered Suite, largely comprising the Dwars River Norites and Vermont Hornfels.
- ⇒ The Steelpoort climate is warm and temperate; the Köppen-Geiger chart describes the prevailing climate in Steelpoort as a local steppe climate (BSh, hot semi-arid climate).
- ⇒ Average temperatures for the local region range between 13.8°C (June) and 24.2°C (January).
- ⇒ The Mean Annual Precipitation (MAP) was estimated to be approximately 606 mm per annum, which occur mostly in the form of severe thundershowers during summer, mainly during the months of October and March with the peak period being January.
- ⇒ Winds are predominantly in a northeastern direction with significant windspeeds often ranging between 12 and 28 km/h, but rarely exceeding 28 km/hr.
- ⇒ The proposed sites are geographically situated on the slightly undulating plains around Steelpoort. Local drainage patterns and topographical features include shallow and incised drainage lines that are often characterised by steep banks. The land generally slopes in a northwestern direction; topographical elevation varies between approximately 810 m (Site 2) and 747 m (Site 5).
- ⇒ The study area is situated in the Olifants-North Primary Catchment area. The Steelpoort River is the main river of the immediate area, with typical non-perennial drainage lines and valleys that feeds into the river.

3 REGIONAL ECOLOGICAL SENSITIVITIES

- ⇒ The proposed site is spatially situated within the Sekhukhune Centre of Plant Endemism. One of the characteristic trees of this bushveld type is *Kirkia wilmsii*, a species that is relatively rare in other parts of the Mixed Bushveld, but which occur in parts of the proposed development footprints, notably Site 2.
- ⇒ The genus *Aloe* is particularly prolific, with many of the species being shared with the adjacent Wolkberg Centre, as can also be noted from the proposed development footprints.
- ⇒ The sites are not situated within, or in proximity to, any informal or declared protected area.
- ⇒ The Limpopo Conservation Plan (v2, 2013) categorised the respective sites as inclusive of CBA1, CBA2, ESA1 and ESA2 categories, although the author is not entirely in agreement with ascribed categories, and rather considers the higher conservation categories an erroneous interpretation of available regional information sets.
- ⇒ Further revision of the LCPv2 bioregional plan was developed in 2018, notably addressing the Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) that were originally identified and delineated for LCPv2 (2013) and designated the remaining areas of natural habitat within the development footprints as ESA1 habitat, while remaining areas are mostly (and more accurately) categorised as 'no natural habitat remaining'.
- ⇒ An appraisal of the Sekhukhune District Bioregional Conservation Plan categories, specifically in comparison with the LPCPv2, provides for a more accurate and appropriate categorisation of habitat within the proposed development footprints.

⇒ A review of the evaluation of local and regional information sources ultimately indicates a moderate to moderate-high ecological status and sensitivity of the proposed site, which correlates with preliminary floristic and faunal results obtained from the site inspection, and also taking note of the following key aspects:
- Botanical diversity, importance and sensitivity – moderate-high sensitivity that is mostly a result of the presence of several species of conservation importance and remaining natural woodland habitat that is considered moderately representative of the regional type;
- Faunal and avifaunal diversity, importance. A poor compliment of terrestrial fauna species, reflecting severe anthropogenic impacts from surrounding land use activities, including industrial, peri-urban, residential, commercial and severe utilisation, ultimately rendering the faunal component moderately compromised;
- Biophysical and regional sensitivity and importance attributes; and
- Context of the proposed industrial development on a temporal and spatial scale.

4 BOTANICAL ATTRIBUTES AND IMPACT STATEMENT

The following key results were obtained from the botanical assessment:

⇒ The study area is spatially situated within the Sekhukhune Plains Bushveld, with a regional conservation level of Vulnerable; approximately 25 % of this area has already been transformed.

⇒ A small area around Steelpoort is under severe pressure from chrome and platinum mining and industrial activities with associated urbanisation; depending on commodities, these pressures are likely to increase in near future.

⇒ A floristic species richness of at least 196 plant species was recorded, which corresponds (numerically) to approximately 34.2 % of the sampling records from the wider study area, reflecting a moderate-high floristic diversity, notwithstanding the comparative small size of the survey areas.

⇒ Despite the savannoid nature of the study areas, herbaceous and graminoid life forms dominate the species richness with 36 species (18.4 %) and 34 (17.3 %), respectively. Trees (22 species, 11.2 %), shrubs (20 species, 10.2 %) and small trees (17 species, 8.7 %) comprise lower species richness, although dominating the physiognomy. The succulent diversity of the areas is noted with a total of 22 species (11.4 %), while life forms of lower abundance include dwarf shrubs, climbers, prostrate herbs and geophytes.

⇒ A total of 54 plant families were recorded during the surveys, typically dominated by Poaceae (grasses, 35 species, 18.1 %), Fabaceae (24 species, 12.4 %), Asteraceae (15 species, 7.8 %) and Malvaceae (13 species, 6.7 %). Families with lower representation include Euphorbiaceae, Apocynaceae, Asphodelaceae, Lamiaceae, Cactaceae, Capparaceae, Acanthaceae and Combretaceae.

⇒ Nine protected and conservation important plant species were recorded from the proposed development footprints, including:
- *Adenia fruticosa* (Vulnerable, IUCN)*;*
- *Aloe burgersfortensis;*
- *Balanites maughamii;*
- *Boscia albitrunca;*
- *Elephantorrhiza praetermissa;*
- *Eulophia petersii;*
- *Sclerocarya birrea* subsp. *caffra;*
- *Stapelia gettliffei*; and
- *Stapelia gigantea*;

⇒ The National Web-based Environmental Screening Report indicated eight species of conservation concern that are considered likely to be present in the immediate region. A review of their habitat requirements and the available habitat diversity and status indicated that none of these species are considered likely to persist within the proposed development footprints.

The following broad-scale habitat types were recognised from the study areas and the immediate surrounds:

⇒ Artificial Impoundments (low floristic sensitivity);
⇒ Deteriorated Open Shrubland Types (moderate-low floristic sensitivity);
⇒ Drainage Lines and Variable Shrubland Banks (moderate-high floristic sensitivity);
⇒ Steelpoort River, Tall Closed Riparian Banks and Phragmites Levees (moderate-high floristic sensitivity);
⇒ Tall Closed Riparian Bushland (moderate-high floristic sensitivity);
⇒ Closed Mixed Thicket and Bushland (moderate-high floristic sensitivity);
⇒ Transformed Areas, Infrastructure, Industries, etc. (low floristic sensitivity); and
⇒ Variable Mixed Shrubland (moderate-high floristic sensitivity).

A review of the proposed development and activities, indicated the following potential and anticipated impacts on the floristic receiving environment:

Impact 1: Impacts on/ losses of conservation important and protected plant species (individuals, stands, populations) as well as habitat that is associated with these plant of conservation consideration;
Impact 2: Losses, and deterioration, of natural and sensitive habitat types, including essential habitat refugia, atypical and unique/ restricted habitat types;
Impact 3: Depletion of local floristic diversity and loss of rare species or flora communities;
Impact 4: Deterioration and changes to untransformed habitat in the surrounds, with specific reference to sensitive habitat types and habitat types of limited representation on a local scale;
Impact 5: Disruption of important ecological processes, services, and infrastructure and altered ecological functionality (including fire, erosion) of surrounding areas and natural habitat;
Impact 6: Introduction of exotic and invasive species to the area, or exacerbating the spread of existing infestations;
Impact 7: Exacerbated decline in the aesthetic appeal of the landscape;
Impact 8: Inappropriate harvesting of natural resources and exacerbation of pressure on natural resources due to increased human encroachment, accessibility to the site, also considering changes in land use of surrounding areas that are not compatible to conservation efforts;
Impact 9: Exacerbation of existing levels of habitat fragmentation and isolation, considering past, present and reasonably foreseeable future anthropogenic disruptive activities in the immediate region, with specific reference to mining activities; and
Impact 10: Cumulative impacts on local/ regional and national conservation efforts, targets, and obligations (loss of natural habitat).

1) Much of Site 1 comprises deteriorated woodland and results of the site inspection indicated that the presence of conservation important and protected plant species on this site is low, or unlikely. Anticipated impacts from a botanical perspective is likely to be moderate, mostly as a result of the minor losses of remaining natural woodland from the site (also in context with the location of the proposed site adjacent to existing transformed areas). However, the abundant presence of invasive exotic species on the site and the likely (if left uncontrolled) spread of these species to surrounding areas of natural woodland habitat types is considered an important consideration. The introduction of a generic mitigation approach, but with specific reference to the management and control of invasive plant species from the site, is likely to reduce the anticipated impacts significance to acceptably low levels.
2) Parts of Site 2 are considered moderately deteriorated and infested with exotic and invasive plants, but portions comprise are considered representative of the regional ecological types and losses of remaining natural habitat therefore represents an important consideration. Notably, the presence of several protected plants, notably the vulnerable *Adenia fruticosum*, ultimately renders the remaining natural vegetation comparatively sensitive, and losses of these conservation important plants is an additional consideration on a local scale. As this site is spatially situated on the perimeter of areas of existing transformation, including industrial and linear activities to the north,

the buffering role that this portion of land plays between these areas and pristine and natural habitat further to the south of the site is also considered important. While the anticipated impact significance is considered to be moderately high, the introduction of generic and site-specific mitigation measures, notably a dedicated invasive species management programme will ameliorate high significance impacts to a more acceptable level.

3) Site 3 comprises natural shrubveld habitat that is representative of the regional ecological types. Considering that the regional type is categorised as vulnerable, and also with the known presence of conservation important plants within this site, the floristic sensitivity is considered moderately high. Losses of conservation important plants and natural savanna habitat is therefore considered significant on a local scale and the implementation of a generic mitigation approach, notably the relocation of conservation important plants from the site, will only render the post-mitigation significance of anticipated impacts moderate, albeit mostly localised.

4) Site 4 comprises natural shrubveld habitat that is representative of the regional ecological types. Considering that the regional type is categorised as vulnerable, and also with the known presence of conservation important plants within this site, the floristic sensitivity is considered moderately high. Losses of conservation important plants and natural savanna habitat is considered significant, although only from a local perspective and the implementation of a generic mitigation approach, notably the relocation of conservation important plants from the site, will only render the post-mitigation significance of anticipated impacts moderate, although mostly localised.

5) Aspects that render Site 5 moderately high in sensitivity, despite the moderately deteriorated nature of most of the habitat, include the abundant presence of conservation important plants and protected tree species, the presence of the ecologically significant and sensitive Steelpoort River system to the immediate north of the site and several smaller drainage lines across the larger site. The proximity of these surface drainage systems are important considerations, albeit mostly in ecological terms (and not necessarily as significant botanical features), ultimately renders the anticipated significance of impacts on the floristic receiving environment of a high nature, despite the moderately deteriorated status of much of the shrubveld of this site.

The following key consideration are presented in support of the Professional Opinion:

⇒ Ecological attributes of the study site are regarded common and ubiquitous to the wider region;

⇒ No threatened plant species were recorded within the site during the site investigation, or are considered highly likely to occur within any of the development footprints;

⇒ A number of protected species were recorded within the site during the site investigation;

⇒ No habitat type within the site are regarded restricted on a local or wider scale. The site also does not exhibit any biophysical feature of rarity or elevated ecological importance or sensitivity;

⇒ The development footprints comprise mostly woodland habitat that exhibit moderate levels of deterioration;

⇒ The loss of deteriorated habitat from the site is not expected to result in significant, or unacceptable, impacts on provincial biodiversity conservation efforts;

⇒ The loss of these portions of woodland habitat is also not anticipated to result in significant changes or disruptions to ecological processes on a local or regional scale; and

⇒ The application of the recommended mitigation approach is expected to ameliorate anticipated impacts to an acceptable low level.

It is therefore the considered opinion, based on results of this botanical investigation, that no specific objections are raised to the proposed development. This opinion is based on the explicit understanding that the recommended mitigation approach is timeously and comprehensively implemented and also adhered to during all stages of the development.

5 FAUNAL ATTRIBUTES AND IMPACT STATEMENT

The following key results were obtained from the faunal EIA assessment:

⇒ The expected mammal richness on the study area and immediate surroundings was approximately 63 species, of which only 10 species have so far been documented for the QDS 2430CA quarter degree grid (QDS) that is sympatric to the larger part of the the study area.

⇒ Approximately 49 mammal species (78 % of the expected richness) have a high probability to be present on the study area, of which 15 of these species (31 % of species with a high probability of occurrence) were confirmed during the survey (April/May 2021). This diversity included:
- four (4) rodents;
- three (3) bovid antelopes;
- one (1) canid (jackals);
- one (1) primate (monkeys and baboons);
- one (1) herpestid (mongoose);
- one (1) viverrid (genet);
- one (1) leporid (hares and rabbits);
- one (1) orycteropid (aardvark); and
- two (2) suids (pigs).

⇒ It was evident that the mammal richness on the study areas is relatively poor, which is best explained by a high degree of industrial and human-induced activities in the area.

⇒ Domestic cats (*Felis catus*) are prevalent on the study area, posing an eminent threat to extant small vertebrate fauna within the wider area. The occurrence of domestic cats may also result in genetic contamination of the indigenous feline population, in particular the African Wild Cat (*F. sylvestris*) due to inbreeding.

⇒ The presence of surface outcrops immediately east of Site 2 provided micro-habitat for small mammal taxa with rupicolous affinities as well as large mammal taxa with large home range sizes. These features also provide foraging habitat for an overlooked sub-population of Southern Mountain Reedbuck (*Redunca f. fulvorufula*).

⇒ The study area provides habitat for three threatened and four near threatened mammal species. Four of these species exhibit a high probability of occurrence, of which the endangered Southern Mountain Reedbuck *Redunca f. fulvorufula*) was confirmed.

⇒ The amphibian richness on the study area is considered low, with only 14 frog species expected to occur.

⇒ The reptile composition on the study area is poorly known with only 23 species currently known from the wider study area, although the expected richness was predicted to be as high as 54 species.

⇒ The species accumulation curve (SAC) for all bird point counts pooled reached an asymptote at approximately 20 counts. The sampling sufficiency captured approximately 80 % of the number of bird species at 20 counts as predicted by the Michaelis-Menten model. Approximately 82 % of the predicted bird species was captured by the total number of sampling points (n=23).

⇒ Approximately 253 bird species are expected to occur on the wider study area (including adjacent habitat), of which 127 species were observed during the April/May 2021 survey on the project sites.

⇒ A total of eight (8) bird species of conservation importance has been recorded from the wider study area (sensu SABAP2 and personal observations), which included four (4) globally threatened species, two (2) regionally threatened species and two (2) regionally near threatened species.

⇒ The regionally vulnerable Lanner Falcon (*Falco biarmicus*) was the only species of conservation concern that was observed on the study sites (c. Site 5 and Site 3) during the April/May 2021 site visit. It is however regarded as a regular foraging visitor to the study area, with at least one pair present in the area and it is likely that local inhabitants of this species probably breeds in the high mountains north of the study sites at the Lekgobo mountains on the Farms Winterveld and Doornbosch.

Anticipated impacts from the proposed solar facility on the faunal receiving environment include the following:

Table 1: Summary of impact significance on the faunal receiving environment

Nature	*Before Mitigation*	*After Mitigation*
Impact 1: Direct and permanent loss of natural fauna habitat within the development footprints during the construction, operational and also the decommissioning phases.	19.0	9.75
Impact 2: Indirect losses of animal taxa, especially threatened and near threatened animal species due to the displacement from the area during the construction and operational phases.	17.0	6.5
Impact 3: Indirect ecological impacts during all phases pertaining to the loss of the ecological connectivity and faunal dispersal corridors	17.25	8.5
Impact 4: Secondary impacts related to infrastructure attracting animals (nesting and roosting on structures, foraging underneath panels, bird pollution)	13.5	7.0
Impact 5: Subsequent habitat changes and changes to the local fauna community structure and composition (mainly generalists and secondary species).	14.25	7.0
Impact 6: Indirect impacts related to anthropogenic encroachment (job-seeking people, increased plundering of natural resources and poaching of wildlife due to increased human encroachment).	9.0	9.0
Impact 7: Cumulative impacts on local/ regional and national conservation targets and obligations (e.g. loss of natural habitat) and expansion of developments in the wider study area	15.0	10.0

This report ultimately concludes that the general faunal assemblages on the study area are mainly represented by widespread taxa that show large distribution ranges across the Savanna Biome. Charismatic and threatened animal taxa were, in general, uncommon on the respective sites, apart from the regular occurrence of the vulnerable Lanner Falcon (*Falco biarmicus*) at Site 5 and Site 3, and the occurrence of an overlooked sub-population of the endangered Southern Mountain Reedbuck (*Redunca f. fulvorufula*) near Site 2. The preservation of habitat with a high ecological connectivity, for example all drainage lines and the riparian thicket corridor along the Steelpoort River is regarded as a high priority in order to maintain and facilitate extant animal dispersal corridors across the study area. Nevertheless, most of the project sites were located and surrounded by industrial infrastructure and areas where human activities were relatively of high frequency, which collectively contributed over time to the formation of short open deteriorated woodland habitat or habitat that were fragmented, thereby containing unspecialised and generalist taxa.

It is predicted that anticipated and likely impacts on the faunal component of the study areas were likely to be of medium significance (prior to mitigation) at most of the proposed project sites, although the loss of habitat and dispersal corridors (e.g. Site 5) was regarded to be of high significance (prior to mitigation). The implementation of the suggested mitigation approach is expected to result in the amelioration of the anticipated impacts to an acceptable level, with priority given to the natural dispersal of animals between and among habitat units in the wider study area. Therefore, no specific objections to the project was raised, but with the understanding that the suggested mitigation protocol is timeous and comprehensively implemented.

SECTION B: ADMINISTRATIVE DETAILS

6 PROJECT MINUTIAE

Table 2: Project details	
Client	Royal HaskoningDHV, on behalf of Samancor Chrome Limited
Report name	Terrestrial Biodiversity EIA Assessment for the proposed 100 MW Photovoltaic Plant at the Tubatse Ferrochrome Plant, situated near Steelpoort in the Limpopo Province
BEC reference number	RHD – SPV – 2021/15
Report version	2021.10.10.02
Report status	Final Report
Royal HaskoningDHV reference	MD5462-101-101
Botanical section compiled by	Riaan A. J. Robbeson (Pr.Sci.Nat.), Bathusi Environmental Consulting cc
Faunal section compiled by	Lukas J. Niemand (Pr.Sci.Nat.), Pachnoda Consulting cc

7 REPORT REFERENCE & CITATION

When used as a reference, or included as an addendum, this report should be cited as:
Bathusi Environmental Consulting cc (2021). Terrestrial Biodiversity EIA Assessment for the proposed 100 MW Photovoltaic Plant at the Tubatse Ferrochrome Plant, situated near Steelpoort in the Limpopo Province. Reference Number RHD – SPV – 2021/15. Version 2021.10.10.02.

8 SPECIALIST REQUIREMENTS AND DETAILS

8.1 Ecosystem Environmental Assessment Guidelines

It is a requirement for specialists that conduct surveys and compile results and reports that they are suitable registered at SACNASP in the relevant field for the assessment. In terms of the Natural Scientific Professions Act, 2003 (Act No. 27 of 8 2003), it is illegal to practice in a professional (paid) consulting capacity without appropriate SACNASP registration. Registration with SACNASP further ensures adherence to their code of conduct.

A list of previous experience (as part of a CV) is also required for the relevant biome and/or ecosystem e.g. an experienced forest ecology specialist cannot be considered as a freshwater specialist without demonstrated qualifications and experience in this regard. Relevant experience is to be clearly highlighted in the specialist's curriculum vitae attached to the specialist report.

The specialists performing the required field survey and the reporting must be experienced and qualified to do so. The practice where unqualified, inexperienced persons conduct unsupervised fieldwork and reporting, which is then underwritten or 'signed off' by a qualified and/or SACNASP-registered specialist is not acceptable. It is, however, acceptable for Candidate Natural Scientists (Cand.Sci.Nat.) to work under the supervision of a Professional Natural Scientist (Pr.Sci.Nat) who signs off on their work, but only if the person qualified as Pr.Sci.Nat is present on site during the field survey and appends a signed declaration to the report stating that all facets of the work performed by the Cand.Sci.Nat. were appropriately supervised.

8.2 SACNASP

The Natural Scientific Professions Act (South Africa, No. 27 of 2003) aims to 'provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP), and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith'. Quoting the South African Council for Natural Scientific Professions Act revised 2019), specialists must:

"5 Only undertake natural scientific work which their education, experience or background have rendered them competent to perform; and

8 Not knowingly misrepresent or permit misrepresentation of their own or their associates' academic or professional qualifications, neither exaggerate their own degree of responsibility for any work of a natural scientific nature."

Quoting the Natural Scientific Professions Act of 2003: '*Only a registered person may practice in a consulting capacity*' (20(1) – pg 14).

8.3 BIODIVERSITY SPECIALIST DETAILS

Table 3: Biodiversity specialists for this project	
Botanical and Ecological Specialist:	*Riaan Robbeson (Pr.Sci.Nat.)*
Qualification:	M.Sc. (Botany), UP
Affiliation:	South African Council for Natural Scientific Professions (SACNASP)
Fields of Expertise:	Botanical Scientist & Ecological Scientist
Fields of Expertise:	Zoological Scientist (Cert.Nat.Sci.)
Registration Number:	400005/03
Affiliation:	Grassland Society of Southern Africa
Affiliation:	South African Association of Botanists
Affiliation:	South African Wildlife Management Association
Affiliation:	Zoological Society of Southern Africa
Faunal and Avifaunal Specialist:	*Lukas Niemand (Pr.Sci.Nat.)*
Qualification:	M.Sc. (Restoration Ecology), University of Pretoria
Professional Affiliation:	South African Council for Natural Scientific Professions
Fields of expertise:	Ecological Scientist & Zoological Scientist
Registration number:	400095/06
Affiliation:	Birdlife South Africa (1039913)
Affiliation:	Hartbeespoort Natural Heritage Society

CVs are presented in Appendix 8

8.4 DECLARATION OF INDEPENDENCE

We, the undersigned, acting in the capacity as specialist biodiversity consultants, and the legal representatives of the respective companies (Bathusi Environmental Consulting, Pachnoda Consulting), declare that:

⇒ while we are committed to the conservation of biodiversity, we also concomitantly acknowledge and recognize the need for economic development and the sustainable utilisation of natural resources;

⇒ we executed our duties as independent specialist consultants conducting the biodiversity impact assessments and preparing the products;

⇒ we performed all activities associated with the project in line with relevant legislation and comply with ethical requirements related to our profession;

⇒ findings, results, observations, conclusions, and recommendations presented in this report are based on the authors' best scientific and professional knowledge as well as the interpretation of information available to them at the time of compiling this report.

⇒ at the time of presenting this proposal, we did not have any interest, hidden or otherwise, in the proposed development or activity, as outlined in this document, other than expecting fair financial compensation for work performed in a professional capacity, as specified by the National Environmental Management Act (No 107 of 1998) (2014) Regulations GNR 983 and GNR 986, as amended in 2017;

⇒ as affiliated members, we consider ourselves bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);

⇒ neither BEC, nor Pachnoda Consulting are subsidiaries, legally or financially, of Royal HaskoningDHV or SAMANCOR;

⇒ we shall not be affected in any manner by the outcome of the environmental process of which the reports and biodiversity assessments form part of, other than being part of the general public;

⇒ we do not necessarily object to or endorse the proposed development from a personal perspective, but aim to present facts and recommendations based on scientific data and relevant professional experience;

⇒ we do not have any influence over decisions made by the governing authorities; and

⇒ we undertake to disclose to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2005.

Riaan A. J. Robbeson (Pr.Sci.Nat.)
(Bathusi Environmental Consulting cc)

Lukas J. Niemand (Pr.Sci.Nat.)
(Pachnoda Consulting cc)

10th October 2021

9 SITE LOCATION

Country:	South Africa
Province:	Limpopo Province
District Municipality:	Sekhukhune District Municipality
Local Municipality:	Fetakgomo-Greater Tubatse Local Municipality
Magisterial District:	Tubatse
Nearest town:	Steelpoort
Extent:	Approximately 161.4 ha (5 sites collectively), without with consideration of access roads and OHL
Site access:	The sites are spatially arranged east and west of Steelpoort and north and south, and with direct access, from the R555.

Table 4: Development site details

Site	*GPS Location*	*Extent (ha)*	*Farm and Portion Details*
Site 1	S24.7276° & E30.2091°	31.7 ha	Goudmyn 337-KT Portion 10
			Olifantspoortje 319-KT Remainder of Portion 5
Site 2	S24.7583° &E30.2104°	24.2 ha	Goudmyn 337-KT Portion 10
Site 3	S24.7459° &E30.1865°	15.8 ha	Goudmyn 337-KT Portion 0
Site 4	S24.7496° &E30.1826°	20.0 ha	Goudmyn 337-KT Portion 0
Site 5	S24.7415° &E30.1828°	69.7 ha	Goudmyn 337-KT Portion 0
			Goudmyn 337-KT Portion 6

An indication of the regional location is provided in Figure 1 and aerial imagery of the site and local surrounds are provided in Figure 2.

10 PROJECT SYNOPSIS

The client is planning to develop and operate a Photovoltaic (PV) Solar Plant (100 MW) on selected portions of the Farms Goudmyn 337-KT and Olifantspoortje 319-KT, situated around the town of Steelpoort in the Limpopo Province. The plant will be spread over a total of 5 sites and will consist of the following infrastructure:

⇒ Solar PV panels that will be able to deliver up to 100 MW to the Samancor grid;
⇒ Inverters that convert direct current (DC) generated by the PV modules into alternating current (AC) to be exported to the electrical grid;
⇒ Inverter and transformer combination – each power block will have a centralised inverter which converts the DC power generated by the PV panels, to AC power and a transformer which transforms the power to a higher voltage of 33 kV to facilitate transmitting the power over longer distances to connect to the East and West Plant Substations; and
⇒ Instrumentation and Control consisting of hardware and software for remote plant monitoring and operation of the facility.

Appurtenant infrastructure will also include:

⇒ Mounting structures for the solar panels in a fixed tilt of rotating tracking configuration;
⇒ Cabling between the structures, to be lain underground where practical;
⇒ New 33 kV powerlines (either overhead lines or underground cables) between the various sites and the Tubatse East and West substation buildings;
⇒ Local substation and transformer yard at each PV site;
⇒ Containerized switchgear substation at Tubatse East and West MV substations for connecting to the Tubatse substation busbars;

⇒ Water provision infrastructure (i.e. pipeline/s, storage tank/s, etc.) for PV panel cleaning;

⇒ Battery Energy Storage System (BESS); and

⇒ Internal access roads (4- 6 m wide) will be constructed (existing roads will be used as far as possible), fencing (approximately 1.8 m in height), gates and access control.

Table 5: Technical specifications and dimensions of the PV plant arrays and facility components	
Facility Component	*Description*
Height of PV panels:	Approx. 0.8 m
Area of PV Arrays:	Refer to main EIA report for indicative illustration
Area occupied by inverter/ transformer stations/ substations:	60 m2
Capacity of on-site substation:	62.5 MW (East) + 37.5 MW (West)
Area occupied by both permanent and construction laydown areas:	The proposed size of laydown areas is defined as follows; 6m000 m² for West region (Site 3,4 & 5) and 5,000m² for East region (Site 1&2).
Area occupied by buildings:	The construction camp of approximately 2,000 m². The camp will at least consist of Office/ Admin/Storehouse, which will be located to the southeast of Site 5, close to the R555 Road
Length of internal roads:	Typically 5 m to 20 m long
Width of internal roads:	5 m
Proximity to grid connection:	Refer to attached map, varies for each site
Height of and type of fencing:	Security Fencing 1.8 m high
Overhead powerline length:	Varies in length according to site location and connection point
Overhead powerline servitude;	11 m
Overhead powerline tower height:	Between 11 m and 15 m
Battery Energy Storage System (BESS):	It is proposed to locate the BESS next to the 33 kV connector substations. Li-ion technology will be used for the BESS. The BESS will have an on-board inverter system and will connect directly to the 33 kV switchboard of the connector substations. The proposed size of the BESS combined for East and West plant locations is a minimum value of 200 MWh. This will typically require a combined footprint of approximately 2-3 ha.
Construction/ labor camp:	Construction camp to be constructed for up to 600 people, with an approximate size of 2,000 m², as indicated on the layout map. The camp will at least consist of Office/Admin/Storehouse and will be situated in the southeast of Site 5, close to the R555 Road.

A basic illustration of the spatial arrangement of the proposed sites and appurtenant road and powerline infrastructure is presented in Figure 2.

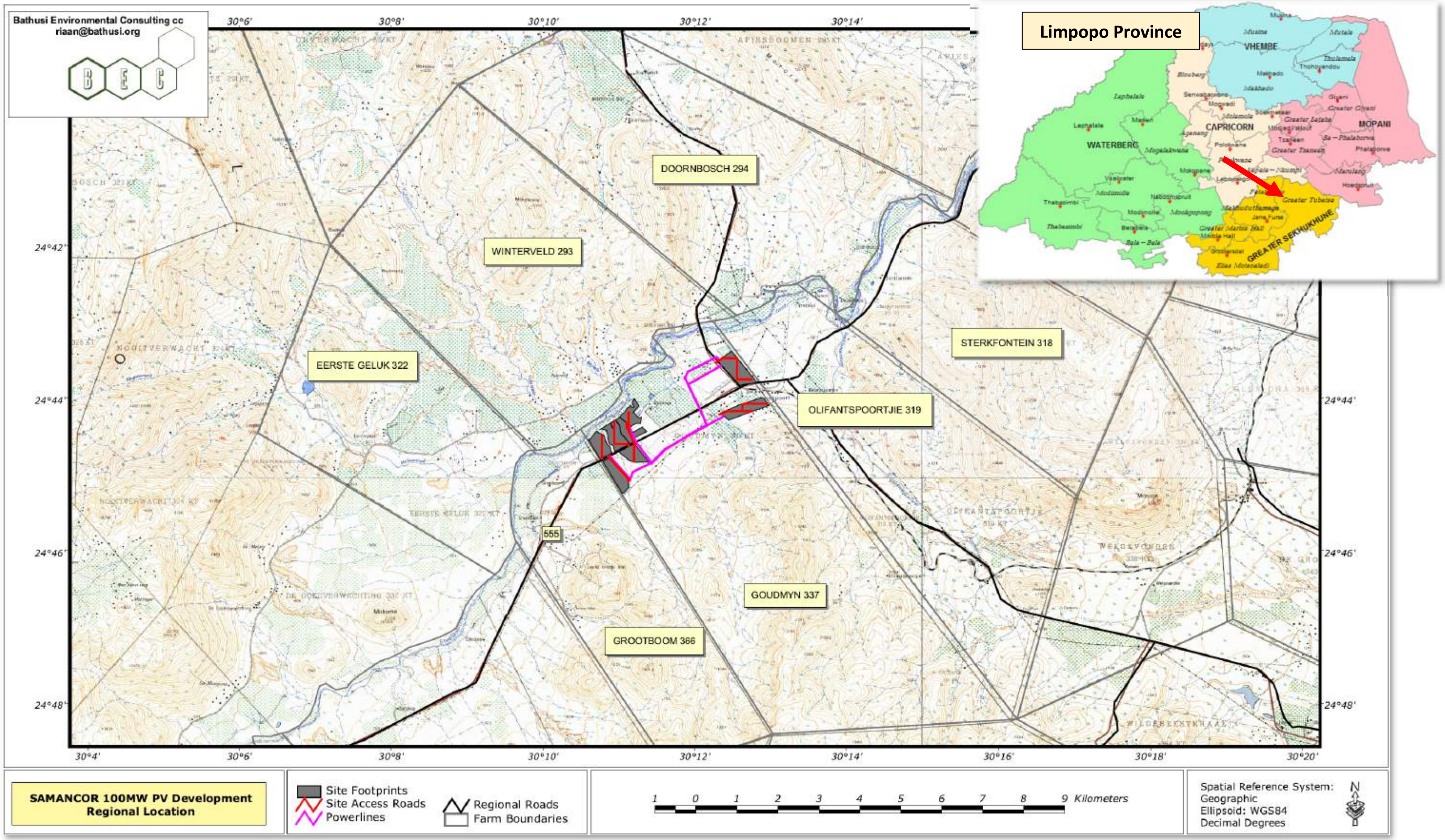


Figure 1: Regional location of the study area
imagery courtesy of Google Earth© (2021), note insert for municipalities within Limpopo Province and arrow for approximate site location

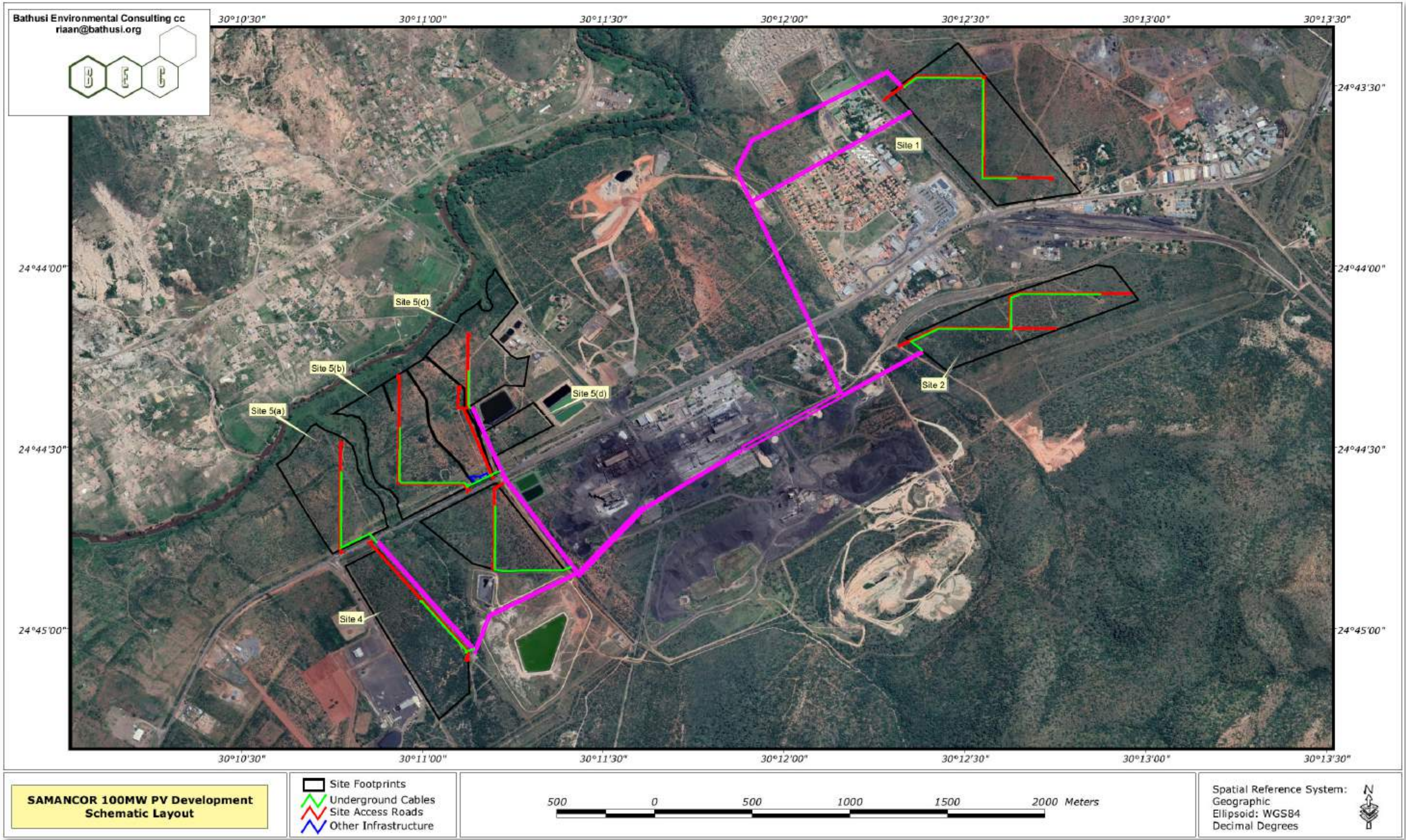


Figure 2: Aerial imagery of the site and immediate surrounds and schematic layout of the project

SECTION C: BIOPHYSICAL ATTRIBUTES OF THE AREA

11 LAND COVER & LAND USE

BGIS (2021) information source indicates the extent of the (Fetakgomo) Greater Tubatse Local Municipality as approximately 459,900 ha of which roughly 85 % remains untransformed, although anecdotal evidence indicates that high levels of habitat deterioration might have contributed to losses of natural habitat that are greater than the levels reflected by the BGIS information dataset. Consolidated urban areas in this municipality include Steelpoort, Burgersfort and Ohrigstad. These towns function as service centres of the surrounding villages and commercial farms, which have very low economic bases and urbanisation of people from surrounding villages to the major towns represent a significant migration pattern and are serviced by moderately developed linear road and railway infrastructure.

Land use within the larger region is decidedly rural, characterised by commercial agriculture and extensive livestock farming. Numerous small villages are sprawled across the landscape, notably along the Steelpoort River and major roads, characterised by deteriorated and transformed areas in the immediate surrounds. Mining and associated beneficiation industries account for major industrial type of land uses of the immediate region, which is particularly prevalent in the Steelpoort area. Steelpoort town comprises mainly mining (inclusive of mineral processing and beneficiation plants) and other industrial land use types as well as medium density housing (peri-urban) and a small retail/ commercial component.

Table 6: Distribution of land use in Greater Tubatse Municipality

Land Cover Category	*Extent*
Permanent commercial dryland	48.1 %
Temporary commercial irrigated	0.8 %
Degraded: thicket and bushland	0.1 %
Degraded: unimproved grassland	0.3 %
Forest and woodland	0.1 %
Plantation	0.2 %
Mines and quarries	2.1 %
Thicket and bushland	5.6 %
Unimproved grassland	40.9 %
Urban	1.8 %
Waterbodies	0.1 %

**Source: Housing Development Agency (2013)*

Aerial imagery of the immediate region (<2 km, refer Figure 2) reflects a moderately transformed local region that is accompanied and characterised by moderate levels of deterioration that are typically associated with intensive industrial and residential/ commercial land use activities around Steelpoort (south and southwest), as well as loss of habitat and associated impacts that are evident from rural villages and intensive utilisation of natural resources for subsistence purposes (northwest and west). Impacts associated with subsistence agriculture and persistent and high grazing pressure to the north of the site is evident from a severely deteriorated woody component of the area and a poorly developed and depauperate herbaceous stratum is often present. Commercial agricultural practices of the region is strongly correlated with the Steelpoort River, Speekboom and other smaller, perennial rivers from which water is extracted for irrigation purposes (mainly citrus). Severe erosion patterns are also noted from drainage channels, nearby banks and floodplains, notably to the northwest of the sites, exhibiting severe erosion and the effects of persistent and inappropriate utilisation (GTLM SDF, 2007).

From available imagery it is however evident that extensive areas of natural habitat remain in the larger region; these areas are typically associated with land uses that are conducive to the preservation of natural habitat, including wildlife farming and livestock grazing activities. Topographically heterogeneous habitat that creates low accessibility and mountainous terrain results in low habitation and cultivation. Conversely, most of the formal and informal exploited areas are associated with areas that are characterised by plains and 'flatland' areas. Local and regional fragmentation and habitat isolation patterns correlate to these land use patterns, manifesting as fragmented and isolated parcels in proximity to nodal development areas as well as the linear infrastructures (roads), while lower fragmentation and isolation patterns are associated with land use patterns that are conducive to preservation principles, resulting in comparatively high ecological connectivity between areas of natural habitat.

The proposed sites comprise mostly natural (woodland) habitat, but because of proximity to the Steelpoort town area, exhibit a moderate level of habitat deterioration that stems from typical and surrounding land use activities, including severe and persistent grazing pressure and inappropriate fire regimes as well as the effects from surrounding industrial land uses, such mining and industrial activities, mining infrastructure (ponds, artificial impoundments, spoils heaps, etc.), roads and railway lines, informal and illegal sand mining activities and residential areas and rural townships. However, most of the remaining natural woodland exhibit ecological attributes that correspond to the regional ecological type.

12 GEOLOGY & SOILS

The site is located in the Eastern limb of the Bushveld Igneous Complex and is underlain by the rocks of the Rustenburg Layered Suite, largely comprising the Dwars River Norites and Vermont Hornfels (refer Figure 3). Norite is a mafic intrusive igneous rock (magna forced into older rocks at depths) composed largely of the calcium-rich plagioclase labradorite, orthopyroxene and olivine, and is predominantly composed of orthopyroxenes, largely high magnesian enstatite or an iron bearing intermediate hypersthene. The Vermont Formation is composed mainly of hornfels[1]), with subordinate quartzite, dolomitic limestone and chert.

Weathering of these geological formations produces soils that are included in the Ae27 and Ea88 land types (refer Figure 4). Map units A refer to yellow and red soils without water tables and belonging in one or more of the following soil forms: Inanda, Kranskop, Magwa, Hutton, Griffin and Clovelly. The map units refer to land which does not qualify as a plinthic catena and in which one or more of the above soil forms occupy at least 40 % of the area. In Ae (red-yellow apedal, freely drained soils, red high base status, >300 mm deep, no dunes) yellow soils occupy less than 10 % of the area while dystrophic and/or mesotrophic soils occupy a larger area than high base status red-yellow apedal soils.

The Ea88 land type indicates land with high base status, dark coloured and/ or red soils, usually clayey, associated with basic parent materials, often described as dark, swelling clays. A land type more than half of which is covered by soil forms with vertic, melanic and red structured diagnostic horizons qualifies for inclusion in unit Ea provided it does not qualify for inclusion in units A, B, or C. Land types in which these soils cover less than half of the area may also qualify for inclusion (i) where duplex soils occur in the non-rock land but where unit Ea soils cover a larger area than the duplex soils, or (ii) where exposed rock covers more than half the land type. The Arcadia soil form predominates in this unit.

High variability of soils across the proposed development footprints were noted, ranging between rocky and gravelly soils in upland areas, red, sandy and loamy soils in midland positions and soils of a dark, clayey and structured disposition in bottomland positions.

[1] *A hornfel is a metamorphic rock formed by the contact between mudstone/ shales, or other clay-rich rock, and a hot igneous body, and represents a heat-altered equivalent of the original rock. The process is termed contact metamorphism*

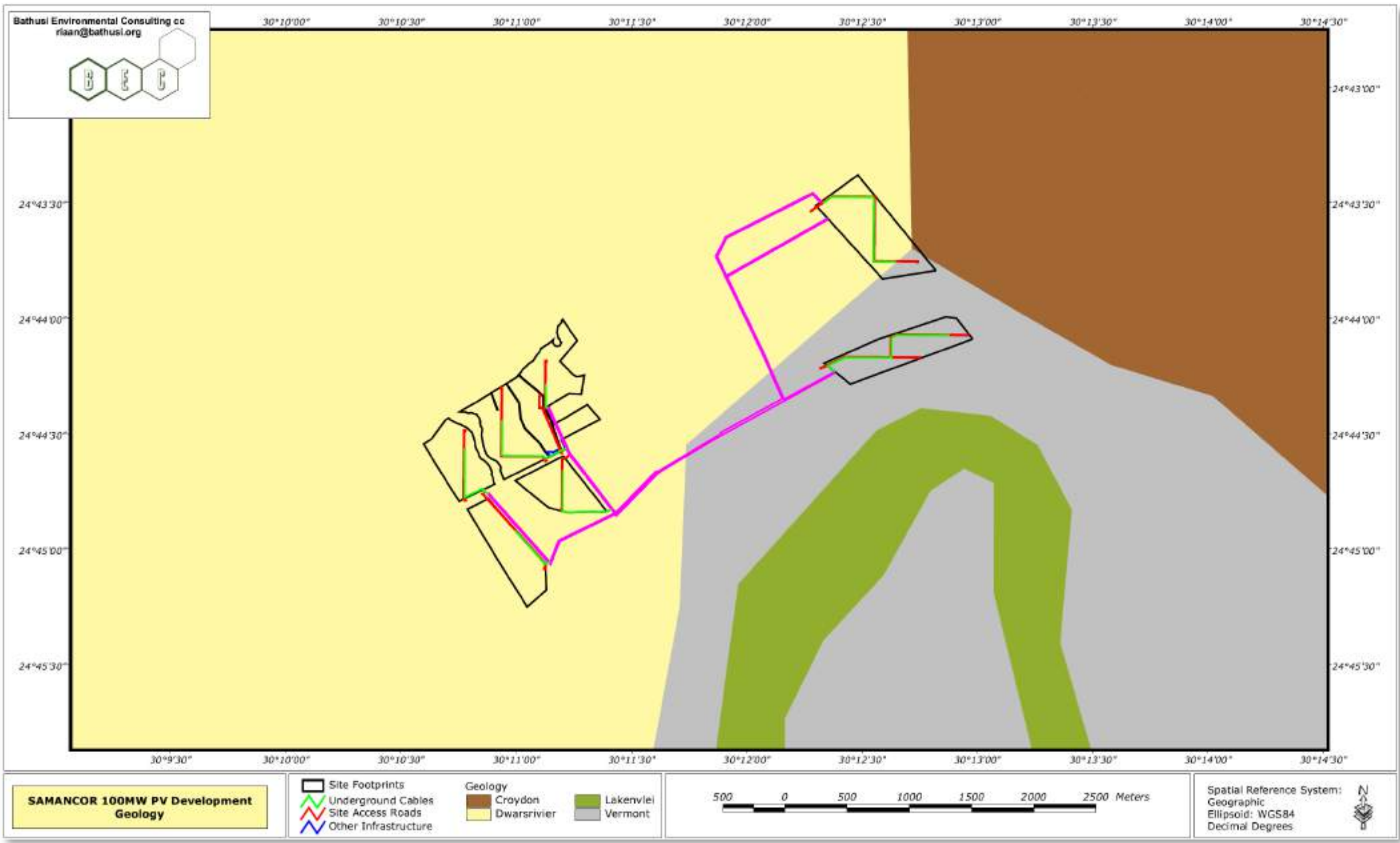


Figure 3: Geological patterns of the immediate surrounds

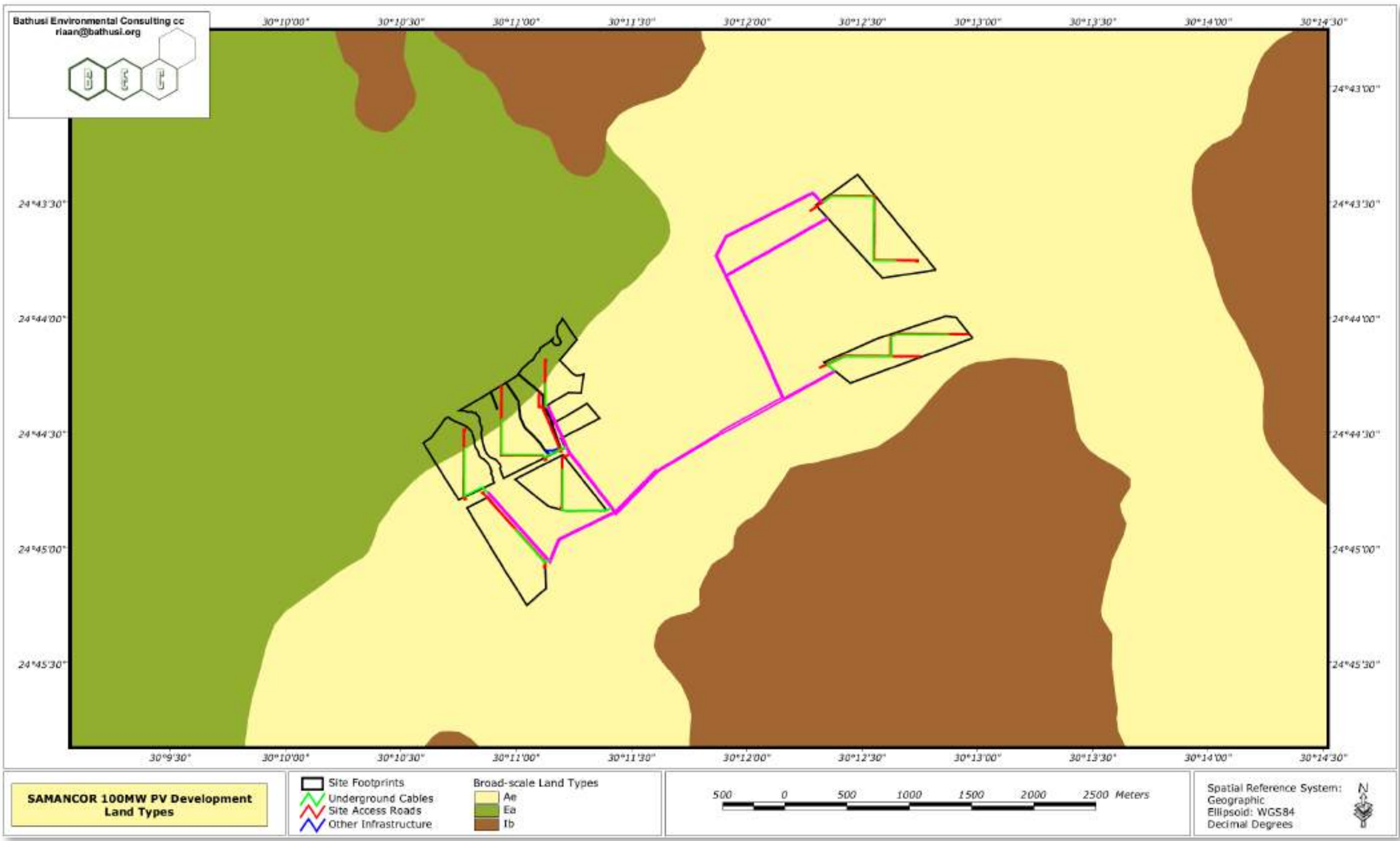


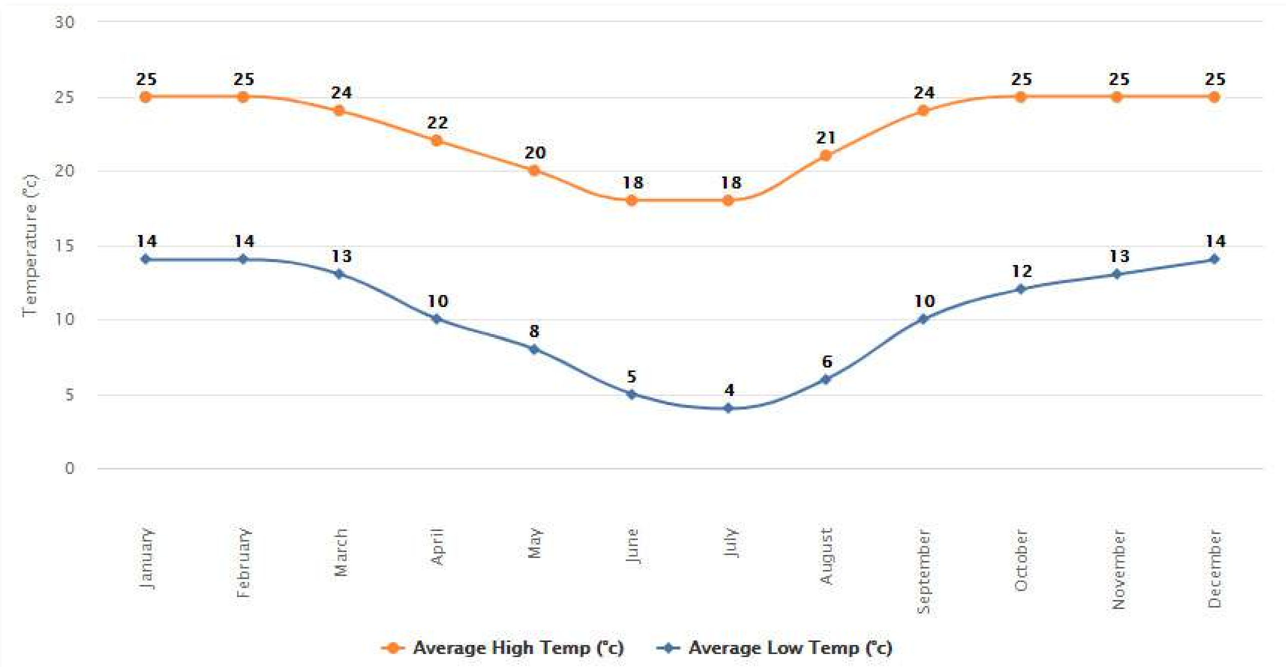
Figure 4: Land types of the immediate surrounds

13 CLIMATE

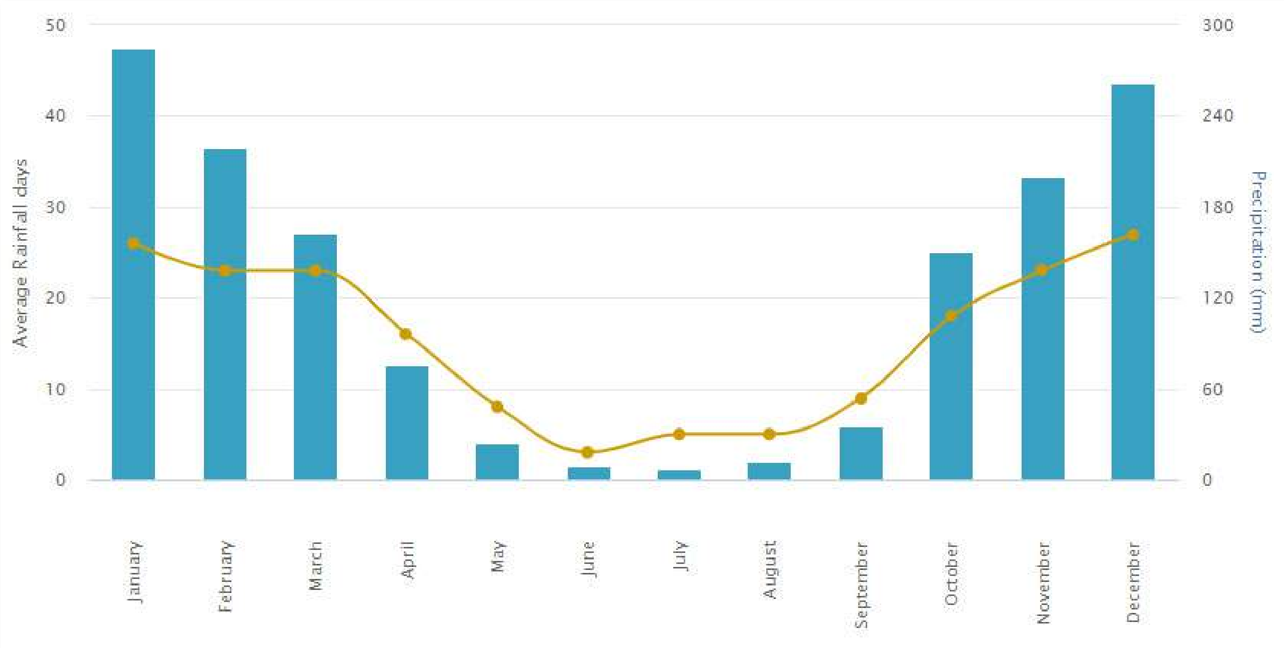
The Steelpoort climate is warm and temperate. The Köppen-Geiger chart describes the prevailing climate in Steelpoort as a local steppe climate (BSh, hot semi-arid climate). Throughout the year, the average daily maximum temperatures in the region range between 18°C (June, July) and 25°C (October - February), while daily minimum temperatures range from 14°C (December – February) and a low of round 4°C in July (refer **Graph 1**) (*www.worldweatheronline.com*) Frost and hail in the region is rare.

The Mean Annual Precipitation (MAP) in the vicinity of the sites was estimated to be approximately 606 mm per annum, which occur mostly in the form of severe thundershowers during summer (refer **Graph 2**), mainly during the months of October and March with the peak period being January. The average precipitation during the winter season is significantly less than that of the summer periods and precipitation between May and September is generally low, representing the 'dry period'.

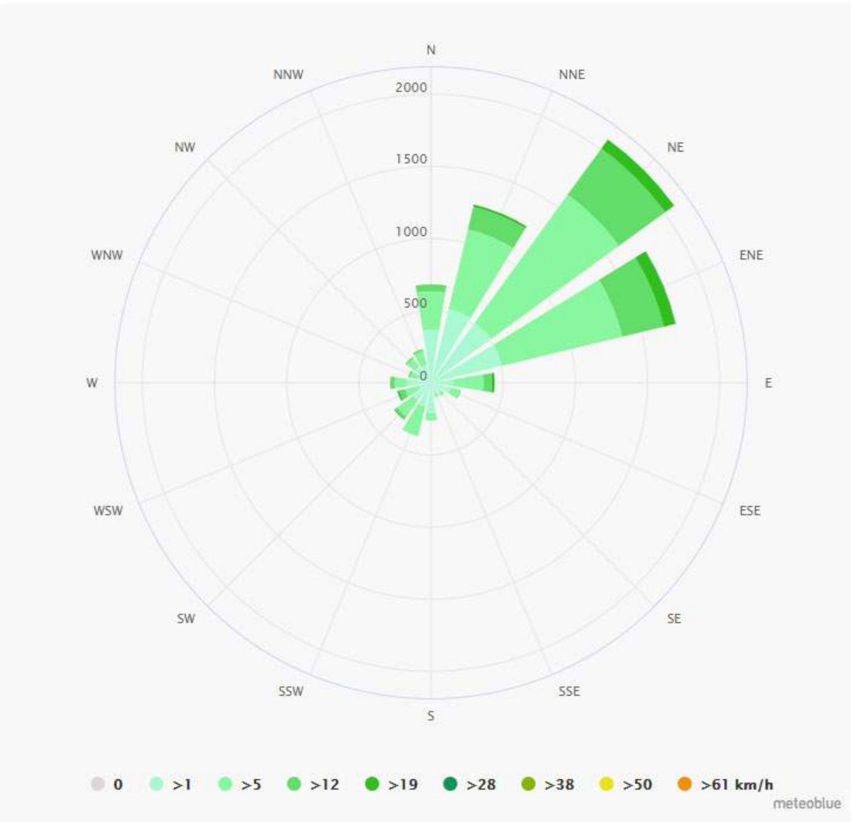
Winds are predominantly in a north-eastern direction (refer **Graph 3**) with significant windspeeds ranging between 12 and 28 km/h, rarely exceeding 28 km/hr (www.meteoblue.com). Higher wind speeds were also recorded during winter and spring months.



Graph 1: Average daily maximum and minimum temperatures
Courtesy of www.worldweatheronline.com



Graph 2: Average monthly rainfall and rainfall days
Courtesy of www.worldweatheronline.com



Graph 3: Average wind speed and direction
Image courtesy of www.meteoblue.com

14 TOPOGRAPHY, RELIEF AND SLOPES

Spatially heterogeneous habitat types provide critically important services in the habitat preferences of numerous fauna and flora species. High biodiversity levels are therefore a typical feature of hills and ridges, which also represent important habitat types for numerous sensitive species. The preservation and effective management of these landscape features on a local and regional scale will therefore provide impetus for successful conservation of sensitive habitat types and biodiversity.

The Steelpoort region is highly mountainous, hence development occurs mostly in valleys, while ridges and mountains form linear dividers between settlements. This is particularly evident from developments and anthropogenic activities along the Steelpoort River. Ridges further divide the municipal areas creating pockets of homogenous compositions, which determine growth and development potential.

The proposed sites are geographically situated on the slightly undulating plains around Steelpoort. Local and minor drainage patterns and topographical features include shallow and incised drainage lines that are often characterised by steep banks. The land generally slopes in a northwestern direction towards the Steelpoort River and the topographical elevation varies between approximately 810 m (Site 2) and 747 m (Site 5) (refer Figure 5). The Steelpoort River drains in a northeastern direction.

No site-specific and accurate contours were available for the sites at the time of this report.

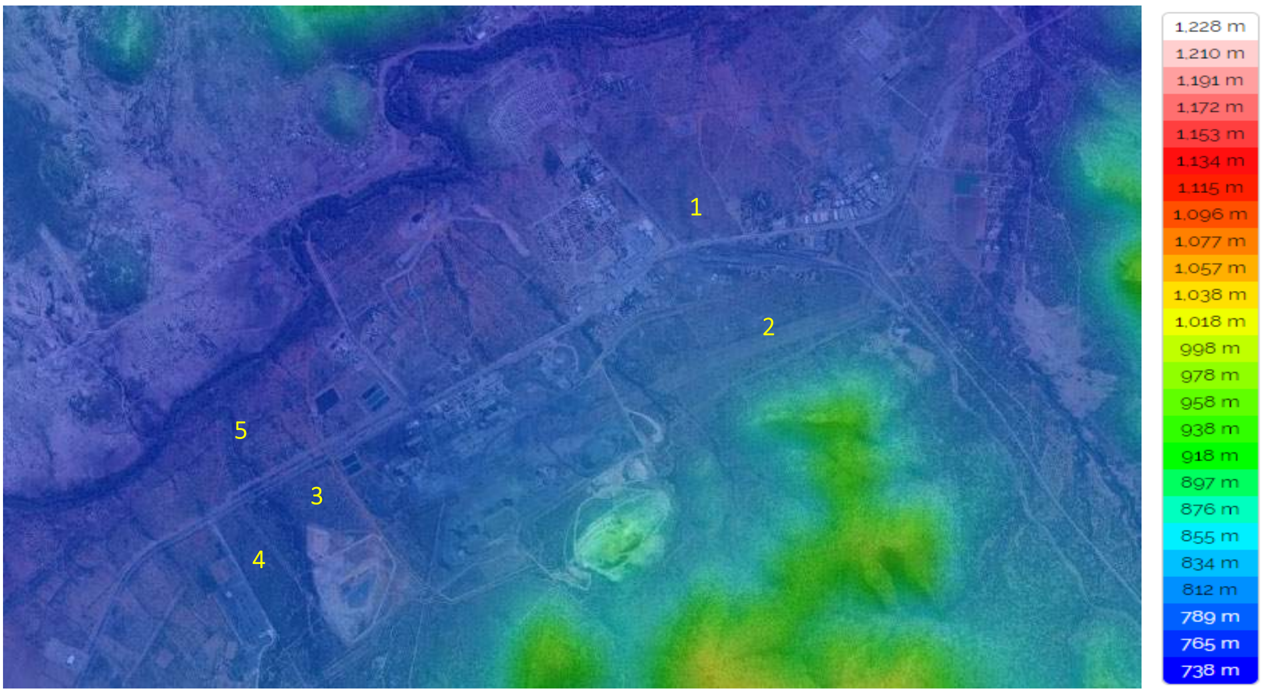


Figure 5: Topographical variations on a local scale
Numbers provide a rough indication of the site alternatives

15 WETLANDS AND SURFACE HYDROLOGY

Water, salt and processes linked to concentration of both are the major controls of the creation, maintenance and development of peculiar habitats. Habitats formed in and around flowing and stagnant freshwater bodies, experiences waterlogging (seasonal or permanent) and flooding (regular, irregular, or catastrophic), leading to the formation of special soil forms and unique habitat types. Invariably, both waterlogged and salt-laden habitats appear as 'special', deviating strongly from the typical surrounding zonal vegetation. They are considered to be of azonal character (Mucina & Rutherford, 2006). Water, in conjunction with geology, soil, topography and climate, is responsible for the creation of remarkably many types of habitats. Water chemistry, temperature and temporary changes in both, together with the amount of water (depth of water column), timing of occurrence (regular tides or irregular floods) and speed of its movement (discharge, flow and stagnation) are the major factors shaping the ecology of biotic communities occupying such habitats (VEGMAP, 2006).

Ecotones (areas or zones of transition between different habitat types) are occupied by species occurring in both the bordering habitats, and are generally rich in species due to the confluence of habitats. In addition to the daily visitors that utilise the water sources on a frequent basis, some flora and fauna species are specifically adapted to exploit the temporal or seasonal fluctuation in moisture levels in these areas, exhibiting extremely low tolerance levels towards habitat variation. Ecotonal interface areas form narrow bands around areas of surface water, and they constitute extremely small portions when calculated on a purely mathematical basis. However, considering this high species richness, these areas are extremely important on a local and regional scale. Rivers also represent important linear migration routes for a number of fauna species as well as an important distribution method for plant seeds.

The study area is situated in the Olifants-North Primary Catchment area. There are no RAMSAR site within proximity to the site, or in the Greater Tubatse Municipality. The BGIS information source indicates the Steelpoort River as the main river of the local region, with typical non-perennial drainage lines and valleys that feed into the river. Despite being non-perennial, these drainage lines feature represent significant topographical features in the form of channelled streambeds and incised low valleys with banks that may exceed 5 m in places and are either devoid of a prominent vegetatal layer, or exhibiting a composition that is similar to the surrounding terrestrial environment, hence reflecting the highly irregular occurrence of water in the system (mostly only subsequent to significant raining events. In lower topographical placements where the slopes are flatter, these drainage features conforms to wide and deep, sandy streambeds that are dominated by reedbeds, which have developed as a result of the long-term presence of a high moisture regime during the raining period.

Because of the proximity to the Steelpoort River (100 m to the north, Site 5) and the spatial presence of several smaller non-perennial drainage lines and rivers within the sites, realistic impacts are expected on this habitat type. Site observations indicated a moderate to severe deterioration of general habitat conditions within the Steelpoort River, notably as a result of illegal sand mining operations. Furthermore, severe and persistently high grazing pressure resulted in altering the dominant vegetation to a sub-climax status that is also characterised by a high infestation by weeds and declared invasive species.

Figure 6 provides a rough indication of the spatial placement of the study sites in relation to the Steelpoort River and tributary and non-perennial drainage lines. For a comprehensive assessment of the status and nature of the wetland features on the site, the reader is referred to the relevant specialist report (SAS 2021).

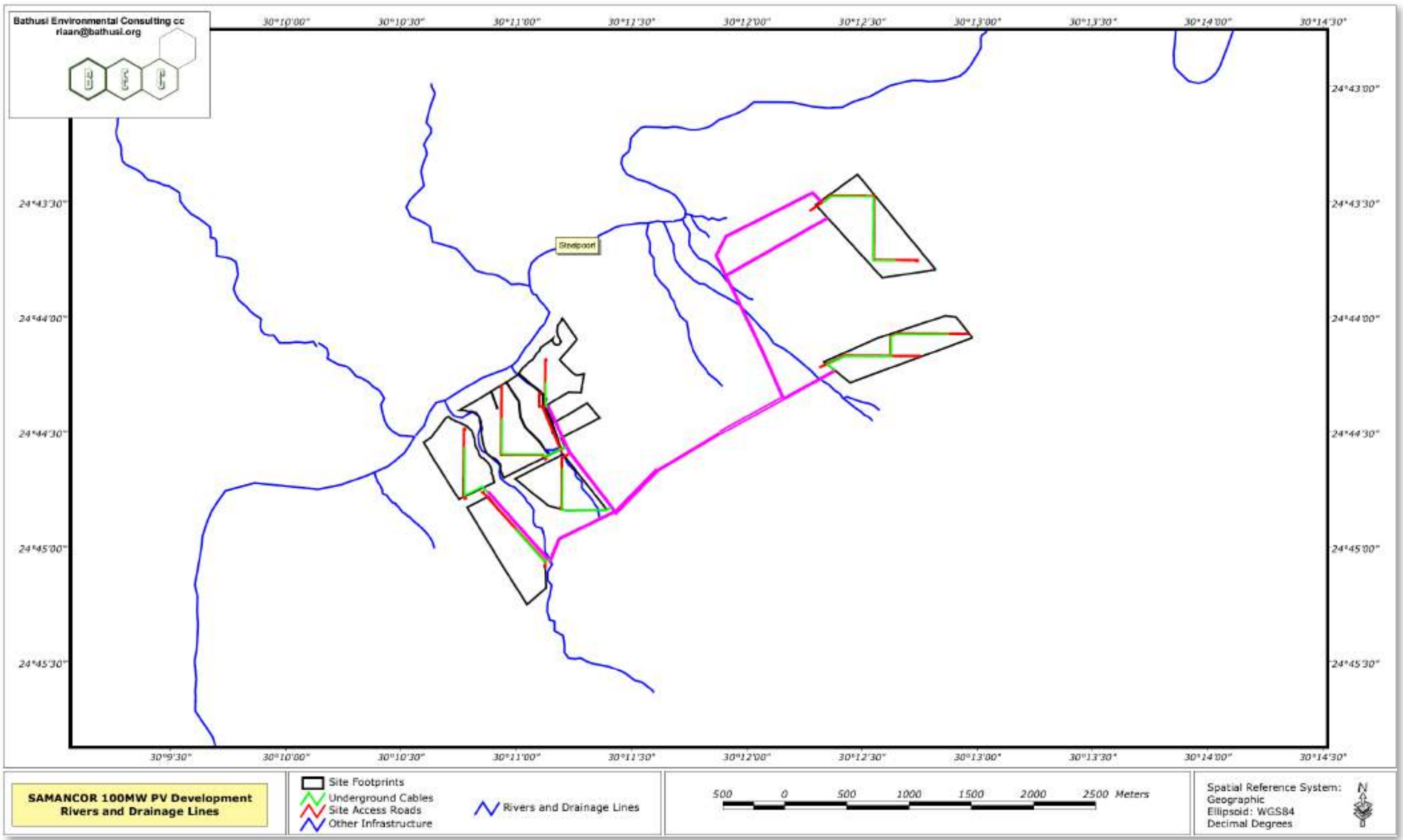


Figure 6: Rivers and non-perennial streams in the surrounds of the study sites

SECTION D: REGIONAL ECOLOGICAL SENSITIVITY AND CONSERVATION EFFORTS

The preservation, and management, of natural habitat is a priority on a local, regional and national basis, hence the development of conservation tools, such as the Limpopo Province Conservation Plan and all developments need to be scrutinised to ascertain the biological diversity and inherent ecological sensitivity of the remaining habitat. The following categories were employed in establishing the ecological sensitivity of the range of habitat types within the study area:

Low No natural habitat remains, poor species composition, low biodiversity; this category is represented by developed/ transformed areas, nodal and linear infrastructure, areas of agriculture or cultivation, areas where exotic species dominate exclusively, mining land (particularly surface mining), etc. The possibility of these areas reverting to a natural state is impossible, even with the application of detailed and expensive rehabilitation activities. Similarly, the likelihood of species of conservation importance occurring in these areas is regarded negligent.

Moderate – low Areas where the natural habitat is degraded, with the important distinction that the vegetation has not been entirely decimated and a measure of the original vegetation remain, albeit dominated by secondary/ transitional climax species and status. The likelihood of species of conservation importance occurring in these areas is regarded low. These areas also occur as highly fragmented and isolated patches, typical to cultivated fields, areas that have been subjected to clearing activities and areas subjected to severe grazing pressure. The species composition of these areas is typically low and is frequently dominated by a low number of species, or invasive plants.

Medium Indigenous natural habitat that comprehend habitat with a high diversity, but characterised by moderate to high levels of degradation, fragmentation and habitat isolation. Also includes areas where species of conservation importance could potentially occur, but habitat is regarded marginal;

Moderate – high Indigenous natural vegetation that comprehend a combination of the following attributes:

- The presence of habitat that is suitable for the presence of these species;
- Areas that are characterised by a high/ moderate-high intrinsic floristic diversity;
- Areas characterised by moderate to low levels of habitat fragmentation and isolation;
- Regional vegetation types of lower conservation categories, particularly prime examples of these vegetation types;
- Low to moderate levels of habitat transformation;
- A moderate to high ability to respond to disturbance factors;

It may also include areas that are classified as protected habitat, but that are of a moderate status;

High Indigenous natural vegetation that comprehend for a combination of the following attributes:

- The presence of species of conservation importance, particularly threatened categories (Critically Endangered, Endangered, Vulnerable);
- Areas where 'threatened' species occur, or habitat that is highly suitable for the presence of these species;
- Regional ecological types that are included in the 'threatened' categories (Critically Endangered, Endangered, Vulnerable), particularly prime examples of these vegetation types;
- Habitat types are protected by national or provincial legislation (Lake Areas Act, National Forest Act, draft Ecosystem List of NEM:BA, Mountain Catchment Areas Act, Ridges Development Guideline, Integrated Coastal Zone Management Act, etc.);
- Areas that have an intrinsic high biodiversity (species richness, unique ecosystems), with particular reference to Centres of Endemism.

High sensitivity areas are generally also characterised by low transformation rates and habitat isolation levels and contribute significantly on a local and regional scale in the ecological functionality of nearby and dependent ecosystems, with particular reference to catchment areas, pollination and migration corridors, genetic resources, etc. A major reason for the high conservation status (sensitivity) of these areas is a poor ability to respond to disturbances (low plasticity and elasticity characteristics).

16 AREAS OF ENDEMISM – SEKHUKHUNELAND CENTRE OF PLANT ENDEMISM (SCPE)

The proposed site is spatially situated within the Sekhukhune Centre of Plant Endemism (refer Figure 8). The SCPE comprises a mountainous region with flat to undulating valleys. Sekhukhuneland is known for its parallel belts or rocky ridges and mountains, including the Leolo and Dwars River ranges. The core of the Centre is formed by the surface outcrops of the Rustenburg Layered Suite of the eastern Bushveld Complex. The area is bordered by the Highveld Escarpment to the south, Strydpoort Mountains to the north, the Steenkampsberg and Drakensberg to the east and the Springbok Flats to the west.

Valleys have a sub-tropical climate with little or no frost in the winter, whereas in the mountains, conditions become more temperate with increasing altitude. Fire is an important natural factor in the mountains, affecting both vegetation structure and plant biology. Soils in the SCPE tend to be rich in clay; whereas granite gives rise to 'normal' soils and serpentinite to toxic soils, norite contains slightly higher concentrations of heavy metals than granite, thus giving rise to heavy metal soils. In the SCPE the ultramafic substrates, norite, anorthosite and pyroxenite, show a significant positive correlation with percentage endemism (Siebert, 1998).

Little is known of the vegetation of the SCPE, but the bushveld is unique and deserves recognition as a separate type. One of the characteristic trees of this bushveld type is *Kirkia wilmsii*, a species that is relatively rare in other parts of the Mixed Bushveld. Vegetation differences between the north- and south-facing aspects of the mountains are often striking. Intriguing vegetation anomalies associated with heavily eroded soils are present throughout the region. These areas (not serpentinite) are very sparsely vegetated with a distinctive, though highly impoverished flora including, for example *Searsia keetii, Euclea linearis* and *Amphiglossa triflora*. The origin and chemical composition of these eroded areas, which are natural features, are not known.

Many apparent endemic species of the SCPE are awaiting formal description (e.g. in *Acacia, Boscia, Polygala* and *Stylochiton*). The genus *Lydenburgia* (Celastraceae), represented by *Lydenburgia cassinoides* (= *Catha transvaalensis*), is near-endemic to the region, also including in the 'Vulnerable' conservation category (POSA, 2012). Succulents abound in the hot, arid valleys of the SCPE. The genus *Aloe* is particularly prolific, with many of the species being shared with the adjacent Wolkberg Centre. The area around Burgersfort is reputed to have the highest concentration of *Aloe* species in the world.

Despite it scenic landscapes, there is only one official nature reserve in the SCPE, namely Potlake Nature Reserve. Owing to the ruggedness of the terrain, however, the mountainous parts of the SCPE are still fairly intact, with many private land owners keen to promote ecotourism in the region. Overgrazing by domestic livestock has seriously degraded the vegetation in the densely populated areas in around the Leolo Mountains. Population pressure is also adversely affecting the flora of the Steelpoort River Valley, particularly in the Steelpoort-Burgersfort-Maandagshoek area. Efforts to conserve high-priority areas in the SCPE must acquire an increased urgency in light of the unusual natural features of these areas, such as the rich phytodiversity of the ultramafic soils. Conservation of this botanically important area should receive the highest priority, not only from a biodiversity point of view, but also because of its importance as a water catchment area.

17 PROTECTED AREAS (DECLARED AREAS OF CONSERVATION)

The sites are not situated within, or in proximity to, a declared protected area (refer Figure 7).

18 INFORMAL PROTECTED AREAS

The sites are not situated within, or in proximity to any informal protected area (refer Figure 8).

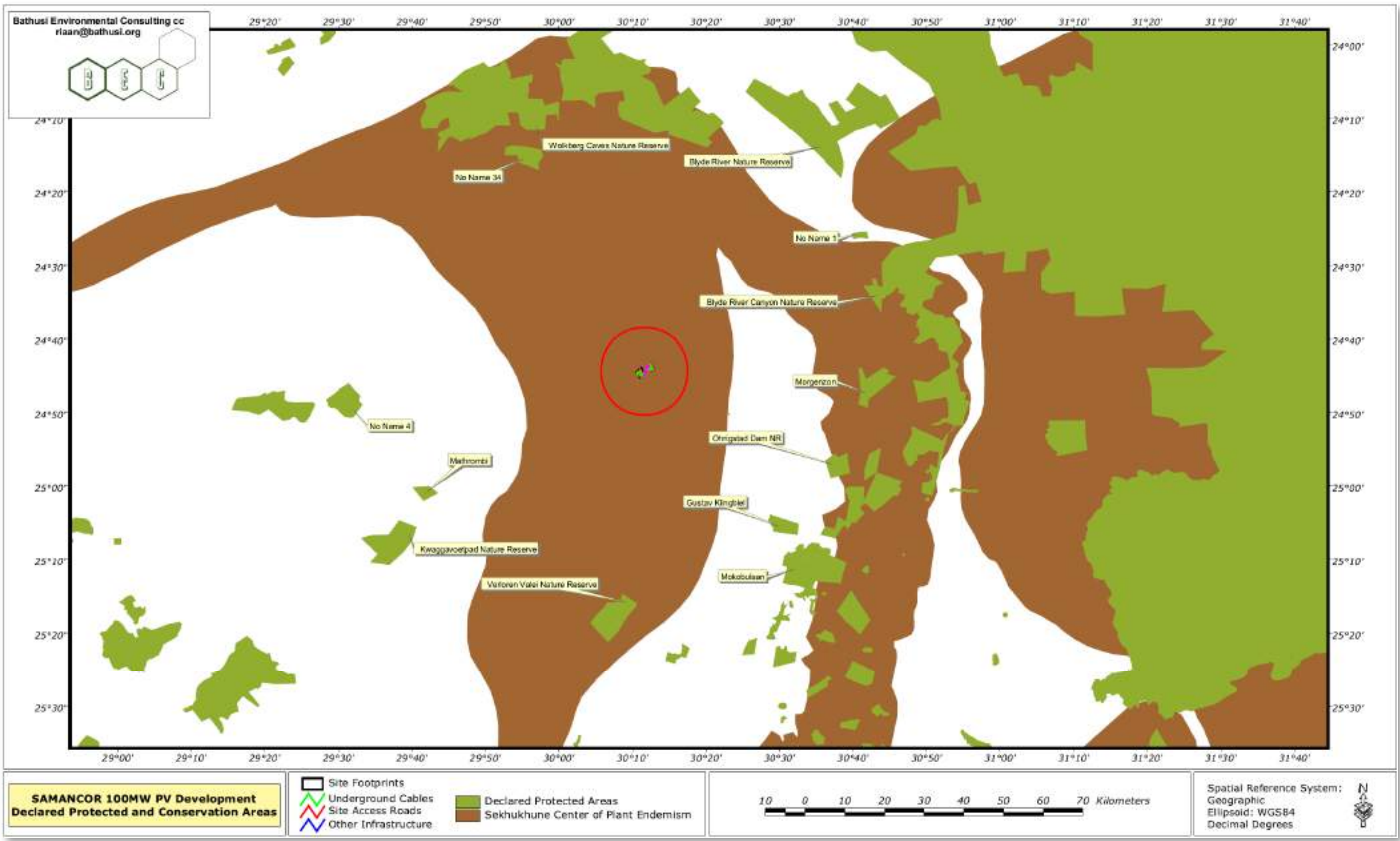


Figure 7: South African Declared Protected Areas
** note red circle with an approximate 10 km radius*

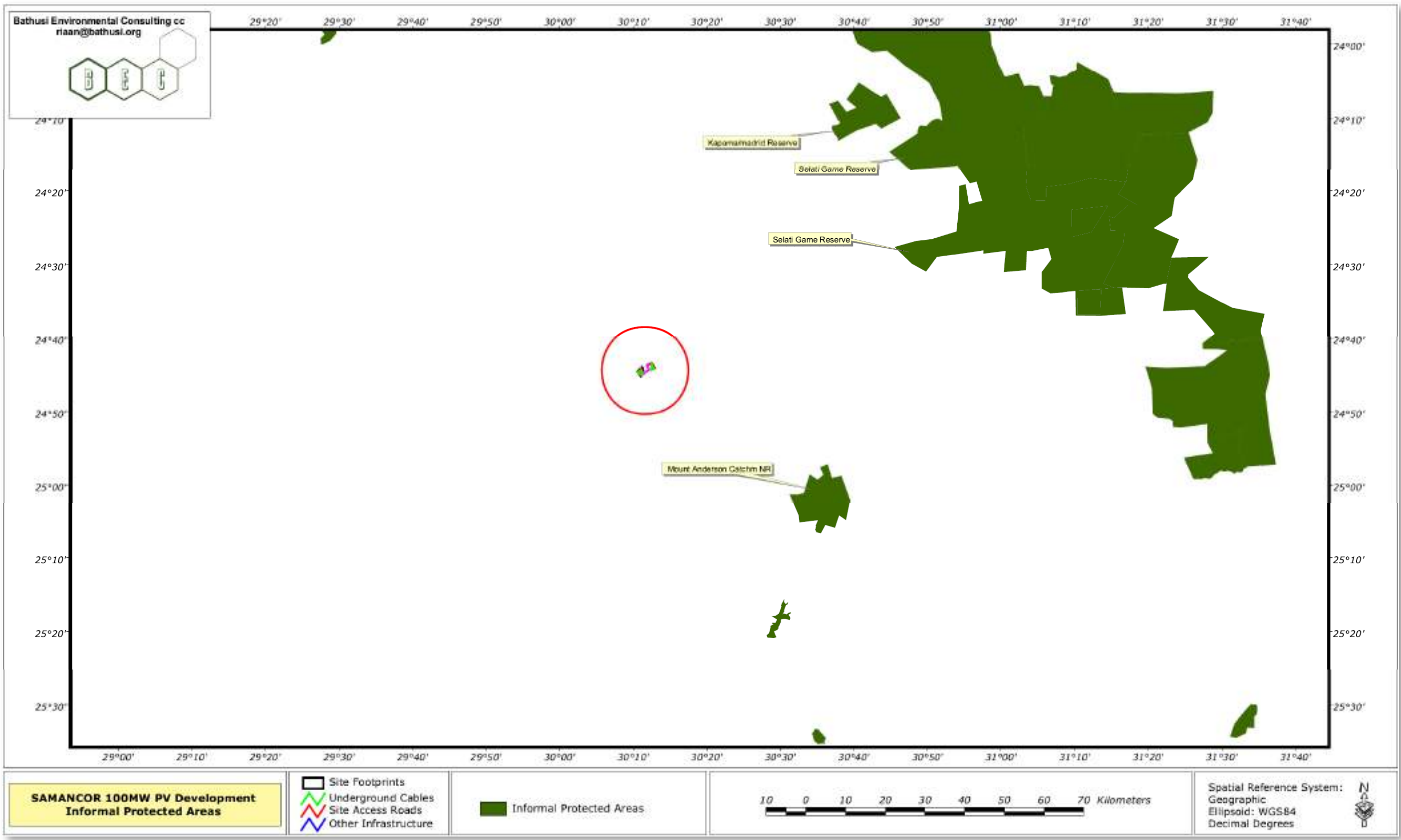


Figure 8: Informal Protected Areas
** note red circle with an approximate 10 km radius*

19 REGIONAL CONSERVATION PLANNING

The following generic categories are often employed in regional conservation planning sources:

Protected Areas:

Declared and formally protected areas under the Protected Areas Act, such as National Parks, Nature Reserves, World Heritage Sites and Protected Environments that are secured by appropriate legal mechanisms. Recommendations for this category include maintaining of the current status or obtaining formal conservation protection.

Critical Biodiversity Areas (CBAs):

Based on the Limpopo Conservation Plan, 40 % of the province is designated as Critical Biodiversity Area. These CBAs have been split into CBA1 and CBA2 on the basis of selection frequency and the underlying characteristics of the biodiversity features which are being protected (i.e. location fixed features such as sites for CR species and flexible ones such as Least Cost Corridors). Sites that are required to meet biodiversity targets for ecosystems and species and need to be maintained in good ecological condition. The majority of the CBAs in the Sekhukhune District are CBA1, which can be considered irreplaceable in that there is little choice in terms of areas available to meet targets. If CBA1 areas are not maintained in a natural state, then targets cannot be achieved. Those areas falling within CBA2 are considered optimal. Although they represent areas where there are other spatial options for achieving targets, the selected sites are the ones that best achieve targets of the systematic biodiversity plan. Recommendations for this category include obtaining formal conservation protection where possible, and the implementation of appropriate zonation to avoid loss of intact habitat or intensification of land use.

Ecological Support Areas (ESAs):

An additional 23 % of the province is designated as Ecological Support Area. This category has also been split on the basis of land-cover into ESA1 (16 %) and ESA2 (7 %), with ESA1 being in a largely natural state while ESA2 areas are no longer intact but potentially retain significant importance from a process perspective (e.g. maintaining landscape connectivity). Areas that are important for supporting the ecological functioning of CBAs and protected areas and for meeting biodiversity targets for ecological processes. Recommendations for this category include implementation of appropriate zoning and land management guidelines to avoiding impacting of ecological processes, avoiding intensification of land use and avoiding fragmentation of the natural landscape, also avoiding conversion of agricultural land to more intensive land uses, which may have a negative impact on threatened species or ecological processes.

Other Natural areas (ONAs):

Other Natural Areas make up 20 % of the province and just over 11 % is designated as formal Protected Area. The relatively high portion of remaining natural habitats which have been designated in one of the priority categories is a function of the fully integrated terrestrial and freshwater assessment (i.e. unlike many provinces there is not a second additional map of freshwater priorities), the comprehensive corridor and climate change adaptation features and the relatively poor overlap of features (i.e. priority areas for one taxa do not spatially correlate well with those of other taxa in most of the savanna areas). Areas that still contain natural habitat but that are not required to meet biodiversity targets. Recommendations for this category is subject to town and regional planning guidelines and policies.

No Natural Habitat Remaining (NNRs):

Areas without any remaining intact habitat remaining, entirely transformed. Recommendations for this category is subject to town and regional planning guidelines and policies.

19.1 Limpopo Province Conservation Plan (V2, 2013)

The primary objective of this information source was to present a revised conservation plan for the Limpopo Province (V1) that conformed to the Bioregional Planning guidelines that were published by SANBI in 2009. The principal Limpopo Conservation Plan (V1) was therefore comprehensively revised through the development and execution of a quantitative systematic spatial biodiversity planning methodology that:

⇒ Addressed the deficiencies of the current provincial plan;
⇒ Took into account the most up-to-date spatial data and institutional and expert knowledge;
⇒ Aligned the methods and terminology of the plan with the national guidelines for the development of bioregional plans;
⇒ Considered existing spatial biodiversity planning products; and
⇒ Involved skills transfer through working with LEDET staff on the development of the CBA map and GAP assessment.

Revision of gathered data revealed that more than three quarters of Limpopo remained in a natural or near natural state (85 %), while urbanisation (2.6 %) and agriculture (11.4 %) covering 15 % accounts for the major anthropogenic transformative and disruptive processes within the province. Formal protected areas cover just more 11 % of Limpopo.

As bioregional plans are one of a range of tools provided for in the Biodiversity Act that can is used to facilitate biodiversity conservation in priority areas outside the protected area network, a subsequent objective of the LCPv2 was to develop the spatial component of a bioregional plan, i.e. a map of Critical Biodiversity Areas and associated land-use guidelines. The purpose of this bioregional plan is to inform land-use planning, environmental assessment and authorisations and natural resource management, by a range of sectors whose policies and decisions impact on biodiversity. This is done by providing a map of biodiversity priority areas or Critical Biodiversity Areas (CBA) together with accompanying land-use planning and decision-making guidelines. The conservation plan applies a target driven systematic spatial biodiversity planning methodology to develop this map and it is based on the best available biodiversity and context data and an explicit set of biodiversity conservation targets. The resultant map represents the minimum area necessary to maintain biodiversity pattern and ecological processes in the landscape, i.e. ecologically functional landscapes.

The systematic conservation planning process resulted in 40 % of the province being identified as Critical Biodiversity Areas (CBA1, 22 % and CBA2, 18 %). Ecological Support Areas cover a further 22 % of the province, of which 16 % are intact natural areas (ESA1) and 7 % are categorised as degraded, or comprise areas with no natural remaining, which are nonetheless required as they potentially retain some value for supporting ecological processes (ESA2). The Critical Biodiversity map links to the land-use guidelines tables which are based on a combination of products from Mpumalanga, KZN and Gauteng provinces. These guidelines and recommendations are aimed at informing strategic decision making and facilitating biodiversity conservation in priority areas outside the protected area network.

Figure 9 illustrates the categorisation of the respective sites as inclusive of CBA 1, CBA 2, ESA 1 and ESA 2 categories from the LCPv2 source. However, the author is not entirely in agreement with ascribed categories from the proposed sites and footprints, considering the higher conservation categories an erroneous interpretation of available regional information sets and does not accurately reflect the level of habitat loss and deterioration from the urban and industrial sones around Steelpoort that is prevalent from recent aerial imagery or from site inspections (refer Figure 2). It should be noted that this erroneous assignment of conservation categories is most likely the result of data with a coarse scale and outdated information on a local scale. Since the inception of this information source in 2013, considerable changes in land-use and the associated deterioration of ecological status and connectivity of habitat occurred, notably in the immediate surrounds of settlements and residential areas. One of the important functions of environmental reports (such as this and other biodiversity related reports from the application) is therefore to inform on the level of accuracy and contribute substantiating evidence to augment initial estimations on a landscape and regional scale.

Ultimately, pertaining to the proposed development sites and footprints, despite the incorrect categorisation of conservation categories, natural habitat appears to have been accurately captured, considering the results of this assessment and the site inspections. An appraisal of the layers employed in the conservation plan and assigning conservation value to polygons include the following attributes for consideration (LCPv2), and are considered relevant to the terrestrial ecological sensitivity of the local region:

⇒ 1 km buffer on large rivers (Steelpoort River);
⇒ Location within the Sekhukhune Centre of Plant Endemism;
⇒ Corridors – Corridors and Connectivity.
⇒ CBA 1, CBA 2, CBA, 3, CBA 5 – Areas supporting climate change resilience;
⇒ High value EBA areas;
⇒ LBCP 3 Highly Significant;
⇒ LBCP 4 Important and necessary;
⇒ NPAES;
⇒ Other non-phase 1 FEPA rivers and 100 m buffer;
⇒ Ridges and escarpment;
⇒ Sekhukhune Eastern Plains Bushveld;
⇒ Sekhukhune Mountain Bushveld;
⇒ Sekhukhune Mountainlands;
⇒ Sekhukhune Plains Bushveld;
⇒ Threatened Plants; and
⇒ Threatened Species (White-backed Vulture).

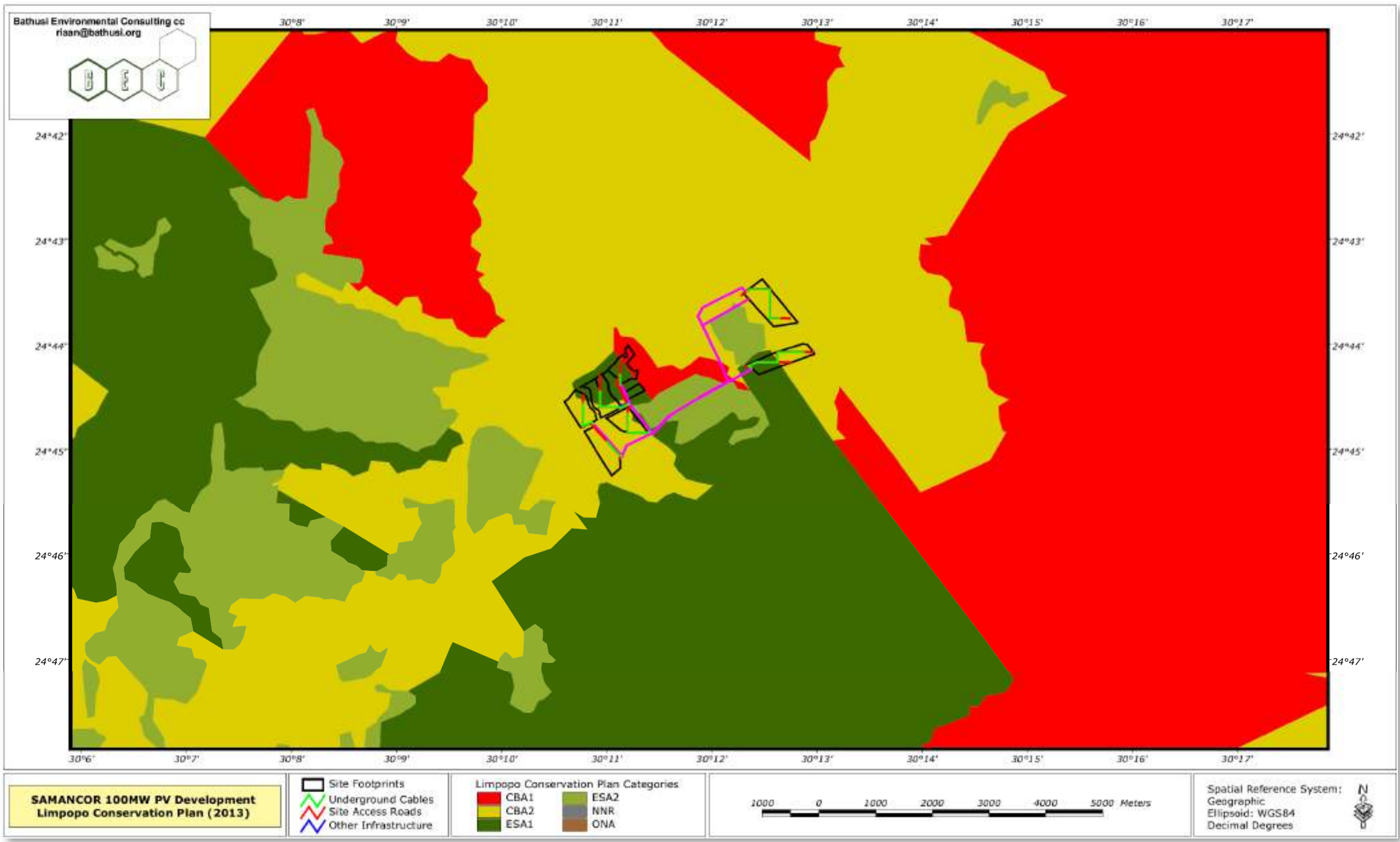


Figure 9: Limpopo Province Conservation Plan (LPCPV2), illustrating conservation categories and importance

19.2 Sekhukhune District Bioregional Plan (2020)

Further revision of the LCPv2 bioregional plan was developed in 2018 and was based primarily on datasets and information available at the time, notably from the Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) that were originally identified and delineated for LCPv2 (2013). It should be noted that, since is the first bioregional plan for the Sekhukhune District Municipality, it does not replace any other bioregional plans, but serves as the primary biodiversity information source to a range of planning and land-use authorisation processes.

The purpose of a bioregional plan is to facilitate the safeguarding of biodiversity within identified biodiversity priority areas that fall outside of the Protected rea (PA) Network, as well as providing a map of biodiversity priorities with accompanying land use planning and decision-making guidelines to inform land-use planning, environmental assessment and authorisations, and natural resource management, and while feeding relevant information to the larger provincial conservation planning efforts, considers information from a smaller, regional (district) scale.

One of the outputs of this bioregional plan is therefore provision of updated information and data towards LCPv2 in response to potential losses and threats that were identified during the alignment process undertaken during the development of the Sekhukhune District Bioregional Plan, the CBAs and ESAs of the LCPv2 to ensure that biodiversity targets remained intact within the District. Specifically, the following were considered:

⇒ Losses due to land uses that result in irreversible modification of natural habitat;

⇒ Threat due to altered land uses; and

⇒ Threats due to incompatible DSDF zonation.

This bioregional information source designated the remaining areas of natural habitat within the development footprints as ESA1 habitat, while remaining areas are mostly (and more accurately) appraised as 'no natural habitat remaining' (refer Figure 10). An appraisal of the Sekhukhune District Bioregional Conservation Plan categories, specifically in comparison with the Limpopo Province Conservation Plan (v2), provides for a more accurate and appropriate categorisation of habitat within the proposed development footprints, although local discrepancies are still noted, specifically to the immediate east of Site 5 where CBA habitat is categorised, but habitat appears to be deteriorated. However, whereas LCPv2 (2013) indicates elevated conservation contribution and status, the BRP more accurately describes land transformation and habitat deterioration that is associated with the fragmented and isolated portions of woodland habitat in the immediate surrounds oof Steelpoort. The discrepancy between the two datasets is likely a result of refined and more recent interpretation of background layers.

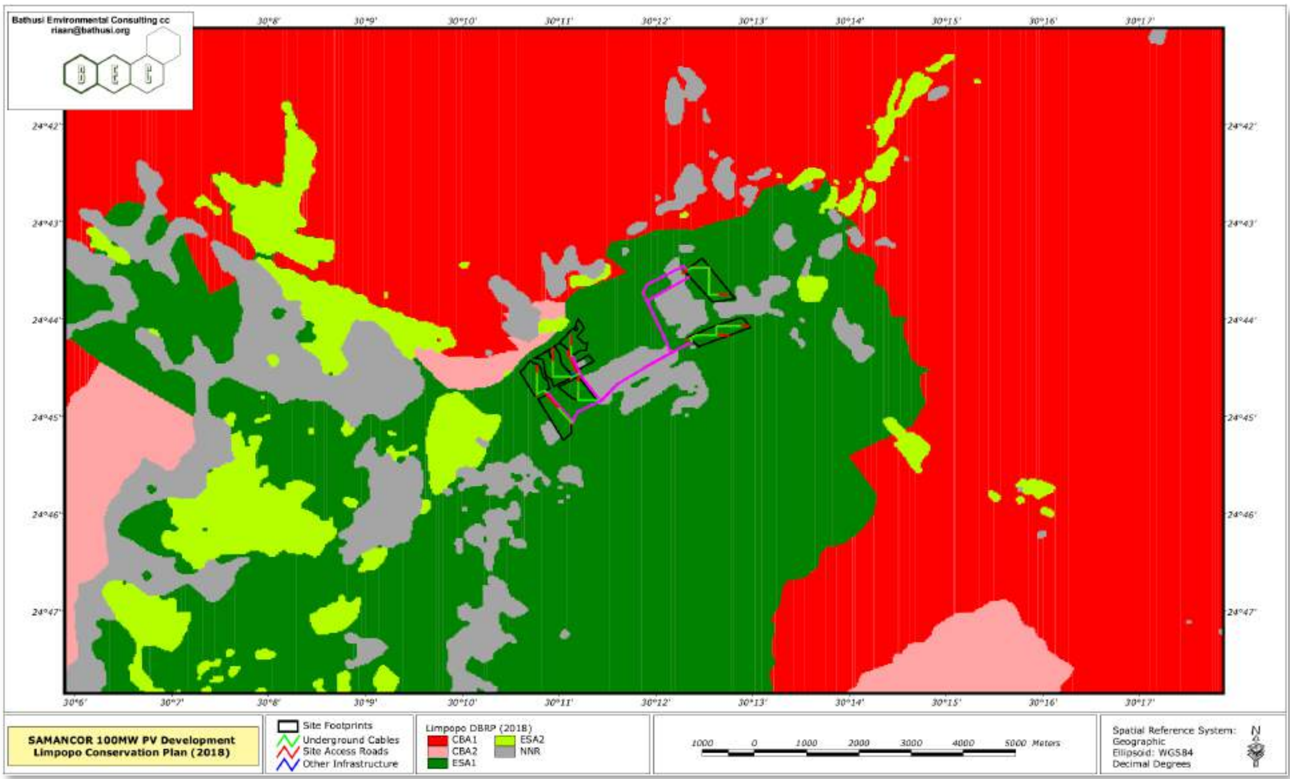


Figure 10: Sekhukhune Bioregional Conservation Plan (2020) for the immediate region
Please note that this information source is still in draft form and should not be disseminated indiscriminately

20 DISCUSSION

A review of the local and regional information sources ultimately indicates a moderate to moderate-high ecological status and sensitivity of the proposed site, which correlates with preliminary floristic and faunal results obtained from the site inspection, and also taking note of the following key considerations:

⇒ Botanical diversity, importance and sensitivity – moderate-high sensitivity that is mostly a result of the presence of several species of conservation importance and remaining natural woodland habitat that is considered representative of the regional ecological type (refer Section E);
⇒ Faunal and avifaunal diversity, importance – a poor compliment of terrestrial fauna species that reflects the severity of anthropogenic impacts from surrounding land use activities, including industrial, peri-urban, residential, commercial and severe utilisation, ultimately rendering the faunal component moderately sensitive (refer Section F);
⇒ Biophysical and regional sensitivity and importance attributes (refer Section D); and
⇒ Context of the proposed industrial development on a temporal and spatial scale.

While the proposed sites comprise mostly natural habitat, impacts and pressures of surrounding land use activities are persistent, severe and a continuous decline of remaining portions of natural habitat within the peri-urban areas of Steelpoort (inclusive of the proposed development footprints) is reasonably expected should the development not take place. As with any type of industrial development within a region of natural habitat, the loss of habitat and species from direct impacts (footprint clearance, etc.) and significant indirect impacts will undoubtedly occur. Considering the sites and the inherent ecological attributes, the loss of protected plant species is considered a significant aspect and will likely require a stringent mitigation approach and/ or an offset agreement. However, the spatial placement of the proposed footprints within proximity to existing areas of transformation will likely effectively limit the cumulative impacts that are typically associated with 'greenfields' developments.

SECTION E: BOTANICAL ATTRIBUTES OF THE AREA

21 TERMS OF REFERENCE FOR THE BOTANICAL ASSESSMENT

Based on the Scope of Works, this botanical assessment is guided by:

⇒ Establishing the nature of the project and activities that are likely to affect the areas' botanical attributes and ecological receiving environment;

⇒ Assimilating and appraise existing records, data and reports that is available for the project area, with particular reference to results of the National Environmental Screening Tool;

⇒ Providing a local and regional context of the botanical nature and pertinent floristic attributes that characterise the area, taking cognizance of relevant biodiversity plans and bioregional planning documents for the region;

⇒ Conducting strategic site investigations to collate required botanical data, with reference to national guidelines and protocols for biodiversity studies;

⇒ Providing a clear description of the broad floristic attributes of the study areas and immediate surrounds. The following shall be identified and described where appropriate:
- o Community and ecosystem level;
- o Species level; and
- o Other pattern issues;

⇒ Defining and mapping different broad-scale habitat types based on an evaluation of available aerial imagery and site investigations from the respective sites;

⇒ Compile species inventories that are present within each of the affected areas, based on strategic sampling and observation methods and an appraisal of available information sources;

⇒ Identifying key natural resources, with emphasis on environmental sensitivities, wetlands; ecology, red data communities, conservation important species and ecological types, that exist or may exist within the development areas;

⇒ Identifying ecologically valuable (threatened, protected and Red Data) species, communities and habitat types;

⇒ Providing a clear description of perceived floristic sensitivity aspects towards the proposed activity;

⇒ Providing a clear description of the ecological sensitivity of the environment as well as the local and regional conservation value of the various flora species and habitat types;

⇒ Compiling a sensitivity analysis of the receiving environment with the aim to highlight areas of particular (high) botanical and/ or ecological sensitivity;

⇒ Providing a prediction, assessment, and evaluation of potentially significant direct and indirect impacts in terms of botanical nature, ecological processes, species, and ecosystem services of concern (where relevant);

⇒ Providing a comprehensive assessment of the nature and extent of cumulative impacts on the botanical receiving environment; and

⇒ Providing a mitigation and management approach that will aid in minimising impacts on the environment.

This botanical assessment will be informed by (*inter alia*) the following information sources:

⇒ Satellite imagery;

⇒ IUCN and Regional Red List information;

⇒ NEWPOSA;

⇒ National Vegetation Map;

⇒ Available reports and biodiversity assessments; and

⇒ BGIS information source.

22 REGIONAL FLORISTIC PATTERNS

22.1 BACKGROUND TO THE SAVANNA ECOLOGY

The Savanna Biome is the largest biome in southern Africa, covering about 46 % of its area. The term savanna is widely accepted as describing a vegetation type with a well-developed grassy layer and a dominant upper layer of woody plants. Many environmental factors correlate with the distribution of different savanna vegetation types, including landform, climate, soil types, fire and a very specific fauna. South African savannas of nutrient-poor substrates are characteristically broad-leaved and without thorns, while those of nutrient-rich substrates are fine-leaved and thorny (Knobel, 1999), although microphyllous species are encroaching in many areas due to inappropriate management and over-exploitation (pers. obs.).

The diversity of African savanna is exceptional, comprising more than 13,000 plant species, of which 8,000 are savanna endemics; more specifically, dry savannas have more than 3,000 species. This diversity equals that of South African grassland regions and is exceeded only by the Fynbos Biome (Knobel 1999). Similarly, in respect of animal diversity, savannas are without peer, including approximately 167 mammals (15 % endemism), 532 birds (15 % endemism), 161 reptiles (40 % endemism), 57 amphibians (18 % endemism) and an unknown number of invertebrates (Knobel, 1999). Flagship species include the Starburst Horned Baboon Spider (*Ceratogyrus bechuanicus*), ground Hornbill (*Bucorvus leadbeateri*), Cape Griffon (*Gyps coprotheres*), Wild dog (*Lycaon pictus*), Short-Eared Trident Bat (*Cloeotis percivali*) and the White Rhino (*Ceratotherium simum*) (EWT, 2002).

Conservation within, and of, the Savanna Biome is good in principle, mainly due to the presence of a number of wildlife reserves. Urbanisation is currently not a significant threat, perhaps because the hot, dry climate and diseases prominent in the savanna areas have hindered extensive urban development. Much of the savanna regions are used for game farming and the importance of tourism and big-game hunting in the conservation areas must not be underestimated. Savannas are the basis of the African wildlife and ecotourism industry and play a major role in the meat industry, but surprisingly little is known about the vegetation as most studies have been done in nature reserves and game farms.

The vegetation that characterises the savanna region has developed many survival strategies, including the ability to produce tannins that are triggered when the leaves are browsed, the production of toxic sap, the development of thorns or their adaptation to sourveld areas that are not generally favoured by grazers. The interaction of vegetation, fire and animals play important roles in maintaining savanna ecosystems (Knobel, 1999). Over thousands of years, the savanna system and the antelope that inhabit them have developed side by side. Grasses, for example, have become well adapted to defoliation, as much a defensive response to constant pressure by grazers as to the regular veld fires that rage through the savanna in the dry seasons. The success of grasses has been a constantly renewed vast reservoir of food upon which large herds of grazers flourish. The woody component is also constantly exploited by many browsers, and with so many herbivores present, the carnivore component of the complex ecological system has also flourished (Knobel, 1999).

The savanna biome is populated by a greater diversity of bird species than any other biome in South Africa. The presence of both woody plants and a well-developed herbaceous layer provides diverse sources of food and shelter for specialist and generalist bird species, including seedeaters, insectivores and diurnal and nocturnal birds of prey abound.

Much of the area is used for game farming and big game hunting, illustrating that utilisation and conservation of an area are not mutually exclusive. The savanna biome is the core of the wildlife, ecotourism and meat-production industries. Threats include rapidly expanding development of settlements for impoverished human populations and the associated need for firewood and building materials, diminishing water supply, agriculture and over-grazing (Knobel, 1999).

22.2 CHARACTERISATION OF THE SEKHUKHUNE PLAINS BUSHVELD (SVCB27)

The study area is spatially situated within the Sekhukhune Plains Bushveld (refer Figure 11), which is geographically placed in the lowland areas from Burgersfort and the lower basin of the Steelpoort River in the south, northwards through the plains of the Motse River basin to Jobskop and Legwareng (south of the Strydpoort Mountains), and continuing up the basin of the Olifants River to around Tswaing and the valleys of the Lepellane and Mohlaletsi Rivers. The vegetation conforms to mainly semi-arid plains and open valleys between chains of hills and small mountains running parallel to the escarpment. It is characterised by a predominantly short, open to closed thornveld with an abundance of *Aloe* species and other succulent plants. Although locally heavily degraded because of over-exploitation for cultivation, mining and urbanisation, much remains in a natural and pristine state. Both man-made and natural erosion dongas occur in areas containing clays rich in heavy metals. Encroachment by indigenous microphyllous trees and invasion by alien species is common throughout the area.

The current conservation level of this unit is set at Vulnerable (refer Figure 12); with a target of 19 %, only 2 % is statutorily conserved in Potlake, Bewaarkloof and Wolkberg Caves Nature Reserves. Approximately 25 % of this area has already been transformed and is mainly under dry-land subsistence cultivation. A small area is under pressure from chrome and platinum mining activities and associated urbanisation, notably around the Steelpoort area, and depending on commodities, this threat is likely to increase in near future. There is a high level of degradation of much of the remaining vegetation as a result of unsustainable harvesting, utilisation and exploitation. Erosion is widespread at usually high to very high levels with donga formation, but also expansive sheet and rill erosion (pers. obs.). Alien *Agave* species, *Caesalpinia decapetala*, *Lantana camara*, *Melia azedarach*, *Nicotiana glauca*, *Opuntia* species, *Verbesina encelioides* and *Xanthium strumarium* are widespread but scattered, often with strong correlation with drainage lines and rivers.

This semi-arid bushveld is a disturbed and degraded system with many erosion dongas, although much of the erosion can be attributed to inherent edaphic properties. It is situated in the Sekhukhuneland CE (Van Wyk & Smith 2001), and a paucity of comprehensive and accurate floristic information is noted; several endemic taxa of this unit still require formal description (Siebert et al. 2001). A high correlation is indicated with the nearby Sekhukhune Mountain Bushveld (SVcb28), Polokwane Plateau Bushveld (SVcb23) and Springbokvlakte Thornveld (SVcb15) in terms of floristic diversity, species richness and vegetation structure (Breebaart & Deutschländer 1997, Siebert et al. 2002b).

Typical and important taxa for this unit include:

Tall Trees:	*Vachellia erioloba* (NFA, 2014), *Philenoptera violacea* (NFA, 2014).
Small Trees:	*Senegalia mellifera* subsp. *detinens*(d), *Vachellia nilotica* (d), *V. tortilis* subsp. *heteracantha*(d), *Boscia foetida* subsp. *rehmanniana*(d), *Vachellia grandicornuta*, *Albizia anthelmintica*, *Balanites maughamii* (NFA, 2014), *Combretum imberbe* (NFA, 2014), *Commiphora glandulosa*, *Maerua angolensis*, *Markhamia zanzibarica*, *Mystroxylon aethiopicum* subsp. *schlechteri*, *Ptaeroxylon obliquum*, *Schotia brachypetala*, *Ziziphus mucronata*.
Succulent Tree:	*Euphorbia tirucalli*(d).
Tall Shrubs:	*Searsia engleri*(d), *Cadaba termitaria*, *Dichrostachys cinerea*, *Ehretia rigida* subsp. *rigida*, *Grewia bicolor*, *Karomia speciosa*, *Maerua decumbens*, *Rhigozum brevispinosum*, *R. obovatum*, *Tinnea rhodesiana*, *Triaspis glaucophylla*.
Low Shrubs:	*Felicia clavipilosa* subsp. *transvaalensis*(d), *Seddera suffruticosa*(d), *Gnidia polycephala*, *Gossypium herbaceum* subsp. *africanum*, *Jamesbrittenia atropurpurea*, *Jatropha latifolia* var. *latifolia*, *Lantana rugosa*, *Melhania rehmannii*, *Monechma divaricatum*, *Myrothamnus flabellifolius*, *Pechuel-Loeschea leubnitziae*, *Plinthus rehmannii*.

Succulent Shrubs:	*Aloe cryptopoda*(d), *Euphorbia enormis*(d), *Kleinia longiflora*(d), *Aloe castanea*, *A. globuligemma*.
Woody Succulent Climber:	*Cynanchum viminale*.
Herbaceous Climbers:	*Coccinia rehmannii*, *Decorsea schlechteri*.
Graminoids:	*Cenchrus ciliaris*(d), *Enneapogon cenchroides*(d), *Panicum maximum*(d), *Urochloa mosambicensis*(d), *Aristida adscensionis*, *A. congesta*, *Eragrostis barbinodis*, *Paspalum distichum*, *Schmidtia pappophoroides*, *Stipagrostis hirtigluma* subsp. *patula*, *Tragus berteronianus*.
Herbs:	*Becium filamentosum*(d), *Phyllanthus maderaspatensis*(d), *Blepharis integrifolia*, *Corchorus asplenifolius*, *Hibiscus praeteritus*, *Ipomoea magnusiana*.
Geophytic Herbs:	*Drimia altissima*, *Sansevieria pearsonii*.

Biogeographically Important Taxa[2] include:

Small Tree:	*Lydenburgia cassinoides*[SK].
Tall Shrub:	*Nuxia gracilis*[D].
Low Shrubs:	*Amphiglossa triflora*[D], *Asparagus fourei*[N], *Hibiscus barnardii*[SK], *Orthosiphon fruticosus*[CB], *Petalidium oblongifolium*[CB], *Searsia batophylla*[SK].
Woody Climber:	*Asparagus sekukuniensis*[SK].
Herb:	*Aneilema longirrhizum*[SK].
Geophytic Herb:	*Chlorophytum cyperaceum*[SK].
Succulent Herb:	*Piaranthus atrosanguineus*[CB].

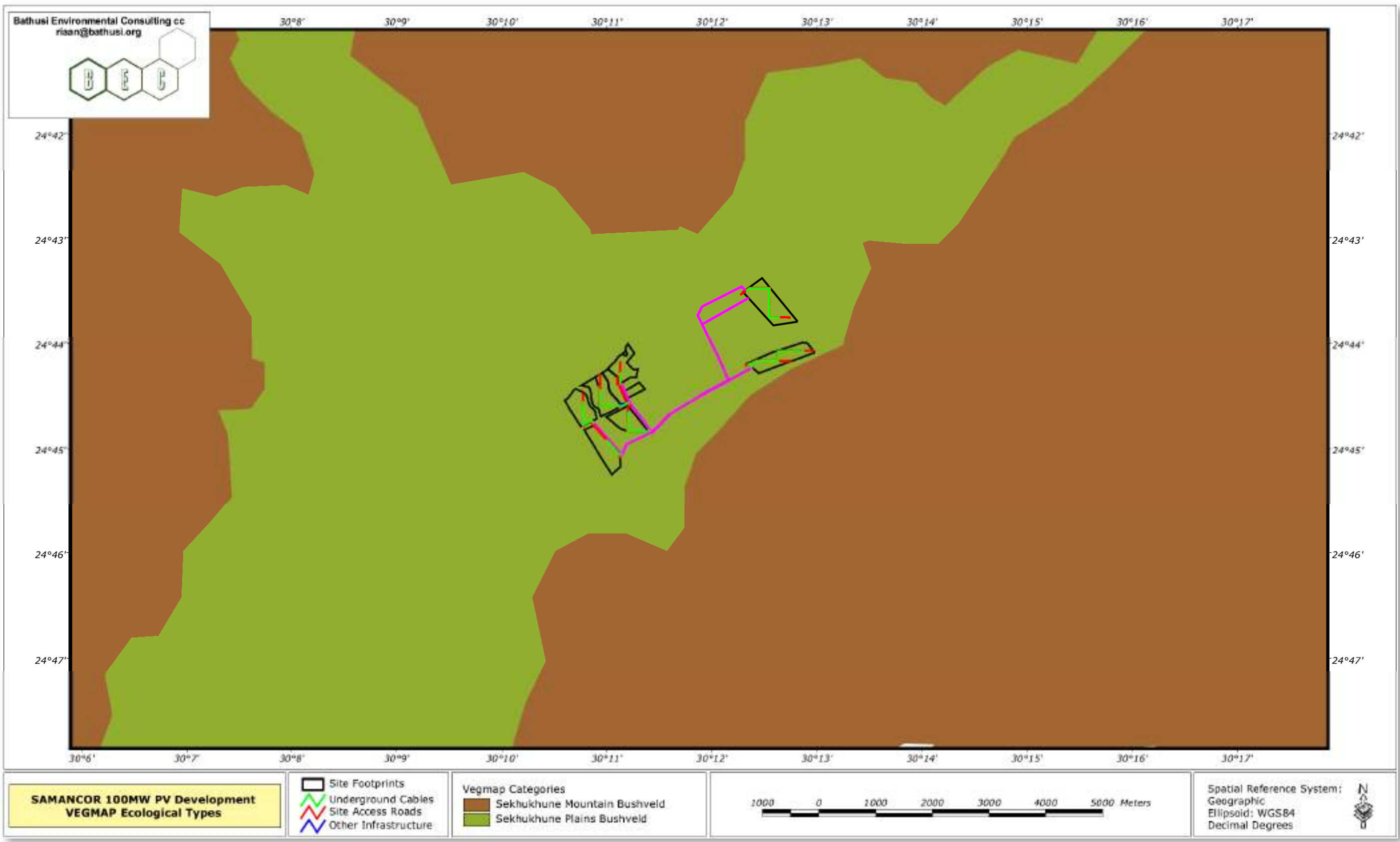


Figure 11: Regional Ecological Types (Vegmap)

[2] ([N]Northern Sourveld endemic, [CB]Central Bushveld endemic, [SK]Sekhukhune endemic, [D]Broadly disjunct distribution)

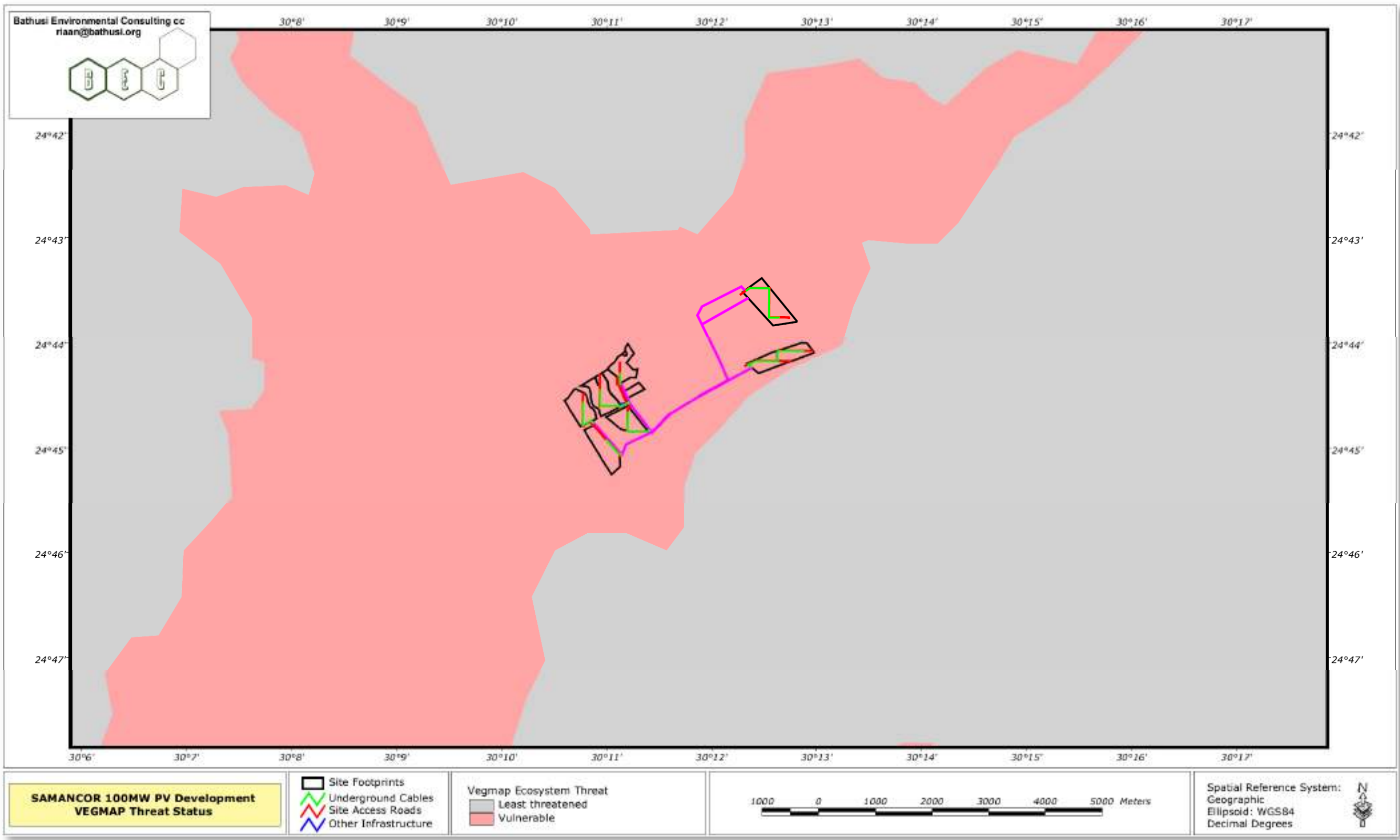


Figure 12: Conservation status of regional ecological types (Vegmap Ecosystem Threat Status)

23 BOTANICAL SPECIES RICHNESS

23.1 REGIONAL SPECIES RICHNESS (GAMMA DIVERSITY)

Information extracted from the SANBI information source (NEWPOSA, 2021) provides for the known presence of approximately 573 plant species within the immediate region of the study area. Data records were selected within the immediate region from an area between S24.6°, E30.1° and S24.8°, E30.3° (refer **Figure 13**) (approximately 0.2 x 0.2 degrees, 450 km²)[3].

The known floristic richness of the region reflects the high regional floristic richness context of the Savanna Biome, as well as the regional ecological type (Sekhukhune Plains Bushveld). It is therefore reasonable to expect that untransformed and natural (indigenous) vegetation within the immediate region is likely to exhibit similarly high floristic richness and diversity patterns. However, because of extensive and large-scale deterioration of the savanna types in the local region, much of the area does not reflect the natural status of the savanna type, but rather a somewhat depauperate and depleted species composition that strongly reflects the deteriorated and altered vegetatal structures. In particular, the removal of the woody layer (through wood harvesting, noted to the north of the Steelpoort River) and intensive land-use practices, which includes persistent and high grazing patterns and inappropriate fire regimes as well as erosion on a landscape level, results in the deteriorated and altered nature of the local vegetation, and therefore locally depleted floristic species richness and diversity patterns.

[3] *The selection of a suitable area took note of collection records to obtain a minimum of 500 plant species collection records, but also with reference to comparable habitat types and status. The study sites are therefore not necessarily centred in the selection area.*

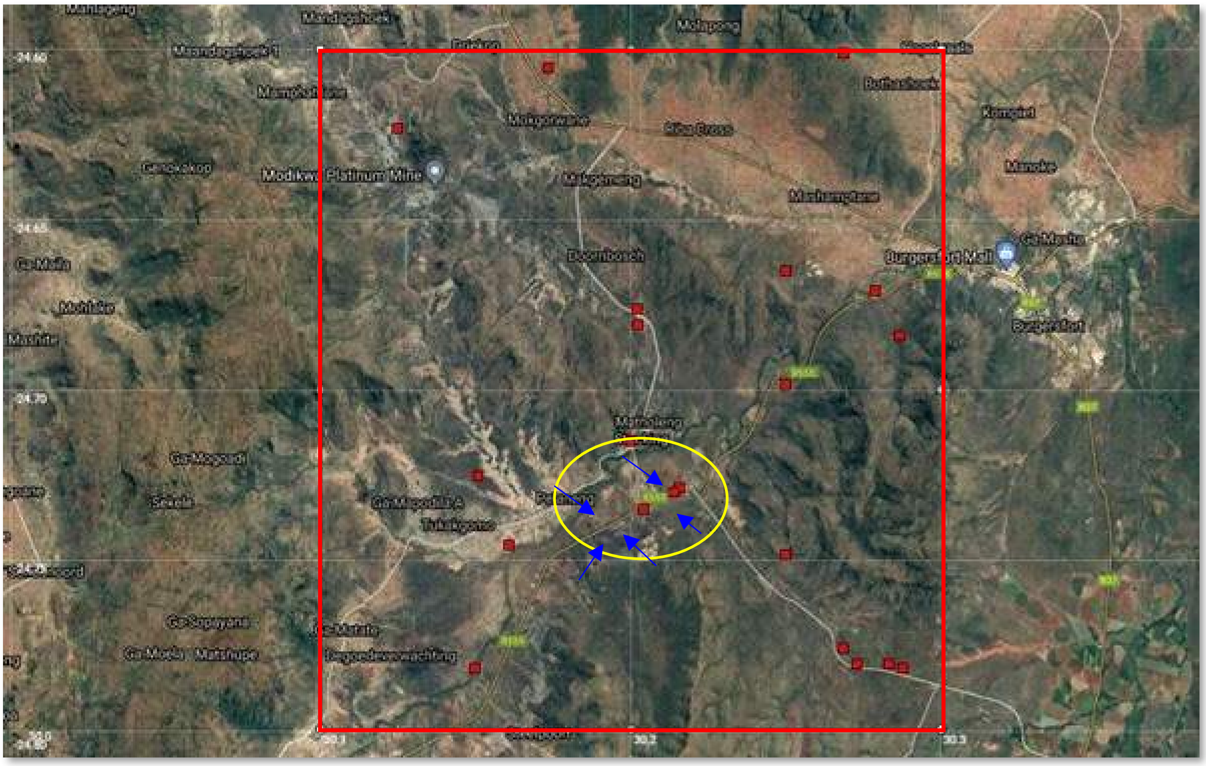
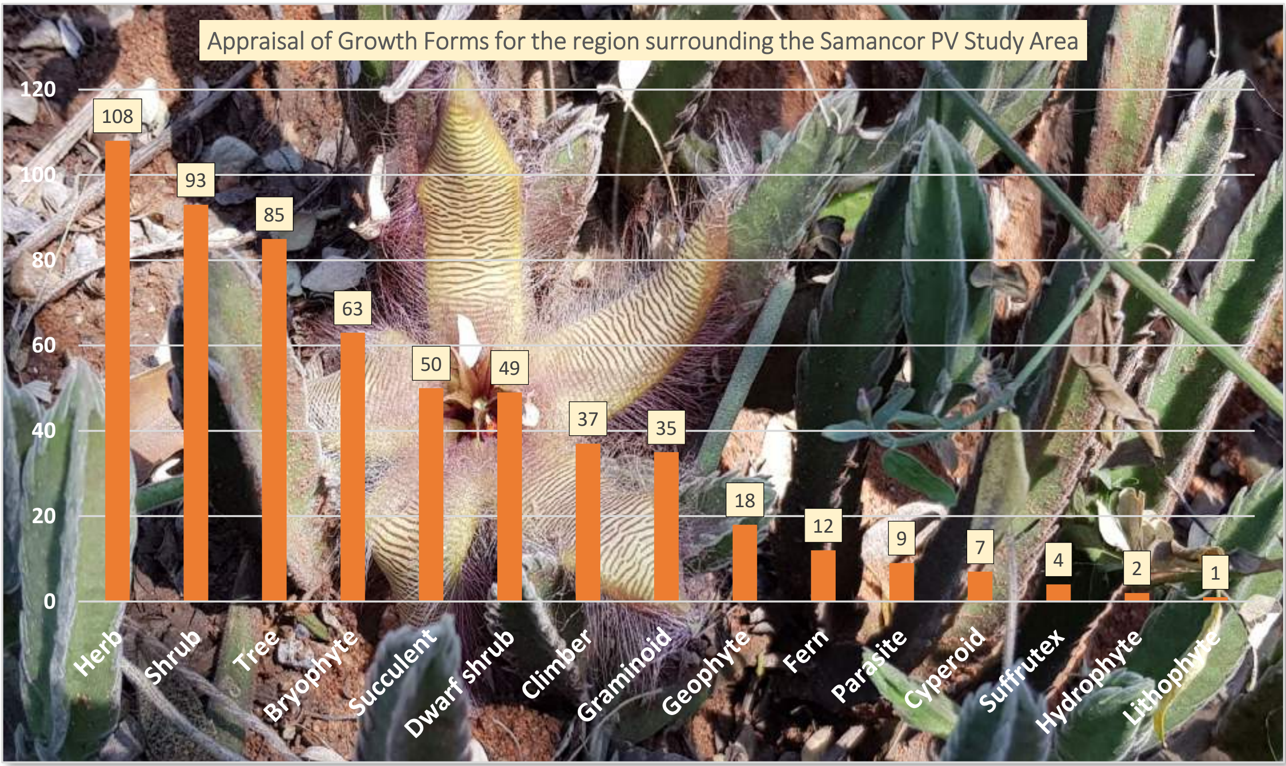


Figure 13: Floristic data records for the local region (red rectangle)

Note red rectangle for selection area, blue arrows for approximate location of study sites, yellow circle for the location of local collection localities. Red dots indicate sampling record localities within the selected area.

An appraisal of the growth forms of the region (refer **Graph 4**) indicates that herb species (108 species, 18.8 %) numerically dominate the vegetation as a growth form. However, shrubs (93 species, 16.2 %) and trees (85 species, 14.8 %), in addition to comprising a high percentage of the species composition, is also physiognomically dominant, dictating the woodland and savanna physiognomy of the region. It would appear that a detailed and comprehensive survey pertaining to bryophyte species has been conducted in the region as this life form comprises an impressive 63 species (11.0 %) of the species composition of the region. Life forms of secondary importance include succulents and dwarf shrubs. Surprisingly, grasses comprise a comparatively low abundance of species, i.e. only 35 species (6.1 %).

A total of 118 plant families have been recorded in the wider study region, numerically dominated by Fabaceae (50 species, 8.7 %), while Asteraceae (42 species, 7.3 %), Poaceae (35 species, 6.1 %) and Lamiaceae (25 species, 4.4 %) are prominently represented.



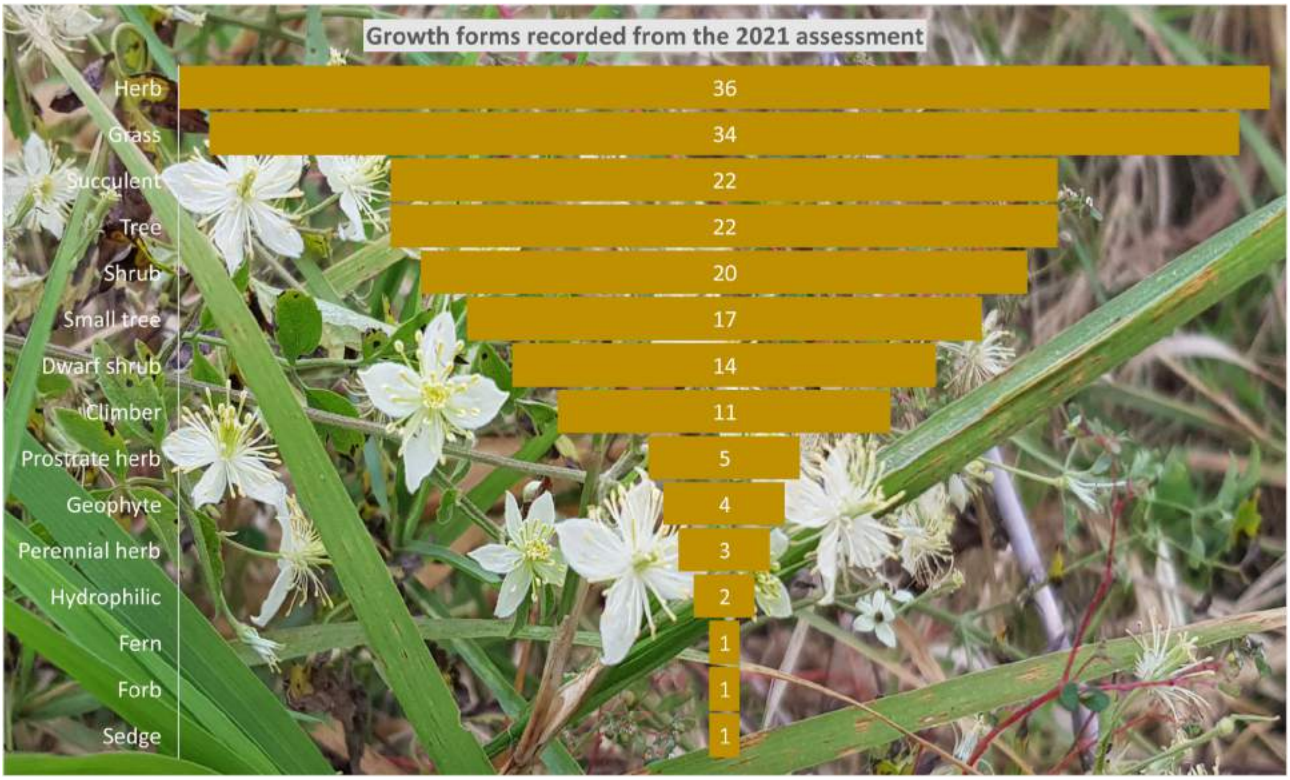
Graph 4: Growth form patterns for the region surrounding the study sites

23.2 Local Species Richness – Survey Results (2021)

A brief survey of the proposed sites revealed a floristic species richness of 196 plant species (refer Appendix 1), which corresponds (numerically) to approximately 34.2 % of the sampling records from the wider study area (refer Section 22.1), reflecting a high floristic diversity, notwithstanding the comparative small size of the survey areas and the instantaneous nature of the surveys. A total of 96 species that have been recorded during this particular assessment, have not previously been recorded from the wider study area, indicating under sampling or identification discrepancies; further verification/ sampling during seasonally appropriate (reproductive) times and more intensive assessments that take cognisance of habitat diversity, will likely result in higher accuracies from both the existing SANBI information source and results of local studies. The moderate correlation to the regional species richness is also explained by the comparatively natural status of the remaining natural vegetation, despite localised deterioration patterns. A collage of images of selected plant species is presented in Appendix 2.

A brief review of growth forms recorded from the site assessments provides insight into the physiognomy, species richness and diversity patterns on a local scale (refer Graph 5). Despite the savannoid nature of the study areas, the herbaceous and graminoid life forms dominate the species richness with 36 species (18.4 %) and 34 (17.3 %), respectively. Trees (22 species, 11.2 %), shrubs (20 species, 10.2 %) and small trees (17 species, 8.7 %) comprise lower species richness, but typically dominates the physiognomy of the receiving area. The succulent diversity of the areas is noted with a total of 22 species (11.4 %), while life forms of lower abundance include dwarf shrubs, climbers, prostrate herbs and geophytes.

A total of 54 plant families were recorded during this survey bout, dominated by the Poaceae family (grasses, 35 species, 18.1 %), Fabaceae (24 species, 12.4 %), Asteraceae (15 species, 7.8 %) and Malvaceae (13 species, 6.7 %). Families with lower representation include Euphorbiaceae, Apocynaceae, Asphodelaceae, Lamiaceae, Cactaceae, Capparaceae, Acanthaceae and Combretaceae. A total of 37 plant families have representation of either 1 or 2 species.



Graph 5: Plant life forms recorded from the study areas during 2021

23.3 PLANT SPECIES OF CONSERVATION CONCERN

23.3.1 BACKGROUND

The following information sources were consulted as background information for a brief evaluation of plant species of conservation concern:

1 SANBI Distribution data (NEWPOSA), (IUCN Criteria);

2 National Forest Act of 1998 (protected tree species) (refer Appendix 1); and

3 Limpopo Environmental Management Act (Act No 7 of 2003, including Schedule 11 (Specially protected plants) and Schedule 12 (Protected plants) (Refer Appendix 2).

South Africa's Red List system is based on the IUCN Red List Categories and Criteria Version 3.1 (finalized in 2001) (http://www.iucnredlist.org), amended to include additional categories to indicate species that are of local conservation concern. The IUCN Red List system is designed to detect risk of extinction. Species that are at risk of extinction, also known as threatened or endangered species are those that are classified in the categories Critically Endangered (CR), Endangered (EN) and Vulnerable (VU). The South African Red List contains three additional categories (Critically Rare, Rare and Declining) to highlight plant species that are not in danger of extinction, but are of local conservation concern because they are rare, or there are threatening processes affecting their populations (refer Figure 14).

These categories have been developed to highlight those taxa classified as Least Concern according to the IUCN system, should be considered in conservation prioritization processes. It is important to emphasize that the South African categories Critically Rare, Rare and Declining are intended for use in local conservation prioritization processes only. In submission to the IUCN Red List of Threatened Species, these taxa have to be categorized according to the IUCN system and therefore their global status will be Least Concern.

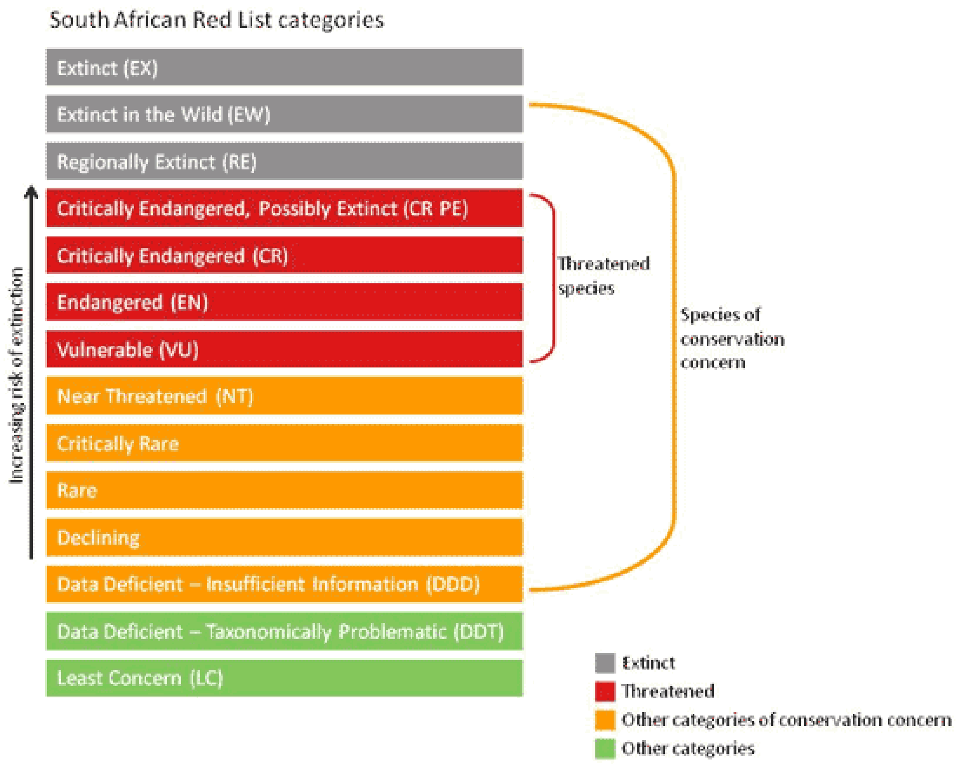


Figure 14: South African Red List Categories (courtesy of SANBI)

Guidelines for the assessment of Red List species include (but are not necessarily limited to):

⇒ A botanical specialist with local botanical and ecological knowledge and experience should undertake the survey;

⇒ A suitable survey should be undertaken; in the summer-rainfall areas of the country, botanical surveys should take place October to April while in the winter-rainfall areas they should take place between August and October;

⇒ Prior to visiting the site, the specialist consultant should download a list of species that could potentially occur at the site from POSA;

⇒ It is important that specimens are collected as part of the botanical survey, especially for taxonomic groups likely to be of conservation concern;

⇒ Plants should be identified to species level wherever possible, not genus level;

⇒ Species that may be dormant should also be reported;

⇒ Once specimens are collected, they should be identified at an herbarium. Potential species of conservation concern sampled should be identified by a taxonomist specializing in the plant group in question;

⇒ Specialist botanists should also include in their reports a list of species of conservation concern that may occur at a site but may be dormant as a result of unfavourable environmental conditions, for example species that were not seen because the vegetation at a site has not been burnt for many years.

23.3.2 PLANT SPECIES OF CONSERVATION CONCERN – REGIONAL RECORDS (NEWPOSA, 2021)

Table 6 provides a list of SCC plants that have been recorded from the immediate region surrounding the study site (refer Figure 14 for an indication of the geographical extent of sampling records). While the dataset indicates a comparative high diversity of SCC known from the region, systemic and long-term anthropogenic impacts on the vegetation of the areas, and accelerated deterioration that resulted from severe and persistent grazing and utilisation pressure, as well as the absence of local and regional conservation efforts, generally implies that a lower diversity is likely.

Table 7: Plant species of conservation concern recorded in the region (NEWPOSA, 2021)

Taxon	*Family*	*Status*
Acalypha caperonioides Baill. var. *caperonioides*	Euphorbiaceae	DD (IUCN)
Adenia fruticosa **Burtt Davy subsp.** ***fruticosa***	**Passifloraceae**	**NT (IUCN), LEMA (Schedule 12)**
Aloe castanea Schonland	Asphodelaceae	LC (IUCN), LEMA (Schedule 12)
Aloe longibracteata Pole-Evans	Asphodelaceae	LEMA (Schedule 12)
Aloe pienaarii Pole-Evans	Asphodelaceae	LEMA (Schedule 12)
Aloe pretoriensis Pole-Evans	Asphodelaceae	LC (IUCN), LEMA (Schedule 12)
Aloe verecunda Pole-Evans	Asphodelaceae	LC (IUCN), LEMA (Schedule 12)
Asparagus intricatus (Oberm.) Fellingham & N.L.Mey.	Asparagaceae	DD (IUCN)
Balanites maughamii **Sprague subsp.** ***maughamii***	**Zygophyllaceae**	**Protected tree (NFA, 2014)**
Bonatea antennifera Rolfe	Orchidaceae	LC (IUCN), LEMA (Schedule 12)
Boscia albitrunca **(Burch.) Gilg & Gilg-Ben.**	**Brassicaceae**	**Protected tree (NFA, 2014)**
Catha edulis (Vahl) Forssk. ex Endl.	Celastraceae	LC (IUCN), Protected tree (NFA, 2014)
Ceropegia ampliata E.Mey. var. *ampliata*	Apocynaceae	LC, LEMA (Schedule 12)
Chlorophytum cyperaceum (Kies) Nordal	Agavaceae	LC, Regional importance (Central Bushveld endemic, Vegmap)
Delosperma rileyi L.Bolus	Aizoaceae	DD (IUCN)
Dicliptera fruticosa K.Balkwill	Acanthaceae	NT (IUCN)
Elephantorrhiza praetermissa **J.H.Ross**	**Fabaceae**	**LC (IUCN), LEMA (Schedule 12)**
Eulophia petersii (Rchb.f.) Rchb.f.	Orchidaceae	LC (IUCN), LEMA (Schedule 12)
Eulophia speciosa **(R.Br. ex Lindl.) Bolus**	**Orchidaceae**	**LC (IUCN), LEMA (Schedule 12)**
Eulophia streptopetala Lindl.	Orchidaceae	LC (IUCN), LEMA (Schedule 12)
Euphorbia barnardii A.C.White, R.A.Dyer & B.Sloane	Euphorbiaceae	EN (IUCN), LEMA (Schedule 12)
Huernia kirkii N.E.Br.	Apocynaceae	LC (IUCN), LEMA (Schedule 12)
Huernia zebrina N.E.Br. subsp. *insigniflora* (C.A.Maass) Bruyns	Apocynaceae	LC (IUCN), LEMA (Schedule 12)
Myrothamnus flabellifolius Welw.	Myrothamnaceae	DD (IUCN)
Nuxia gracilis Engl.	Stilbaceae	LC (IUCN), Regional importance (Disjunct distribution, Vegmap)
Orbea melanantha (Schltr.) Bruyns	Apocynaceae	LC (IUCN), LEMA (Schedule 12)
Orthosiphon fruticosus Codd	Lamiaceae	LC, (IUCN), Regional importance (Central Bushveld Endemic, Vegmap)
Papillaria africana (Mull.Hal.) A.Jaeger	Meteoriaceae	LEMA (Schedule 12)
Petalidium oblongifolium C.B.Clarke	Acanthaceae	LC, (IUCN), Regional importance (Central Bushveld Endemic, Vegmap)
Polygala sekhukhuniensis Retief, S.J.Siebert & A.E.van Wyk	Polygalaceae	VU (IUCN)
Riocreuxia sp.	Apocynaceae	LEMA (Schedule 12)
Satyrium cristatum Sond. var. *cristatum*	Orchidaceae	LC (IUCN), LEMA (Schedule 12)
Sclerocarya birrea **(A.Rich.) Hochst. subsp.** ***caffra*** **(Sond.) Kokwaro**	**Anacardiaceae**	**LC (IUCN), Protected tree (NFA, 2014)**
Searsia batophylla (Codd) Moffett	Anacardiaceae	VU (IUCN), LEMA (Schedule 12), Regional importance (Sekhukhune endemic, Vegmap)
Spirostachys africana Sond.	Euphorbiaceae	LC (IUCN), LEMA (Schedule 12)
Stapelia gettliffei **R.Pott**	**Apocynaceae**	**LC (IUCN), LEMA (Schedule 12)**

Results of the site inspections indicated the presence of several of these species within the proposed development footprints and impacts on these species are likely to be significant, although of localised extent.

23.3.3 *PLANT SPECIES OF CONSERVATION CONCERN – SURVEY RESULTS (2021)*

Table 7 provides a list of protected and conservation important plant species that were recorded from the proposed development footprints where if occur in varying abundance. It is emphasised that valid permits need to be obtained from LEDET and DFFE prior to the removal, damage, relocation, or any other activity that might affect these species. Considering the threat level and abundance of conservation important plant species within the proposed development footprints, an 'Offset Strategy' maybe be required as part of the mitigation approach.

The author is however of the opinion, based on the following aspects, that a formal Offset is not a requirement for this particular project:

1 One species that is included in a threatened category is present within the development footprints, i.e. *Adenia fruticosa* (Vulnerable), although a relocation programme, as part of the mitigation approach is anticipated to address likely impacts on these individuals;

2 although the regional ecological type is categorised as vulnerable, the present status of the area is considered moderate, at best, exhibiting significant effects of deterioration and impacts from surrounding land use and anthropogenic activities; and

3 proposed mitigation measures, including *ex situ* conservation actions (although not always a preferred option) is considered adequate to address impacts on certain species.

Despite this opinion, the discretion for an Offset Strategy still remains with the competent authority and the provincial authority (LEDET) and guidance will be provided upon review of this report.

Table 8: Plant species of conservation concern recorded in the respective development footprints

Species Name	*Family*	*Conservation/ Invasive Status*	*Abundance/ Note*
Adenia fruticosa Burtt Davy subsp. *fruticosa*	Passifloraceae	Near Threatened (IUCN). Protected Plant Schedule 12 (Limpopo Environmental Management Act 7 of 2003)	Moderately abundant, widely distributed
Aloe burgersfortensis Reynolds	Asphodelaceae	Least Concern (IUCN). Sekhukhune endemic. Protected Plant Schedule 12 (Limpopo Environmental Management Act 7 of 2003)	Abundant, widely distributed
Balanites maughamii Sprague	Balanitaceae	Least Concern (IUCN). Protected Tree (National Forest Act, 1998)	Abundant, widely distributed
Boscia albitrunca (Burch.) Gilg & Gilg-Ben.	Capparaceae	Least Concern (IUCN). Protected Tree (National Forest Act, 1998)	Moderately abundant, widely distributed
Elephantorrhiza praetermissa J.H.Ross	Fabaceae	Least Concern (IUCN). Protected Plant Schedule 12 (Limpopo Environmental Management Act 7 of 2003)	Moderately abundant, localised distribution
*Eulophia petersii (*Rchb.f.) Rchb.f.	Orchidaceae	Least Concern (IUCN). Protected Plant Schedule 12 (Limpopo Environmental Management Act 7 of 2003)	Moderately abundant, localised distribution
Sclerocarya birrea (A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro	Anacardiaceae	Least Concern (IUCN), Protected Tree (National Forest Act, 1998)	Moderately abundant, localised distribution
Stapelia gettliffei R.Pott	Apocynaceae	Least Concern (IUCN). Protected Plant Schedule 12 (Limpopo Environmental Management Act 7 of 2003)	Moderately abundant, localised distribution
Stapelia gigantea N.E.Br.	Apocynaceae	Least Concern (IUCN). Protected Plant Schedule 12 (Limpopo Environmental Management Act 7 of 2003)	Moderately abundant, localised distribution

Survey conditions were considered to be optimal, and the site inspections were conducted during seasonal periods that coincided with the flowering period of most plant taxa that could reasonably be expected to occur in the region. It is emphasised that valid permits need to be obtained from DFFE and LEDET prior to the removal, damage, relocation, or any other activity that might affect these species. An accurate estimation of the abundance, status, health and location of these species within the respective development footprints should be established with a dedicated 'walkthrough' assessment.

Sclerocarya birrea

Adenia fruticosa

Boscia albitrunca

Eulophia petersii

Balanites maughamii

Stapelia cf. *gigantea*

Stapelia cf. *gettliffei*

Figure 15: Images highlighting plant taxa of conservation concern that were recorded from the site (May 2021)

23.3.4 ANNOTATIONS ON SCC FROM THE NATIONAL ENVIRONMENTAL SCREENING REPORT

Regulation 16(1)(v) of the Environmental Impact Assessment Regulations, 2014 (EIA Regulations) provides that an applicant for Environmental Authorisation is required to submit a report generated by the Screening Tool as part of its application. On 5 July 2019, the Minister of Environmental Affairs, Forestry and Fisheries published a notice in the Government Gazette giving notice that the use of the Screening Tool is compulsory for all applicants to submit a report generated by the Screening Tool from 90 days of the date of publication of that notice. The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing a mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas. The Screening Tool report will indicate the (preliminary) environmental sensitivities that intersect with the proposed development footprint as defined by the applicant as well as the relevant Protocols that the applicant would need to adhere to.

The Screening Tool comprises a collection of information sources that are mapped at a national scale; ultimately there may be areas where the Screening Tool erroneously assigns, or misses, environmental sensitivities because of mapping resolution and a high paucity of available and accurate data. Broad-scale site investigations will provide for an augmented and site-specific evaluation of the accuracy and 'infilling' of obvious and large-scale inaccuracies.

It is a requirement of the National Environmental Management Act, 298 (Act No. 107 of 1998) that "the Initial Site Sensitivity Verification must be undertaken by an Environmental Assessment Practitioner (EAP) or a registered specialist with expertise in the relevant environmental theme being considered". Information will be extracted from the National Web-based Environmental Screening Tool will guide assessments and biodiversity aspects of importance. The main purpose of the EIA Assessments will be to establish the sensitivity of the terrestrial ecological receiving environment that could render the proposed site either technically flawed, or have the potential to give rise to significant or unacceptable environmental consequences.

Table 9: Conservation important species highlighted by the National Environmental Screening Report

Species Name	*Family*	*Status*	*Environmental Sensitivity*	*Note*
Sensitive species[4] 1252	Dioscoreaceae	Vulnerable[5]	Medium Sensitivity	Habitat within footprints vary between unsuitable to moderately suitable. A moderate to low likelihood of this species occurring is estimated for the project area. A suitable 'walkthrough' assessment will establish presence/ absence.
Sensitive species 1033	Euphorbiaceae	Endangered[6]	Medium Sensitivity	Suitable habitat for this species include closed woodland on rocky summits and slopes and succulent dominated vegetation with low grass and tree cover. Habitat within development footprints are not considered particularly suitable and low to moderate-low potential of occurrence is estimated. A suitable 'walkthrough' assessment will establish presence/ absence as it is easy to locate and identify from vegetative material.
Sensitive species 587	Euphorbiaceae	Rare[7]	Medium Sensitivity	Usually restricted to specialised habitat with steep slopes, large boulders and rocky outcrops. Habitat within development footprints does not confirm to habitat requirements and a low probability of occurrence is estimated for the development area.
Asparagus fourei (VU)	Asparagaceae	Vulnerable	Medium Sensitivity	Range-restricted Sekhukhuneland endemic species that is restricted to dolerite outcrops. Habitat within development footprints does not conform to requirements for this species and a low probability of occurrence is estimated for this species. Northern Sourveld Endemic (Vegmap)
Polygala sekhukhuniensis (VU)	Fabaceae	Vulnerable	Medium Sensitivity	Range-restricted and edaphic specialist species that prefers sparsely vegetated and heavy-metal rich soils on lower slopes and valley bottoms, also on erodible, clayey soils. Habitat within development footprints does not conform to requirements for this species and a low probability of occurrence is estimated for this species.

[4] Please note that the National Environmental Screening report includes lists of animal and plant species of conservation concern that are known or expected to occur on the proposed development footprint. Some of these SCC are sensitive to illegal harvesting. As per the best practise guideline that accompanies the protocol and screening tool, names of the sensitive species may therefore not appear in the final EIA report, or any specialist reports released into the public domain. It should be referred to as '*sensitive species'*.
[5] A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction
[6] A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction
[7] A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria

Table 9: Conservation important species highlighted by the National Environmental Screening Report				
Species Name	*Family*	*Status*	*Environmental Sensitivity*	*Note*
Searsia batophylla (VU)	Anacardiaceae	Vulnerable	Medium Sensitivity	Most often in dry savanna in low-lying areas and along watercourses and shallow soils. Habitat within development footprints is considered low to moderately suitable for this species. A population approximately 5 km from the development footprints have been noted. Although no individuals were noted during the principal assessment, a suitable 'walkthrough' assessment will confirm presence/ absence as it is easy to locate and identify from vegetative material.
Searsia sekhukhuniensis (Rare)	Anacardiaceae	Rare	Medium Sensitivity	Habitat specialist in arid savanna areas in Sekhukhuneland region (SA endemic species). Occurring on rocky hillsides, on pyroxenitic substrate s. Habitat within development footprints does not conform to requirements for this species and a low probability of occurrence is estimated for this species.
Combretum petrophilum (Rare)	Combretaceae	Rare	Medium Sensitivity	Habitat specialist in arid savanna areas in Sekhukhuneland region (SA endemic species). Occurring on rocky outcrops and shrubby savanna in mountain bushveld. Habitat within development footprints are considered moderately to poorly suited for this species and a moderate-low to low probability of occurrence is estimated for this species. Although no individuals were noted during the principal assessment, a suitable 'walkthrough' assessment will confirm presence/ absence.

23.4 Declared Invasive Species & Common Weeds

Table 10 denotes a list of common weeds species as well as declared alien and invasive species that were recorded on the study site during the site investigation.

Table 10: List of common weeds and declared alien and invasive plant species within the study area			
Species Name	*Family*	*Status*	*Abundance/ Threat*
Achyranthes aspera L. var. *aspera*	Amaranthaceae	Naturalised exotic, weed. Not Evaluated	Moderately abundant, low threat
Agave sisalana Perrine	Agavaceae	Declared Invader - NEMBA (Category 2). CARA (Category 2).	Abundant, high threat
Argemone ochroleuca Sweet subsp. *ochroleuca*	Papaveraceae	Declared Invader - NEMBA (Category 1B). CARA (Category 1). GBIF Listed.	Moderately abundant, low threat
Bidens pilosa L.	Asteraceae	Naturalised exotic, weed. Not evaluated	Moderately abundant, low threat
Catharanthus roseus (L.) G.Don	Apocynaceae	Declared Invader - NEMBA (Category 1B)	Low abundance, low threat
Cereus jamacuru (L.) Mill.	Cactaceae	Declared Invader - CARA (Category 1). NEMBA (Category 1B). GBIF listed	Moderately abundant, high threat
Datura stramonium L.	Solanaceae	Declared Invader - CARA (Category 1), NEMBA (Category 1B), GBIF listed.	Moderately abundant, low threat
Flaveria bidentis (L.) Kuntze	Asteraceae	Declared Invader - NEMBA (Category 1B. AIP, 2016). Not GBIF listed. Not listed for CARA.	Moderately abundant, low threat
Melia azedarach L.	Meliaceae	Declared Invader - CARA (Category 3), NEMBA (a. Category 1b b. Category 3 in urban areas). GBIF listed.	Low abundance in riparian woodland, high threat
Morus alba L.	Moraceae	Declared Invader - NEMBA (Category 3). GBIF listed. CARA Category 3.	Moderate abundance in riparian woodland, high threat
Nicotiana glauca Graham	Solanaceae	Declared Invader - CARA 2002 (Category 1), NEMBA – (Category 1B). GBIF listed. CARA Category 1.	Moderate abundance in riparian woodland, high threat
Opuntia ficus-indica (L.) Mill.	Cactaceae	Declared Invader - NEMBA (Category 1B). CARA (Category 1). GBIF listed.	Low abundance in riparian woodland, high threat

Table 10: List of common weeds and declared alien and invasive plant species within the study area			
Species Name	*Family*	*Status*	*Abundance/ Threat*
Opuntia humifusa (Raf.) Raf.	Cactaceae	Declared Invader - CARA 2002 – Category 1 NEMBA – Category 1B	Low abundance, moderate threat
Opuntia leucotricha DC.	Cactaceae	Declared Invader - CARA 2002 – Category 1 NEMBA – Category 1B	Low abundance, moderate threat
Pennisetum clandestinum Chiov.	Poaceae	Declared Invader - NEMBA (Category 1B in protected areas and wetlands in which it does not already occur). Not GBIF listed. Not CARA listed.	Low abundance, moderate threat
Populus x *canescens* (Aiton) Sm.	Salicaceae	Declared Invader - NEMBA (Category 2), CARA (Category 2). Originally from America, used for timber. GBIF listed.	Low abundance, moderate threat
Ricinus communis L. var. *communis*	Euphorbiaceae	Declared Invader - NEMBA (Category 2)	Moderate abundance, moderate threat
Salix babylonica L.	Salicaceae	Naturalised exotic, Not evaluated	Low abundance, low threat
Schkuhria pinnata (Lam.) Cabrera	Asteraceae	Naturalised exotic. Not Evaluated	Low abundance, low threat
Senna didymobotrya (Fresen.) H.S.Irwin & Barneby	Fabaceae	Declared Invader - CARA 2002 (Category 1) . NEMBA (a. 1B in Eastern Cape, KwaZulu-Natal, Limpopo, Mpumalanga and Western Cape. b. Not listed elsewhere).	Low abundance, moderate threat
Sesbania bispinosa (Jacq.) W.Wight var. *bispinosa*	Fabaceae	Currently unlisted	Low abundance, low threat
Sesbania punicea (Cav.) Benth.	Fabaceae	Declared Invader - NEMBA (Category 1B). CARA (Category 1). GBIF listed.	Low abundance, moderate threat
Solanum elaeagnifolium Cav.	Solanaceae	Declared Invader - NEMBA (Category 1B)	Low abundance, low threat
Tagetes minuta L.	Asteraceae	Not NEM:BA listed. GBIF listed.	Low abundance, low threat
Tecoma stans (L.) Juss. ex Kunth var. *stans*	Bignoniaceae	Declared Invader - CARA 2002 (Category 1). NEMBA (Category 1B)	Low abundance, moderate threat
Typha capensis (Rohrb.) N.E.Br.	Typhaceae	Naturalised exotic, Not evaluated	Moderate abundance, low threat
Xanthium strumarium L.	Asteraceae	Declared Invader - CARA 2002 (Category 1). Proposed legislation: NEMBA (Category 1B)	Moderate abundance, low threat

23.5 PLANTS WITH TRADITIONAL MEDICINAL USES

Table 11 lists plants with popular traditional and medicinal uses that were recorded on the sites.

Table 11: List of popular traditional and medicinal plant species recorded within the site and immediate surrounds		
Species Name	*Common Name*	*Status/ Uses*
Adenia fruticosa Burtt Davy subsp. *fruticosa*	Sekhukhune Green-stem (e), Sekoekoenie-bobbejaangif (a)	Poisonous fruit, edible leaves
Aloe castanea Schönland	Cat's-tail Aloe (e), Katstertaalwyn (a)	Harvested for ornamental purposes
Aloe marlothii A.Berger subsp. marlothii	Mountain Aloe (e), Bergaalwyn (a)	Ornamental, heavily harvested
Argemone ochroleuca Sweet subsp. *ochroleuca*	White-flowered Mexican poppy (e), Bloudissel (a), Hlaba-hlabane-e-putsoa (s)	Possible toxicity to animals and humans, medicinal uses, irritant
Balanites maughamii Sprague	Greenthorn (e), Groendoring (a)	Potentially poisonous parts for fish, fruits are edible, traditional and medicinal uses
Bolusanthus speciosus (Bolus) Harms	Elephant Wood (e), Tree Wisteria (e), Vanwykshout (a)	Roots used medicinally, traditional and practical uses
Boscia albitrunca (Burch.) Gilg & Gilg-Ben.	Sheperd's Tree (e), Witgat (a), Matoppie (a), Mohlopi (ns)	Important fodder, traditional uses, traditional medicinal uses
Boscia foetida Schinz subsp. *rehmanniana* (Pestal.) Toelken	Bushveld Shepherd Tree (e), Stinkwitgat (a), Mopipi (ns)	Medicinal uses, browsing value
Carissa bispinosa (L.) Desf. ex Brenan	Forest num-num (e), Bosnoemnoem (a)	Edible parts, medicinal uses
Catharanthus roseus (L.) G.Don	Madagascar periwinkle (e), Begraafplaasblom (a)	Traditional medicinal uses, originally from Madagascar, ornamental
Cissus cactiformis Gilg	Cactus vine (e)	Traditional medicinal uses
Combretum apiculatum Sond. subsp. *apiculatum*	Red bushwillow (e), Rooibos (a), Mogoeleri (ss)	Traditional medicinal uses, seeds possibly poisonous but consumed by Brown-

Table 11: List of popular traditional and medicinal plant species recorded within the site and immediate surrounds		
Species Name	*Common Name*	*Status/ Uses*
		headed Parrots, , leaves eaten by game, firewood
Combretum erythrophyllum (Burch.) Sond.	River bushwillow (e), Vaderlandswilg (a)	Medicinal uses, ornamental in urban areas
Commelina africana	Yellow Wandering Jew (e), Geeleendagsblom (a)	Medicinal properties
Croton gratissimus Burch. var. *gratissimus*	Lavender fever-berry (e), Laventelkoorsbessie (a)	Medicinal uses, larval food for *Charaxes candiope candiope*
Cynanchum viminale (L.) Bassi subsp. *viminale*	Viny milkweed (e), Melktou (a)	Medicinal uses, potentially poisonous
Dalechampia galpinii Pax	Lowveld Wildhop (e)	Traditional medicinal uses
Datura stramonium L.	Common thorn apple (e), Malpitte (a), Letjoi (s)	Originally from Mexico, North America. Seed poisonous to animals and humans, medicinal uses
Dichrostachys cinerea (L.) Wight & Arn. subsp. *africana* Brenan & Brummitt	Small-leaved Sickle Bush (e), Kleinblaar-sekelbos (a), Ugagake (z)	Encroacher species, traditional medicinal uses, firewood, pods browsed extensively by game and stock
Dicoma anomala Sond.	Maagbitterwortel (a)	Medicinal uses
Dicoma capensis	Koorsbossie (a)	Medicinal uses
Dombeya rotundifolia (Hochst.) Planch. var. *rotundifolia*	Wild Pear (e), Drolpeer (a)	Wood is used for traditional purposes, bark, roots and root is used medicinally
Ehretia rigida (Thunb.) Druce subsp. *nervifolia* Retief & A.E.van Wyk	Puzzle Bush (e), Deurmekaarbos (a)	Roots are used medicinally
Euclea natalensis A.DC. subsp. *angustifolia* F.White	Bushveld hairy guarri (e), Bosveld harige guarrie (a)	Traditional and medicinal uses, edible parts
Euclea undulata Thunb.	Common Guarri (e), Gewone ghwarrie (a)	Firewood, edible fruit, traditional medicinal uses
Euphorbia ingens E.Mey. ex Boiss.	Giant euphorbia (e), Naboom (a)	Latex is toxic and caustic, used medicinally and as a fish poison
Gardenia volkensii K.Schum. subsp. *volkensii* var. *volkensii*	Bushveld gardenia (e), Bosveldkatjiepiering (a)	Fruit and root are used medicinally, traditional uses
Geigeria burkei Harv. subsp. *fruticulosa* Merxm.	Vermeerbos (a)	Potentially poisonous
Grewia bicolor Juss. var. *bicolor*	White-leaved Raisin (e), Witrosyntjie (a)	Medicinal uses, edible parts, highly variable
Gymnosporia buxifolia (L.) Szyszyl.	Common spike-thorn (e), Gewone pendoring (a)	Traditional uses, toxic parts, medicinal uses
Kalanchoe rotundifolia (Haw.) Haw.	Nentakalanchoe (e), Nentabos (a)	Medicinal uses, potentially poisonous
Kleinia stapeliiformis (E.Phillips) Stapf	--	Harvested for ornamental purposes
Leonotis ocymifolia (Burm.f.) Iwarsson	Minaret Flower (e), Wildedagga (a)	Medicinal uses, colours & dyes
Melia azedarach L.	Seringa (e), Persian lilac (e), Gewone sering (a)	Originally from Asia, Australia. Poisonous seeds, ornamental
Momordica balsamina L.	Balsam Pear (e), Laloentjie (a), Balsam Peer (a)	Rigorous climber, edible parts, traditional medicinal uses
Opuntia ficus-indica (L.) Mill.	Sweet Prickley pear (e), Turksvy (a), Torofeiee (s)	Originally from Mexico. Edible parts, medicinal uses. Cladodes poisonous when fed to cattle in large quantities, irritants
Peltophorum africanum Sond.	Weeping wattle (e), Huilboom (a)	Medicinal properties
Pergularia daemia (Forssk.) Chiov. subsp. *daemia*	Bobbejaankambro (a), Kgaba	Medicinal uses
Polydora poskeana (Vatke & Hildebr.) H.Rob.sens.lat.	Vernonia (a)	Medicinal uses
Pouzolzia mixta Solms	Soap-nettle (e), Seepnetel (a)	Traditional and traditional medicinal uses
Ricinus communis L. var. *communis*	Castor-oil plant (e), Kasterolie (a)	Poisonous parts
Schkuhria pinnata (Lam.) Cabrera	Dwarf Marigold (e), Bitterbossie (a)	Medicinal uses, weed (S. America)
Searsia pyroides Burch. var. *pyroides*	Common wild currant (e), Gewone taaibos (a)	Edible parts, medicinal uses
Selaginella dregei (C.Presl) Hieron.	Resurrection Plant (e)	Medicinal uses

Table 11: List of popular traditional and medicinal plant species recorded within the site and immediate surrounds		
Species Name	*Common Name*	*Status/ Uses*
Senegalia mellifera (Vahl) Seigler & Ebinger subsp. *detinens* (Burch.) Kyal. & Boatwr.	Black Thorn (e), Swarthaak (a)	Declared indicator of encroachment, medicinal uses, poison source
Senna italica Mill. subsp. *arachoides* (Burch.) Lock	Wild senna (e), Elandsertjie (a)	Medicinal uses
Sesamum triphyllum Welw. ex Asch. var. *triphyllum*	Wild sesame (e), Brandboontjie (a)	Edible parts, essential oils
Smilax anceps Willd.	Thorny Rope (e), Doringtou (a)	Medicinal uses, irritant
Stapelia gigantea N.E.Br.	Giant Carrion Flower (e), Reeuseaasblom (a)	Traditional medicinal uses
Stylochaeton natalensis Schott	Bushveld Arum (e), Bosvelld Varkoor (a)	Root and leaves used for traditional medicinal purposes
Tribulus terrestris L.	Common Dubbeltjie (e), Gewone Dubbeltjie (a)	Medicinal uses
Typha capensis (Rohrb.) N.E.Br.	Bulrush (e), Papkuil (a)	Cosmopolitan weed, edible parts, medicinal uses
Vachellia nilotica (L.) P.J.H.Hurter & Mabb. subsp. *kraussiana* (Benth.) Kyal. & Boatwr.	Scented-pod Thorn (e), Lekkerruikpeul (a)	Dyes and tans, traditional and medicinal uses
Vachellia tortilis (Forssk.) Gallaso & Banfi subsp. *heteracantha* (Burch.) Kyal. & Boatwr.	Curly-pod Acacia (e), Haak-en-steek (a), Isishoba (z)	Medicinal uses (bark). Often regarded as an encroacher species
Volkameria glabra (E.Mey.) Mabb. & Y.W.Yuan	Smooth Tinderwood (e), Bitterblaar (a)	Traditional and medicinal uses. Flowers attract birds and butterflies
Ziziphus mucronata Willd. subsp. *mucronata*	Buffalo-thorn (e), Blinkblaar-wag-'n-bietjie (a)	Edible parts, traditional medicinal uses, traditional uses

24 FLORISTIC HABITAT TYPES OF THE PROPOSED SITES AND IMMEDIATE SURROUNDING AREA

Historically, regional floristic patterns are the result of complex interacting biophysical driving forces that include climate, geology (soil), topography and moisture gradients that characterise a region. However, anthropogenic land use activities have caused, and accelerated, the intensity changes to the principal floristic patterns. The extent and nature of impacts and developmental factors on vegetation, include severe, immediate and complete decimation of the flora for instantaneous development activities, to gradual, peripheral and long-term changes, such as increased grazing pressure, altered moisture regimes, altered fire and burning patterns, changes in natural resource utilisation, etc. Such changes to the flora of a specific site are notoriously difficult to quantify and detect, specifically from the perspective of instantaneous observations or without the benefit of a quantified assessment with a regional perspective. Ultimately, the flora of a specific site is often portrayed as altered and variable types that exhibit floristic and vegetatal attributes different to the local, regional types, or historic descriptions of the ecological types. Therefore, and to an extent, some of the minor changes that is relatable to anthropogenic impacts are interpreted in the context of the original, natural vegetation, and only in cases where significant changes have resulted that from these impacts, notably structural changes that are accompanied by significant compositional changes, are categorised as 'separate' units.

The suite of development footprints for the proposed activity provides evidence of the range of anthropogenic impacts that resulted from disruptive and transformative industrial and associated activities over an extensive time period. Irremediable changes in vegetatal structure, species abundance, presence, absence, and composition resulted from land clearance activities in some parts, often recent, while other parts comprise natural and pristine bushland and shrubland types.

The following broad-scale habitat types[8] and categories were recognised from the study areas and the immediate surrounds (refer Figure 15):

⇒ Artificial Impoundments;
⇒ Deteriorated Open Shrubland Types;
⇒ Drainage Lines and Variable Shrubland Banks;
⇒ Steelpoort River, Tall Closed Riparian Banks and *Phragmites* Levees;
⇒ Tall Closed Riparian Bushland;
⇒ Closed Mixed Thicket and Bushland;
⇒ Transformed Areas, Infrastructure, Industries, etc.; and
⇒ Variable Mixed Shrubland.

[8] *The structural classification proposed here is independent of, but complementary to floristic, habitat and ecological classifications of vegetation (Edwards 1983).*

Figure 16: Broad-scale habitat types of the study areas and immediate surrounds

Figure 17: Floristic sensitivity of the study areas and immediate surrounds

24.2 Artificial Impoundments

A number of artificial impoundments were constructed as part of the existing operations. As these areas comprise no natural vegetation, they were excluded from the surveys and were ascribed a low floristic sensitivity (refer Figure 17).

24.3 Deteriorated Open Shrubland Types

The range and nature of land-use activities of the wider area represent the major developmental force for this habitat type, causing immediate direct and medium-term, indirect impacts that affect the status of extensive portions of the regional shrubland types, adversely affecting both the floristic composition and structure. The dominant floristic attributes of these parts therefore no longer correlate to the regional ecological types, i.e. the Sekhukhune Plains Bushveld. Activities such as bush clearance within powerline servitudes and recent and historic surface disturbances from industrial and residential land use activities resulted in an altered and dynamic/ transitional floristic status, ultimately rendering the floristic status of these parts compromised and poor.

The floristic nature of these parts is highly variable, depending on the nature and timing of the disturbance events, varying between areas where the woody layers appear depleted and shrubby, generally conforming to (deteriorated) open savannoid types, to areas where a secondary development of the woody layer is present, but with a composition that comprises mostly microphyllous (*Acacia* and *Dichrostachys*) type indigenous encroacher species and not the typical broad-leaf species that are encountered in natural shrubland of the immediate regions. Similarly, the herbaceous and grass layers exhibit a low species richness and diversity and is generally dominated by poor quality *Aristida* species. The depleted and deteriorated nature of the herbaceous stratum also strongly reflects the severity and persistently high grazing pressure to which these parts are often subjected. Coupled with a poor fire management regime, the poor (and atypical) composition of the herbaceous and woody strata ultimately render the floristic sensitivity of these parts moderately low (refer Figure 17). It was also noted that the presence of conservation important species is considerably lower in these parts.

While this habitat/ type is generally represented as isolated portions throughout the wider area, Site 1 is entirely comprised of this habitat type.

24.4 Drainage Lines and Variable Shrubland Banks

Apart from the dominant Steelpoort River that is situated immediately north of Site 5, the presence of several small and medium sized drainage lines are noted from the wider area. These features generally drains northwards into the Steelpoort River.

Smaller drainage lines are generally shallow and comparatively narrow, and due to the rapid evacuation of rainwater along these features, the highly ephemeral presence of water in these features does not allow for the development of a mesic vegetation type that would be characterised by the presence of hydrophilic plant types, such as along the Steelpoort River. Therefore, although categorised as a riparian habitat type, the dominant vegetation does not exhibit the typical mesic or riparian characteristics, but is rather a reflection of the xeric surrounding variable shrubland types, notably the woody (trees and shrubs) component, which may be locally slightly denser compared to the surrounding terrestrial areas. Channelled bottoms are often exposed rock, with thin layers of overlying, loose sand. The herbaceous composition of the streambeds and banks are often quite poor and sparse, but may comprise a selection of succulent species that are able to withstand the periodic disruptive events, such as *Aloe*, *Euphorbia*, *Kalanchoe, Kleinia* and *Stapelia* species. Grass species that typically occupy these parts are most often pioneer and poor-quality species, including *Aristida* species.

The drainage line situated between Sites 3 and 4 and across Site 5 is a significant feature; the width is in excess of 50 m in places and the depth may exceed 5 m. This drainage line is characterised by deeply incised banks and a wide, flat and clayey stream bottom from which the overlying sandy layers have been removed. While the banks of this feature, similarly, exhibit a reflection of the surrounding variable woodland types, the wide streambed is characterised by a secondary and transitional climax status that features a prominent and diverse herbaceous layer, but also a depleted collection of tree and shrub species that survives periodic flooding. It is thought that anthropogenic development of the wider area have resulted in severe alteration of the flow patterns within this area; ultimately ameliorating the severe nature of flood events and therefore facilitating the formation of a transitional climax vegetation layer. Evidence of erosion is noticeable from the banks of this feature.

These drainage features strongly reflect the status of the surrounding variable shrubland, appearing locally deteriorated, notably the larger drainage line between Sites 3 and 4. Although likely to be ecologically more significant, particularly the larger drainage line, the floristic sensitivity is not considered to be high and was ascribed a moderately high sensitivity, at best (refer Figure 17). No specific floristic feature of importance or sensitivity is associated with these features, and protected and conservation important species only occur sporadically within these features at lower abundance values compared to the surrounding variable shrubland.

24.5 Steelpoort River, Tall Closed Riparian Banks and *Phragmites* Levees

The perennial Steelpoort River and associated tall and dense wooded banks as well as the seasonally inundated *Phragmites* levees comprise a distinctive topographical and ecological feature of the immediate area. While the macro elements of this unit, such as the large trees and (southern) riverbanks, are considered comparatively natural, the undergrowth, levee areas, and smaller topographical features exhibit significant evidence of deterioration from high utilisation and resource plundering (informal sand mining practices); numerous and prominent weeds and invasive species, poor water quality, high grazing pressure and poor fire management resulted in a moderately deteriorated status of this unit.

Species that characterise the riverbanks along the Steelpoort River include the indigenous trees *Combretum erythrophyllum* and *Senegalia galpinii* as well as other lower strata species such as *Cyphostemma* species, *Grewia* species, *Gymnosporia buxifolia, Senegalia* and *Vachellia* species and dense, localised stands of the grasses *Cymbopogon validus, Dicanthium aristatum,* and *Panicum maximum* that manifests as dense and low, overhanging vegetation into the Steelpoort River. The deteriorated status of this ecosystem is indicated by the significant presence of exotic and invasive woody species such as *Melia azedarach, Morus alba, Populus* x *canescens, Salix babylonica, Senna didymobotrya, Sesbania bispinosa, S. punicea* and *Tecoma stans,* as well as the invasive herbs *Xanthium strumarium, Flaveria bidentis* and the grass *Pennisetum clandestinum.*

Localised levees that are situated immediately upland of the riverbanks, and which are typically inundated during high flood periods, comprise a closed, thicket-type shrub layer that is locally dominated by tall, dense stands of *Phragmites australis, Datura stramonium, Ricinus communis* and *Sida cordifolia* and tall grass stands comprising *Digitaria eriantha, Dactyloctenium giganteum, Dichanthium aristatum* and the forbs. Vegetation along the riverbanks is particularly dense.

The Steelpoort River ecosystem represents a system that has restricted presence on a wider scale and could therefore be considered ecologically sensitive. However, no floristic aspects of particular importance, and or species of conservation importance was recorded from this unit, a moderate-high floristic sensitivity is thus ascribed (refer Figure 17).

24.6 TALL CLOSED RIPARIAN BUSHLAND

Terrestrial habitat that is situated in proximity to the Steelpoort River is characterised by a prominent and dense layer of tall '*Acacia*' vegetation, prominent species include *Dichrostachys cinerea, Vachellia nilotica* and *V. tortilis*, but also comprising other woody species such as *Ehretia rigida, Euclea natalensis, Grewia bicolor, G. flava, G. vernicosa, Gymnosporia buxifolia,* as well as a well-developed herbaceous stratum that include a high occurrence of species that are strongly correlated to the xeric terrestrial habitat types (variable woodland), such as *Aloe* species and the grasses *Aristida diffusa, A. rhiniochloa, Digitaria eriantha, Eragrostis capensis, Perotis patens* and *Stipagrostis hirtigluma.*

The prominent layer of '*Acacia*' trees reflects a higher clay content of the deeper soils on lower topographical positions, ultimately rendering the vegetation 'sweet' and more palatable compared to surrounding habitat that comprise more sandy soils. The dense nature of the vegetation results in poor access for grazing animals, providing some protection against severe grazing pressure, although the ground layer appear depleted and open in parts of this unit, mostly attributed to periodic flooding and localised surface erosion.
The sporadic presence of the protected tree *Balanites maughamii* is noted in this unit, and also because of the association with the nearby riparian habitat and a comparatively natural status, albeit not pristine, a moderate-high floristic sensitivity is ascribed to these parts of the site (refer Figure 17).

24.7 CLOSED MIXED THICKET AND BUSHLAND

Isolated parts of the sites comprise particularly dense (closed) thickets and bushland where the cover of shrubs and trees often exceed 60 %. The species composition within these parts, although variable, correlates to the regional types and a number of co-dominant species were noted. The tree and shrub layer is dominant, comprising species such as *Commiphora pyracanthoides, Dichrostachys cinerea, Ehretia rigida, Gymnosporia buxifolia, Senegalia erubescens, Terminalia prunioides, Vachellia grandicornuta, Ximenia caffra, Balanites maughamii, Boscia albitrunca, Croton gratissimus, Peltophorum africanum, Sclerocarya birrea, Senegalia nigrescens, Senegalia senegal, Vachellia nilotica* and *Vachellia tortilis.* The herbaceous stratum, although variable, is comparatively diverse and includes notable species such as the grasses *Aristida diffusa, A. rhiniochloa, Enneapogon cenchroides, Eragrostis capensis, E. rigidior, Fingerhuthia africana, Heteropogon contortus, Panicum maximum, Schmidtia pappophoroides* and *Themeda triandra,* and the succulent species *Aloe castanea, A. marlothii, Euphorbia ingens, Kleinia longiflora, K. stapeliiformis* and *Stapelia gigantea.*
A prominent growth form in this unit include climber species, such as *Cissus cactiformis, Clematis brachiata, Cynanchum viminale, Dalechampia galpinii, Peponium caledonicum* and *Senecio pleistocephalus.*

The reason for the excessive densification of the woody layer is unclear, and is possibly attributed to variation in management or exclusion of fire for a prolonged period. Despite some structural differences between this and the nearby Variable Mixed Shrubland, the species composition is comparatively similar, providing some evidence that these types were historically similar types, generally correlating to the regional Sekhukhune Plants Bushveld type.

A relative high abundance of protected and conservation important species were recorded in this unit, including the vulnerable *Adenia fruticosa,* and the protected trees *Balanites maughamii, Boscia albitrunca* and *Sclerocarya birrea*. As a result, and despite a moderate level of deterioration, a moderate-high floristic sensitivity is ascribed to these parts (refer Figure 17).

24.8 TRANSFORMED AREAS, INFRASTRUCTURE, INDUSTRIES, ETC.

Parts of the region where natural habitat has been entirely replaced by infrastructure, mining and related industrial areas, residential areas, etc. No, or minimal natural, vegetation remain in these parts. No surveys have been conducted in these parts and a low floristic sensitivity is ascribed to these parts (refer Figure 17).

24.9 VARIABLE MIXED SHRUBLAND

This type represents the dominant habitat type within the wider area, manifesting as a variable shrubland with woody cover ranging between 20 % and 65 % and the average height of shrubs and trees between 3 m and 10 m. It conforms to an open to closed microphyllous and broad-leafed savanna type and is situated on the plains where shallow and sandy soils generally prevail where surface rock occur sporadically.

Typically, the local species composition is highly variable, ranging between areas of dense grass layers, dominated by tall grass species such as *Digitaria eriantha, Cenchrus ciliaris* and *Digitaria eriantha,* but mostly to an open and sparse grass cover that are dominated by *Aristida* species, *Urochloa mossambicensis*, *Stipagrostis hirtigluma* and other poor-quality species that signify a deteriorated status caused by high utilisation factors. Similarly, the woody layer is dominated by a range of species, depending on the location, management history, and also ranging between comparatively natural to moderately deteriorated. Locally the extensive presence of invasive species is also noted, specifically the succulent *Agave sisalana.* Prominent woody species include the shrubs *Boscia foetida*(d)*, B. albitrunca, Commiphora pyracanthoides*(d)*, Dichrostachys cinerea*(d)*, Combretum hereroense, Ehretia rigida, Euclea undulata, Grewia* species(d), *Searsia* species, *Terminalia prunelloides*(d)*, Senegalia mellifera, Vachellia grandicornuta,* and the larger trees *Balanites maughamii, Peltophorum africanum, Sclerocarya birrea, Senegalia nigrescens, Vachellia nilotica, V. tortilis* and *Volkameria glabra.*

The herbaceous stratum is particularly diverse, comprising numerous succulents such as the tall *Aloe castanea* and the low-growing *Aloe burgersfortensis*, *Euphorbia schinzii, E. lydenburgensis, Kalanchoe* species, *Kleinia longiflora* and *Stapelia gettliffei,* and notable herbs such as *Clematis brachiata, Blepharis subvolubilis, Ledebouria* species, *Flaveria bidentis, Hibiscus cannabinus, Holubia saccata, Kyphocarpa angustifolia, Petalidium oblongifolium, Polydora poskeana, Rhynchosia totta, Sida* species, *Tephrosia* species, *Waltheria indica, Sansevieria hyacinthoides* and *Senna italica.*

The floristic status of this habitat varies considerably. Portions within Site 5 is considered moderately deteriorated, while portions from Sites 3 and 4 exhibit more natural conditions. Site 2, due to certain edaphic factors and proximity to the mountainous areas to the south (and therefore different edaphic attributes), provide for a slightly different composition and structure, although it is included under this variable shrubland type, and despite the localised infestation by *Agave sisalana* and *Opuntia* species and isolated surface disturbances, include species such as the notable tree *Kirkia wilmsii*. The notable presence of protected trees *Sclerocarya birrea, Balanites maughamii, Boscia albitrunca,* as well other (provincially) protected species such as *Eulophia petersii, Stapelia* species and the vulnerable (IUCN) *Adenia fruticosa* ultimately renders the floristic sensitivity of these areas moderate-high, despite localised deterioration factors (refer Figure 17).

25 ANNOTATIONS ON FLORISTIC ATTRIBUTES OF THE DEVELOPMENT FOOTPRINT SITES

Annotations on the floristic attributes of the development footprints are provided individually.

25.1 SITE 1

Apart from localised areas that are entirely transformed from recent surface disturbances, this site and immediate surrounds comprise entirely of deteriorated shrubland that bears evidence of long-term deterioration, removal/ harvesting of trees, and severe and intensive grazing, also bearing no correlation to the regional ecological type. Notably, the woody layer is dominated by microphyllous encroacher shrub species *Dichrostachys cinerea* and *Vachellia exuvialis* and is additionally locally infested by the succulent *Agave sisalana.* Sporadic occurrences of *Aloe* species are noted, and only occasional and isolated protected trees occur within the site. The floristic species richness of the site is comparatively low, with only 45 species recorded during the survey (refer Table 11).

Site 1 is also situated immediately east of the commercial and residential areas of Steelpoort and is affected by peripheral and indirect impacts. The floristic nature of the site is homogenous with no topographic or ecological distinguishing features. Apart from a low number of protected tree species, no floristic aspect of sensitivity or importance was recorded during the survey and the floristic sensitivity of the site is ultimately considered moderate-low.

Table 12: Species recorded from Site 1

Growth Form	*Species Name*
Climber	*Dalechampia galpinii* Pax
Dwarf shrubs	*Blepharis subvolubilis* C.B.Clarke, *Dicoma tomentosa* Cass., *Leucosphaera bainesii* (Hook.f.) Gilg
Grasses	*Aristida adscensionis* L., *A. diffusa* Trin. subsp. *burkei* (Stapf) Melderis, *Digitaria eriantha* Steud., *Eragrostis chloromelas* Steud., *E. lehmanniana* Nees var. *lehmanniana, E. rigidior* Pilg., *Schmidtia pappophoroides* Steud., *Setaria sphacelata* (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. *torta* (Stapf) Clayton, *Themeda triandra* Forssk., *Urochloa mosambicensis* (Hack.) Dandy
Herbs	*Abutilon* species, *Cleome* species, *Hibiscus microcarpus* Garcke, *Kyphocarpa angustifolia* (Moq.) Lopr., *Leucas* species, *Petalidium oblongifolium* C.B.Clarke, *Schkuhria pinnata* (Lam.) Cabrera, *Sesamum triphyllum* Welw. ex Asch. var. *triphyllum*
Shrubs	*Commiphora pyracanthoides* Engl., *Grewia bicolor* Juss. var. *bicolor, G. flava* DC., *G. flavescens* Juss.
Small trees	*Boscia foetida* Schinz subsp. *rehmanniana* (Pestal.) Toelken, *Dichrostachys cinerea* (L.) Wight & Arn. subsp. *africana* Brenan & Brummitt, *Senegalia erubescens* (Welw. ex Oliv.) Kyal. & Boatwr., *Terminalia prunioides* M.A.Lawson, *Vachellia exuvialis* (I.Verd.) Kyal. & Boatwr., *V. grandicornuta* (Gerstner) Seigler & Ebinger, *Ximenia caffra* Sond. var. caffra
Succulents	*Agave americana* L. subsp. *americana* var. *americana,* *Aloe burgersfortensis* Reynolds, *A. castanea* Schönland, *A. globuligemma* Pole-Evans, *Cereus jamacuru* (L.) Mill., *Kleinia longiflora* DC., *Opuntia ficus-indica* (L.) Mill.
Trees	*Boscia albitrunca* (Burch.) Gilg & Gilg-Ben., *Kirkia wilmsii* Engl., *Sclerocarya birrea* (A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro, *Senegalia nigrescens* (Oliv.) P.J.H.Hurter, *Vachellia tortilis* (Forssk.) Gallaso & Banfi subsp. *heteracantha* (Burch.) Kyal. & Boatwr.

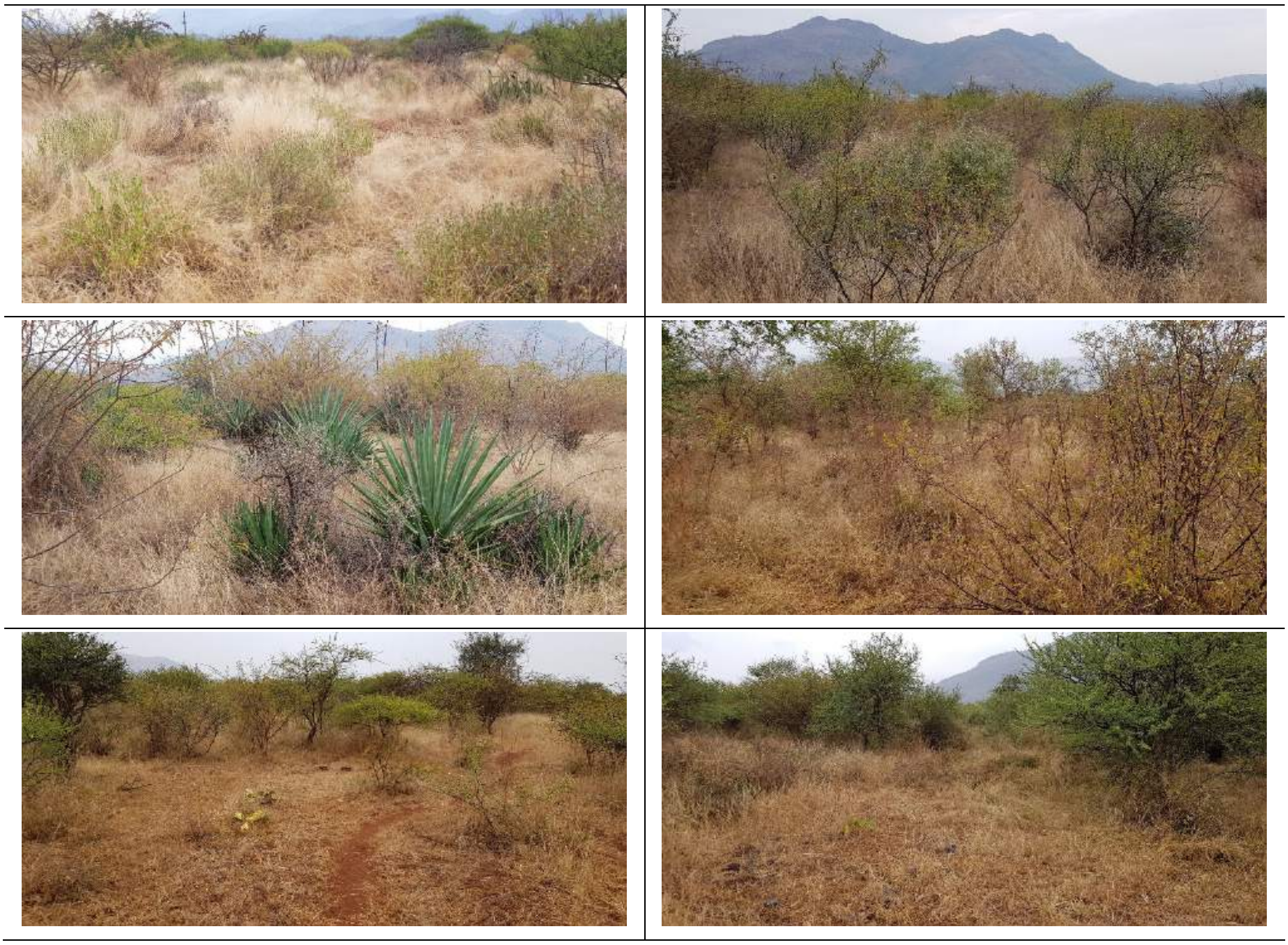


Figure 18: Collage of images of habitat conditions within Site 1

25.2 SITE 2

Site 2 comprise entirely of the Variable Mixed Shrubland habitat type, but do exhibit minor attributes that sets it slightly apart from other portions of this habitat type. Specifically, the presence of the tree *Kirkia wilmsii*, provides some evidence of the ecotonal location. This site is situated proximally to the Sekhukhune Mountain Bushveld and contain some elements of this topographically heterogenous ecological type, notably *Senegalia nigrescens, S. senegal var. leiorhachis, Kirkia wilmsii (d), Terminalia prunioides, Bolusanthus speciosus, Boscia albitrunca, Dichrostachys cinerea* and *Grewia vernicosa*, some of which is also abundantly represented in other portions of the Variable Mixed Shrubland.

Surrounding land use activities have had a detrimental effect on the status of this area, and the presence of several invasive exotic species, such as *Agave sisalana, Cereus jamacuru, Opuntia ficus-indica, O. humifusa, O. leucotricha* as well as indigenous encroacher microphyllous species is noted across the site. This, in association with a poor grass component and the extensive presence of a weedy disposition of much of the herbaceous layer, ultimately detract from the floristic status, although some parts are considered comparatively natural and representative of the regional type.

The presence of several protected and conservation important plants, such as the vulnerable *Adenia fruticosa* and the protected trees *Balanites maughamii, Boscia albitrunca* and *Sclerocarya birrea* and a high connectivity to pristine savanna types to the south of the site, renders the floristic sensitivity moderately high.

Table 13: Species recorded from Site 2

Growth Form	*Species Name*
Climber	*Cissus cactiformis* Gilg, *Clematis brachiata* Thunb., *Cynanchum viminale* (L.) Bassi subsp. *viminale*, *Jasminum fluminense* Vell. subsp. *fluminense*, *Momordica balsamina* L.
Dwarf shrub	*Blepharis subvolubilis* C.B.Clarke, *Dicoma tomentosa* Cass., *Geigeria burkei* Harv. subsp. *fruticulosa* Merxm., *Leucosphaera bainesii* (Hook.f.) Gilg, *Solanum elaeagnifolium* Cav.
Fern	*Selaginella dregei* (C.Presl) Hieron.
Grass	*Aristida adscensionis* L., *A. congesta* subsp. *barbicollis*, *A. diffusa* Trin. subsp. *burkei* (Stapf) Melderis, *Digitaria eriantha* Steud., *Enneapogon cenchroides* (Roem. & Schult.) C.E.Hubb., *Eragrostis lehmanniana* Nees var. *lehmanniana*, *E. rigidior* Pilg., *Fingerhuthia africana* Lehm., *Heteropogon contortus* (L.) Roem. & Schult., *Panicum maximum* Jacq., *Schmidtia pappophoroides* Steud., *Setaria sphacelata* (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. *torta* (Stapf) Clayton, *Sporobolus ioclados* (Trin.) Nees
Herb	*Abutilon* species, *Achyranthes aspera* L. var. *aspera*, *Cleome gynandra* L., *Hibiscus microcarpus* Garcke, *Indigofera* species, *Justicia flava* (Vahl) Vahl, *Kyphocarpa angustifolia* (Moq.) Lopr., *Leucas* species, *Ocimum obovatum* E.Mey. ex Benth. subsp. *obovatum*, *Petalidium oblongifolium* C.B.Clarke, *Polydora poskeana* (Vatke & Hildebr.) H.Rob.sens.lat., *Requienia sphaerosperma* DC., *Rhynchosia totta* (Thunb.) DC. var. *totta*, *Schkuhria pinnata* (Lam.) Cabrera, *Senna italica* Mill. subsp. *arachoides* (Burch.) Lock, *Sesamum triphyllum* Welw. ex Asch. var. *triphyllum*, *Sida cordifolia* L.
Perennial herb	*Sansevieria hyacinthoides* (L.) Druce
Prostrate herb	*Tribulus terrestris* L.
Sedge	*Bulbostylis burchellii* (Ficalho & Hiern) C.B.Clarke
Shrub	*Asparagus* species, *Commiphora pyracanthoides* Engl., *Grewia flava* DC., *G. flavescens* Juss., *G. vernicosa* Schinz
Small tree	*Adenia fruticosa* Burtt Davy subsp. *fruticosa*, *Boscia foetida* Schinz subsp. *rehmanniana* (Pestal.) Toelken, *Dichrostachys cinerea* (L.) Wight & Arn. subsp. *africana* Brenan & Brummitt, *Ehretia rigida* (Thunb.) Druce subsp. *nervifolia* Retief & A.E.van Wyk, *Searsia pentheri* (Zahlbr.) Moffett, *Senegalia erubescens* (Welw. ex Oliv.) Kyal. & Boatwr., *S.mellifera* (Vahl) Seigler & Ebinger subsp. *detinens* (Burch.) Kyal. & Boatwr., *Terminalia prunioides* M.A.Lawson, *Vachellia exuvialis* (I.Verd.) Kyal. & Boatwr., *V. grandicornuta* (Gerstner) Seigler & Ebinger, *Ximenia caffra* Sond. var. *caffra*
Succulent	*Agave americana* L. subsp. *americana* var. *americana*, *Aloe burgersfortensis* Reynolds, *A. castanea* Schönland, *A. globuligemma* Pole-Evans, *A. marlothii* A.Berger subsp. *marlothii*, *Cereus jamacuru* (L.) Mill., *Euphorbia ingens* E.Mey. ex Boiss., *Kleinia longiflora* DC., *K. stapeliiformis* (E.Phillips) Stapf, *Opuntia ficus-indica* (L.) Mill., *O. humifusa* (Raf.) Raf., *O. leucotricha* DC.
Tree	*Balanites maughamii* Sprague, *Boscia albitrunca* (Burch.) Gilg & Gilg-Ben., *Sclerocarya birrea* (A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro, *Senegalia nigrescens* (Oliv.) P.J.H.Hurter, *Sterculia rogersii* N.E.Br., *Vachellia tortilis* (Forssk.) Gallaso & Banfi subsp. *heteracantha* (Burch.) Kyal. & Boatwr.

Figure 19: Collage of images of habitat conditions within Site 2

25.3 SITE 3

Site 3 comprise of the Variable Mixed Shrubland and a small drainage line in the eastern perimeter of the site. The nature of the woodland is comparatively natural and representative of the regional ecological type with minor deterioration aspects noted, which is assumed to be a result of the protection against high utilisation pressure afforded by fencing as part of the Samancor properties.

The woody layer correlate to the regional type, with densities ranging between 20 and 45 %, with notable species including *Adenia fruticosa, Boscia foetida*(d), *Balanites maughamii*(d), *Boscia albitrunca*, *Combretum hereroense*, *Commiphora pyracanthoides*(d), *Dichrostachys cinerea*(d), *Grewia* species(d), *Sclerocarya birrea*, *Senegalia nigrescens, S. senegal* and *Terminalia prunioides*(d). The grass sward provides an indication of historic utilisation and is dominated by *Aristida* species(d), *Enneapogon cenchroides, Eragrostis chloromelas, E. rigidior, Heteropogon contortus*(d), *Schmidtia pappophoroides* and *Stipagrostis hirtigluma*(d). The herbaceous layer is comparatively diverse; prominent species include the climbers *Cissus cactiformis, Clematis brachiata*(d), *Peponium caledonicum*(d) and *Senecio pleistocephalus*(d), the forbs *Blepharis subvolubilis*(d), *Dicoma tomentosa*(d), *Eulophia petersii, Holubia saccata, Petalidium oblongifolium*(d), *Sansevieria hyacinthoides* and the succulent species *Aloe* species(d), *Euphorbia* cf. *lydenburgensis, E. ingens, E. schinzii, Kalanchoe* species and *Stapelia* species. Invasion by exotic species is generally low, with isolated occurrences of *Cereus jamacuru.*

Comparatively high densities of protected and conservation important plants were recorded from this site, including the vulnerable *Adenia fruticosa,* the provincially protected *Eulophia petersii, Aloe burgersfortensis, Stapelia* species and the protected trees *Balanites maughamii, Boscia albitrunca* and *Sclerocarya birrea.*

The small drainage line on the eastern perimeter conforms to the xeric surrounding shrubland, but with a shallow streambed where the overlying sandy soils were removed to expose the underlying rocky substrate. The vegetation does not correlate to a mesic environment and the herbaceous layer is somewhat depleted, while the woody stratum correlates to the surrounding shrubveld. A major drainage line is situated on the western perimeter of the site, but is not spatially included in the site.

Table 14: Species recorded from Site 3

Growth Form	*Species Name*
Climber	*Cissus cactiformis* Gilg, *Clematis brachiata* Thunb., *Cyphostemma* species, *Dalechampia galpinii* Pax, *Momordica balsamina* L., *Peponium caledonicum* (Sond.) Engl., *Senecio pleistocephalus* S.Moore
Dwarf shrub	*Blepharis subvolubilis* C.B.Clarke, *Dicoma tomentosa* Cass., *Geigeria burkei* Harv. subsp. *fruticulosa* Merxm., *Leucosphaera bainesii* (Hook.f.) Gilg
Geophyte	*Eulophia petersii (*Rchb.f.) Rchb.f, *Stylochaeton natalensis* Schott
Grass	*Aristida adscensionis* L., *A. congesta* subsp. *barbicollis*, *A. diffusa* Trin. subsp. *burkei* (Stapf) Melderis, *A. rhiniochloa* Hochst., *Cenchrus ciliaris* L., *Digitaria eriantha* Steud., *Enneapogon cenchroides* (Roem. & Schult.) C.E.Hubb., *Eragrostis chloromelas* Steud., *E. rigidior* Pilg., *Fingerhuthia africana* Lehm., *Heteropogon contortus* (L.) Roem. & Schult., *Panicum maximum* Jacq., *Schmidtia pappophoroides* Steud., *Sporobolus ioclados* (Trin.) Nees, *Stipagrostis hirtigluma* (Steud.) De Winter subsp. *patula* (Hack.) De Winter
Herb	*Abutilon* species, *Cleome* species, *Commelina erecta* L., *Hibiscus microcarpus* Garcke, *Holubia saccata* Oliv., *Indigofera* species, *Jamesbrittanea aurantiaca*, *Kyphocarpa angustifolia* (Moq.) Lopr., *Petalidium oblongifolium* C.B.Clarke, *Requienia sphaerosperma* DC., *Sida* species
Perennial herb	*Sansevieria hyacinthoides* (L.) Druce, *Zinnia peruviana* (L.) L.
Shrub	*Asparagus* species, *Commiphora pyracanthoides* Engl., *Grewia bicolor* Juss. var. *bicolor*, *G. flava* DC., *G. flavescens* Juss., *G. vernicosa* Schinz, *Karomia speciosa* (Hutch. & Corbishley) R.Fern., *Pouzolzia mixta* Solms, *Rhigozum brevispinosum* Kuntze
Small tree	*Adenia fruticosa* Burtt Davy subsp. *fruticosa*, *Bolusanthus speciosus* (Bolus) Harms, *Boscia foetida* Schinz subsp. *rehmanniana* (Pestal.) Toelken, *Combretum hereroense* Schinz, *Dichrostachys cinerea* (L.) Wight & Arn. subsp. *africana* Brenan & Brummitt, *Ehretia rigida* (Thunb.) Druce subsp. *nervifolia* Retief & A.E.van Wyk, *Searsia pentheri* (Zahlbr.) Moffett, *Senegalia mellifera* (Vahl) Seigler & Ebinger subsp. *detinens* (Burch.) Kyal. & Boatwr., *Terminalia*

	prunioides M.A.Lawson, *Vachellia exuvialis* (I.Verd.) Kyal. & Boatwr., *V. grandicornuta* (Gerstner) Seigler & Ebinger, *Ximenia caffra* Sond. var. *caffra*
Succulent	***Aloe burgersfortensis*** **Reynolds,** *A. castanea* Schönland, A. *marlothii* A.Berger subsp. *marlothii, A.* species, *Cereus jamacuru* (L.) Mill., *Euphorbia* cf. *lydenburgensis* Schweick. & Letty, *E. ingens* E.Mey. ex Boiss., *E. schinzii* Pax, *E.* species, *Kalanchoe luciae* Raym.-Hamet subsp. *luciae*, *K. paniculata* Harv., *K. rotundifolia* (Haw.) Haw., *Kleinia longiflora* DC., *K. stapeliiformis* (E.Phillips) Stapf, *Opuntia ficus-indica* (L.) Mill., ***Stapelia gettliffei*** **R.Pott,** ***S. gigantea*** **N.E.Br.**
Tree	***Balanites maughamii*** **Sprague,** ***Boscia albitrunca*** **(Burch.) Gilg & Gilg-Ben.,** *Peltophorum africanum* Sond., ***Sclerocarya birrea*** **(A.Rich.) Hochst. subsp.** ***caffra*** **(Sond.) Kokwaro**, *Senegalia nigrescens* (Oliv.) P.J.H.Hurter, *S. senegal* (L.) Britton var. *leiorhachis* (Brenan) Kyal. & Boatwr., *Vachellia nilotica* (L.) P.J.H.Hurter & Mabb. subsp. *kraussiana* (Benth.) Kyal. & Boatwr., *V. tortilis* (Forssk.) Gallaso & Banfi subsp. *heteracantha* (Burch.) Kyal. & Boatwr.

Figure 20: Collage of images of habitat conditions within Site 3

25.4 SITE 4

Similar to Site 3, Site 4 correlates largely to the regional Sekhukhune Plains Bushveld, but historic management practices, specifically the exclusion of fire for a prolonged period, resulted in significant densification of the shrub layer, which allowed the development of the Closed Mixed Thicket and Bushland habitat in the southern extent of the site. The northern part of the site conforms to the Variable Mixed Shrubland, but with varying levels of deterioration. A major drainage line is situated on the eastern perimeter of the site, but is not spatially included in the site.

The dense thickets of the southern part of the site is dominated by an admixture of co-dominant woody species that include *Carissa bispinosa*, *Commiphora pyracanthoides*(d), *Euclea* species, *Grewia* species(d), *Dichrostachys cinerea*(d), *Ehretia rigida*, *Senegalia erubescens*(d), *S. mellifera*, *Terminalia prunioides*(d), *Ximenia caffra, Balanites maughamii*, *Carissa bispinosa, Boscia albitrunca*, *Sclerocarya birrea* and *Senegalia nigrescens.* As a result of the dense woody layer and the subsequent shade effect, the herbaceous layer is not as diverse or developed as the Variable Mixed Shrubland, but notable species include the grasses *Aristida* species(d), *Enneapogon scoparius*(d)*, Heteropogon contortus*(d)*, Panicum maximum*(d) and *Themeda triandra,* as well as the herbaceous species *Cynanchum viminale, Peponium caledonicum, Aloe* species(d), *Kleinia longifolia*(d)*, Euphorbia ingens* and *Dicoma tomentosa.* Sporadic occurrences of the invasive *Opuntia ficus-indica* and *Cereus jamacuru* is noted.

Comparatively high densities of protected and conservation important plants were recorded from this site, including the vulnerable *Adenia fruticosa,* the provincially protected *Eulophia petersii, Aloe burgersfortensis, Stapelia* species and the protected trees *Balanites maughamii, Boscia albitrunca* and *Sclerocarya birrea.*

Table 15: Species recorded from Site 4

Growth Form	*Species Name*
Climber	*Cissus cactiformis* Gilg, *Clematis brachiata* Thunb., *Cynanchum viminale* (L.) Bassi subsp. *viminale*, *Dalechampia galpinii* Pax, *Peponium caledonicum* (Sond.) Engl., *Senecio pleistocephalus* S.Moore
Dwarf shrub	*Blepharis subvolubilis* C.B.Clarke, *Dicoma tomentosa* Cass.
Forb	*Dicliptera* species
Geophyte	***Eulophia petersii (*****Rchb.f.) Rchb.f**, *Stylochaeton natalensis* Schott
Grass	*Aristida congesta* subsp. *barbicollis*, *A. diffusa* Trin. subsp. *burkei* (Stapf) Melderis, *A. rhiniochloa* Hochst., *Cenchrus ciliaris* L., *Enneapogon cenchroides* (Roem. & Schult.) C.E.Hubb., *Eragrostis capensis* (Thunb.) Trin., *E. rigidior* Pilg., *Fingerhuthia africana* Lehm., *Heteropogon contortus* (L.) Roem. & Schult., *Panicum maximum* Jacq., *Schmidtia pappophoroides* Steud., *Sporobolus ioclados* (Trin.) Nees, *Themeda triandra* Forssk.
Herb	*Achyranthes aspera* L. var. *aspera*, *Helichrysum* species, *Hibiscus microcarpus* Garcke, *Justicia flava* (Vahl) Vahl, *Leucas* species, *Petalidium oblongifolium* C.B.Clarke, *Requienia sphaerosperma* DC., *Sida* species
Shrub	*Asparagus* species, *Carissa bispinosa* (L.) Desf. ex Brenan, *Commiphora pyracanthoides* Engl., *Euclea natalensis* A.DC. subsp. *angustifolia* F.White, *Euclea* species, *Grewia flava* DC., *G. flavescens* Juss., *G. vernicosa* Schinz, *Gymnosporia polyacantha* (Sond.) Marais, *Phyllanthus* species
Small tree	***Adenia fruticosa*** **Burtt Davy subsp. *fruticosa***, *Dichrostachys cinerea* (L.) Wight & Arn. subsp. *africana* Brenan & Brummitt *Ehretia rigida* (Thunb.) Druce subsp. *nervifolia* Retief & A.E.van Wyk, *Gymnosporia buxifolia* (L.) Szyszyl., *Senegalia erubescens* (Welw. ex Oliv.) Kyal. & Boatwr., *S. mellifera* (Vahl) Seigler & Ebinger subsp. *detinens* (Burch.) Kyal. & Boatwr., *Terminalia prunioides* M.A.Lawson, *Vachellia grandicornuta* (Gerstner) Seigler & Ebinger, *Ximenia caffra* Sond. var. *caffra*
Succulent	*Aloe castanea* Schönland, *A. marlothii* A.Berger subsp. *marlothii*, *Euphorbia ingens* E.Mey. ex Boiss., *Kalanchoe paniculata* Harv., *Kleinia longiflora* DC., *K. stapeliiformis* (E.Phillips) Stapf, *Opuntia ficus-indica* (L.) Mill., ***Stapelia gigantea*** **N.E.Br.**
Tree	***Balanites maughamii*** **Sprague**, ***Boscia albitrunca*** **(Burch.) Gilg & Gilg-Ben.**, *Croton gratissimus* Burch. var. *gratissimus* *Peltophorum africanum* Sond., ***Sclerocarya birrea*** **(A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro**, *Senegalia nigrescens* (Oliv.) P.J.H.Hurter, *S. senegal* (L.) Britton var. *leiorhachis* (Brenan) Kyal. & Boatwr., *Vachellia nilotica* (L.) P.J.H.Hurter & Mabb. subsp. *kraussiana* (Benth.) Kyal. & Boatwr., *V. tortilis* (Forssk.) Gallaso & Banfi subsp. *heteracantha* (Burch.) Kyal. & Boatwr.

Figure 21: Collage of images of habitat conditions within Site 4

25.5 SITE 5

Site 5 is characterised by numerous smaller variations that cannot necessarily be correlated to natural biophysical attributes, but rather to mosaical effect of varying management applications, subsistence grazing strategies and an altered fire regime. What is however evident is that habitat from this site is comparatively deteriorated and in a poorer condition compared to the Variable Mixed Shrubland that from Sites 3 and 4. Specifically, the grass sward is considered poor, comprising the prominent species *Aristida adscensionis, A. bipartita, A. congesta, A. diffusa, A. rhiniochloa, Perotis patens, Stipagrostis hirtigluma* and *Urochloa mosambicensis* in areas where poor conditions are noted, as well as parts where dense grass layers are encountered, comprising *Digitaria eriantha* and *Dactyloctenium giganteum, Fingerhuthia africana, Panicum maximum* and *Themeda triandra*. The shrub and tree layers are, similarly, highly variable, but generally comprise of the dominant species *Commiphora pyracanthoides, Grewia bicolor, G. vernicosa, G. flava, Boscia foetida, B. albitrunca, Terminalia prunioides, Ziziphus mucronata, Balanites maughamii, Sclerocarya birrea* and *Vachellia tortilis*.

While the herbaceous layer is diverse, the composition provide further evidence of deterioration through the abundant presence of low growing succulent *Aloe burgersfortensis,* as well as the climbers *Momordica balsamina, Pergularia daemia* and *Abutilon* species, *Achyranthes aspera, Flaveria bidentis, Kyphocarpa angustifolia, Petalidium oblongifolium, Schkuhria pinata, Sida* species, *Argemone ochroleuca* as well as some declared invasive species. Notably, the habitat closer to the Steelpoort River in the northern part of the site becomes denser along a clay content gradient, also reflected in an increase on microphyllous '*Acacia*' type and *Dichrostachys cinerea* shrubs and trees. The structure of the shrubland generally range between 3 and 5 m and densities of the shrub/ tree layer between 25 and 40 %.

The presence of numerous protected trees, notably *Balanites maughamii, Boscia albitrunca* and *Sclerocarya birrea* and other protected plant species is noted across the site. Despite the somewhat deteriorated status of the vegetation, the abundant presence of these species warrant a moderate-high floristic sensitivity of much of the area.

A wide drainage line also runs centrally in a northern direction across the site and is characterised by a compendium of shrubs and herbaceous species that correlate the surrounding terrestrial shrubland environment.

Table 16: Species recorded from Site 5

Growth Form	*Species Name*
Climber	*Clematis brachiata* Thunb., *Cyphostemma* species, *Momordica balsamina* L., *Pergularia daemia* (Forssk.) Chiov. subsp. *daemia, Smilax anceps* Willd.
Dwarf shrub	*Acalypha* species, *Blepharis subvolubilis* C.B.Clarke, *Dicoma anomala* Sond., *D. capensis, Eriosema* species, *Geigeria burkei* Harv. subsp. *fruticulosa* Merxm. *Hermannia* species, *Jamesbrittenia burkeana* (Benth.) Hilliard, *Leonotis ocymifolia* (Burm.f.) Iwarsson, *Leucosphaera bainesii* (Hook.f.) Gilg, *Rhynchosia* species, *Xanthium strumarium* L.
Geophyte	*Drimia altissima* (L.f.) Ker Gawl., *Ledebouria* species
Grass	*Aristida adscensionis* L., *A. bipartita* (Nees) Trin. & Rupr., *A. congesta* subsp. *barbicollis, A. congesta* subsp. *congesta, A. diffusa* Trin. subsp. *burkei* (Stapf) Melderis, *A. rhiniochloa* Hochst., *Bothriochloa insculpta* (A.Rich.) A.Camus, *Cenchrus ciliaris* L., *Cymbopogon validus* (Stapf) Stapf ex Burtt Davy, *Cynodon dactylon* (L.) Pers., *Dactyloctenium giganteum* Fisher & Schweick., *Dichanthium aristatum, Digitaria eriantha* Steud., *Eragrostis capensis* (Thunb.) Trin., *E. rigidior* Pilg., *Fingerhuthia africana* Lehm., *Heteropogon contortus* (L.) Roem. & Schult., *Hyparrhenia tamba* (Steud.) Stapf, *Hyperthelia dissoluta* (Nees ex Steud.) Clayton, *Panicum maximum* Jacq., *Pennisetum clandestinum* Chiov., *Perotis paten*s Gand., *Schizachyrium sanguineum* (Retz.) Alston, *Schmidtia pappophoroides* Steud., *Sporobolus ioclados* (Trin.) Nees, *S. pyramidalis* P.Beauv., *Stipagrostis hirtigluma* (Steud.) De Winter subsp. *patula* (Hack.) De Winter, *Themeda triandra* Forssk., *Tricholaena monachne* (Trin.) Stapf & C.E.Hubb.. *Urochloa mosambicensis* (Hack.) Dandy
Herb	*Abutilon* species, *Achyranthes aspera* L. var. *aspera, Bidens pilosa* L., *Cleome* species, *Commelina africana, Datura stramonium* L., *Flaveria bidentis* (L.) Kuntze, *Gossypium herbaceum* subsp. *africanum, Hibiscus cannabinus* L., *H. microcarpus* Garcke, *Holubia saccata* Oliv., *Indigofera filipes* Benth. ex Harv., *Kyphocarpa angustifolia* (Moq.) Lopr., *Leucas* species, *Ocimum obovatum* E.Mey. ex Benth. subsp. *obovatum, Petalidium oblongifolium* C.B.Clarke, *Polydora poskeana* (Vatke & Hildebr.) H.Rob.sens.lat., *Requienia sphaerosperma* DC., *Rhynchosia totta* (Thunb.) DC. var. *totta, Schkuhria pinnata* (Lam.) Cabrera, *Senna didymobotrya* (Fresen.) H.S.Irwin & Barneby, *S. italica* Mill. subsp. *arachoides* (Burch.) Lock, *Sida alba* L., *S. cordifolia* L., *S.* species, *Tagetes minuta* L., *Tephrosia* species, *Tragia dioica* Sond., *Waltheria indica* L.

Hydrophilic	*Phragmites mauritianus* Kunth, *Typha capensis* (Rohrb.) N.E.Br.
Perennial herb	*Argemone ochroleuca* Sweet subsp. *ochroleuca, Sansevieria hyacinthoides* (L.) Druce, *Zinnia peruviana* (L.) L.
Prostrate herb	*Chascanum* species, *Cucumis zeyheri* Sond., *Ipomoea* species, *Sphenostylis angustifolia* Sond.
Sedge	*Bulbostylis burchellii* (Ficalho & Hiern) C.B.Clarke
Shrub	*Carissa bispinosa* (L.) Desf. ex Brenan, *Catharanthus roseus* (L.) G.Don, *Commiphora pyracanthoides* Engl., ***Elephantorrhiza praetermissa* J.H.Ross**, *Euclea natalensis* A.DC. subsp. *angustifolia* F.White, *Grewia bicolor* Juss. var. *bicolor, G. flava* DC., *G. flavescens* Juss., *G. vernicosa* Schinz, *Nicotiana glauca* Graham, *Phyllanthus* species, *Ricinus communis* L. var. *communis, Sesbania bispinosa* (Jacq.) W.Wight var. *bispinosa, Tecoma stans* (L.) Juss. ex Kunth var. *stans*
Small tree	*Bolusanthus speciosus* (Bolus) Harms, *Boscia foetida* Schinz subsp. *rehmanniana* (Pestal.) Toelken, *Combretum hereroense* Schinz, *Dichrostachys cinerea* (L.) Wight & Arn. subsp. *africana* Brenan & Brummitt, *Ehretia rigida* (Thunb.) Druce subsp. *nervifolia* Retief & A.E.van Wyk, *Euclea undulata* Thunb., *Gymnosporia buxifolia* (L.) Szyszyl. *Searsia pentheri* (Zahlbr.) Moffett, *S. pyroides* Burch. var. *pyroides. Senegalia mellifera* (Vahl) Seigler & Ebinger subsp. *detinens* (Burch.) Kyal. & Boatwr., *Terminalia prunioides* M.A.Lawson, *Vachellia exuvialis* (I.Verd.) Kyal. & Boatwr., *V. grandicornuta* (Gerstner) Seigler & Ebinger, *Ximenia caffra* Sond. var. *caffra, Ziziphus mucronata* Willd. subsp. *mucronata*
Succulent	***Aloe burgersfortensis* Reynolds,** *A. castanea* Schönland, *A.* cf. *ammophila* Reynolds, *Cereus jamacuru* (L.) Mill., *Euphorbia* cf. *lydenburgensis* Schweick. & Letty, *Euphorbia schinzii* Pax, *Kalanchoe paniculata* Harv., *K. rotundifolia* (Haw.) Haw., *Kleinia longiflora* DC., *Opuntia ficus-indica* (L.) Mill., ***Stapelia gettliffei* R.Pott**
Tree	***Balanites maughamii* Sprague, *Boscia albitrunca* (Burch.) Gilg & Gilg-Ben.**, *Combretum apiculatum* Sond. subsp. *apiculatum, C. erythrophyllum* (Burch.) Sond., *Dombeya rotundifolia* (Hochst.) Planch. var. *rotundifolia, Gardenia volkensii* K.Schum. subsp. volkensii var. *volkensii, Kirkia wilmsii* Engl., *Melia azedarach* L., *Morus alba* L., *Peltophorum africanum* Sond.l, *Populus* x *canescens* (Aiton) Sm., *Salix babylonica* L., ***Sclerocarya birrea* (A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro**, *Senegalia galpinii* (Burtt Davy) Seigler & Ebinger, *S. nigrescens* (Oliv.) P.J.H.Hurter, *S. senegal* (L.) Britton var. *leiorhachis* (Brenan) Kyal. & Boatwr., *Sesbania punicea* (Cav.) Benth., *Vachellia nilotica* (L.) P.J.H.Hurter & Mabb. subsp. *kraussiana* (Benth.) Kyal. & Boatwr., *V. tortilis* (Forssk.) Gallaso & Banfi subsp. *heteracantha* (Burch.) Kyal. & Boatwr., *Volkameria glabra* (E.Mey.) Mabb. & Y.W.Yuan






Figure 22: Collage of images of habitat conditions within Site 5

26 BOTANICAL IMPACT ASSESSMENT

The approach to determine a quantified severity of the anticipated impacts is presented in Appendix 6. Quantification of impacts are presented in Table 20

26.1 NATURE OF IMPACTS

26.1.1 *DIRECT IMPACTS*

The largest extent of impacts within the botanical environment is likely to stem from direct (physical) effects of land clearing activities and associated habitat losses. Typically, with activities that involve the complete removal or existing vegetation, these impacts are locally destructive and devastating. Impacts of a direct nature therefore include the variety of effects on natural habitat types, locally endemic species, populations and species and populations of conservation importance, as well as habitat that is associated with these species. Also included are effects on overall floristic species richness, diversity, and abundance. These impacts also frequently include effects on genetic variability, population dynamics, overall species existence or health. Lastly, losses of sensitive habitat, spatially restricted habitat types, and protected habitat types are also included in this category.

These impacts are measurable and easy to identify; effects are mostly predictable and immediately visible (after the fact) and can therefore be established or predicted with an acceptable level of certainty. It is however notoriously difficult to prevent (apart from preventing the activity in its entirety by means of the "No-Go Option") while predictions on future ecosystem changes are more problematic and variable.

Impacts of a direct nature on the floristic environment include the following:

Impact 1: Impacts on/ losses of conservation important and protected plant species (individuals, stands, populations) as well as habitat that is associated with these plant of conservation consideration;

Impact 2: Losses, and deterioration, of natural and sensitive habitat types, including essential habitat refugia, atypical and unique/ restricted habitat types; and

Impact 3: Depletion of local floristic diversity and loss of rare species or flora communities.

26.1.2 *INDIRECT IMPACTS*

Indirect impacts are not always immediately evident and can consequently not be measured at a specific moment in time. These 'spill-over effects' or 'edge effects' are spatially (realising outside the site perimeter) and temporally (occurring sometime after the actual impact, in future, ranging from immediate to several years) removed from the actual activity. Manifestations thereof are typically more subtle and not as locally devastating as direct impacts. The extent is most often at a scale that is larger than the actual site where the activity is undertaken, but it is usually restricted to a local scale (< 2 km), rarely regional.

A measure of estimation, extrapolation, or interpretation and specialist knowledge is therefore required to evaluate the significance of indirect impacts and it is usually an integrated factor of the sensitivity of the receiving surrounding environment, correlated against the severity and realistic expectations (based on experience) of the development. Indirect impacts typically result in adverse effects or deterioration of the surrounding areas, with an effect that diminishes from the edge of the impact, which is determined by the specific vectors of transport. For example, considering the nature of rivers, some impacts are 'carried' much further than others. For example, impacts that are related to increased dust levels might adversely affect a radius of approximately 2 km, contaminated water and alien and invasive species (seeds) that are carried by rivers might affect areas as far away as 20 km, or more). Notwithstanding the vector, in most cases it is the ecological functionality of the surrounding area that is adversely affected, as opposed to impacts on species level.

One of the most important effects of indirect impacts is the alteration of biophysical characteristics of the surrounding areas through the introduction and proliferation of species with an exotic nature or encroachment characteristics, changes in topographical features, etc. Lastly, the aesthetic appeal of the region, although a personal and highly debatable attribute, is regarded a potential receiver of landscape changes, declining with continued transformation of natural land and addition of industrial landscapes and skylines, lights, infrastructure, etc.

Impacts of an indirect and induced nature generally include the following:

Impact 4: Deterioration and changes to untransformed habitat in the surrounds, with specific reference to sensitive habitat types and habitat types of limited representation on a local scale;

Impact 5: Disruption of important ecological processes, services, and infrastructure and altered ecological functionality (including fire, erosion) of surrounding areas and natural habitat;

Impact 6: Introduction of exotic and invasive species to the area, or exacerbating the spread of existing infestations; and

Impact 7: Exacerbated decline in the aesthetic appeal of the landscape.

26.1.3 INDUCED AND CUMULATIVE IMPACTS

Induced and impacts of a cumulative nature have little direct relationship with the activity, but is reasonably anticipated to realise because of the presence of project. Cumulative impacts represent the totality of impacts in a given area resulting from this activity and related (similar projects or activities that could conceivably be regarded as ‘spin-offs’ from this project), viewed in context of past projects and other reasonably foreseeable future anthropogenic disruptive activities in the immediate region and how these activities impact upon the ecology of a region. The exact nature, duration, significance, and scale of cumulative impacts are difficult to quantify and also extremely problematic to mitigate against. However, cumulative impacts are significant and require consideration during this process of mitigating impacts and managing the natural ecological environment of the region.

Anticipated cumulative impacts of the proposed project on the ecology of the region include:

Impact 8: Inappropriate harvesting of natural resources and exacerbation of pressure on natural resources due to increased human encroachment, accessibility to the site, also considering changes in land use of surrounding areas that are not compatible to conservation efforts;

Impact 9: Exacerbation of existing levels of habitat fragmentation and isolation, considering past, present and reasonably foreseeable future anthropogenic disruptive activities in the immediate region, with specific reference to mining activities; and

Impact 10: Cumulative impacts on local/ regional and national conservation efforts, targets, and obligations (loss of natural habitat).

26.2 SUMMARIES OF THE QUANTIFICATION OF IMPACTS

Summaries of the anticipated impacts on the botanical receiving environment for each of the respective areas are provided.

26.2.1 *SITE 1*

Table 17: Summary of Botanical Impact Significance for Site 1

Nature	Before Mitigation	After Mitigation
Impact 1: Impacts on/ losses of conservation important and protected plant species (individuals, stands, populations) as well as habitat that is associated with plants of conservation importance	7.5	2
Impact 2: Losses, and deterioration, of natural and sensitive habitat types, including essential habitat refugia, atypical and unique/ restricted habitat types	5	1
Impact 3: Depletion of local floristic diversity and loss of rare species or flora communities	5	2
Impact 4: Deterioration and changes to untransformed habitat in the surrounds, with specific reference to sensitive habitat types and habitat types of limited representation on a local scale	2.2	0.8
Impact 5: Disruption of important ecological processes, services, and infrastructure and altered ecological functionality (including fire, erosion) of surrounding areas and natural habitat	2	0.9
Impact 6: Introduction of exotic and invasive species to the area, or exacerbating the spread of existing infestations	11.25	2.2
Impact 7: Exacerbated decline in the aesthetic appeal of the landscape	5.5	1.4
Impact 8: Inappropriate harvesting of natural resources and exacerbation of pressure on natural resources due to increased human encroachment, accessibility to the site, also considering changes in land use of surrounding areas that are not compatible to conservation efforts	2	0.6
Impact 9: Exacerbation of existing levels of habitat fragmentation and isolation, considering past, present and reasonably foreseeable future anthropogenic disruptive activities in the immediate region	5.5	4.5
Impact 10: Cumulative impacts on local/ regional and national conservation efforts, targets, and obligations (loss of natural habitat).	2.2	0.9

Discussion:

Much of Site 1 constitute deteriorated woodland and results of the site inspection indicated that the presence of conservation important and protected plant species on this site is low, or unlikely. Anticipated impacts from a botanical perspective is therefore likely to be moderate, mostly as a result of the minor losses of remaining natural woodland from the site (also in context with the location of the proposed site adjacent to existing transformed areas). However, the abundant presence of invasive exotic species on the site and the likely (if left uncontrolled) spread of these species to surrounding areas of natural woodland habitat types is considered an important consideration. The introduction of a generic mitigation approach, but with specific reference to the management and control of invasive plant species from the site, is likely to reduce the anticipated impacts significance to acceptably low levels.

26.2.2 *SITE 2*

Table 18: Summary of Botanical Impact Significance for Site 2

Nature	Before Mitigation	After Mitigation
Impact 1: Impacts on/ losses of conservation important and protected plant species (individuals, stands, populations) as well as habitat that is associated with plants of conservation importance	23.0	18.0
Impact 2: Losses, and deterioration, of natural and sensitive habitat types, including essential habitat refugia, atypical and unique/ restricted habitat types	14.25	6.5
Impact 3: Depletion of local floristic diversity and loss of rare species or flora communities	9.5	6.5
Impact 4: Deterioration and changes to untransformed habitat in the surrounds, with specific reference to sensitive habitat types and habitat types of limited representation on a local scale	11.25	4.5
Impact 5: Disruption of important ecological processes, services, and infrastructure and altered ecological functionality (including fire, erosion) of surrounding areas and natural habitat	7.5	4.5
Impact 6: Introduction of exotic and invasive species to the area, or exacerbating the spread of existing infestations	14.25	2.6
Impact 7: Exacerbated decline in the aesthetic appeal of the landscape	7.5	4.5
Impact 8: Inappropriate harvesting of natural resources and exacerbation of pressure on natural resources due to increased human encroachment, accessibility to the site, also considering changes in land use of surrounding areas that are not compatible to conservation efforts	10.5	4.0
Impact 9: Exacerbation of existing levels of habitat fragmentation and isolation, considering past, present and reasonably foreseeable future anthropogenic disruptive activities in the immediate region	15.0	6.75
Impact 10: Cumulative impacts on local/ regional and national conservation efforts, targets, and obligations (loss of natural habitat).	11.25	4.5

Discussion:

While parts of this proposed site are considered deteriorated and heavily infested with exotic and invasive plants, other portions comprise comparatively natural savanna habitat that is also representative of the regional ecological types (which is considered vulnerable on a regional scale), and losses of remaining natural habitat is an important consideration. Ultimately, the abundant presence of several protected plants, notably the vulnerable *Adenia fruticosum*, ultimately renders the remaining natural vegetation comparatively sensitive, and losses of these conservation important plants is an important consideration on a local scale. As this site is spatially situated on the perimeter of areas of existing transformation, including industrial and linear activities, the buffering role that this portion of land plays between these areas and pristine and natural habitat further to the south of the site is also considered important. While the anticipated impact significance is considered to be moderately high, the introduction of generic and site-specific mitigation measures, notably a dedicated invasive species management programme will result in amelioration of high significance impacts to a more acceptable level.

26.2.3 Site 3

Table 19: Summary of Botanical Impact Significance for Site 3

Nature	Before Mitigation	After Mitigation
Impact 1: Impacts on/ losses of conservation important and protected plant species (individuals, stands, populations) as well as habitat that is associated with plants of conservation importance	19.0	18.0
Impact 2: Losses, and deterioration, of natural and sensitive habitat types, including essential habitat refugia, atypical and unique/ restricted habitat types	19.0	13.0
Impact 3: Depletion of local floristic diversity and loss of rare species or flora communities	14.25	9.75
Impact 4: Deterioration and changes to untransformed habitat in the surrounds, with specific reference to sensitive habitat types and habitat types of limited representation on a local scale	14.25	6.5
Impact 5: Disruption of important ecological processes, services, and infrastructure and altered ecological functionality (including fire, erosion) of surrounding areas and natural habitat	7.5	4.5
Impact 6: Introduction of exotic and invasive species to the area, or exacerbating the spread of existing infestations	14.25	2.6
Impact 7: Exacerbated decline in the aesthetic appeal of the landscape	9.0	6.0
Impact 8: Inappropriate harvesting of natural resources and exacerbation of pressure on natural resources due to increased human encroachment, accessibility to the site, also considering changes in land use of surrounding areas that are not compatible to conservation efforts	10.5	4.0
Impact 9: Exacerbation of existing levels of habitat fragmentation and isolation, considering past, present and reasonably foreseeable future anthropogenic disruptive activities in the immediate region	15.0	6.75
Impact 10: Cumulative impacts on local/ regional and national conservation efforts, targets, and obligations (loss of natural habitat).	11.25	4.5

Discussion:

This site comprises natural shrubveld habitat that is representative of the regional ecological types. Considering that the regional type is categorised as vulnerable, and also with the known presence of conservation important plants within this site, the floristic sensitivity is considered moderately high. Losses of conservation important plants and natural savanna habitat is therefore considered significant on a local scale and the implementation of a generic mitigation approach, notably the relocation of conservation important plants from the site, will only render the post-mitigation significance of anticipated impacts moderate, albeit mostly localised.

26.2.4 *SITE 4*

Table 20: Summary of Botanical Impact Significance for Site 4		
Nature	Before Mitigation	After Mitigation
Impact 1: Impacts on/ losses of conservation important and protected plant species (individuals, stands, populations) as well as habitat that is associated with plants of conservation importance	19.0	18.0
Impact 2: Losses, and deterioration, of natural and sensitive habitat types, including essential habitat refugia, atypical and unique/ restricted habitat types	19.0	13.0
Impact 3: Depletion of local floristic diversity and loss of rare species or flora communities	14.25	9.75
Impact 4: Deterioration and changes to untransformed habitat in the surrounds, with specific reference to sensitive habitat types and habitat types of limited representation on a local scale	14.25	6.5
Impact 5: Disruption of important ecological processes, services, and infrastructure and altered ecological functionality (including fire, erosion) of surrounding areas and natural habitat	7.5	4.5
Impact 6: Introduction of exotic and invasive species to the area, or exacerbating the spread of existing infestations	14.25	2.6
Impact 7: Exacerbated decline in the aesthetic appeal of the landscape	9.0	6.0
Impact 8: Inappropriate harvesting of natural resources and exacerbation of pressure on natural resources due to increased human encroachment, accessibility to the site, also considering changes in land use of surrounding areas that are not compatible to conservation efforts	10.5	4.0
Impact 9: Exacerbation of existing levels of habitat fragmentation and isolation, considering past, present and reasonably foreseeable future anthropogenic disruptive activities in the immediate region	15.0	6.75
Impact 10: Cumulative impacts on local/ regional and national conservation efforts, targets, and obligations (loss of natural habitat).	11.25	4.5

Discussion:

This site comprises natural shrubveld habitat that is representative of the regional ecological types. Considering that the regional type is categorised as vulnerable, and also with the known presence of conservation important plants within this site, the floristic sensitivity is considered moderately high. Losses of conservation important plants and natural savanna habitat is therefore considered significant on a local scale and the implementation of a generic mitigation approach, notably the relocation of conservation important plants from the site, will only render the post-mitigation significance of anticipated impacts moderate, albeit mostly localised.

26.2.5 *SITE 5*

Table 21: Summary of Botanical Impact Significance for Site 5		
Nature	Before Mitigation	After Mitigation
Impact 1: Impacts on/ losses of conservation important and protected plant species (individuals, stands, populations) as well as habitat that is associated with plants of conservation importance	23.0	18.0
Impact 2: Losses, and deterioration, of natural and sensitive habitat types, including essential habitat refugia, atypical and unique/ restricted habitat types	19.0	13.0
Impact 3: Depletion of local floristic diversity and loss of rare species or flora communities	14.25	9.75
Impact 4: Deterioration and changes to untransformed habitat in the surrounds, with specific reference to sensitive habitat types and habitat types of limited representation on a local scale	14.25	6.5
Impact 5: Disruption of important ecological processes, services, and infrastructure and altered ecological functionality (including fire, erosion) of surrounding areas and natural habitat	7.5	4.5
Impact 6: Introduction of exotic and invasive species to the area, or exacerbating the spread of existing infestations	14.25	2.6
Impact 7: Exacerbated decline in the aesthetic appeal of the landscape	7.5	4.5
Impact 8: Inappropriate harvesting of natural resources and exacerbation of pressure on natural resources due to increased human encroachment, accessibility to the site, also considering changes in land use of surrounding areas that are not compatible to conservation efforts	10.5	4.0
Impact 9: Exacerbation of existing levels of habitat fragmentation and isolation, considering past, present and reasonably foreseeable future anthropogenic disruptive activities in the immediate region	15.0	6.75
Impact 10: Cumulative impacts on local/ regional and national conservation efforts, targets, and obligations (loss of natural habitat).	11.25	4.5

Aspects that render this site moderately high in sensitivity, despite the moderately deteriorated nature of most of the habitat, include the abundant presence of conservation important plants and protected tree species, the presence of the ecologically significant and sensitive Steelpoort River system to the immediate north of the site and several smaller drainage lines across the larger site. The proximity of these surface drainage systems are important considerations, albeit mostly in ecological terms (and not necessarily as significant botanical features), ultimately renders the anticipated significance of impacts on the floristic receiving environment of a high nature, despite the moderately deteriorated status of much of the shrubveld of this site.

26.3 RECOMMENDED PROTOCOL FOR THE BOTANICAL MONITORING PROGRAMME (AS PART OF THE BIODIVERSITY MONITORING PROGRAMME)

As part of the proposed (annual) Monitoring Programme, the following aspects will be executed:

⇒ Selection of a suitable number of sampling points that is representative of the project activities within a natural, receiving environment, with particular reference to sensitive habitat types and species of conservation concern;
⇒ Annual monitoring of vegetatal aspects, including aspects of diversity, compositional and structural attributes as well as accumulation of impacts within nearby habitat;
⇒ Prevalence and continued persistence of plants of conservation concern;
⇒ Prevalence and continued persistence of plants with ethno-botanical properties;
⇒ Prevalence and management of alien and invasive plant species; and
⇒ Land change/ habitat loss and transformation.

Through implementation and execution of a botanical monitoring programme, the anticipated and actual impacts of the proposed activities within the floristic environment can be established and monitored. Collated information data and results will contribute towards a responsive management approach to minimize the impact footprints and associated spheres of influence.

Frequency: annual
Responsibilities client, Environmental Manager, appointed specialist(s);

The following phases are relevant:

1 Pre- construction environment – the baseline ecological report will suffice in highlighting existing conditions and terrestrial botanical attributes;
2 Construction phase – implementation of the botanical monitoring protocol at a frequency of at least annually, taking cognisance of seasonal variations; and
3 Post-construction environment – execution of the botanical monitoring protocol annually until such time that closure has been granted by the authorities.

While the details of a monitoring plan is subject to negotiations prior to appointment, the following aspects (inter alia) should form part of the monitoring protocol, as a minimum:

⇒ Fixed point monitoring should be applied as the preferred method of monitoring. The selection of monitoring points should consider the spatial layout of mining activities and infrastructure in relation to sensitive environments, also taking note of control points to provide a comparative assessment;
⇒ All data gathered should be measurable (qualitative and quantitative) – attention should be provided to species diversity and abundance;
⇒ Monitoring report should be repeatable and temporally and spatially comparable, with specific reference to seasonal variation;
⇒ Data, when compared to previous sets, should show spatial and temporal trends; and
⇒ General habitat unit overviews should also be undertaken to augment quantitative data.

The recommended terrestrial biodiversity monitoring protocol will comprise the following aspects, or a variation thereof:

1. Alien and Invasive plant species monitoring; and
2. Vegetation/ ecological monitoring.

These aspects should ideally be executed during an optimal period of the year, considering seasonal variation in vegetation attributes. Ultimately, the objectives are to demonstrate the stability of the surrounding environment and sensitive receptors, monitoring results should therefore ideally be repeated during the same time of year. The responsibility of the implementation and auditing of monitoring performance would remain with the client, notably the Environmental Manager.

Requirements for the appointed specialists should conform to the guidelines of the South African Council for Natural Scientific Professions Act (2019), and specifically adhere to regulations pertaining to the minimum requirements as per the National Environmental Management Act, 1998 (Act No. 107 of 1998).

26.3.1 ALIEN AND INVASIVE PLANT MANAGEMENT PLAN

⇒ Conduct a brief assessment of the legal framework pertaining to the management, responsibilities and requirements of the landowner pertaining to the occurrence of alien and invasive plants on the property and immediate surrounds;
⇒ Undertake a site assessment/ ground-truth to identify and record alien invasive vegetation, identify threats to the ecology of the area, etc.;
⇒ Compile GIS spatial maps to support the Control Compilation of an AIS Plan as per the requirements of the AIS Regulations, 2015 and Invasive Species List, 2016;
⇒ Spatially map the parcels of land within the immediate surrounds of the mining footprint, with reference to land use activities;
⇒ Compile a working inventory of Invasive Species for each management unit compartment;
⇒ Describe the prioritization of the land parcels in the management unit compartments in accordance with the categories as per the Alien and Invasive Listing, 2016;
⇒ Provide targets and timelines for the Control Plan;
⇒ Provide responsibilities and reporting requirements of the Control Plan;
⇒ Provide control and/or eradication methods for identified invasive species in the Control Plan;
⇒ Indicate how the Control Plan will be monitored and evaluated as part of the vegetation monitoring plan;
⇒ Provide a suitable report for implementation as part of the EMP for the development; and
⇒ Execute the AIP monitoring protocol on an annual basis.

Monitoring of the presence, abundance, and diversity of alien and invasive plants on the site, while forming an integral part of the terrestrial monitoring programme, is partly the responsibility of the following persons:

1 Environmental Manager (Project);
2 Subcontractor responsible for alien and invasive plant control; and
3 Vegetation/ Ecology Monitoring Programme subcontractor.

27 BOTANICAL CONCLUDING STATEMENT AND PROFESSIONAL OPINION

The general area provides for a physiognomically homogenous savannoid landscape and ecosystem that is characterised by locally variable broad-scale and micro-habitat types that has their origin from the continuum and interrelationship of slopes, geomorphological attributes, topographical heterogeneity and moisture regimes. Significant to moderate levels of deterioration are noticeable from changes to compositional and structural aspects of the flora on a local scale, to the extent that portions of the proposed sites no longer can be considered entirely representative of the regional ecological type. Despite the deteriorated nature of the flora, the presence of several conservation important plant species resulted in a moderate-high floristic sensitivity of much of the receiving environment. A review of the anticipated impacts from the proposed development on the floristic receiving environment indicates that none of the anticipated impacts (if managed and mitigated correctly) can be highlighted or construed to represent unacceptable or severe threats to sensitive floristic elements within the study areas and immediate surrounds. However, caution is advised in the manner that protected and conservation plant species are dealt with. While any impact on these species is subject to a permitting process, the removal and relocation of some species is advised as a minimum measure. While *ex situ* conservation measures are not always regarded as a suitable option, it is nonetheless recommended in this particular instance.

The following key consideration are presented in support of the Professional Opinion:

⇒ Ecological attributes of the study site are regarded common and ubiquitous to the wider region;

⇒ No threatened plant species were recorded within the site during the site investigation, or are considered highly likely to occur within any of the development footprints;

⇒ A number of protected species were recorded within the site during the site investigation;

⇒ No habitat type within the site are regarded restricted on a local or wider scale. The site also does not exhibit any biophysical feature of rarity or elevated ecological importance or sensitivity;

⇒ The proposed development footprints comprise mostly woodland habitat that exhibit moderate to significant levels of deterioration;

⇒ The loss of deteriorated habitat from the site is not expected to result in significant, or unacceptable, impacts on provincial biodiversity conservation efforts;

⇒ The loss of these portions of woodland habitat is also not anticipated to result in significant changes or disruptions to ecological processes on a local or regional scale; and

⇒ The application of the recommended mitigation approach is expected to ameliorate anticipated impacts to an acceptable low level.

It is therefore the considered opinion, based on results of this botanical investigation, that no specific objections are raised to the proposed development. This opinion is based on the explicit understanding that the recommended mitigation approach is timeously and comprehensively implemented and also adhered to during all stages of the development.

SECTION F: FAUNAL AND AVIFAUNAL ATTRIBUTES OF THE AREA

28 TERMS OF REFERENCE FOR THE FAUNAL ASSESSMENT

The study aims to provide a description of the terrestrial fauna diversity as delineated on the accompanying maps. The main objective of the study is to provide an overview of the faunal diversity with emphasis placed on bird assemblages as the main indicator group and the potential occurrence of conservation important animal taxa. Specific tasks that were undertaken during the assessment included:

⇒ Identification of bird and terrestrial faunal compositions on the study sites and their association with particular broad-scale habitats and in context of identified floristic communities;

⇒ Providing an evaluation of their importance in a local, regional or national context, especially "rare" and/or threatened species;

⇒ Identification of habitat units or discrete habitat areas that are considered locally important for faunal species that are threatened or near-threatened (Red Data);

⇒ An evaluation of the importance of the site as foraging/roosting/breeding habitat for charismatic (iconic) bird species and large mammalian carnivores (such as Leopard *Panthera pardus* and large birds of prey);

⇒ A brief examination of the ecological relationships/associations between recorded species and taxa, and the different habitat types in which they are found; and

⇒ An identification of any specific areas in the study site that may require special protective measures to avoid future degradation or environmental damage.

It should be noted that, although the avifaunal component is also addressed as a 'stand-alone' report (Royal HaskoningDHV, P. da Cruz 2021), this assessment nonetheless places specific emphasis on bird composition and structure associated with the project area as it is inherently related to faunal diversity patterns and richness attributes of the receiving environment. It aims to comply with the requirements as promulgated by the (1) protocol for the specialist assessment and minimum report content requirements for environmental impacts on TERRESTRIAL ANIMAL SPECIES and the (2) protocol for the specialist assessment and minimum report content requirements for environmental impacts on TERRESTRIAL BIODIVERSITY. It should therefore not be confused with the avifaunal survey that is required in terms the protocol for the specialist assessment and minimum report content requirements for environmental impacts on avifaunal species by onshore energy generation facilities and/ or as per the best practice guidelines by BirdLife South Africa for assessing the impacts of solar power generating facilities on birds in South Africa (Jenkins et al., 2017).

29 ANNOTATIONS ON THE NATIONAL WEB-BASED ENVIRONMENTAL SCREENING TOOL

Regulation 16(1)(v) of the Environmental Impact Assessment Regulations, 2014 (EIA Regulations) provides that an applicant for Environmental Authorisation is required to submit a report generated by the Screening Tool as part of its application. On 5 July 2019, the Minister of Environmental Affairs, Forestry and Fisheries published a notice in the Government Gazette giving notice that the use of the Screening Tool is compulsory for all applicants to submit a report generated by the Screening Tool from 90 days of the date of publication of that notice.

The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas. The Screening Tool report will indicate the (preliminary) environmental sensitivities that intersect with the proposed development footprint as defined by the applicant as well as the relevant Protocols that the applicant would need to adhere to.

As the Screening Tool contains datasets that are mapped at a national scale, there may be areas where the Screening Tool erroneously assigns, or misses, environmental sensitivities because of mapping resolution and a high paucity of available and accurate data. Broad-scale site investigations will provide for an augmented and site-specific evaluation of the accuracy and 'infilling' of obvious and large-scale inaccuracies. Information extracted from the National Web-based Environmental Screening Tool (Department of Environmental Affairs, 2020), indicated the following aspects (inter alia) pertaining to the terrestrial ecological component of the project (report generated 2021/06/18):

⇒ Terrestrial Biodiversity Impact Assessment; and

⇒ Animal Species Assessment.

Results of the National Web-based Environmental Screening Tool indicated a medium sensitivity for animals of conservation importance to occur (refer Figure 23).

Table 22: Faunal results of the National Environmental Screening Report	
Sensitivity	*Feature (s)*
Medium	Invertebrate-*Aroegas fuscus*
Medium	Aves-*Sagittarius serpentarius*
Medium	Mammalia-*Crocidura maquassiensis*
Medium	Mammalia-*Dasymys robertsii*
Medium	Mammalia-*Lycaon pictus*

Results of the National Web-based Environmental Screening Tool indicated a very high and low sensitivity for the terrestrial biodiversity on the wider study area (refer Figure 24).

Table 23: Faunal results of the National Environmental Screening Report	
Sensitivity	*Feature (s)*
Low	Low sensitivity
Very High	Ecological support area 1
Very High	Ecological support area 2

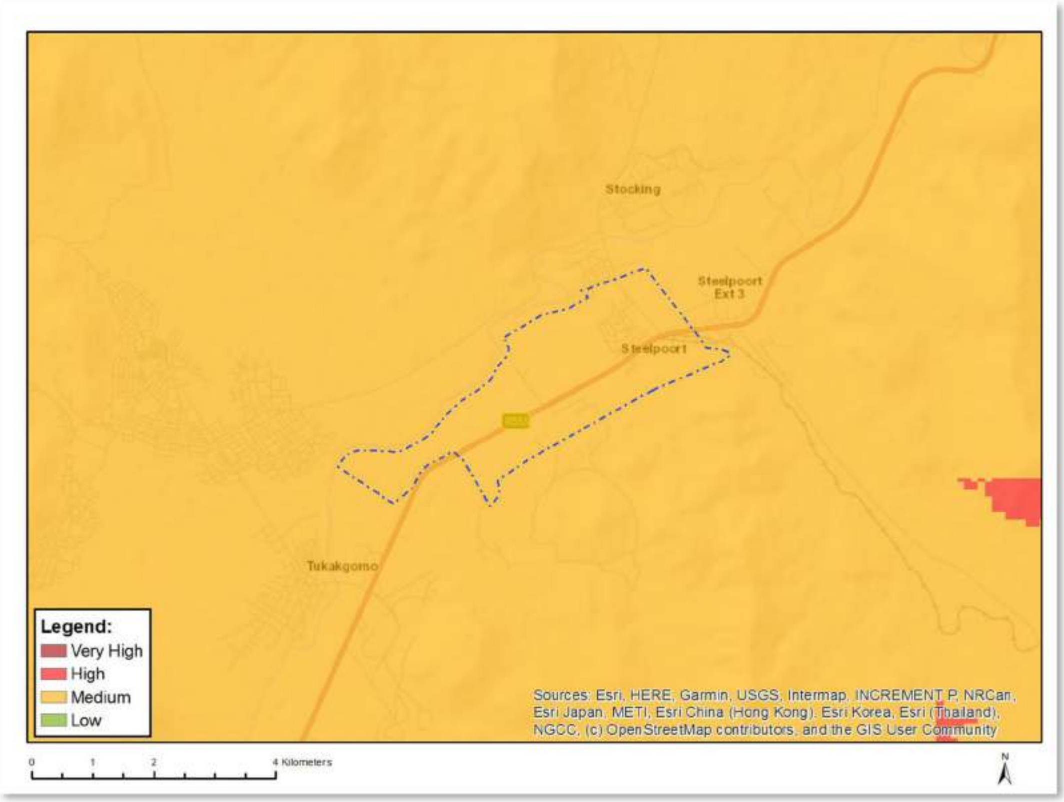


Figure 23: Animal species sensitivity of the wider study area

Figure 24: Terrestrial biodiversity sensitivity of the wider study area

30 METHODS AND APPROACH

The faunal assemblage attributes on the proposed study site were investigated between 28th of April 2021 and 1st of May 2021 with the objective to evaluate the terrestrial vertebrate faunal structure, composition, and conservation value of the natural habitat units on the study area.

30.1 LITERATURE REVIEW AND DATABASE ACQUISITION

Mammals

⇒ The potential (expected) occurrence and conservation status of mammal taxa were based on the IUCN Red List (2021) and the national Red Data Book by Child et al. (2016), while mammalian nomenclature was informed by Stuart and Stuart (2015) and Child et al. (2016), unless otherwise indicated.

⇒ The historical and extant (contemporary) distribution ranges of mammal taxa sympatric to the study sites were sourced from MammalMap (c. 2430CA and bordering grids with emphasis on QDS 2430CA, 2430CB, 2430CD and 2430CC; refer Figure 25) and the online dataset of iNaturalist along with applicable field guides, in particular Stuart & Stuart (2015), Skinner & Chimimba (2005), Child et al. (2016) and Friedmann & Daly (2004).

⇒ Additional information was also sourced from the online iNaturalist database.

Avifauna

⇒ Hockey et al. (2005), Harrison et al. (1997) and Del Hoyo et al. (1992-2011) were consulted for general information on the life history attributes of the relevant bird species. They also provide basic distributional information at small geographic scales.

⇒ Marnewick et al. (2015) was consulted for information regarding the biogeographic affinities (sensu Important Bird and Biodiversity Areas) of selected bird species that could be present on the study sites.

⇒ The conservation status of bird species was categorised according to the global IUCN Red List of threatened species (IUCN, 2021) and the regional conservation assessment of Taylor et al. (2015).

- ⇒ Distributional data was sourced from the South African Bird Atlas Project (SABAP1) and verified against Harrison et al. (1997) for species corresponding to the quarter-degree grid cell (QDGC) 2430CA (although all eight bordering pentad grids were also investigated; refer **Figure 25**). The information was subsequently modified according to the prevalent habitat types present on the study area. SABAP1 data provides a "snapshot" of the abundance and composition of species recorded within a quarter degree grid cell (QDGC) which was the sampling unit chosen (corresponding to an area of approximately 15 min latitude and 15 min longitude). It should be noted that the atlas data employs reporting rates that were calculated from observer cards submitted by the public as well as citizen scientists. It therefore provides an indication of the thoroughness of which the QDGCs were surveyed between 1987 and 1991.
- ⇒ Additional distributional data was also sourced from the SABAP2 database (http://www.sabap2.birdmap.africa). The information was then modified according to the prevalent habitat types present on the study area. Since bird distributions are dynamic (based on landscape changes such as fragmentation and climate change), SABAP2 was launched in 2007 from SABAP1 with the main difference being that all sampling is done at a finer scale known as pentad grids (5 min latitude x 5 min longitude, equating to 9 pentads within a QDGC). Therefore, the data is considered more site-specific, recent, and more comparable with observations made during the site survey (due to increased standardisation of data collection). The pentad grids that are relevant to the current project include 2440_3010, 2440_3005, 2445_3005 and 2445_3010. In addition, the pentad grids adjacent the study sites were also inspected during the assessment (c. 2435_3005, 2435_3010, 2435_3015, 2440_3015 and 2445_3015; refer **Figure 26**).
- ⇒ The choice of scientific nomenclature, taxonomy and common names were recommended by the International Ornithological Committee (the IOC World Bird Names, version 11.2), unless otherwise specified (see www.worldbirdnames.org; Gill et al., 2021).

<u>Herpetofauna</u>

- ⇒ Red List categories for reptile species were chosen according to the conservation assessment conducted by Bates et al. (2014).
- ⇒ Red List categories and listings of amphibian taxa follow Minter et al. (2004) and Measey (2010).
- ⇒ The distribution of reptile and amphibian species was verified against the ADU's database consisting of ReptileMap and FrogMap (c. QDS 2430CA, 2430CB, 2430CD and 2430CC; refer **Figure 25**) along with the online web-based database iNaturalist.

<u>Invertebrate Taxa of Conservation Concern</u>

- ⇒ The occurrence of threatened butterfly taxa (if applicable) was based on Woodhall (2005), while Mecenero et al. (2013) was consulted regarding their conservation status.
- ⇒ The SABCA database (c. LepiMap) provided a preliminary list of butterflies for the study area (QDS 2430CA, 2430CB, 2430CD and 2430CC, including bordering grids; see refer **Figure 25**).
- ⇒ The online web-based database iNaturalist was also consulted.
- ⇒ The potential occurrence and conservation status of shieldback katydids (with reference to *Aroegas fuscus*) was sourced from Bazelet & Naskrecki (2014), Naskrecki (1996) and the online Orthoptera Species File (http://orthoptera.speciesfile.org/).

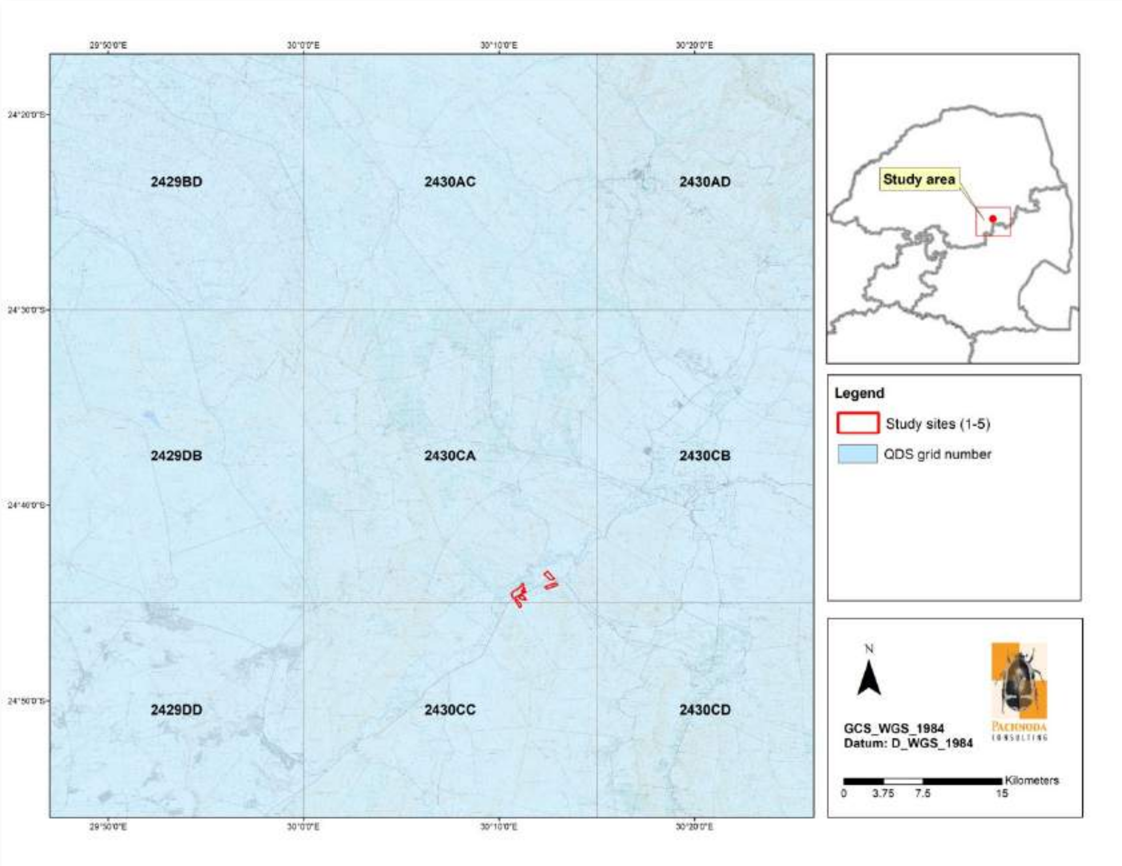


Figure 25: Quarter-degree grid squares (sensu ADU and SABAP1) relevant to the wider study area

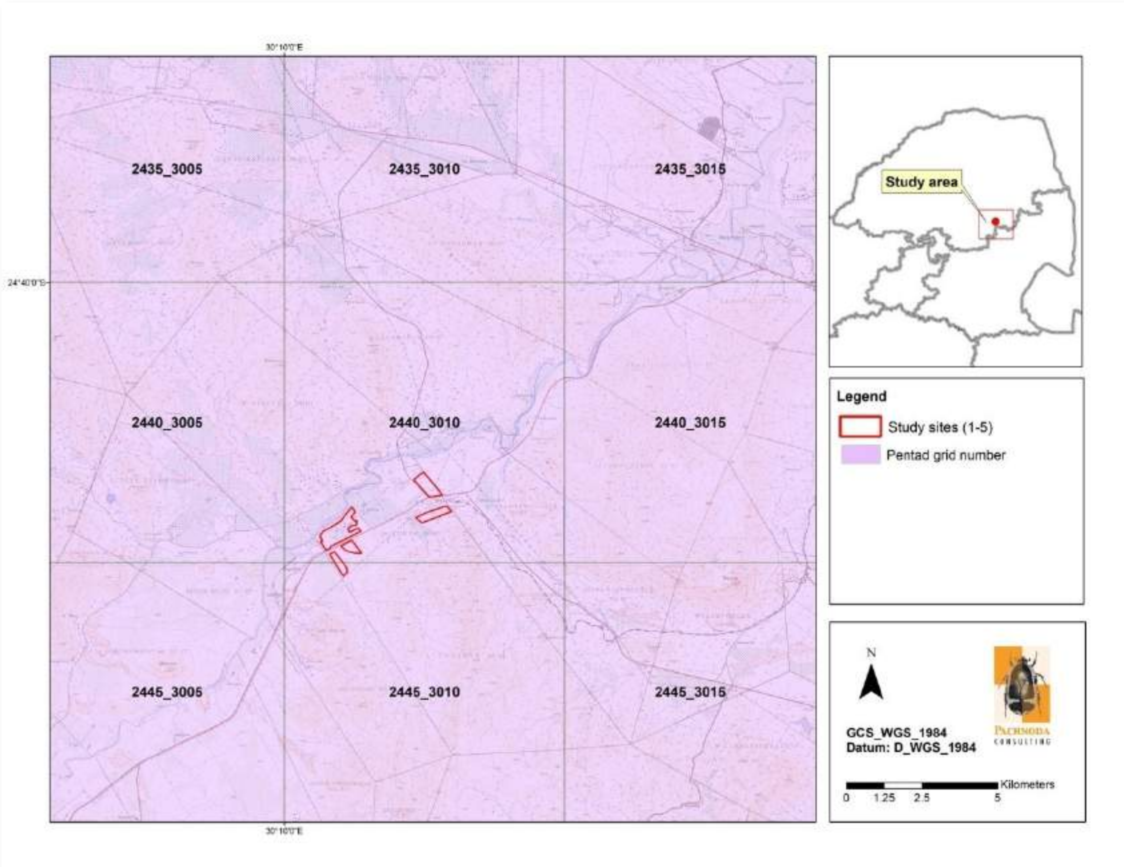


Figure 26: Pentad grids (sensu SABAP2) relevant to the wider study area

30.2 FIELD SURVEYS

30.2.1 MAMMALS

The following methods were considered during the fieldwork:

⇒ *Likelihood of Occurrence*: There is a high likelihood that not all mammal species known to occur on the lease area will be recorded during the baseline survey; a 'Likelihood of Occurrence' review was therefore applied. A summary of expected and observed mammals, as well as those species of conservation concern are provided, with a simple probability of occurrence attached.

⇒ *Camera trapping*: Considering the general accessibility of the proposed sites (to humans), only one camera was deployed at Site 3 to detect nocturnal mammal taxa based on available cover[9]. Site 3 is the only site that is surrounded by a security fence structure (refer Figure 27 and Figure 28); the locality of the trap was selected to minimise the risk of possible theft. Areas with human activities/presence were avoided to prevent possible tampering, theft, or damage to the traps.

⇒ *Scats and pellets*: Mammal scats and owl pellets were used to identify the presence of mammal taxa and to identify rodent taxa present in the study area. Scats and droppings were randomly acquired and identified during field surveys.

⇒ *Ad hoc observations*: All mammals observed during the survey were noted along with their geographic coordinates and habitat preference. Observations were obtained by means of driving, walking and active searching.

⇒ *Additional observations*: Particular notice was given to important dispersal or migratory routes and spoor within the study area or within the immediate region. These will invariably be relative to larger herbivores and carnivores.

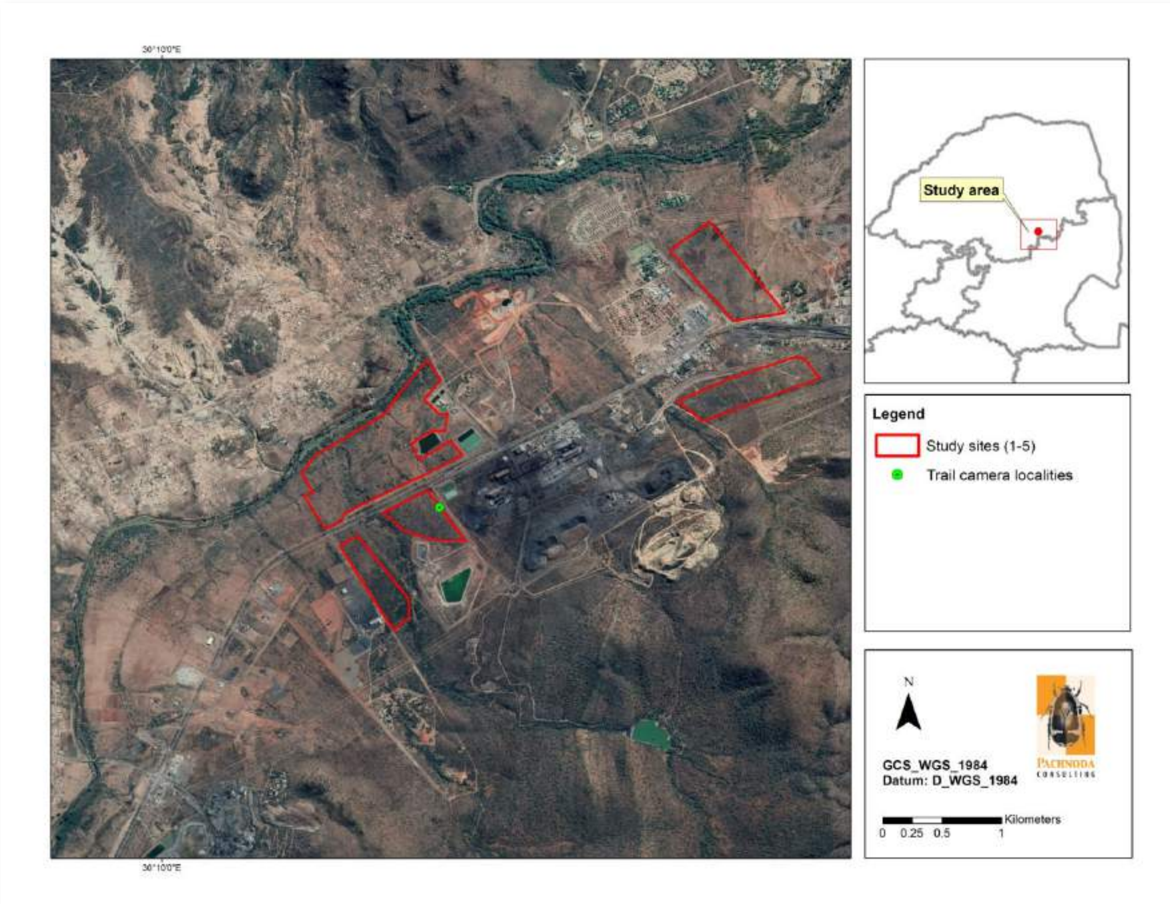


Figure 27: Satellite image of the study area illustrating the spatial localities of remote trail cameras

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[9] *The localities for camera trap deployment were dependent on dominant habitat, the probability for detecting nocturnal mammals and accessibility.*

Figure 28: An example of a remote trail camera deployed on Site 3

30.2.2 AVIFAUNA

The baseline avifaunal survey was conducted by employing the following survey techniques:

Point counts:

Bird data was collected by means of 23 point counts[10] (Buckland et al. 1993), where all birds observed and heard from a specific point over a set period of time are recorded. Data from the point counts was analysed to determine dominant and indicator bird species (so-called discriminant or typical species) and to delineate the different associations present.

The use of point counts is considered advantageous since it is the preferred method to use for skulking or elusive species. In addition, it is the preferred method to line transect counts where access is problematic, or when the terrain appears to be complex (e.g. mountainous). It is considered to be a good method to use, and very efficient for gathering a large amount of data in a short period of time (Sutherland, 2006). The spatial position survey point counts are illustrated in Figure 29. The spatial placement of the point counts was determined through a stratified random design, which ensures coverage of each habitat type and/or macro-habitat (Sutherland et al., 2004).

At each point, all bird species seen within approximately 50 m from the centre of the point were recorded along with their respective abundance values. Each point count lasted at least 10-20 minutes, while the area within the immediate vicinity was slowly traversed to ensure that all bird species were detected (according to Watson, 2003). To ensure the independence of observations, points were positioned at least 200 m apart. Observations were not truncated, and in order to standardise data collection, the following assumptions were conformed to (according to Buckland et al., 1994):

⇒ All birds on the point must be seen and correctly identified. This assumption is in practice difficult to meet in the field as some birds in the nearby vicinity may be overlooked due to dense vegetation or low visibility. It is therefore assumed that the portion of birds seen on the point count is representative of the total assemblage at the point.

⇒ All birds must be recorded at their initial location. Movements of birds are generally random and therefore natural in relation to the movements of the observer. None of the birds moved in response to the presence of the observer, and birds flying past without landing were omitted from the analysis. In other words, no bird is recorded more than once.

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[10] A semi-random stratified sampling approach was used to determine the locality (placement) of point counts. Only natural, untransformed habitat types were sampled given the available sampling time frame. Sample size was determined by means of species accumulation curves (based on the number of points sampled with a Michaelis-Menten model fitted to the data to define curve fit and exhaustiveness of the sampling, i.e. where one additional sampling effort unit would yield <1 additional species).

Random (ad hoc) surveys:

To obtain an inventory of bird species present, all bird species observed/detected while moving between vegetation sampling points were identified and noted. Particular attention was devoted to habitat that is considered suitable for roosting, foraging and nesting purposes for species of conservation concern (e.g. threatened or near threatened species).

Playback/broadcasting and recording of bird vocalisations:

The probability of detecting skulking/ elusive species or species for which the distribution ranges are insufficiently known in the area was verified by playback of bird calls/songs wherever suitable habitat was detected. Special care was taken to keep disturbance to a minimum and not to affect the bird's natural behaviour (e.g. to prevent unnecessary habituation).

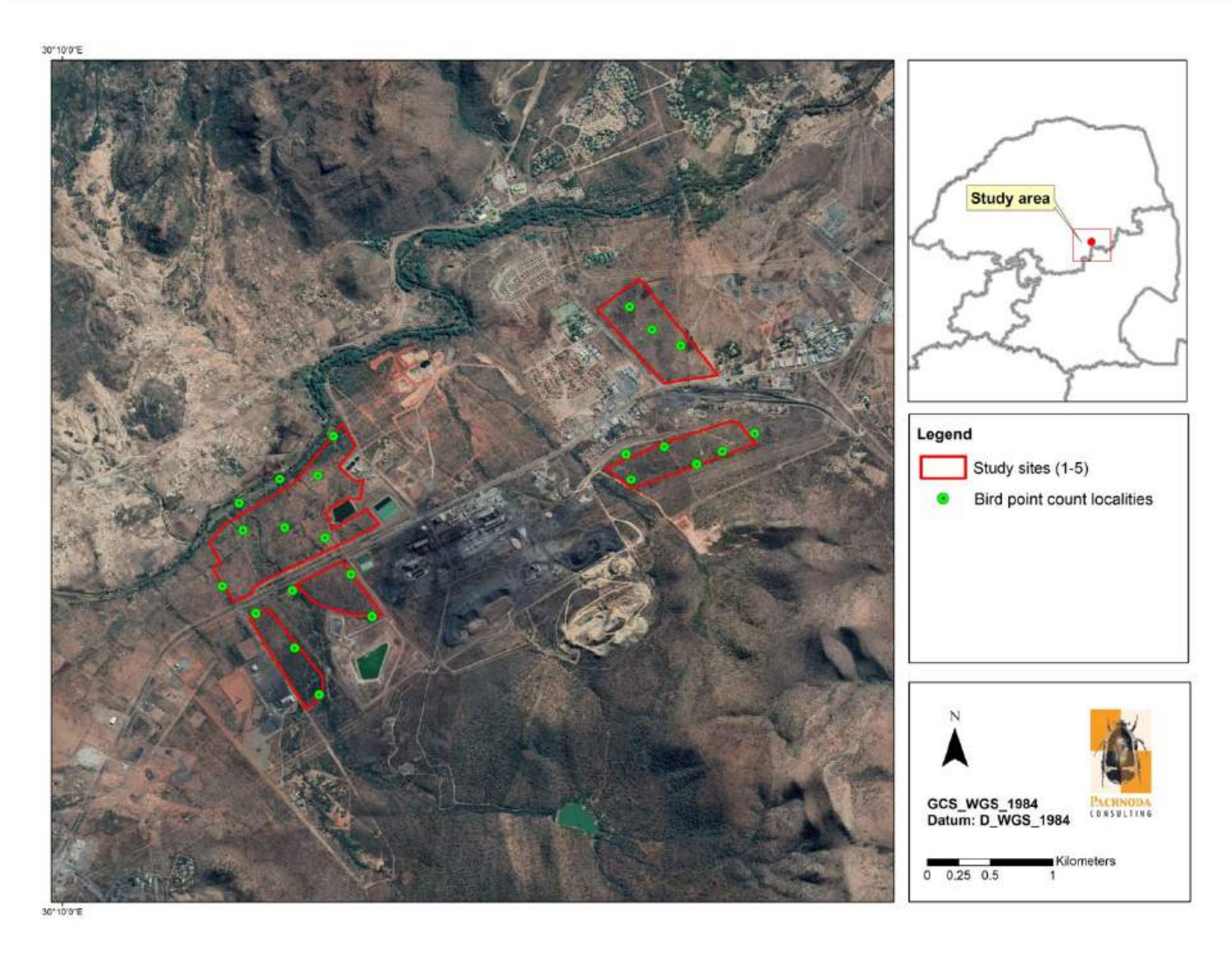


Figure 29: Satellite image of the study area illustrating the spatial localities of the bird point counts

30.2.3 *INVERTEBRATE TAXA OF CONSERVATION CONCERN*

⇒ The occurrence of threatened butterfly taxa was verified on areas comprising of suitable habitat by means of standard handnetting procedures and was verified by means of hand collecting and digital photography (using a digital SLR camera with a 300 mm, f4 telephoto lens fitted with a 1.4x extender. The lens is capable of close range focussing (~1.5m)).

⇒ To determine the occurrence of threatened katydids (genera *Aroegas* species) following field techniques are typically advised:

- *Active searching*: Katydids (Tettigoniidae) may be sampled by means of active searching at night using a flashlight. This technique may be used from sunset to approximately 22h00, which proved to be the most successful method to detect and collect stridulating males of a similar species (c. *Arytropteris basalis*) from the vegetation canopy by hand.
- *Auditory searches*: Nocturnal auditory searches can be useful to locate katydid species (Tettigoniidae) and to capture individuals by hand. It proved to be a highly effective way to locate and capture a similar species (c. *Arytropteris basalis*).
- *Light trapping*: A simple light trap consisting of a battery operated (12V DC) ultraviolet fluorescent tube and a white fluorescent tube suspended in front of a white sheet can be useful to attract nocturnal katydids. Light trapping should be employed from sunset until 22h00. However, light trapping of flightless katydids are often unsuccessful, probably since most of the SCC katydids may need to travel long distances to reach the light trap.

Please refer to Section 31.4 for a brief discussion on the potential occurrence of *Aroegas fuscus* on the study sites and a motivation on its likelihood of occurrence.

30.2.4 *HERPETOFAUNA*

Possible burrows, or likely reptile habitat (termitaria, stumps, or rocks) were inspected for any inhabitants. Amphibians were also identified by their vocalisations (if any) and through likely habitat types (e.g. water features, drainage lines, etc.). The main approach used for the identification of reptile species involved direct searching techniques by turning rocks and logs.

30.3 STATISTICAL ANALYSIS (BIRDS ONLY)

30.3.1 *SPECIES ACCUMULATION CURVES*

Species accumulation curves (SAC) for the point count data were generated using the software program Estimates S (version 9) with 100 randomizations (as recommended in Colwell, 2013). Curves were generated for the full data set (all point counts combined). Sampling sufficiency was determined by establishing whether a point had been reached where a line representing one new sample adding one new species was tangent to the curve. The Michaelis-Menten equation was fitted to the predicted number of species using Estimates S. A satisfactory level of sampling was achieved if 90 % of the bird species were detected, and hence predicted by the model (Moreno & Halffter, 2000).

30.3.2 *PRIMARY ANALYSIS, SPECIES COMPOSITION AND RICHNESS MEASURES*

All data collected are presented in a matrix, with rows representing the relative abundances of each species/taxon, and columns representing the respective point counts/samples within each of the sampled habitat types. This matrix formed the basis for the data analyses. The observations were converted to relative abundance values and the Bray-Curtis similarity coefficient was used. All multivariate analyses were performed using the software package Primer 5 (Plymouth Routines in Multivariate Ecological Research, version 5.2.2; www.primer-e.com). The importance of very abundant species had to be down-weighted in order to give some importance to low abundance or rare species. This was achieved by performing a fourth root transformation on the data (Clarke & Warwick, 1994).

A comparison of the different avifaunal associations relative to each habitat type was performed using multivariate community analyses of Bray-Curtis similarity coefficients. The calculated similarity matrix was exposed to a cluster analysis based on hierarchical agglomerative clustering with group-average linking, as described by Clarke & Warwick (1994). Therefore, sampling entities (point counts) that group together (being more similar) are believed to have similar compositions. Non-metric multidimensional scaling (NMDS) was used to map the inter-relationships between the point counts in an ordination with a specified number of dimensions (Kruskal & Wish, 1978).

The program SIMPER was used to determine the contribution (%) of each species to each habitat type, including the consistency of its contribution (Clarke & Warwick, 1994). Species with high consistencies represent typical species for the given association. The same program was used to measure the dissimilarity between habitat types. Therefore, a species with a high contribution to the dissimilarity between two sites are diagnostic and a good discriminant/indicator species of the particular habitat or area.

The mean number of species (S) and the Shannon-Wiener diversity index (H') were calculated for each habitat type (refer to Magurran (1988) for a description of the Shannon-Wiener diversity index).

30.4 Faunal Importance and Sensitivity

The ecological sensitivity of any piece of land is based on its inherent ecosystem service (e.g. wetlands) and overall preservation of biodiversity. In addition, the sensitivity of any piece of land is a key consideration when identifying impacts.

30.4.1 Ecological Functionality & Connectivity and Biodiversity Importance

The extent to which a site is ecologically connected to surrounding areas is an important determinant of its sensitivity. Systems with a high degree of landscape connectivity amongst one another are perceived to be more sensitive and will be those contributing to better ecosystem service (e.g. wetlands) or overall preservation of biodiversity. Therefore, any environmental management plan must include mitigation measures to ensure that negative environmental impacts do not interfere with the natural ecological process of the area.

Biodiversity importance relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened and protected species or ecosystems protected by legislation.

30.4.2 Sensitivity Scale/ Categorization

High Sensitive ecosystems with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered being important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems OR with high species diversity and usually provide suitable habitat for a number of threatened or rare species. These areas should be protected;

Moderate These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems OR ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species; and

Low Degraded and highly disturbed/transformed systems with little ecological function and are generally poor in species diversity (many species are exotic or weeds).

31 RESULTS & DISCUSSION

31.1 MAMMALS

31.1.1 TAXONOMIC OVERVIEW & DIVERSITY

According to the presence of suitable habitat and the extant (or known) distribution ranges of mammal taxa in the study area (sensu MammalMap, Child et al., 2016 and Stuart & Stuart, 2015), the expected mammal richness on the study sites and immediate surroundings is approximately 63 species (refer Table 24), of which only 10 species have so far been documented for QDS 2430CA which is sympatric to the majority of the study sites. It implies that the mammal richness on the study sites is poorly documented given the higher number of species that is anticipated.

Approximately 49 species (78 % of the expected richness) have a high probability to be present on the study sites (refer Table 24), of which 15 of these species (31 % of species with a high probability of occurrence) were confirmed during the survey, which include the following (refer Table25 and Figure 30):

⇒ four (4) rodents;
⇒ three (3) bovid antelopes;
⇒ one (1) canid (jackals);
⇒ one (1) primate (monkeys and baboons);
⇒ one (1) herpestid (mongoose);
⇒ one (1) viverrid (genet);
⇒ one (1) leporid (hares and rabbits);
⇒ one (1) orycteropid (aardvark); and
⇒ two (2) suids (pigs).

One of the confirmed species (c. Southern Mountain Reedbuck *Redunca f. fulvorufula*) is endangered.

A total of thirty (30) species are reasonably expected to be present with the sites and immediate areas. Furthermore, a total of five (5) species were confirmed during the surveys that have not been previously observed within the study area (sensu MammalMap), even though some of these species are considered to be widespread and relatively abundant within their respective distribution ranges. Furthermore, 11 of the expected species indicates a moderate probability of occurrence (17.5 %), of which two species are considered to be regular in the area (c. Serval *Leptailurus serval* and Brown Hyaena *Parahyaena brunnea*), while three (3) of the expected species have a low probability of occurrence (5 %). The latter species (species with low probabilities of occurrence) either share distribution ranges peripheral to the study sites or optimal foraging and roosting habitat were absent, thereby rendering their presence on the site as uncertain or questionable. It is worth mentioning that the Leopard (*Panthera pardalis*) could be an occasional foraging visitor to the study area given the high number of MammalMap records for the QDS sympatric to the study area, although it is believed that most of these records stem from remote mountainous areas north of the study area.

During the baseline survey it became evident that large bodied species were rare on the study sites, which is largely attributed to the intensity of human and industrial activities, nearby settlements and a high degree of fragmentation (dispersal barriers) in the area.

Table 24: An inventory of mammalian taxa predicted to occur on the study sites (and immediate surroundings)
based on the presence of suitable habitat and with known distribution ranges sympatric to the site (sensu MammalMap and professional judgement)
**- sensu Child et al (2016)*

Family	*Scientific name*	*Common name*	*Conservation Status**	*Probability of Occurrence*
Bathyergidae	*Cryptomys cf. pretoriae (=hottentotus)*	Highveld Mole-rat	Least Concern	High (confirmed)
Bovidae	*Aepyceros melampus*	Impala	Least Concern	Moderate
Bovidae	*Redunca fulvorufula*	Mountain Reedbuck	Endangered	High (confirmed)
Bovidae	*Raphicerus campestris*	Steenbok	Least Concern	High (confirmed)
Bovidae	*Sylvicapra grimmia*	Common Duiker	Least Concern	High (confirmed)
Bovidae	*Tragelaphus scriptus*	Bushbuck	Least Concern	High
Bovidae	*Tragelaphus strepsiceros*	Greater Kudu	Least Concern	Moderate
Canidae	*Canis mesomelas*	Black-backed Jackal	Least Concern	High (confirmed)
Cercopithecidae	*Chlorocebus pygerythrus*	Vervet Monkey	Least Concern	High (confirmed)
Cercopithecidae	*Papio ursinus*	Chacma Baboon	Least Concern	High
Emballonuridae	*Taphozous perforatus*	Egyptian Tomb Bat	Least Concern	High
Felidae	*Caracal caracal*	Caracal	Least Concern	Moderate
Felidae	*Felis sylvestris cafra*	African Wild Cat	Least Concern	Moderate
Felidae	*Leptailurus serval*	Serval	Near Threatened	Moderate-High
Felidae	*Panthera pardus*	Leopard	Vulnerable	Low-Moderate
Galagidae	*Galago moholi*	Southern Lesser Galago	Least Concern	High
Galagidae	*Otolemur crassicaudatus*	Thick-tailed Galago	Least Concern	Moderate
Gliridae	*Graphiurus (Graphiurus) platyops*	Rock Dormouse	Least Concern	Low
Herpestidae	*Atilax paludinosus*	Marsh Mongoose	Least Concern	High
Herpestidae	*Helogale parvula*	Dwarf Mongoose	Least Concern	Moderate
Herpestidae	*Herpestes sanguineus*	Slender Mongoose	Least Concern	High (confirmed)
Herpestidae	*Ichneumia albicauda*	White-tailed Mongoose	Least Concern	High
Herpestidae	*Mungos mungo*	Banded Mongoose	Least Concern	High
Hyaenidae	*Parahyaena brunnea*	Brown Hyena	Near Threatened	Moderate-High
Hystricidae	*Hystrix africaeaustralis*	Cape Porcupine	Least Concern	High (confirmed)
Leporidae	*Lepus victoriae (=saxatilis)*	African Savanna Hare	Least Concern	High (confirmed)
Macroscelididae	*Elephantulus brachyrhynchus*	Short-snouted Sengi	Least Concern	Moderate
Miniopteridae	*Miniopterus natalensis*	Natal Long-fingered Bat	Least Concern	High
Molossidae	*Tadarida aegyptiaca*	Egyptian Free-tailed Bat	Least Concern	High
Muridae	*Aethomys ineptus*	Tete Veld Rat	Least Concern	High
Muridae	*Dendromus melanotis*	Grey Climbing Mouse	Least Concern	High
Muridae	*Dendromus mystacalis*	Chestnut Climbing Mouse	Least Concern	High
Muridae	*Gerbilliscus cf. leucogaster*	Bushveld Gerbil	Least Concern	High (confirmed)
Muridae	*Lemniscomys rosalia*	Single-striped Grass Mouse	Least Concern	High
Muridae	*Mastomys sp.*	Multimammate Mice	Least Concern	High
Muridae	*Mus minutoides*	Pygmy Mouse	Least Concern	High
Muridae	*Otomys angoniensis*	Vlei Rat	Least Concern	High (confirmed)
Muridae	*Otomys auratus*	Southern African Vlei Rat (Grassland type)	Near Threatened	Moderate
Muridae	*Rhabdomys pumilio*	Four-striped Grass Mouse	Least Concern	High
Muridae	*Saccostomus campestris*	Pouched Mouse	Least Concern	High
Muridae	*Steatomys pratensis*	Fat Mouse	Least Concern	High
Muridae	*Thallomys paedulcus*	Acacia Rat	Least Concern	High
Mustelidae	*Aonyx capensis*	Cape Clawless Otter	Near Threatened	High
Mustelidae	*Ictonyx striatus*	Striped Polecat	Least Concern	High
Mustelidae	*Mellivora capensis*	Honey Badger	Least Concern	High
Myoxidae	*Graphiurus murinus*	Woodland Dormouse	Least Concern	Moderate
Orycteropodidae	*Orycteropus afer*	Aardvark	Least Concern	High (confirmed)
Pedetidae	*Pedetes capensis*	Southern African Springhare	Least Concern	High
Pteropodidae	*Epomophorus wahlbergi*	Wahlberg's Epauletted Fruit Bat	Least Concern	High
Rhinolophidae	*Rhinolophus cohenae*	Cohen's Horseshoe Bat	Vulnerable	Low
Sciuridae	*Paraxerus cepapi*	Tree Squirrel	Least Concern	High
Soricidae	*Crocidura cyanea*	Reddish-grey Musk Shrew	Least Concern	High
Soricidae	*Crocidura hirta*	Lesser Red Musk Shrew	Least Concern	High
Soricidae	*Myosorex various*	Forest Shrew	Least Concern	High

Table 24: An inventory of mammalian taxa predicted to occur on the study sites (and immediate surroundings) *based on the presence of suitable habitat and with known distribution ranges sympatric to the site (sensu MammalMap and professional judgement)*
**- sensu Child et al (2016)*

Family	*Scientific name*	*Common name*	*Conservation Status**	*Probability of Occurrence*
Suidae	*Phacochoerus africanus*	Common Warthog	Least Concern	High (confirmed)
Suidae	*Potamochoerus larvatus koiropotamus*	Bushpig	Least Concern	High (confirmed)
Thryonomyidae	*Thryonomys swinderianus*	Greater Cane-rat	Least Concern	High
Vespertilionidae	*Myotis welwitschii*	Welwitsch's Hairy Bat	Least Concern	High
Vespertilionidae	*Neoromicia capensis*	Cape Serotine Bat	Least Concern	High
Vespertilionidae	*Scotophilus dinganii*	Yellow-bellied House Bat	Least Concern	High
Viverridae	*Civettictis civetta*	African Civet	Least Concern	High
Viverridae	*Genetta genetta*	Small-spotted Genet	Least Concern	High
Viverridae	*Genetta maculata*	Common Large-spotted Genet	Least Concern	High (confirmed)

Table 25: An inventory of observed mammalian taxa recorded on the study sites during the April-May 2021 site visit
**- sensu Child et al (2016)*

Family	*Scientific name*	*Common name*	*Conservation Status**	*Observed indicators*
Bathyergidae	*Cryptomys cf. pretoriae (=hottentotus)*	Highveld Mole-rat	Least Concern	Soil heaps
Bovidae	*Redunca fulvorufula*	Mountain Reedbuck	Endangered	Droppings
Bovidae	*Raphicerus campestris*	Steenbok	Least Concern	Visual sightings & droppings
Bovidae	*Sylvicapra grimmia*	Common Duiker	Least Concern	Visual sightings & droppings
Canidae	*Canis mesomelas*	Black-backed Jackal	Least Concern	Scats & spoor
Cercopithecidae	*Chlorocebus pygerythrus*	Vervet Monkey	Least Concern	Visual sightings
Herpestidae	*Herpestes sanguineus*	Slender Mongoose	Least Concern	Visual sightings
Hystricidae	*Hystrix africaeaustralis*	Cape Porcupine	Least Concern	Quills& diggings
Leporidae	*Lepus victoriae (=saxatilis)*	African Savanna Hare	Least Concern	Visual sightings & droppings
Muridae	*Gerbilliscus cf. leucogaster*	Bushveld Gerbil	Least Concern	Burrows
Muridae	*Otomys angoniensis*	Vlei Rat	Least Concern	Grass clippings
Orycteropodidae	*Orycteropus afer*	Aardvark	Least Concern	Burrows (dens)
Suidae	*Phacochoerus africanus*	Common Warthog	Least Concern	Visual sightings
Suidae	*Potamochoerus larvatus koiropotamus*	Bushpig	Least Concern	Spoor & diggings
Viverridae	*Genetta maculata*	Common Large-spotted Genet	Least Concern	Spoor

African Savanna Hare (*Lepus victoriae*)

Common Duiker (*Sylvicapra grimmia*)

Aardvark (*Orycteropus afer*) diggings (with tail imprint)

Highveld Mole-rat (*Cryptomys cf. pretoriae*)

Domestic Cat (*Felis cf. catus*)

Vlei Rat (*Otomys cf. angoniensis*)

Mountain Reedbuck (*Redunca cf. fulvorufula*)

Figure 30: Examples of observed mammal indicators

31.1.2 BIODIVERSITY VALUE AND ECOLOGICAL CONSIDERATIONS

The following key observations were made:

⇒ It is evident that the mammal richness on the study area is relatively poor, which is best explained by the high degree of industrial and human-induced activities in the area.

⇒ Domestic cats (*Felis catus*) are prevalent on the study area and may pose an eminent threat to the extant small vertebrate fauna within the wider area. The occurrence of domestic cats may also result in genetic contamination of the indigenous feline population, in particular the African Wild Cat (F. *sylvestris*), due to inbreeding.

⇒ The relative ruggedness and high spatial heterogeneity along with the presence of surface outcrops north of the Steelpoort River (north of the study area) and immediately east of Site 2 provide micro-habitat for small mammal taxa with rupicolous affinities as well as large mammal taxa with large home range sizes. These features provide occasional foraging habitat for large charismatic carnivores and scavenging (c. Leopard *P. pardus* and Brown

Hyaena *P. brunnea*), which also provides suitable habitat for threatened taxa and an overlooked sub-population of Southern Mountain Reedbuck (*Redunca f. fulvorufula*).

31.1.3 THREATENED AND NEAR-THREATENED MAMMAL TAXA

Three regionally threatened and four near threatened mammal species are known to be present in the wider study region (sensu MammalMap; Child et al., 2016) (refer Table 24). Four of these species exhibit a high or moderate-high probability of occurrence, of which one species were confirmed during the survey. The following threatened and near threatened species have been confirmed on the study site or have a high or moderate-high probability of occurrence:

a. Serval (*Leptailurus serval*)

The Serval is listed as least concern on the global IUCN Red List although Child et al. (2016) listed it as near threatened. Servals show a wide distribution range, although they are limited by their obligate preference for surface water. They are therefore always found near water and in areas with sufficient shelter such as tall grass (Skinner & Chimimba, 2005) with an abundance of suitable prey – mainly Murid rodents (e.g. genera *Mastomys, Mus* and *Otomys*).

This species is a specialised rodent hunter and appears to be moderately tolerant to agricultural activities, adapting readily to abandoned cultivation areas that are occupied by secondary vegetatal growth, provided that they are not persecuted or persistently disturbed (in Wilson & Mittermeier, 2009). Evidence based on extensive camera trapping on the western Mpumalanga Highveld (pers. obs.) suggests that Servals are widespread, occurring in moist grassland and floodplains bordering dams, pans, streams, and seeps. While this species was not recorded during the survey period, it is considered moderately to highly likely to be present on tall rank grassland bordering the Steelpoort River and some of the drainage lines (including the tall closed riparian thickets) on Site 5. This habitat that is sympatric to the occurrence of *Otomys cf. angoniensis* and *Rhabdomys pumilio* which is the preferred prey of this species. Servals have been recorded from similar habitat corresponding to the wider study area (c. 12 records, last record was 2011) (sensu MammalMap).

b. Cape Clawless Otter (*Aonyx capensis*)

The Cape Clawless Otter is known to occur along the Steelpoort River within the wider study area (pers. obs.). The global conservation status of the *Aonyx capensis* was recently uplisted from least concern to near threatened due to widespread habitat alteration and pollution (Jacques et al., 2015) within its distribution range. Although *A. capensis* is considered to be occupying a large distribution range in Africa, recent evidence suggests that the spatial size of its occupied habitat has declined significantly, possibly because of the effects of climate change and human conflict for resources such as water and prey (Jacques et al., 2015). In addition, much of its habitat in South Africa is subjected to continued and exacerbated habitat degradation and poor sanitary infrastructure that resulted in water pollution.

It is known to be present along the Steelpoort River from personal observations (also from the Steelpoort town area) and has a high probability to be present on Site 5 (along the Steelpoort River and associated drainage lines - when inundated).

c. Brown Hyaena (*Parahyaena brunnea*)

The Brown Hyaena is listed as near threatened on the global IUCN Red List (Wiesel et al., 2008) since it requires extensive areas (sometimes in excess of 1,000 km^2) to maintain a viable population, especially where inter-specific competition for resources is fierce with other predator taxa. Such massive home ranges often coincide with livestock and agricultural areas where they are heavily persecuted by farmers. These persecution impacts and the loss of habitat due to agricultural intensification are some of the primary threats to this species.

It is regarded as a regular foraging visitor to all the study sites, and probably overlooked due to its secretive habitat. Although it was not observed on the study area, it has a moderate to high likelihood of occurrence. This species could utilise virtually every habitat type on the study area due to its opportunistic behaviour. The Brown Hyaena has also been recorded from habitat corresponding to the wider study area (c. 63 records from four bordering QDS grids) (sensu MammalMap).

d. Southern Mountain Reedbuck (*Redunca f. fulvorufula*)

The Mountain Reedbuck population experienced a drastic decline in South Africa owing to habitat fragmentation and genetic bottlenecks, which spurred the recent dramatic upgrade of its conservation status from least concern to endangered (Taylor et al., 2016a). This species prefers mountainous and hilly habitat dominated by grassland, with a preference for rocky grassland and savannoid grassland types.

The Mountain Reedbuck was confirmed during the survey (refer Figure 31) from variable open woodland on rocky soils corresponding to an area adjacent to Site 2. It was evident that the open rocky woodland provides extensive habitat for this species, and it is anticipated that the proposed construction activities could result in the displacement of this species from the wider study are (away from Site 2).

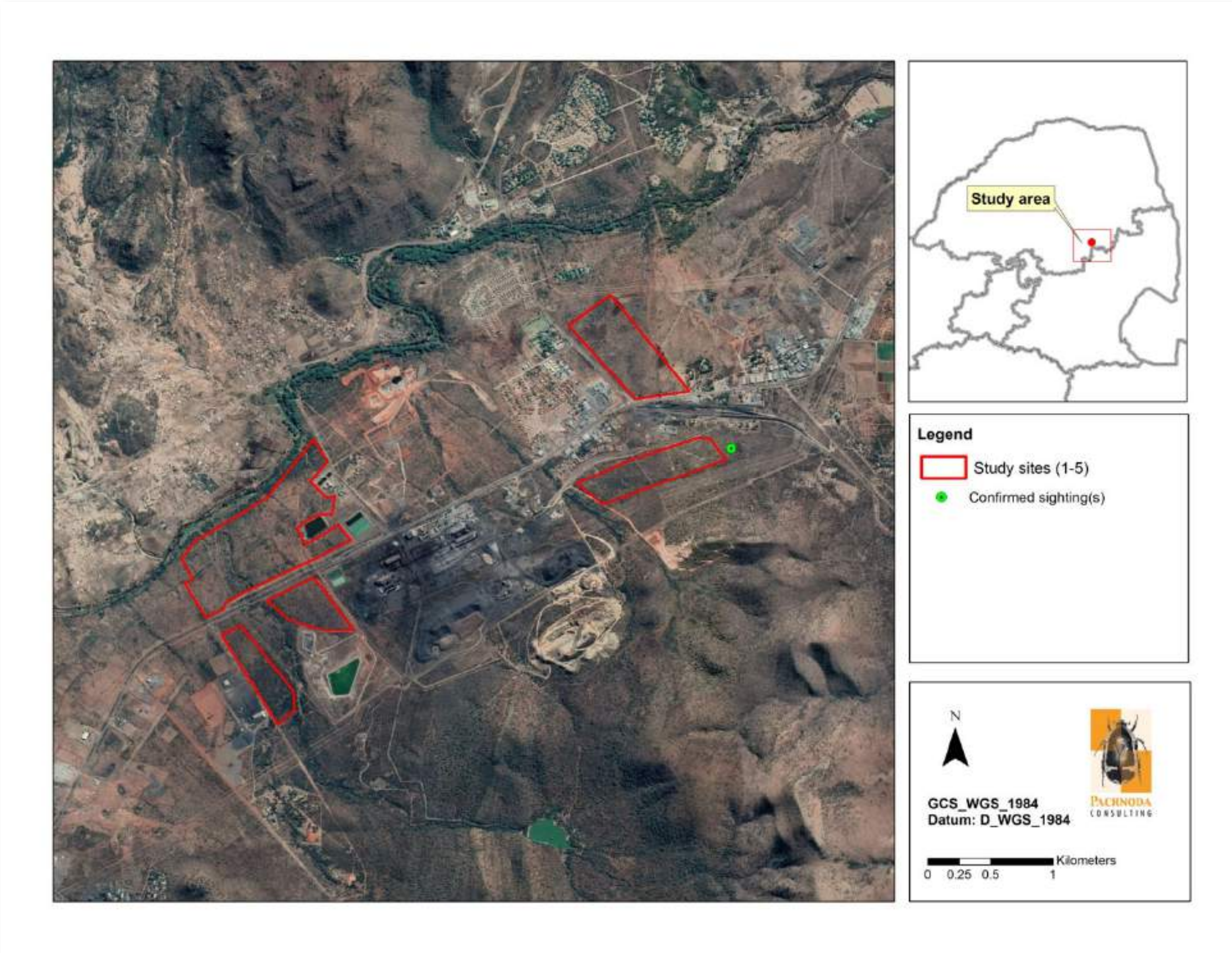


Figure 31: Satellite imagery illustrating evidence of the endangered Southern Mountain Reedbuck (*Redunca f. fulvorufula*) adjacent to the study area

e. Notes regarding other threatened and near-threatened species

Leopard (*Panthera pardus*), although a widespread and adaptable species, is listed as vulnerable (Child et al., 2016). The global population estimate for *P. pardus* is unknown or very unreliable, which is responsible for its placement in a threatened category. Furthermore, increased competition for space along with frequent human encounters (near human settlements) has seriously reduced the global number of subpopulations.

Leopard is regarded as a likely and occasional foraging visitor to the study area, based on the high number of observations of this species in the past, which include six records corresponding to the QDG that is sympatric to the study area, and 78 records from the wider study area. Although invariably displaced from the study area due to the high frequency of human activities, the high rural setting north of the study area (e.g. Leolo Mountains) and the tall ranks riparian vegetation along the Steelpoort River renders a low-moderate probability for this species to occur.

Cohen's Horseshoe Bat (*Rhinolophus cohenae*) was only recently described (c. 2012) as a formal species where it was initially part of the *R. hildebrandtii* complex (Cohen et al., 2016). The total population is inferred to be less than 1,000 individuals with 40 individuals being the highest number counted at a single locality (at an old mine adit), thereby placing this species in the vulnerable category. It is known to occur along the Mpumalanga escarpment from Mariepskop to Barberton but was also known to be present within the wider study area on QDS 2430CD where it is confined to higher-lying mountains terrain with outcrops and sheetrock habitat (refer Figure 32). Due to the absence of suitable roosting and breeding habitat on the study site, the probability that this species could be present on the study area is low, although it could be an uncommon foraging visitor to the tall riparian thickets along the Steelpoort River (Site 5).

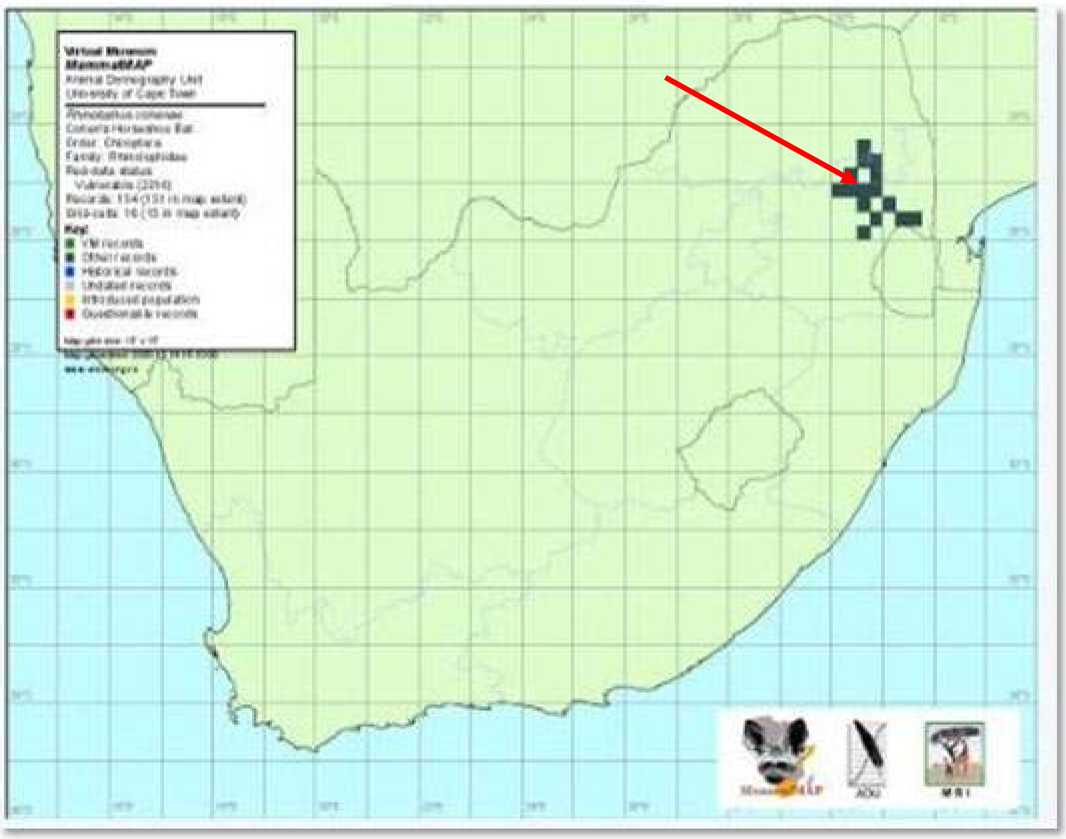


Figure 32: The extant (known) distribution of the vulnerable Cohen's Horseshoe Bat (*Rhinolophus cohenae*) in relation to the study area (see arrow)

Highveld Vlei Rat (*Otomys auratus*) was previously included in the *O. irroratus* group, although recent molecular studies showed that it is in fact a valid species that is closely associated with the Grassland Biome. *O. auratus* is a seemingly widespread rodent confined to moist grassland and the verges of high altitude vleis (mainly within the Grassland Biome), where it feeds voraciously on members of the Cyperaceae and other grasses, thereby leaving behind distinct runways littered by piles of discarded grass clippings. Although widespread, it has declined regionally owing to the loss of habitat and wetland deterioration, especially through climate change, overgrazing and agricultural intensification (Child et al., 2016). Its habitat is becoming increasingly isolated and fragmented which constrain dispersal. The latter is eminent through climate change (which is also accelerated through anthropogenic activities) where it appears that increased modification of grassland into thicket and woodland habitat at higher altitudes (e.g. proliferation by *Seriphium plumosum* shrubland) is responsible for the colonization of *Otomys angoniensis* and displacement of *O. auratus*. It is however considered to be uncommon to rare on the study area, where it could occur within the rank grassland (part of the tall closed riparian thickets) along the Steelpoort River (Site 5). It is only known from two old records corresponding to the wider study area (sensu MammalMap).

f. Notes regarding Mammal Species Listed by the Environmental Screening Tool

Results of a screening report as per the outcome of the Environmental Screening Tool (26/09/2021) produced a medium sensitivity for the animal theme on the study area with the potential occurrence of the Robert's Marsh Rat (*Dasymys robertsii*), Maquassie Musk Shrew (*Crocidura maquassiensis*) and African Wild Dog (*Lycaon pictus*).

There are no recent records or observations of Robert's Marsh Rat (*Dasymys robertsii*) from the study area (sensu MammalMap). The Robert's Marsh Rat (*Dasymys robertsii*) is listed as regionally vulnerable (sensu Child et al., 2016), although Taylor (1998) stated that it is probably not as rare as previously thought, at least within KwaZulu-Natal where the KZN population is considered form part of the genetically distinct species *D. cf incomtus*. Marsh rats have been recorded in a wide variety of habitat types, although it prefers well-vegetated wetland habitat. Skinner and Smithers (1990) also reported that they also utilise reedbeds along rivers and streams. It is therefore possible that this species was previously overlooked based on its shy and elusive habits and life history traits which explains its ominous absence from many parts of South Africa. However, the tall rank grassland and *Phragmites* reedbeds along the Steelpoort River at Site 5 provides suitable habitat for this species to occur. Although the status of *Dasymys robertsii* on the study area remains unresolved, a precautionary approach should be taken whereby the Steelpoort River and riparian thicket habitat (as delineated on the habitat maps) should be preserved (no construction should be allowed on these habitat units).

The occurrence of the endangered African Wild Dog (*Lycaon pictus*) on the study sites are regarded as unlikely and highly opportunistic (vagrant). It has not been observed in recent times on the study area, and considering the high number of human settlements in the area, it is more likely to be displaced from the study area, although suitable habitat is present in the more remote areas to north and south of the study area/ Steelpoort town region. The sub-population in the wider area probably stems from a free-roaming wild population that occurs in parts of the Limpopo Province (Davies-Mostert et al., 2016).

The occurrence of the vulnerable Maquassie Musk Shrew (*Crocidura maquassiensis*) on the study area could not be determined since it was not possible to deploy live small mammal traps in the area due to the risk of theft. However, there are no recent or historical collection records of this species from the study area (Taylor et al, 2016b), thereby rendering the occurrence of this species on the study area as low. However, since this species exhibits a strong correlation to moist and rocky grassland (mainly in montane grassland), it is highly recommended that all drainage lines and the riparian zone along the Steelpoort be preserved (along with appropriate buffer zones as recommended by the aquatic/wetland specialists).

31.2 AMPHIBIANS

31.2.1 *TAXONOMIC OVERVIEW & DIVERSITY*

The amphibian richness on the study area is considered low, with 14 frog species expected to occur. Only eight of these have high probability of occurrence) on the study sites (refer Table 26). The Steelpoort River (e.g. along Site 5) provides breeding habitat for obligate or "true" aquatic frog species such as Common Platanna (Xenopus laevis) and Delalande's River Frog (*Amietia delalandii*), while the floodplains immediately adjacent to the Steelpoort River offer ephemeral foraging and breeding habitat for most of the remaining widespread species (species with a high probability of occurrence).

Table 26: An inventory of frog taxa predicted to occur on the study area (and immediate surroundings)
Based on the presence of suitable habitat and with known distribution ranges sympatric to the sites (sensu FrogMap and professional judgement)

Family	*Scientific name*	*Common name*	*Conservation Status*	*Probability of occurrence*
Brevicepitidae	*Breviceps adspersus*	Bushveld Rain Frog	Least Concern	High
Bufonidae	*Schismaderma carens*	Red Toad	Least Concern	High
Bufonidae	*Sclerophrys capensis*	Raucous Toad	Least Concern	Moderate
Bufonidae	*Sclerophrys gutturalis*	Guttural Toad	Least Concern	High
Bufonidae	*Sclerophrys pusilla*	Flatbacked Toad	Least Concern	Moderate
Hyperoliidae	*Hyperolius marmoratus*	Painted Reed Frog	Least Concern	Low
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina	Least Concern	High
Phrynobatrachidae	*Phrynobatrachus natalensis*	Snoring Puddle Frog	Least Concern	Moderate
Pipidae	*Xenopus laevis*	Common Platanna	Least Concern	High
Ptychadenidae	*Ptychadena anchietae*	Plain Grass Frog	Least Concern	High
Ptychadenidae	*Ptychadena mossambica*	Broadbanded Grass Frog	Least Concern	Low
Pyxicephalidae	*Amietia delalandii*	Delalande's River Frog	Least Concern	High
Pyxicephalidae	*Strongylopus grayii*	Clicking Stream Frog	Least Concern	Moderate
Pyxicephalidae	*Tomopterna natalensis*	Natal Sand Frog	Least Concern	High

31.2.2 *THREATENED AND NEAR THREATENED FROG SPECIES*

No frog species of conservation concern is expected to be present on the study area.

31.3 REPTILES

31.3.1 *TAXONOMIC OVERVIEW & DIVERSITY*

The reptile composition on the study site is poorly known with only 23 species currently known from the wider study area (c. QDS 2430AC, sensu ReptileMap, including personal observations) (refer Table 27). The expected reptile richness is underestimated for the study sites (and surrounds), and predicted that the richness may be as high as 54 species (refer Table 27). However, reptiles remained to be rather uncommon on the respective study sites with Leopard Tortoise (*Stigmochelys pardalis*), Southern Tree Agama (*Acanthocercus atricollis*), Distant's Ground Agama (*Agama aculeata distanti*), Striped Skink (*Trachylepis striata*), Water Monitor (*Varanus niloticus*) and Variable Skink (*Trachylepis varia*) being prominent. The absence of prominent rock outcrops and sheetrock excludes the occurrence of obligatory taxa pertaining to the genera *Platysaurus, Smaug* and *Cordylus*.

Table 27: An inventory of reptile taxa that are sympatric to the study area (sensu ReptileMap) (inclusive of personal observations)

Family	*Scientific name*	*Common name*	*Conservation Status*	*Probability of occurrence*
Agamidae	*Acanthocercus atricollis*	Southern Tree Agama	Least Concern	High
Agamidae	*Agama aculeata distanti*	Distant's Ground Agama	Least Concern	High
Agamidae	*Agama atra*	Southern Rock Agama	Least Concern	High
Chamaeleonidae	*Chamaeleo dilepis*	Common Flap-neck Chameleon	Least Concern	High
Colubridae	*Dasypeltis scabra*	Rhombic Egg-eater	Least Concern	High
Colubridae	*Philothamnus semivariegatus*	Spotted Bush Snake	Least Concern	High

Table 27: An inventory of reptile taxa that are sympatric to the study area (sensu ReptileMap) (inclusive of personal observations)				
Colubridae	*Telescopus semiannulatus semiannulatus*	Eastern Tiger Snake	Least Concern	High
Elapidae	*Dendroaspis polylepis*	Black Mamba	Least Concern	High
Elapidae	*Naja mossambica*	Mozambique Spitting Cobra	Least Concern	High
Gekkonidae	*Afroedura leoloensis*	Sekhukhuneland Flat Gecko	No evaluated	Low
Gekkonidae	*Chondrodactylus turneri*	Turner's Gecko	Least Concern	High
Gekkonidae	*Hemidactylus mabouia*	Common Tropical House Gecko	Least Concern	High
Gekkonidae	*Homopholis wahlbergii*	Wahlberg's Velvet Gecko	Least Concern	Moderate
Gekkonidae	*Lygodactylus capensis*	Common Dwarf Gecko	Least Concern	High
Gekkonidae	*Lygodactylus nigropunctatus*	Black-spotted Dwarf Gecko	Least Concern	High
Gekkonidae	*Pachydactylus affinis*	Transvaal Gecko	Least Concern	High
Gekkonidae	*Pachydactylus vansoni*	Van Son's Gecko	Least Concern	Moderate
Gerrhosauridae	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	Least Concern	High
Lacertidae	*Heliobolus lugubris*	Bushveld Lizard	Least Concern	Moderate
Lacertidae	*Meroles squamulosus*	Common Rough-scaled Lizard	Least Concern	High
Lacertidae	*Nucras holubi*	Holub's Sandveld Lizard	Least Concern	High
Lacertidae	*Nucras ornata*	Ornate Sandveld Lizard	Least Concern	Moderate
Lamprophiidae	*Aparallactus capensis*	Black-headed Centipede-eater	Least Concern	High
Lamprophiidae	*Atractaspis bibronii*	Bibron's Stiletto Snake	Least Concern	High
Lamprophiidae	*Boaedon capensis*	Brown House Snake	Least Concern	High
Lamprophiidae	*Lamprophis guttatus*	Spotted House Snake	Least Concern	
Lamprophiidae	*Psammophis brevirostris*	Short-snouted Grass Snake	Least Concern	High
Lamprophiidae	*Psammophis crucifer*	Cross-marked Grass Snake	Least Concern	Low
Lamprophiidae	*Psammophis mossambicus*	Olive Grass Snake	Least Concern	Moderate
Lamprophiidae	*Psammophis subtaeniatus*	Western Yellow-bellied Sand Snake	Least Concern	High
Lamprophiidae	*Psammophis trinasalis*	Fork-marked Sand Snake	Least Concern	High
Lamprophiidae	*Psammophylax rhombeatus*	Spotted Grass Snake	Least Concern	Moderate
Lamprophiidae	*Psammophylax tritaeniatus*	Striped Grass Snake	Least Concern	Moderate
Leptotyphlopidae	*Leptotyphlops jacobseni*	Jacobsen's Thread Snake	Least Concern	High
Leptotyphlopidae	*Leptotyphlops scutifrons conjunctus*	Eastern Thread Snake		High
Pelomedusidae	*Pelomedusa subrufa*	Central Marsh Terrapin	Least Concern	High
Pythonidae	*Python natalensis*	Southern African Python	Least Concern	Moderate-High
Scincidae	*Mochlus sundevallii*	Sundevall's Writhing Skink	Least Concern	High
Scincidae	*Panaspis maculicollis*	Spotted-neck Snake-eyed Skink	Least Concern	High
Scincidae	*Panaspis wahlbergii*	Wahlberg's Snake-eyed Skink	Least Concern	High
Scincidae	*Trachylepis capensis*	Cape Skink	Least Concern	Moderate
Scincidae	*Trachylepis margaritifera*	Rainbow Skink	Least Concern	High
Scincidae	*Trachylepis sp. (Transvaal varia)*	Skink sp. 1	Not evaluated	Status uncertain
Scincidae	*Trachylepis striata*	Striped Skink	Least Concern	High
Scincidae	*Trachylepis varia sensu lato*	Common Variable Skink Complex	Least Concern	High
Testudinidae	*Kinixys lobatsiana*	Lobatse Hinged Tortoise	Vulnerable	Moderate
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	Least Concern	High
Typhlopidae	*Afrotyphlops bibronii*	Bibron's Blind Snake	Least Concern	High
Typhlopidae	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake	Least Concern	Moderate
Varanidae	*Varanus albigularis albigularis*	Rock Monitor	Least Concern	High
Varanidae	*Varanus niloticus*	Water Monitor	Least Concern	High
Viperidae	*Bitis arietans arietans*	Puff Adder	Least Concern	High
Viperidae	*Causus defilippii*	Snouted Night Adder	Least Concern	Moderate
Viperidae	*Causus rhombeatus*	Rhombic Night Adder	Least Concern	High

31.3.2 THREATENED AND NEAR THREATENED REPTILE SPECIES

Sensitive Species 2, although categorised as Least Concern (IUCN, 2021), is considered a species of concern in the National Environmental Screening Report. This species would be confined to the Steelpoort River and immediate terrestrial surrounds, and because it is a highly opportunistic species, is possible, although unlikely, to persist within the Steelpoort River. This species is an aggressive and opportunistic predator. It is widely distributed across South Africa, with strong, documented populations in many countries in eastern and southern Africa.

Sensitive Species 7[11] (Vulnerable) could potentially persist on the variable open woodland on rocky slopes confined to the eastern parts of Site 2 and along certain sites where surface outcrops are prominent (mainly variable open woodland along some of the larger drainage lines). This species is categorised as Vulnerable since most of its global distribution corresponds to the Limpopo Province of which already 15 % of previously suitable habitat is currently developed or degraded (Hofmeyr and Boycott, 2018). The remaining 85 % of similar habitat occurs in Kruger National Park, where this species does not occur. It also occurs in hills and rocky grassland in Gauteng northwards to the south of the Soutpansberg and is strongly associated with outcrops and hills, which often results in fragmented subpopulations due to plain and valley habitat, which are often degraded or transformed. It is threatened by habitat transformation (e.g., urbanisation, agriculture, and mining) along with inappropriate veld management (many are killed during veld fires). In addition, it is invariably collected as food and for cultural purposes which may result in local extinctions (Mifsud and Stapleton, 2014).

31.4 INVERTEBRATE TAXA OF CONSERVATION CONCERN

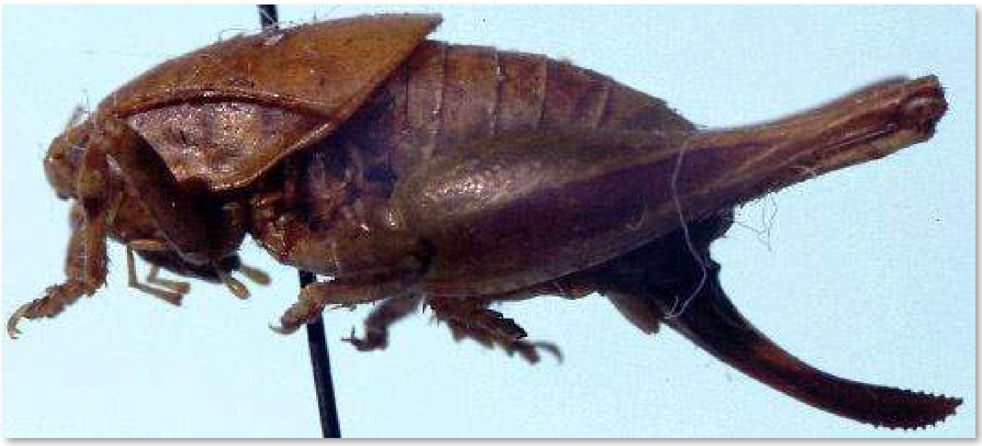
There are no butterfly species of conservation concern known to be present on the study area. However, the results of a screening report as per the outcome of the Environmental Screening Tool (26/09/2021) produced a medium sensitivity for the animal theme on the study area with the potential occurrence of one shieldback katydid (Family Tettigoniidae): Brown False Shieldback (*Aroegas fuscus*). This species is globally endangered due to its small area of occupancy of approximately 10 km^2, where it is only known from two localities confined to the highland areas of Mpumalanga and Limpopo Provinces. These particular localities are threatened by livestock and wildlife grazing, afforestation, cultivation and floristic changes (especially the distribution of its host plant) due to climate change. It occurs at an elevation above 1,200 m in Mesic Highveld Grassland (Bazelet, C. & Naskrecki, 2014).

When considering the habitat preferences of this species, it is of the opinion that *Aroegas fuscus* has a low probability of occurrence due to an absence of suitable habitat. Most of the study area falls within the Savanna Biome and at an elevation that is below 1,200 m (c. 740-800 m above sea level).

[11] Please note that the National Environmental Screening report includes lists of animal and plant species of conservation concern that are known or expected to occur on the proposed development footprint. Some of these SCC are sensitive to illegal harvesting. As per the best practise guideline that accompanies the protocol and screening tool, names of the sensitive species may therefore not appear in the final EIA report, or any specialist reports released into the public domain. It should be referred to as '*sensitive species*'.

Male (lateral view)

Male (dorsal view))



Female (lateral view)

Figure 33: Examples of preserved material of *Aroegas fuscus* obtained from the Orthoptera Species File (http://orthoptera.speciesfile.org/)

This specimen was collected from Woodbush (S 23.7833°, E 30.0667°) in the Limpopo Province during December 1924 (collector G. v. Dam).

31.5 AVIFAUNA (BIRDS)

31.5.1 *SPECIES ACCUMULATION CURVE (SAC)*

The species accumulation curve (SAC) for all bird point counts pooled reached an asymptote at approximately 20 counts (refer **Figure 34**). The sampling sufficiency captured approximately 80.2 % of the number of species at 20 counts as predicted by the Michaelis-Menten model. According to **Figure 34**, 82 % of the predicted species was captured by the total number of sampling points (n=23). Therefore, sampling was considered sufficient and captured most of the bird species present on the study area.

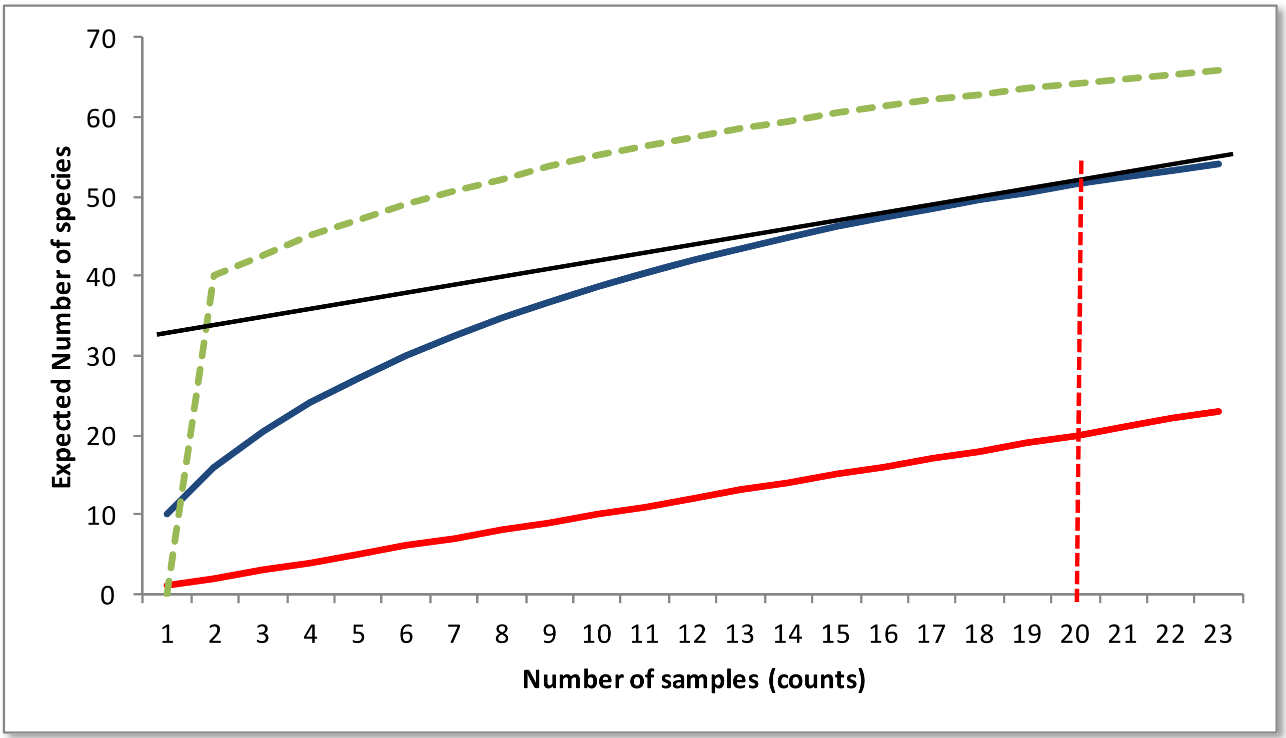


Figure 34: The species accumulation curve (SAC) for 23 point counts sampled during April/May 2021
The red line represents an accumulation of one species for every additional point count. The black line is parallel to the red one and is tangent to the SAC approximately after 20 counts (as represented by the vertical red stippled line). The green stippled line represents the Michaelis-Menten curve.

31.5.2 *SPECIES RICHNESS AND SUMMARY STATISTICS*

A total of approximately 253 bird species are expected to occur on the wider study area (including adjacent habitat), of which 127 species were recorded from the April/May 2021 site visit (refer **Appendix 7** and **Table 28**).

The expected richness was inferred from the South African Bird Atlas Project[12] (SABAP2; www.sabap2.birdmap.africa), professional judgement and the presence of suitable habitat on the study sites. This equates to 26 % of the approximate 985[13] species listed for the southern African subregion[14] (and approximately 30 % of the 857 species recorded within South Africa[15]). Although 127 species were recorded on the study sites and immediate surroundings, the average richness

[12] The expected richness statistic was derived (and adjusted) from pentad grid 2440_3010 including the eight adjacent grids totalling 267 bird species (based on 122 full protocol cards and 94 ad hoc cards.
[13] *sensu* www.zestforbirds.co.za (Hardaker, 2020).
[14] A geographical area south of the Cunene and Zambezi Rivers (includes Namibia, Botswana, Zimbabwe, southern Mozambique, South Africa, Swaziland and Lesotho).
[15] With reference to South Africa (including Lesotho and Swaziland (BirdLife South Africa, 2018).

per pentad grid observed during two hours or more (for full protocol cards) is 37.89 species[16] when the eight adjacent grids are included.

According to Table 28, the study sites are poorly represented by biome-restricted[17] (also refer Table 29) and regional endemic species, while also being unable to support high numbers of local endemic species (species endemic to South Africa). The study area supports only eight regional endemic species and 15 near-endemic species confined to southern Africa, and contains five Biome restricted species that are confined to the Zambezian Woodlands, Afrotropical Highlands and Kalahari-Highveld. Therefore, the study area is not considered as an important endemic bird area, or "hotspot" area which could sustain avian speciation over evolutionary times.

Of the 252 expected bird species, eight are threatened and/or near threatened species, of which the vulnerable Lanner Falcon (*Falco biarmicus*) was the only threatened bird species observed from habitat corresponding to the study area.

Table 28: Summary table of the total number of species, Red listed species to occur in the study area (according to Taylor et al., 2015 and the IUCN, 2021), endemics and biome-restricted species (Marnewick et al., 2015) expected (sensu SABAP2)

Description	*Expected Richness Value (study area and surroundings)****	*Observed Richness Value (study area and surroundings)*****
Total number of species*	252 (26 %)	127 (50 %)
Number of Red Listed species*	8 (6 %)	1 (13 %)
Number of biome-restricted species –Kalahari-Highveld, Afrotropical Highlands and Zambezian Biomes*	5 (13 %)	3 (60 %)
Number of local endemics (BirdLife SA, 2018)*	1 (3 %)	0 (n/a)
Number of local near-endemics (BirdLife SA, 2018)*	4 (13 %)	1 (25 %)
Number of regional endemics (Hockey *et al.,* 2005)**	8 (8 %)	3 (38 %)
Number of regional near-endemics (Hockey *et al.,* 2005)**	15 (25 %)	7 (47 %)

* only species in the geographic boundaries of South Africa (including Lesotho and eSwatini) were considered
** only species in the geographic boundaries of southern Africa (including Namibia, Botswana, Zimbabwe, and Mozambique south of the Zambezi River) were considered
*** Percentage values in brackets refer to totals compared against the South African avifauna (*sensu* BirdLife SA, 2018)
**** Percentage values in brackets refer to totals compared against the expected number of species in the study area

Table 29: Observed biome-restricted species (Marnewick et al, 2015) on the study area

Species	*Kalahari-Highveld*	*Afrotropical Highlands*	*Zambezian*	*Frequency of occurrence*
Southern Bald Ibis (*Geronticus calvus*)		X		Uncommon, foraging visitor
Kalahari Scrub Robin (*Cercotrichas paena*)	X			Uncommon resident
Kurrichane Thrush (*Turdus libonyanus*)			X	Common resident
White-throated Robin-chat (*Cossypha humeralis*)			X	Common resident
White-bellied Sunbird (*Cinnyris talatala*)			X	Common resident

[16] Based on 122 full protocol cards, range= 8 - 124 bird species.
[17] A species with a breeding distribution confined to one biome. Many biome-restricted species are also endemic to southern Africa.

31.5.3 THREATENED AND NEAR THREATENED SPECIES

Table 30 provides an overview of bird species of conservation concern that could occur on the study site based on their distribution ranges and the presence of suitable habitat. According to Table 30, a total of eight (8) species have been recorded in the wider study area (sensu SABAP2 and personal observations) which include four (4) globally threatened species, two (2) regionally threatened species and two (2) regionally near threatened species.

The regionally vulnerable Lanner Falcon (*Falco biarmicus*) was the only species of conservation concern that was observed on the study sites (c. Site 5 and Site 3) during the April/May 2021 site visit. It is regarded as a regular foraging visitor to the study area, with at least one pair present in the area that probably breeds in the high mountains to the north of the study sites at the Lekgobo mountains on the Farms Winterveld and Doornbosch (based on vantage point surveys; pers. obs.).

The remaining species are regarded as irregular visitors to the proposed study sites owing to the (1) absence of optimal breeding and roosting habitat, (2) persistent disturbances and displacement caused by human and industrial-related activities at the proposed study sites.

Table 30: Bird species of 'conservation concern' that have been recorded in the wider study area based on their known distribution range (sensu SABAP2) and the availability of suitable habitat
Red list categories according to the IUCN (2021)* and Taylor et al. (2015)**. Reporting rates were derived from the mean for pentad grid 2440_3010 as well as the eight surrounding grids. Species highlighted in grey were confirmed during the surveys.

Species	*Global Status**	*Regional Conservation Status***	*SABAP2 mean reporting rate*	*Preferred Habitat*	*Occurrence Status*
Aquila rapax (Tawny Eagle)	Vulnerable	Endangered	0.76	Lowveld and Kalahari savannas, especially game farming areas and protected areas with game species.	A highly irregular foraging visitor to the study sites. Its occurrence depends on the presence of carcasses. Probably vagrant to the study area. Last observed record from SABAP2 on the study area was 2019 from a pentad grid adjacent to the study sites.
Alcedo semitorquata (Half-collared Kingfisher)	–	Near threatened	1.19 (ad hoc observation)	Clear, fast running stream and rivers with overhanging vegetation. Steep embankments in close proximity of the streams/rivers required for this species to nest.	Probably uncommon to rare. The Steelpoort River does not provide optimal habitat for this species to breed and foraging habitat structure along the river was largely decimated due to human activities (e.g. clearing of riparian vegetation). Last observed record from SABAP2 on the study area was 2016 from a pentad grid adjacent to the study sites.
Aquila verreauxii # (Verreaux's' eagle)	-	Vulnerable	0.76	Mountainous areas or areas with prominent outcrops with a high prey base (e.g. hyrax)	Regarded as an irregular foraging visitor (although probably more commonly observed at nearby mountain ranges). It is known from a single record observed during 08 April 2021 (from a pentad grid adjacent to the study sites).
Gyps africanus (White-backed Vulture)	Critically Endangered	Critically Endangered	1.53	Breed on tall, flat-topped trees. Mainly restricted to large rural or game farming areas and protected areas with game species.	Regarded as an irregular foraging visitor to the study area. Its occurrence depends on the presence of carcasses. Last observed record from SABAP2 on the study area was during 2019.

Table 30: Bird species of 'conservation concern' that have been recorded in the wider study area based on their known distribution range (sensu SABAP2) and the availability of suitable habitat
Red list categories according to the IUCN (2021)* and Taylor et al. (2015)**. Reporting rates were derived from the mean for pentad grid 2440_3010 as well as the eight surrounding grids. Species highlighted in grey were confirmed during the surveys.

Species	Global Status*	Regional Conservation Status**	SABAP2 mean reporting rate	Preferred Habitat	Occurrence Status
Falco biarmicus (Lanner Falcon)	-	Vulnerable	19.85	Varied, but prefers to breed in mountainous areas.	Considered as a regular foraging visitor on the study sites. Probably breeds north of the study sites at the Lekgobo mountains on the Farms Winterveld and Doornbosch
Geronticus calvus (Southern Bald Ibis)	Vulnerable	Vulnerable	1.19 (ad hoc observations)	A species restricted to upland and montane grassland (especially when burned) and breed/nest on steep cliffs.	Regarded as irregular foraging visitors to habitat consisting of short grassland or recently burned grassland. Breeding and roosting habitat are absent from the study site. The last confirmed record of this species on the study area was during 2017.
Gyps coprotheres (Cape Vulture)	Endangered	Endangered	0.76	Mainly confined to mountain ranges, especially near breeding site. Ventures far afield in search of food.	Regarded as an irregular foraging visitor to the study area. Its occurrence depends on the presence of carcasses. Last observed record from SABAP2 on the study area was 30 March 2021(from a pentad grid adjacent to the study sites).
Ciconia abdimii (Abdim's Stork)	-	Near threatened	0.76	Open grassland, including agricultural land and pastures.	Regarded as an irregular foraging visitor during the austral summer. Last observed record from SABAP2 on the study area was 2008 (from a pentad grid adjacent to the study sites).

The following species accounts refer to taxa confirmed or with a high probability to be present on the study sites:

a. Lanner Falcon (*Falco biarmicus*)

Falco biarmicus is a fairly common species within its global distribution range, where it occurs from south-eastern Europe to the Middle East, south-west Asia and across most of Africa. The global population consists of more than 30,000 breeding pairs with approximately 1,400 pairs confined to the eastern parts of South Africa (Tarboton & Allen, 1984). The national conservation status of this species was upgraded from Near threatened to Vulnerable due to persistent transformation of suitable foraging habitat (e.g. open areas) to make way for agricultural land and disturbances at nesting sites (Taylor et al., 2015).

This species is often associated with hills, ridges, and mountain ranges where it prefers to nest on steep and inaccessible cliffs. It prefers to forage over open terrain and will hunt indiscriminately over almost any open area with suitable prey (mainly terrestrial birds such as francolins and lapwings).

This species was confirmed from Site 5 and Site 3 during the April/May 2021 site visit (**Figure 35**). It is regarded as a regular foraging visitor to the study area, with at least one pair present in the area, which was also observed in the company of Peregrine Falcons (F. *peregrinus*). This pair probably breeds in the high mountains to the north of the study sites at the Lekgobo mountains on the Farms Winterveld and Doornbosch (based on vantage point surveys; pers. obs.).

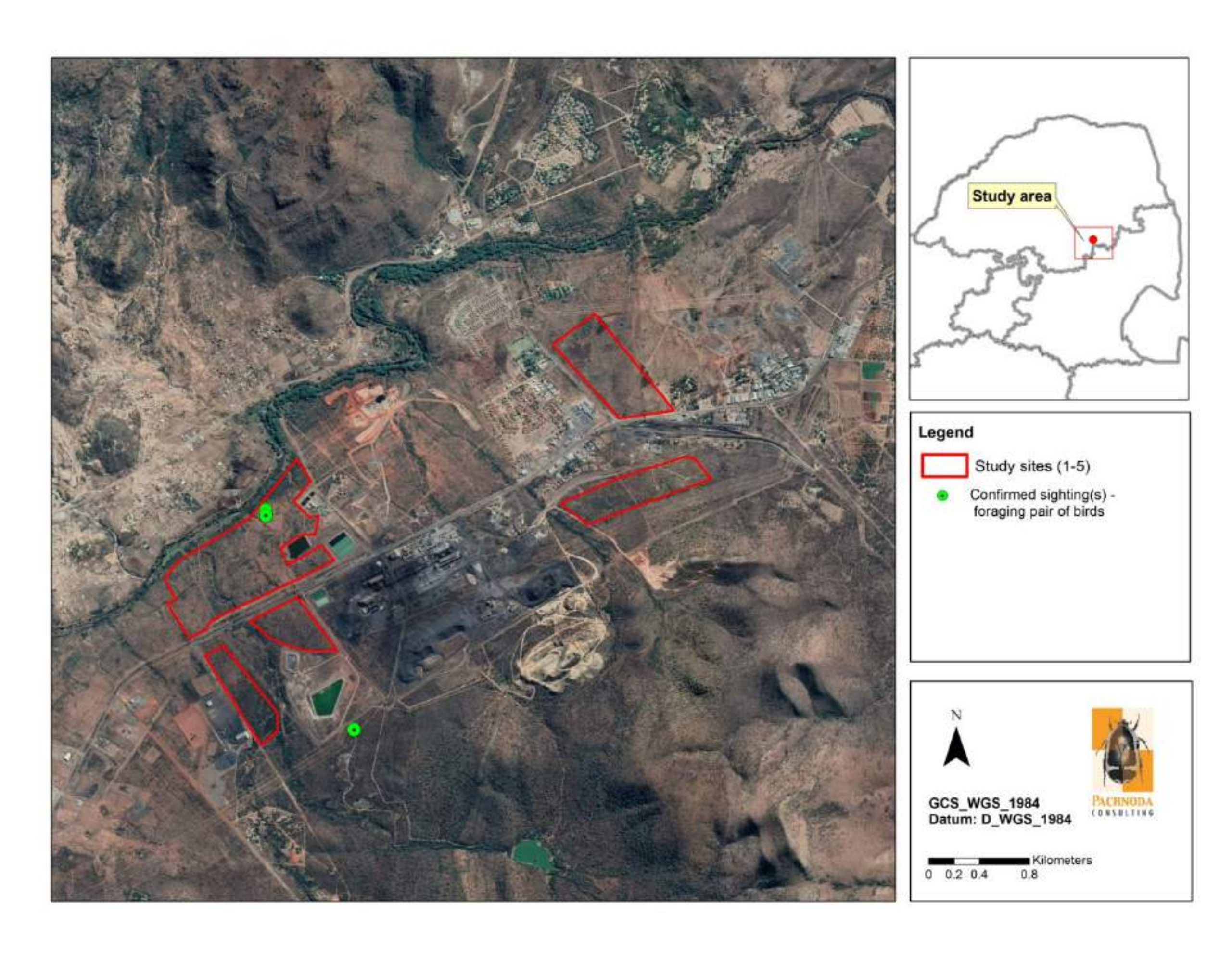


Figure 35: Satellite image illustrating the occurrence the regionally vulnerable Lanner Falcon (*Falco biarmicus*) on the study sites.

b. Notes regarding the occurrence of Secretarybird (*Saggitarius serpentarius*)

The results of a screening report as per the outcome of the Environmental Screening Tool (26/09/2021) produced a medium sensitivity for the animal theme on the study area with the potential occurrence of the Secretarybird (*Sagittarius serpentarius*).

The regional conservation status of the Secretarybird was upgraded to Vulnerable since recent evidence suggests that it has experienced rapid declines across its entire range due to habitat loss, anthropogenic disturbances, and intensive grazing (Taylor et al., 2015). However, its global conservation status was recently uplisted from Vulnerable to Endangered since large declines have been recently reported throughout its range, which include Botswana, eSwatini and South Africa (Birdlife International, 2020). Secretarybirds are widespread in Africa south of the Sahara, but have declined over most of their geographic distribution range. Based on reporting rates, they appear to be more regularly observed in large conservation and rural areas, and this explains why reporting rates are relatively low on areas that are not statutorily conserved. Secretarybirds prefer open areas, in particular open savanna and grassland, but tend to avoid areas of dense bush or very rocky areas.

It is worth mentioning that many large terrestrial bird species, including Secretarybirds, show widespread declines in numbers, primarily due to large-scale loss of habitat, especially the loss of large patches of grassland. It is postulated that this steady decline of suitable habitat has "forced" this species to utilise other "sub-optimal" areas, many being closely associated with human settlements, where it is often confronted or threatened by human activities.

Secretarybirds are regarded as highly irregular foraging visitors to the study sites, and it is of the opinion to be absent from the area. In fact, this species has not been observed from the pentad grids corresponding to the study area since the inception of SABAP2. It is predicted that the increase in anthropogenic activities (as evidenced by settlements, human pedestrian movement and industrial activities) and increased disturbances caused by persistent livestock grazing have potentially displaced this species from the area.

31.5.4 IMPORTANT BIRD AND BIODIVERSITY AREAS

The study sites does not overlap with any Important Bird and Biodiversity Area (IBA), with the nearest IBA (c. Blyde River Canyon; SA127) being approximately 36 km east of the study area (sensu Marnewick et al., 2015).

31.5.5 BIRD ASSEMBLAGE STRUCTURE AND COMPOSITION

A total of 45 bird species and 450 individuals were recorded from 23 bird points. The data provides an estimate of the bird richness and their numbers on the study sites obtained during the late austral wet season. A mean of 9.9 (~10) species and 19.6 individuals were recorded per point count. The highest number of species recorded from a point count was 15-16 species (from tall closed riparian vegetation and variable open woodland) and the lowest was three species (from deteriorated open woodland). The highest number of individuals recorded per point count was 30 individuals (from variable open woodland), and the lowest was seven individuals (from deteriorated open woodland). The mean frequency of occurrence for a bird species was 18.36 % and the median was 8.70 %, while the most common value (mode) was 4.35 %. The mean frequency of occurrence was considered to be relatively high, thereby emphasising the widespread occurrence of the majority of the composition across all the habitat types on the study area. In general, it implies that most of the bird species occurs in all the habitat type due to low floristic structural differences between the respective habitat types.

An analysis of bird data generated from the point counts showed that the Blue Waxbill (*Uraeginthus angolensis*), Rattling Cisticola (*Cisticola chiniana*), Dark-capped Bulbul (*Pycnonotus tricolor*), Jameson's Firefinch (*Lagonosticta rhodopareia*), Southern Boubou (*Laniarius ferrugineus*), White-browed Scrub Robin (*Cercotrichas leucophrys*) and White-bellied Sunbird (*Cinnyris talatala*) have the highest frequency of occurrence on the study area and were detected in more than 50 % of the point counts (refer Table 31). The Blue Waxbill (*Uraeginthus angolensis*) is the most widespread bird species on the study area, and occurred in more than 95 % of the point counts.

The typical bird composition represents most of the major avian guild which include (1) insectivorous species, (2) granivore species, (3) frugivores (important for the regeneration of riparian vegetation) and (4) nectarivores and facultative pollinators. It emphasises the structural variation of the floristic units (e.g. riparian thickets vs. open woodland) and a strong perceived resilience and/or recovery to low - moderate intensity disturbances.

Table 31: Typical (high frequency of occurrence) bird species recorded on the study sites

Species	*Average Abundance*	*Consistency*	*% Contribution*	*Guild*
Blue Waxbill (*Uraeginthus angolensis*)	2.35	1.39	2.24	Granivore (ground to lower gleaner)
Rattling Cisticola (*Cisticola chiniana*)	1.43	0.53	0.97	Insectivore (upper canopy gleaner)
Dark-capped Bulbul (*Pycnonotus tricolor*)	0.96	0.44	1.02	Facultative frugivore (upper canopy gleaner)
Jameson's Firefinch (*Lagonosticta rhodopareia*)	1.26	0.36	0.70	Granivore (ground to lower gleaner)
Southern Boubou (*Laniarius ferrugineus*)	1.04	0.4	0.58	Insectivore (lower canopy foliage gleaner)
White-browed Scrub Robin (*Cercotrichas leucophrys*)	0.70		0.66	Insectivore (upper canopy foliage gleaner)

Table 31: Typical (high frequency of occurrence) bird species recorded on the study sites				
Species	*Average Abundance*	*Consistency*	*% Contribution*	*Guild*
White-bellied Sunbird (*Cinnyris talatala*)	0.61	0.28	0.58	Nectarivore (and facultative insectivore)
Acacia Pied Barbet (*Tricholaema leucomelas*)	0.48	0.37	0.40	Frugivore (upper canopy gleaner)
Long-billed Crombec (*Sylvietta rufescens*)	0.70	0.25	0.35	Insectivore (upper canopy gleaner)
Chinspot Batis (*Batis molitor*)	0.57	0.22	0.30	Insectivore (upper canopy gleaner)

Any significant differences between the bird compositions were obscure and mainly represented by extremes represented by floristic structure (open vs. "thicket" woodland and tall vs. short woodland) (ANOSIM Global R = 0.413, p=0.1). However, the obvious differences include "functional" bird associations confined to a habitat continuum comprising of the following bird associations (refer **Figure 36**):

(1) a closed riparian thicket association (along the Steelpoort River);
(2) an association consisting of dense woodland in close proximity to large drainage systems;
(3) an association relevant to variable open woodland; and
(4) association relevant to short (often deteriorated) open woodland.

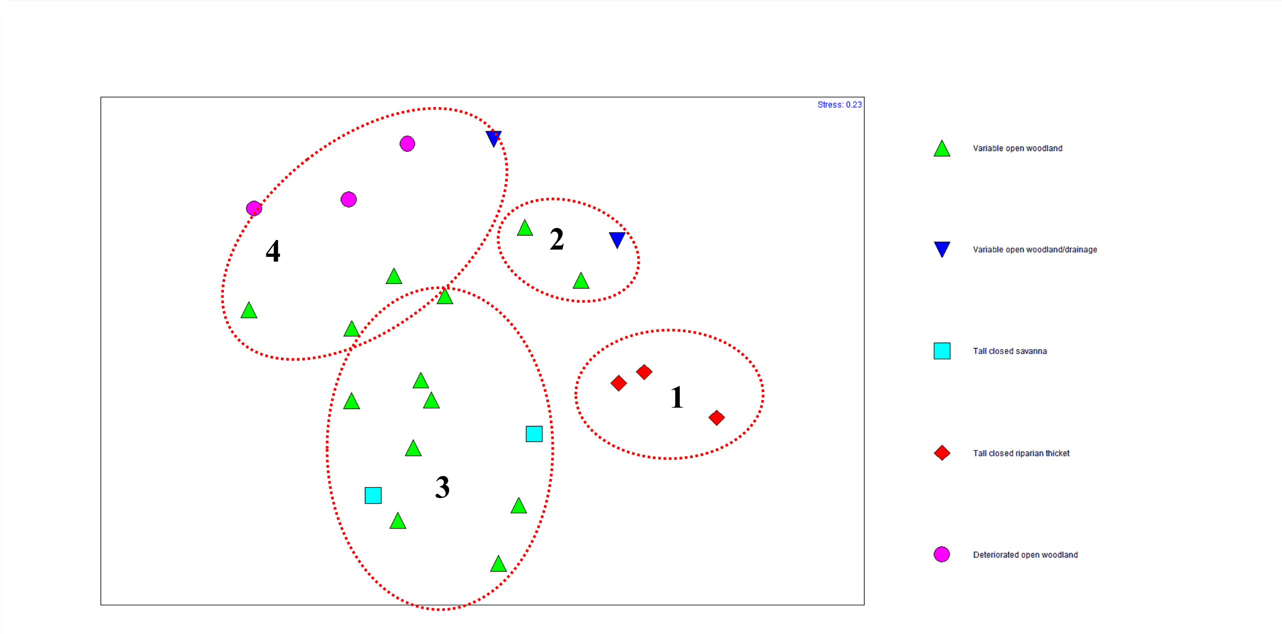


Figure 36: Three-dimensional non-metric multidimensional scaling ordination of the relative abundances of bird species based on Bray-Curtis similarities obtained from 23 point counts
(1) a closed riparian thicket association (along the Steelpoort River);
(2) an association consisting of dense woodland in close proximity to large drainage systems;
(3) an association relevant to variable open woodland; and
(4) an association relevant to short (often deteriorated) open woodland.

The dominant and indicator (discriminant species of low abundance values with a high fidelity to a particular habitat unit) are described below for each of the discrete bird associations:

1. Tall closed Riparian Thicket (along the Steelpoort River - Site 5)

Dominant species: Southern Boubou (*Laniarius ferrugineus*), Tawny-flanked Prinia (*Prinia subflava*), White-throated Robin-chat (*Cossypha humeralis*), Red-faced Cisticola (*Cisticola erythrops*), Common Waxbill (*Estrilda astrild*), Dark-capped Bulbul (*Pycnonotus tricolor*), Brown-hooded Kingfisher (*Halcyon albiventris*), Black-backed Puffback (*Dryoscopus cubla*).

Indicator species:	Tawny-flanked Prinia (*Prinia subflava*), Red-faced Cisticola (*Cisticola erythrops*), Common Waxbill (*Estrilda astrild*), Brown-hooded Kingfisher (*Halcyon albiventris*), African Firefinch (*Lagonosticta rubricata*), Red-eyed dove (*Streptopelia semitorquata*), Cape Robin-chat (*Cossypha caffra*), Mountain Wagtail (*Motacilla clara*).

2. Dense woodland in close proximity to large drainage lines

Dominant species:	Blue Waxbill (*Uraeginthus angolensis*), Black-faced Waxbill (*Brunhilda erythronotos*), Dark-capped Bulbul (*Pycnonotus tricolor*), White-throated Robin-chat (*Cossypha humeralis*), Rattling Cisticola (*Cisticola cheniana*), Speckled Mousebird (*Colius striatus*), Jameson's Firefinch (*Lagonosticta rhodopareia*), Green-winged Pytilia (*Pytilia melba*).
Indicator species:	Common Whitethroat (*Curruca communis*), Marsh Warbler (*Acrocephalus palustris*), Black-collared Barbet (Lybius torquatus - high abundance).

3. Variable open woodland (prominent association on study area)

Dominant species:	Blue Waxbill (*Uraeginthus angolensis*), Rattling Cisticola (*Cisticola cheniana*), Dark-capped Bulbul (*Pycnonotus tricolor*), Jameson's Firefinch (*Lagonosticta rhodopareia*), White-browed Scrub-robin (*Cercotrichas leucophrys*), Chinspot Batis (*Batis molitor*), Long-billed Crombec (*Sylvietta rufescens*).
Indicator species:	Neddicky (*Cisticola fulvicapilla*), White-browed Sparrow-weaver (*Plocepasser mahali*), Arrow-marked Babbler (*Turdoides jardineii* - high abundance values), Fork-tailed Drongo (*Dicrurus adsimilis*- high abundance values), Yellow-breasted Apalis (*Apalis flavida*), Cape Starling (*Lamprotornis nitens*), Brown-crowned Tchagra (*Tchagra australis* - high abundance values), Yellow-throated Bush Sparrow (*Gymnoris superciliaris*).

4. Short and deteriorated open woodland

Dominant species:	Blue Waxbill (*Uraeginthus angolensis*), Dark-capped Bulbul (*Pycnonotus tricolor*), Jameson's Firefinch (*Lagonosticta rhodopareia*), Long-billed Crombec (*Sylvietta rufescens*), Rattling Cisticola (*Cisticola cheniana*), Black-chested Prinia (*Prinia flavicans*), Red-billed Firefinch (*Lagonosticta senegala*), Red-faced Mousebird (*Urocolius indicus*).
Indicator species:	Red-billed Firefinch (*Lagonosticta senegala*), Desert Cisticola (*Cisticola aridulus*), Violet-eared Waxbill (*Granatina granatina*), Little Bee-eater (*Merops pusillus*).

The compositions, particularly the discriminant species, are important considerations as these compositions (and their relative abundance values) represent compositions that will require monitoring during the pre-construction, post-construction and the rehabilitation phase. These taxa are considered as benchmark "indicator" taxa to be used during monitoring protocols.

The highest number of bird species and bird individuals were recorded from the variable open woodland, followed by the short and deteriorated open woodland (refer Table 32). The lowest number of species and number of individuals were recorded from the tall closed riparian thickets. The high number of species on the variable open woodland is best explained by the widespread spatial distribution of this habitat (high surface area), while the riparian thickets provide habitat for habitat specialist species (e.g. shade-tolerant taxa) that are inherently uncommon in the area. However, the latter is an important composition since it is restricted to tall, closed woodland that are spatially limited. In addition, the Shannon-Wiener index (diversity index) for the short deteriorated woodland is lower when compared to the other woodland types, suggesting that persistent disturbances has resulted in a low evenness among bird species. This explains the high prominence of generalist taxa (mainly granivores) that has colonised this habitat type, irrespective of its species richness.

Table 32: Summary of the number of bird species, number of bird individuals and Shannon- Wiener Diversity Index for four discrete "bird associations" on the study site

Bird Association	Number of species	Number of individuals	Shannon-Wiener Diversity Index ('Hlog$_e$)
Tall closed riparian thickets	18	24.3	2.68
Dense woodland in close proximity to large drainage lines	19	21.0	2.69
Variable open woodland	38	21.6	3.24
Short and deteriorated open woodland	20	14.0	2.53

31.5.6 AVIAN RICHNESS AND ABUNDANCE

It is possible to predict where the highest rate of displacement of birds will occur by mapping of the spatial distribution of the number of species and the average abundance values obtained at each point count. According to Figure 37 and Figure 38, the displacement of birds will be most intensive on Site 2 and Site 5 (and in part also Site 3) since these sites contain the highest number of species and bird numbers. Most of these areas correspond to intact closed canopy riparian woodland and semi-transformed variable open woodland. These habitat types promote vertical heterogeneity and bird richness by providing habitat for passerine bird species which are absent from the surrounding deteriorated habitat types. In addition, surface water is a scarce commodity on the study area, and the only reliable source of surface water for granivore species along the Steelpoort River.

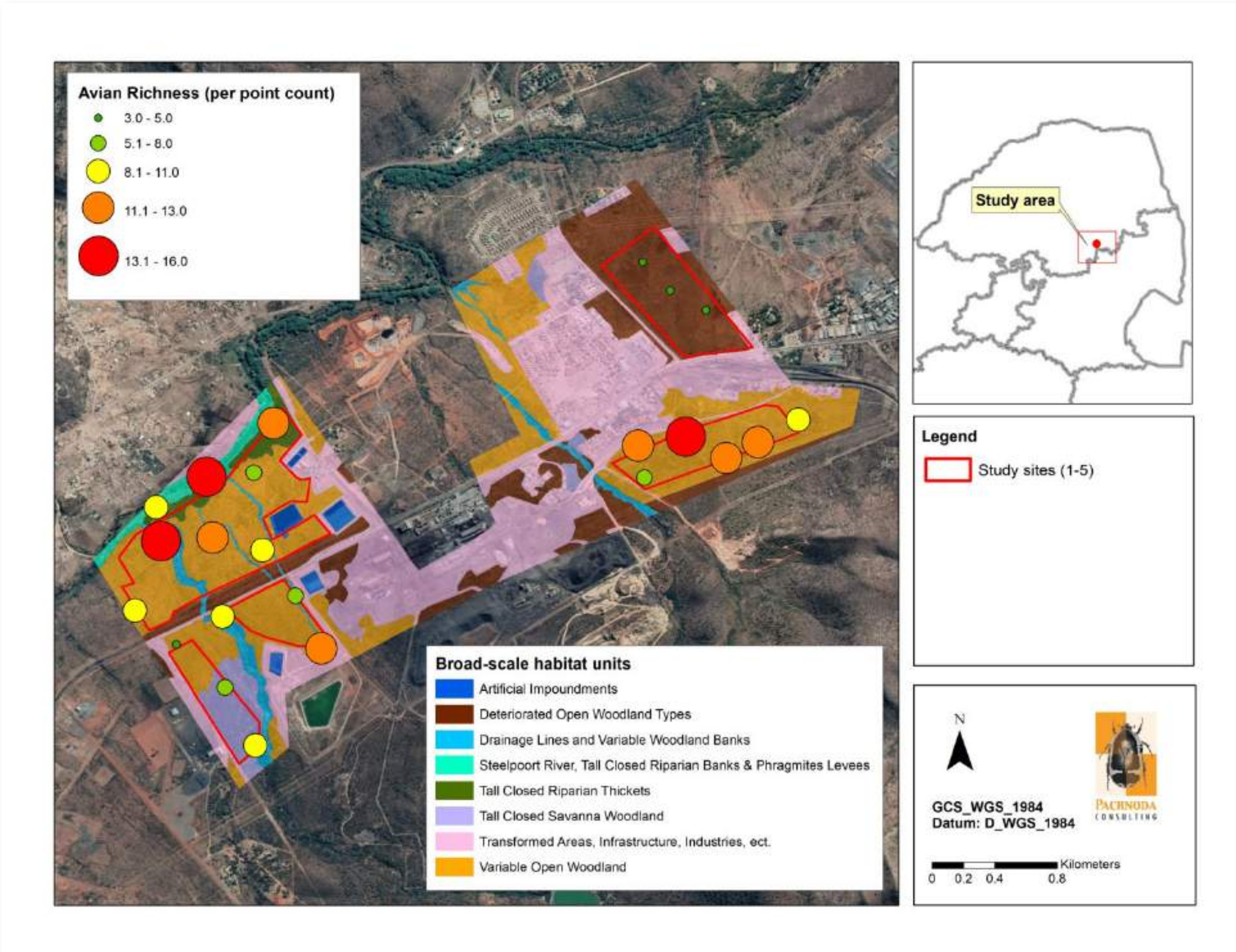


Figure 37: A map of the study area illustrating the spatial distribution of the avian richness values (number of species) obtained for each point count

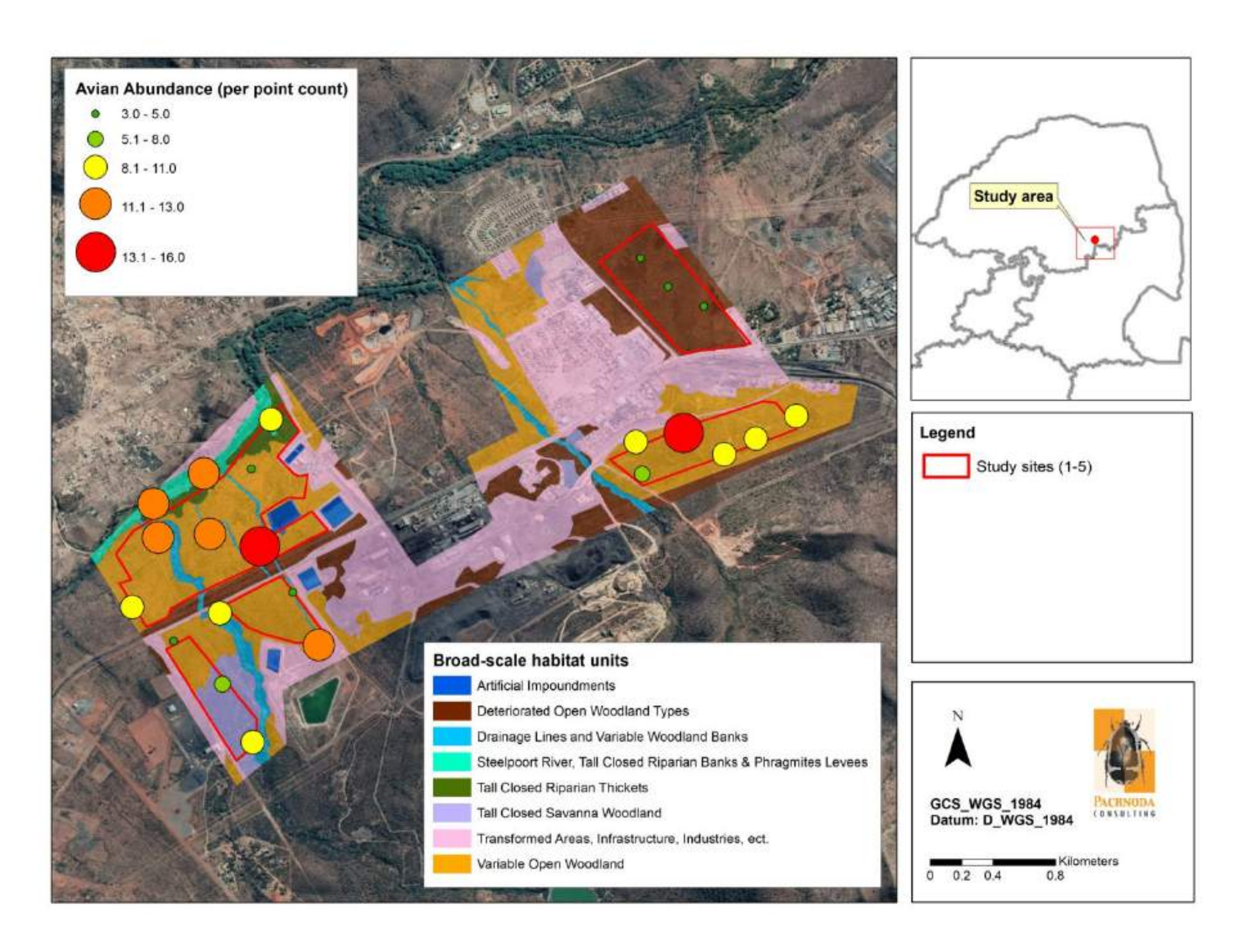


Figure 38: A map of the study area illustrating the spatial distribution of the avian abundance values (number of species) obtained for each point count

31.6 Faunal Importance (Ecological Sensitivity)

The faunal importance of the study sites was based on the inherent biodiversity value and ecological function of the respective habitat units corresponding to each site. Major emphasis was placed on the following functional aspects during the sensitivity grading process:

⇒ *Presence of habitat of high vertical heterogeneity*: Area with intact variable or riparian woodland tend have taller tree canopies. Habitat containing taller canopy structure will provide a higher niche space for bird and arboreal animal species through an ecological process of niche packing. Therefore, it allows species with similar guilds (e.g. insectivorous foliage gleaners in birds) to co-occur without too much inter-specific competition for recourses. The result is that more species could occur in habitat with high vertical heterogeneity.

⇒ *Presence of specialised habitat*: The presence of wetland, riparian or aquatic habitat (including functional manmade impoundments) provide habitat for stenotropic animals species with high affinities to either moist conditions or inundated habitat. Many of these habitat units are either spatially limited (azonal) and hence uncommon in the region. Typical species include facultative wetland taxa, such as shorebirds and waterbirds, which will collectively contribute towards the overall species diversity in the area.

⇒ *Ecological connectivity*: Intact habitat that are located along drainage lines and rivers (Steelpoort River), will promote animal dispersal, thereby allow for more species to utilise the habitat units at a particular site.

The faunal importance of each proposed site is illustrated in Figure 39.

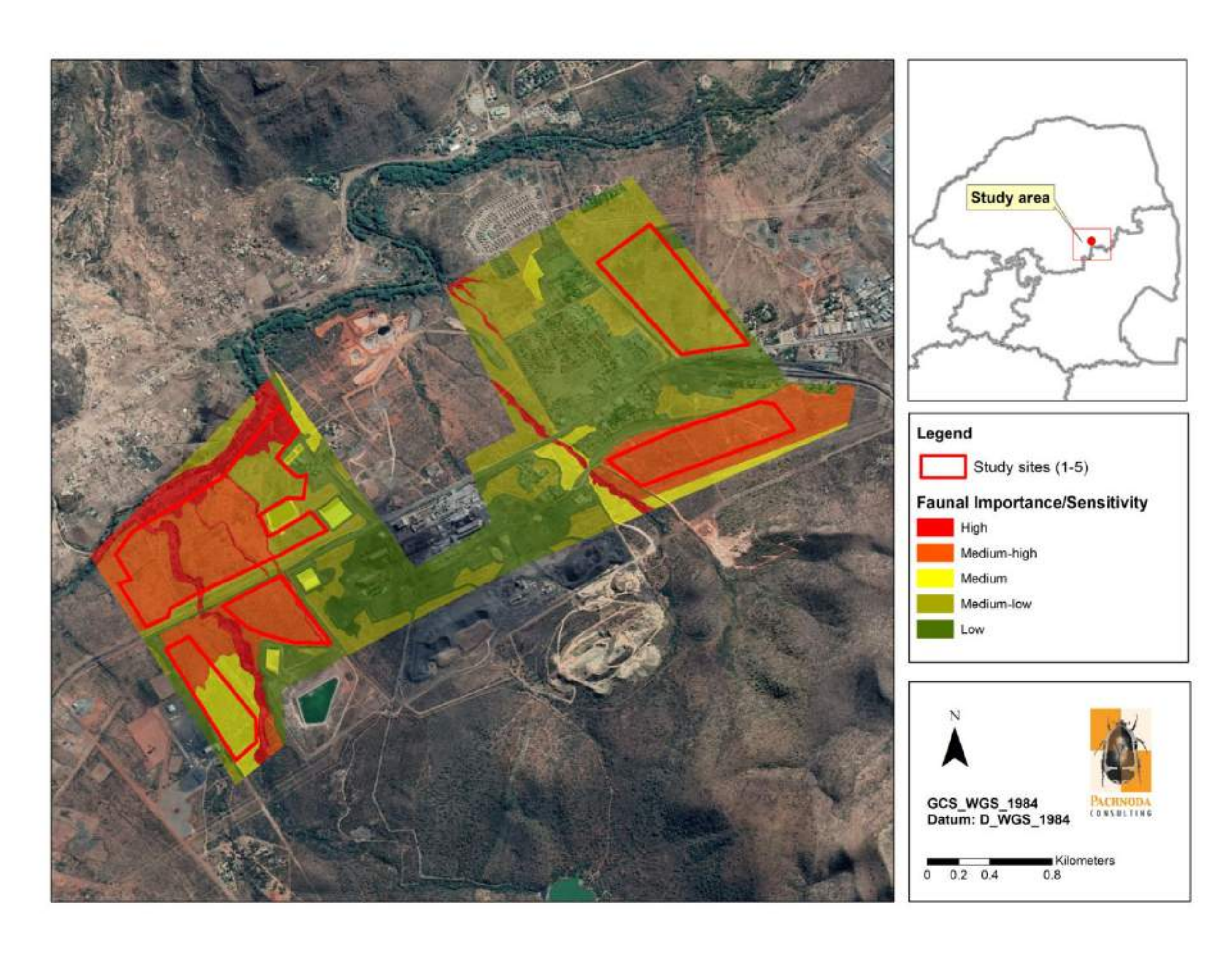


Figure 39: Faunal importance and function (ecological sensitivity) based on the occurrence of terrestrial fauna on the "Eastern Area"

32 ANTICIPATED IMPACTS ON THE FAUNAL ENVIRONMENT

32.1 POTENTIAL ISSUES

⇒ Direct and permanent loss of natural fauna habitat (especially habitat with a high or moderate-high faunal importance) located within the development footprint during the construction, operational and also the decommissioning phases. The decommissioning or closure phase will entail rehabilitation of affected/ lost habitat.

⇒ Indirect losses of animal taxa, especially threatened and near threatened bird and mammal species due to the displacement from the area during the construction and operational phases.

⇒ Indirect ecological impacts during all phases pertaining to the loss of the ecological connectivity and faunal dispersal corridors.

⇒ Secondary impacts related to infrastructure attracting animals (nesting and roosting on structures, foraging underneath panels, bird pollution).

⇒ Subsequent habitat changes and changes to the local fauna community structure and composition (mainly generalists and secondary species).

⇒ Indirect impacts related to anthropogenic encroachment (job-seeking people).

No positive ecological impacts are associated with this project.

32.1.1 DIRECT FAUNAL IMPACTS

The proposed solar facilities will coincide with areas ranging from high to moderate-low sensitivities. In general, the construction of the proposed solar facilities will result in a loss of natural woodland, while also occupying sections comprising of natural drainage lines (e.g. Site 5). The subsequent loss of habitat will displace animal species from the footprint site, especially large bodied species that requires large home ranges. These species occur naturally at low densities, and many are also threatened or near-threatened.

The study area is likely to host a diversity of venomous snakes (e.g. Puff Adder *Bitis arietans*, Black Mamba *Dendroaspis polylepis* & Mozambique Spitting Cobra *Naja mossambica*), as well as charismatic species (e.g. South African Python *Python natalensis*). Workers and personnel could potentially kill snakes when these are encountered.

32.1.2 INDIRECT FAUNAL IMPACTS

It is inevitable that disturbances during the construction, operation and maintenance phase will occur. These will especially be significant near or in close proximity to animal breeding or roosting sites, or where threatened animal species are likely to be present (e.g. Mountain Reedbuck at Site 2). Although it is not anticipated to pose a significant impact, special care should be exercised to avoid riparian thickets along the Steelpoort River and the drainage lines on the respective sites, including habitat units earmarked with high sensitivities. Disturbances during the construction phase are generally of high ambient noise levels when larger terrestrial species will temporarily vacate the area. Operational and maintenance impacts are less intrusive and mainly due to human activities where the disturbance will occur at the level of the individual.

The drainage lines and the riparian thicket along the Steelpoort River are identified as important movement corridors for mammal and bird taxa to gain access to foraging habitat (e.g. various woodland units in the area, as well as the Steelpoort River as a source of water) and roosting sites. It is also instrumental in gene cohesion between different populations of the same species and to facilitate dispersal of emigrating individuals. Any disruption or loss of drainage lines and riparian thicket could lead to increased intra- and inter-specific competition for recourses. Similarly, those species with superior competitive abilities (mainly unspecialized species with widespread distributions, e.g. the Pied Crow *Corvus albus*) could potentially displace specialist taxa leading to taxonomic impoverishment (e.g. over-dominance of certain species).

Badly planned access roads crossing drainage lines could also result in high mortalities when less mobile life forms (e.g. reptiles, frogs, and small mammals) are dispersing. Therefore, fragmentation of the riparian thickets and drainage lines will result in the "creation" of dispersal barriers between sub-populations of animals on the proposed sites and with sub-population that occur on natural habitat units adjacent to the sites. It is also expected that the faunal species composition will shift, due to an anticipated loss in habitat and the creation of "new" habitat underneath the solar panels (due to the shade-effect caused by the panels). In addition, it is predicted that more generalist species (and a loss of functional guilds) will dominate the proposed facilities during operation and during rehabilitation.

Construction activities go hand in hand with high ambient noise levels and the eventual loss of habitat (as discussed above). Many of the larger terrestrial mammal and bird species will vacate the study sites during the construction and operational phases. Many of the smaller taxa are sedentary, and their response to disturbances is to seek refuge rather than to flee. Therefore, some invertebrate, frog and reptile taxa, in particular fossorial species are concealed within a refuge habitat and are in immediate threat of being killed during the construction phase.

It is likely that the animal species composition will shift on areas that are cleared of vegetation due to an anticipated loss in habitat. In addition, it is predicted that more generalist species will dominate the study sites. As mentioned above, it is believed that the densities of certain opportunistic species (mainly bird and rodent species) could increase in the area. These taxa could easily out-compete other less resilient taxa in the area.

Areas cleared of vegetation provide the ideal breeding and roosting habitat for pioneer or introduced mammalian taxa. These areas and the infrastructure provide the ideal nucleus for the proliferation of invader species such as *Mus musculus, Rattus* sp. and even domestic dogs and cats. In addition, these species compete with the indigenous fauna for resources, or they could even prey on the indigenous taxa. Although many of these species are only able to survive in close association with humans, some are known to take up residence in the field.

The construction of the proposed solar facilities will provide a means of “job-creation” for the local community as well as people from abroad. Unfortunately, such an activity will impact negatively on the surrounding habitat types by facilitating “urban-sprawl” and consequential plundering of natural resources (e.g. fire-wood collection, snaring and poaching). Human environments are “magnets” for alien and invader taxa which include feral dogs and cats (see discussions above). The domestic cats are specifically a problem since they will hybridise with the African Wild Cat (*Felis sylvestris*) resulting in genetic contamination of the natural population.

32.1.3 Other Secondary Faunal Impacts

It is possible that the proposed infrastructure could attract different opportunistic animal taxa for reasons such as nesting space, foraging habitat and roosting sites. The panels itself, especially the area underneath the panels are often used as roosting or nesting space, with burrowing species likely to occupy areas of bare soil underneath the panels. Nesting on the solar infrastructures could affect the performance of the infrastructure. On the other hand, roosting could lead to excessive accumulation of faeces on surfaces of the panels.

The “shade-out” effect (as mentioned before) caused by the panels could prevent the successful natural regeneration of vegetation. It is believed that a species-poor, albeit pioneer community will establish underneath the structures. This in turn could attract opportunistic and invader taxa (e.g. *Mastomys* sp, *Rattus* sp. and *Mus musculus*) and domestic animals (e.g. domestic cats *Felis catus*) to the area. Increased rodent populations will attract rodent hunters, with the possibility of abnormal influxes of mammals pertaining to the genera *Canis*.

32.2 Quantification of Impacts

Impacts are collectively quantified for each of the respective areas, as per Table 29.

Direct and Indirect Impacts		
Nature	Impact 1: Direct and permanent loss of natural fauna habitat within the development footprints during the construction, operational and decommissioning phases	
	Before Mitigation	After Mitigation
Intensity	12	8
Extent	2	1
Duration	5	4
Probability	1	0.75
Significance	19.0	9.75
Nature	Impact 2: Indirect losses of animal taxa, especially threatened and near threatened animal species due to the displacement from the area during the construction and operational phases	
	Before Mitigation	After Mitigation
Intensity	12	8
Extent	2	2
Duration	3	3
Probability	1	0.5
Significance	17.0	6.5
Nature	Impact 3: Indirect ecological impacts during all phases pertaining to the loss of the ecological connectivity and faunal dispersal corridors	
	Before Mitigation	After Mitigation
Intensity	16	12
Extent	3	2
Duration	4	3
Probability	0.75	0.5
Significance	17.25	8.5
Nature	Impact 4: Secondary impacts related to infrastructure attracting animals (nesting and roosting on structures, foraging underneath panels, bird pollution)	
	Before Mitigation	After Mitigation
Intensity	12	8
Extent	2	2
Duration	4	4
Probability	0.75	0.5
Significance	13.5	7.0
Nature	Impact 5: Subsequent habitat changes and changes to the local fauna community structure and composition (mainly generalists and secondary species)	
	Before Mitigation	After Mitigation
Intensity	12	8
Extent	3	3
Duration	4	3
Probability	0.75	0.5
Significance	14.25	7.0
Nature	Impact 6: Indirect impacts related to anthropogenic encroachment (job-seeking people, increased plundering of natural resources and poaching of wildlife due to increased human encroachment)	
	Before Mitigation	After Mitigation
Intensity	12	12
Extent	2	2
Duration	4	4
Probability	0.5	0.5
Significance	9.0	9.0
Cumulative Impacts		
Nature	Impact 7: Cumulative impacts on local/ regional and national conservation targets and obligations (e.g. loss of natural habitat) and expansion of developments in the wider study area	
	Before Mitigation	After Mitigation
Intensity	12	12
Extent	3	3
Duration	5	5
Probability	0.75	0.5
Significance	15.0	10.0

Table 33: Summary of impact significance on the faunal receiving environment

Nature	*Before Mitigation*	*After Mitigation*
Impact 1: Direct and permanent loss of natural fauna habitat within the development footprints during the construction, operational the decommissioning phases	19.0	9.75
Impact 2: Indirect losses of animal taxa, especially threatened and near threatened animal species due to the displacement from the area during the construction and operational phases	17.0	6.5
Impact 3: Indirect ecological impacts during all phases pertaining to the loss of the ecological connectivity and faunal dispersal corridors	17.25	8.5
Impact 4: Secondary impacts related to infrastructure attracting animals (nesting and roosting on structures, foraging underneath panels, bird pollution)	13.5	7.0
Impact 5: Subsequent habitat changes and changes to the local fauna community structure and composition (mainly generalists and secondary species)	14.25	7.0
Impact 6: Indirect impacts related to anthropogenic encroachment (job-seeking people, increased plundering of natural resources and poaching of wildlife due to increased human encroachment)	9.0	9.0
Impact 7: Cumulative impacts on local/ regional and national conservation targets and obligations (e.g. loss of natural habitat) and expansion of developments in the wider study area	15.0	10.0

32.3 FAUNAL CONCLUDING STATEMENT AND PROFESSIONAL OPINION

As per Appendix 6 of the Environmental Impact Regulations of 2014 (No. R. 982) of the National Environmental Management Act (Act No. 107 of 1998), the specialist shall provide a reasoned opinion as to whether the proposed activity should be authorised.

This report concludes that the general faunal assemblages on the study area were mainly represented by widespread taxa that show large distribution ranges across the Savanna Biome. Charismatic and threatened animal taxa were in general uncommon on the respective sites, apart from the regular occurrences of the vulnerable Lanner Falcon (*Falco biarmicus*) at Site 5 and site 3, and the occurrence of an overlooked sub-population of the endangered Southern Mountain Reedbuck (*Redunca f. fulvorufula*) near Site 2. However, the preservation of habitat with a high ecological connectivity, for example all drainage lines and the riparian thicket corridor along the Steelpoort River is regarded as a high priority in order to maintain and facilitate extant animal dispersal corridors across the study area. Nevertheless, most of the project sites are located and surrounded by industrial infrastructure and areas where human activities are relatively of high frequency, which collectively contributed over time to the formation of short open deteriorated woodland habitat or habitat that are fragmented, thereby containing unspecialised and generalist taxa.

It is predicted that the impacts on the faunal component of the study area were likely to be of medium significance (prior to mitigation) at most of the proposed project sites, although the loss of habitat and dispersal corridors (e.g. site 5) is regarded to be of high significance (prior to mitigation). The implementation of the suggested mitigation approach is expected to result in the amelioration of the anticipated impacts to an acceptable level, with priority given to the natural dispersal of animals between and among habitat units in the wider study area. Therefore, no specific objections to the project is raised, but with the understanding that the suggested mitigation protocol is timeous and comprehensively implemented.

SECTION G: RECOMMENDED MITIGATION APPROACH

33 MITIGATION HIERARCHY BACKGROUND

Mitigation aims to eliminate or reduce negative biodiversity impacts. Mitigation options should generally be considered in the following order of preference:

1. Avoidance of impacts altogether;
2. Reduction of impacts where unavoidable;
3. Restoration of habitats to their original state;
4. Relocation of affected species or habitats; or
5. Compensation for any residual, unavoidable damage.

The mitigation of negative impacts on biodiversity and ecosystem services is a legal requirement for authorisation purposes and must take on different forms, depending on the significance of the impact and the area being affected. Mitigation requires proactive planning that is enabled by following the mitigation hierarchy, illustrated in Figure 66. Its application, is intended to strive to first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining significant residual negative impacts on biodiversity, where:

Avoiding or preventing impacts – refers to considering options in project location, siting, scale, layout, technology and phasing to avoid impacts on biodiversity, associated ecosystem services, and people. This is the best option but is not always possible if development/ construction is to take place. However, there are areas where the environmental and social constraints are too high, and development should not take place. Such areas are best identified early in the development life cycle, so that impacts can be avoided, and authorisations refused. In the case of areas where environmental constraints might be limiting, this includes some ecosystems, habitats, ecological corridors, or areas that provide essential ecosystem services and are of such significant conservation value or importance that their loss cannot be compensated for (i.e. there is no substitute). In such areas, it is unlikely to be possible or appropriate to rely on the latter steps in the mitigation hierarchy (e.g. rehabilitating or offsetting impacts) to provide effective remedy for impacts on biodiversity or ecosystem services. Information about the location of many such areas is available, often making it possible to avoid them.

Reduction of impacts where unavoidable – refers to considering alternatives in the project location, siting, scale, layout, technology, and phasing that would minimise impacts on biodiversity and ecosystem services. Even in areas where the environmental and social constraints are not particularly high for development to proceed/take place every effort should still be made to minimise impacts.

Restoration of habitats to their original state – refers to the rehabilitation of areas where impacts were unavoidable, and measures are taken to return impacted areas to a condition ecologically similar to their 'pre-development natural state' or an agreed land use after closure. Although rehabilitation is important and necessary, unfortunately even with significant resources and effort, rehabilitation is a limited process that usually falls short of replicating the diversity and complexity of a natural system. Instead, rehabilitation helps to restore some resemblance of ecological functioning in an impacted landscape, to avoid on-going negative impacts, and/or to provide some sort of aesthetic fix for a landscape. Rehabilitation should occur concurrently or progressively with the proposed activity, and/or on cessation of the activity.

Relocation of affected species or habitat – refers to the physical translocation of affected individuals within the footprint, or adjacent areas, where unavoidable and devastating effects are likely to occur. The translocation of individuals is generally subject to permitting requirements and should be based on a like-for like habitat, taking cognisance of potential impacts such as genetic populations, geographic isolation, etc. The relocation of habitat is generally in severely selective events where small, isolated, and biologically significant habitat can be realistically relocated and reproduced outside the affected footprint. This approach can also be augmented by propagation of certain species.

Offset impacts/ Compensation for any residual, unavoidable damage –refers to compensating for remaining and unavoidable negative effects on biodiversity. When every effort has been made to minimise and then rehabilitate remaining impacts to a degree of no net loss of biodiversity against biodiversity targets, biodiversity offsets can provide a mechanism to compensate for significant residual negative impacts on biodiversity.

The mitigation hierarchy is inherently proactive, requiring the on-going and iterative consideration of alternatives of project location, footprint siting, scale, layout, technology and phasing until the proposed development best 'suits' and can be accommodated without significant negative impacts in the receiving environment. In cases where the receiving environment cannot support the development (e.g. there is insufficient water) or where the project will eradicate unique biodiversity, the development may not be feasible; the earlier the developing company knows of these risks, and can plan to avoid them, the better. In cases where biodiversity impacts are likely to be severe, the guiding principle should therefore be to "anticipate and prevent" rather than "assess and repair".

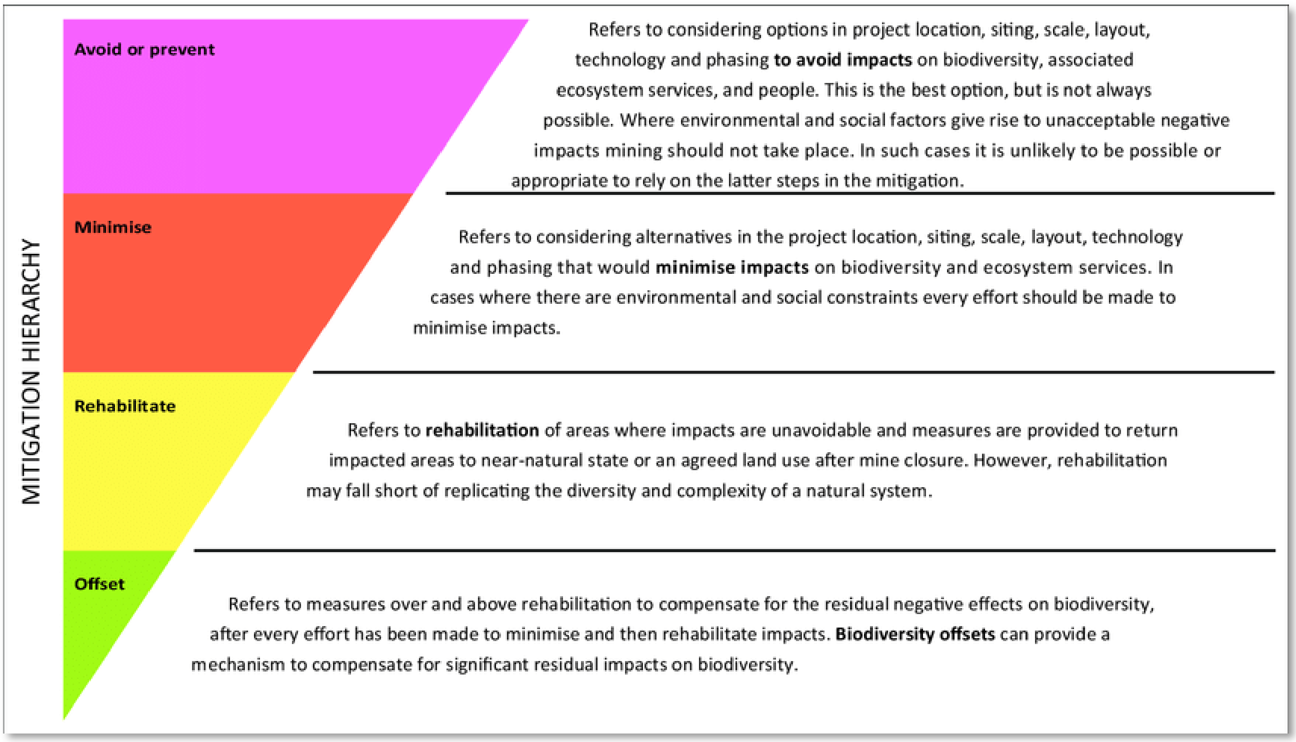


Figure 40: Mitigation hierarchy for dealing with negative impacts on biodiversity

The mitigation approach should be contained and elaborated in the Environmental Management Plan for the activity, notably for the construction phase, and should be regarded as a 'Living Document' that will be amended and updated as new information becomes available. The project should consider minimal disturbance and hazards to the surrounding natural environment. The proposed list of mitigation measures are not considered exhaustive and should be updated where additional or unprecedented impacts are noted during construction and operational phases, i.e. the document should be perceived as a 'living' document that addresses impacts, threats, and issues as it becomes evident.

34 APPLICATION OF THE MITIGATION HIERARCHY

To present the effect of impacts on sensitive areas as well as the need for mitigation strategies, the spatial location of development infrastructure in relation to ecological sensitivity is considered. The proposed sites exhibit a highly variable floristic nature (with moderate to moderate-high floristic sensitivities) and a range of impacts is anticipated, varying between minimal and potentially significant.

34.1 THE "NO-GO" OPTION

The 'No-Go' option is not regarded an appropriate recommendation for this development, based on the following:

1. The proposed development sites comprise comparatively small footprints of natural and deteriorated woodland habitat types within an environment that already exhibits moderate to significant levels of transformation.
2. The regional importance of broad-scale habitat types are expressed as Vulnerable, but exhibit varying levels of deterioration; ultimately extremely little of the proposed sites provides a high correlation to pristine and natural woodland types.
3. Natural habitat on the site does not exhibit any aspect of uniquely high floristic diversity or sensitivity and was mostly found to be in a moderately deteriorated condition with only selected parts representing woodland habitat of a pristine status.
4. Despite the presence of some protected tree species and plants of conservation importance (notably *Adenia fruticosa*, Near Threatened) anticipated losses are not anticipated to trigger an exacerbation in the conservation status of any of these species. The application of a search and rescue operation for selected species is anticipated to ameliorate this impact acceptably.
5. No plant individual, or population, of a threatened conservation status is anticipated to be affected by the proposed development.
6. The implementation of a dedicated mitigation approach is anticipated to ameliorate expected and likely impacts to an acceptable level.

As such, considering the status of the receiving environment and the anticipated significance of impacts on ecological attributes, the No Go alternative is not considered a requirement for this project. The dedicated application of a suitable mitigation approach is considered sufficient to ameliorate likely and anticipated impacts to an acceptable level.

34.2 OFFSET RECOMMENDATIONS

Biodiversity Offset recommendations will be presented should the provincial authority (LEDET) deem this necessary upon review of this report.

34.3 REHABILITATION APPROACH

The near-permanent nature of the proposed development (>20 years), and also considering continued expansion of mining activities and infrastructure within the existing perimeter, implies that it is extremely unlikely that the development will be decommissioned within the immediate future. Addressing unforeseen impacts that result from the development in adjacent natural habitat should be attended immediately and dealt with on a case-by-case basis. The implementation of a generic mitigation approach, which should be based on results and recommendations from a dedicated environmental monitoring programme is expected to be successful in preventing any undue impacts in the surrounding natural environment.

34.4 EXCLUSION AND AVOIDANCE OF HIGH SENSITIVITY AREAS

Anticipated losses, from a numerical perspective, is marginal and effects are unlikely to trigger the exacerbation of existing conservation levels. The proposed development plan represents an iteration of development considerations that took into consideration previous comments and recommendations pertaining to sensitive areas and successful avoidance of potentially sensitive areas have been achieved.

34.5 MINIMIZATION OF IMPACTS

The recommended mitigation approach aims to minimize impacts caused by the development activity within the natural environment. The nature of the development dictates that natural habitat will be entirely compromised during land clearance activities (construction), and the resultant sterile environment will represent the status quo for the development footprint for a considerable time in future. The minimization approach will therefore have the objective to limit adverse effects of the development on the surrounding ecological receiving environment and address impacts outside the development footprint caused by the development on a case-by-case basis.

34.6 AVOIDANCE OR PREVENTION

The nature of the development and characteristics of natural attributes within the development footprint allows for limited avoidance and prevention strategies. Loss of individual protected plants should be avoided by means of a relocation strategy (for certain species), while relocation of certain plants are recommended.

Avoidance and prevention strategies will mostly be aimed at limiting the uncontrolled spread of impacts caused by the proposed activity into nearby/ adjacent natural habitat, notably for declared alien and invasive plant species.

34.7 LAYOUT REDESIGN (LOCATION ALTERNATIVES)

A number of capacity and layout iterations were considered for this project and were subsequently considered in term of the anticipated impacts on the terrestrial biodiversity environment.

34.8 PERMITTING REQUIREMENTS & SEARCH AND RESCUE OPERATIONS

⇒ The removal and damage of any protected and conservation important plant species on the site requires compliance in terms of national and provincial legislation. In particular, the National Forest Act (1998) and Limpopo Environmental Management Act (Act No 7 of 2003, including Schedule 11 (Specially protected plants) and Schedule 12 (Protected plants)), require that permits be obtained prior to the removal, damage, or destruction of certain plant species.

⇒ Timelines involving permit applications need to be considered, taking cognisance of the required time of the completion, submission, and approval of permit applications by relevant authorities. It is emphasised that no activity may commence that will adversely affect protected plant species, prior to the approval of all permitting requirements. The permitting process is also dependent on the Environmental Authorisation for the project as a whole and is included as an authorisation condition.

⇒ A suitable Search and Rescue operation needs to be executed prior to commencement of site clearance activities.

Details pertaining the abundance, location, and diversity of plant taxa of conservation concern will be collated through a site-specific walkdown of the respective sites. Results from this particular assessment indicates the presence of protected plant species, as follows:

Name	Status
Adenia fruticosa subsp. *fruticosa*	Near Threatened (IUCN), Protected Plant, Schedule 11
Aloe burgersfortensis	Least Concern (IUCN), Protected Plant Schedule 12 (Limpopo Environmental Management Act 7 of 2003)
Balanites maughamii	Least Concern (IUCN), Protected Tree (National Forest Act, 1998)
Boscia albitrunca	Least Concern (IUCN), Protected Tree (National Forest Act, 1998)
Elephantorrhiza praetermissa	Least Concern (IUCN), Protected Plant Schedule 12 (Limpopo Environmental Management Act 7 of 2003)

Eulophia petersii	Least Concern (IUCN), Protected Plant. Protected Plant Schedule 12 (Limpopo Environmental Management Act 7 of 2003)
Sclerocarya birrea subsp. *caffra*	Least Concern (IUCN), Protected Tree (National Forest Act, 1998)
Stapelia gettliffei	Least Concern (IUCN). Protected Plant Schedule 12 (Limpopo Environmental Management Act 7 of 2003)
Stapelia gigantea	Least Concern (IUCN), Protected Plant, Schedule 12 (Limpopo Environmental Management Act 7 of 2003)

34.9 Botanical Mitigation Recommendations

⇒ Appoint the responsible officer (Environmental Officer, EO) prior to commencement of land clearance activities. Responsibilities should include, but not necessarily be limited to, ensuring adherence to the authorisation conditions, guidance of activities, planning and reporting. The appointment of an Environmental Officer for the project should consider a suitable knowledge of biological and biodiversity aspects of the site, surrounds, and the general region. The Environmental Officer should also establish communication with a suitable ecologist as soon as possible to communicate relevant project details and direct any questions in cases of uncertainties.

⇒ EO should delegate and oversee the final walkdown to identify and geolocate protected plant species for permitting purposes.

⇒ Apply for and secure all relevant permits from DFFE and LEDET for protected plant species that occur on the site prior to any activity being undertaken. No protected plant species may be affected, removed, excavated, relocated, or impacted in any manner, except under a valid permit granted by the relevant authority and under the supervision of the appointed EO.

⇒ Develop and execute a Search and Rescue operation for certain plants/ trees as per recommendations from the Final Walkdown Report. These plants should be relocated to a secure, suitable, and appropriate location, taking care to duplicate existing habitat conditions as far as possible. It should be noted that the transportation and relocation process of protected plant species is also subject to permitting requirements; this process should be guided by the EO and executed by a suitable horticultural specialist.

⇒ Develop and implement a biodiversity monitoring programme to establish long-term trends of floristic and faunal diversity patterns and the latent and immediate effects of mining on these receiving environments.

⇒ An Alien and Invasive Plant Management Programme should be developed and implemented with the onset of the construction phase. The aim of this programme should include (*inter alia*) the identification, control, and eradication of invasive plants from the site and immediate surrounds through a responsible, yet effective, management strategy that might involve a combination of physical removal methods and application of chemical treatments. The Environmental Officer shall compile relevant action plans to deal with the presence of alien and invasive species.

⇒ Provide consideration for the sensitive drainage lines and rivers in spatial proximity to the proposed development footprints. No effluent of a damaging nature should be released, or permitted to enter, natural drainage lines or rivers.

⇒ Stormwater management should aim to ameliorate destructive erosion events that will result in further deterioration of the drainage channels.

⇒ Erosion control should be prioritized, notably during the planning phase where slopes, runoff from paved and tarmac areas and stormwater control measures need to be highlighted and planned to prevent erosion of surrounding natural areas.

⇒ All development areas shall be demarcated, and no personnel or construction vehicle shall be allowed to access neighbouring properties for any purpose whatsoever.

⇒ Under no circumstances shall any natural area on neighbouring properties (outside the development site footprints) be impacted, degraded, cleared, or affected in any manner.

⇒ Cleared vegetation and debris that has not been utilised must be collected and disposed through an appropriate manner.

⇒ No painting or marking of rocks or vegetation (trees) to identify locality or other information shall be allowed, as it will disfigure the natural setting. Marking shall be done by steel stakes with tags, if required. All temporary markings will be removed upon completion of the construction.

⇒ Collection of branches, wood (dead or alive), shrubs or any vegetation for fire making purposes is strictly prohibited.

⇒ Prevent all open fires on site.

⇒ The irresponsible use of welding equipment, oxy-acetylene torches, and other naked flames, which could result in veld fires, or constitute a hazard should be guided by safe practice guidelines.

⇒ The burning of general waste material is not to be allowed.

⇒ Provide demarcated fire-safe zones, facilities, and suitable fire control measures.

⇒ Provide temporary and suitable on-site ablution, sanitation, litter and waste management and hazardous materials management facilities until such time that adequate permanent and operational facilities can be provided. Abluting anywhere other than in provided ablutions shall not be permitted. Under no circumstances shall use of the veld for ablution purposes be permitted.

⇒ A periodic (at least annual) clean-up of the surrounding natural environment should be undertaken to remove litter and prevent unwanted deterioration of the surrounding natural environment.

⇒ Site induction for contractors and workers should include a familiarization with all aspects relating to environmental components of the project.

⇒ Ensure the implementation of erosion control measures on the perimeter of the development, aimed at avoiding exacerbation of the existing erosion patterns.

⇒ The use of locally indigenous plant species for landscaping purposes is strongly recommended. Under no circumstances shall exotic and invasive plants be used for landscaping purposes.

⇒ Rehabilitation of areas where construction activities have been finalised, shall be prioritised.

34.10 FAUNAL & AVIFAUNAL MITIGATION RECOMMENDATIONS

34.10.1 LOSS OF HABITAT

⇒ Minimize area cleared for construction activities and erect a temporary fence to contain construction operations. This includes the area used by staff and labour during the construction phase and prevent an "overspill" of construction activities into adjacent habitat that is not part of the project footprint.

⇒ All sites should be fenced with a permeable fence structure to allow the free movement of smaller-bodied animal species.

⇒ Development on habitat with high faunal sensitivity should be avoided (riparian thickets and drainage lines).

⇒ Natural corridors (e.g. riparian thicket and drainage lines) must be retained between the sites to promote and allow for the movement of mobile fauna.

⇒ Rehabilitate as a continual process – this will maximise the viability of the natural seed bank and prevent the unnecessary loss of topsoil during storage.

⇒ The project footprint sites should be "screened" prior to, and during the construction phase for reptile species of conservation concern (especially for *Kinixys lobatsiana*) by a qualified herpetologist/zoologist. This person should also be capable of handling venomous snakes. All species found should be relocated to suitable habitat not more than 50 km from the study sites. In addition, the contractor should contact the ECO or herpetologist/zoologist should any snake (or reptile) species be found on or near the construction/operation site.

⇒ If any faunal species of conservation concern (as indicated in this report) is exposed during the construction phase, the ECO shall be informed, who shall then issue instructions for its capture, translocation and safe release to suitable habitat not more than 50 km from the study sites.

34.10.2 *Displacement and Disturbance to Fauna (Especially Species of Conservation Concern)*

⇒ Minimize the use of earthmoving equipment that results in noise generation, notably during the operational phase.

⇒ Due to the type of development, the type and nature of demarcation should not attempt to facilitate free movement of smaller animals as this could lead to unwanted presence (and accidental killing) of animals within the development site. Typical fencing employed for security purposes around the development is considered adequate.

⇒ The use of electric fences (particularly on ground level) is however discouraged.

⇒ The extent of the construction/operational footprint site should be demarcated on site layout plans (preferably on disturbed areas or those identified with low or medium conservation importance), and no construction personnel or vehicles may leave the demarcated area except those authorised to do so. Those areas surrounding the demarcated footprint sites should be considered as “no-go” areas for employees, machinery or even visitors.

⇒ Minimize exterior lighting and implement operational strategies to reduce "spill light" although with the balance to achieve safety and security of the solar facilities. Outside features should be illuminated by using "down-lighting" rather than "up-lighting” as far as possible. Where possible, outside lighting should apply UV filters to high pressure mercury vapour lamps or fluorescent lights to minimise the attraction of nocturnal invertebrates to the lights.

⇒ All domestic waste generated (if present) should be removed from the study site as soon as possible and be disposed at an authorised landfill to reduce the risk of colonization by feral mammals, scavengers or competitively superior bird species (e.g. Pied Crows *Corvus albus*).

⇒ Personnel and staff should be advised (by means of induction) by means of environmental awareness training on the biodiversity importance of the area. The intentional killing of any faunal species (in particular invertebrates, reptiles and snakes) should be avoided by means of awareness programmes presented to the labour force. The labour force should be made aware of conservation issues pertaining to the taxa occurring on the study site.

34.10.3 *Increased Fragmentation & Loss of Ecological Connectivity*

⇒ Natural corridors (e.g. drainage lines and riparian thicket) must be retained to promote the movement of fauna when a high rate of natural disruption is expected.

⇒ All linear units (drainage lines) must be clearly demarcated. Construction and operation should be located outside these areas.

⇒ Appropriate buffer zones must be implemented to the riparian zone and along drainage features to alleviate the effect of habitat fragmentation and edge effects (please refer to the wetland/aquatic report for advice on appropriate buffer sizes).

⇒ Where possible, existing access roads must be used and should preferably be perforated with road calming devices installed to prevent small-bodied or slow-moving animals from being killed, and to facilitate a safe means of dispersal.

⇒ Newly planned roads (and powerlines) should avoid crossing drainage lines where possible. It is also highly advisable to place new powerlines adjacent to existing powerline servitudes.

⇒ Run-off/stormwater control measures on either side of roads and at the solar facilities must be constructed so that small terrestrial animals can cross them. Ditches/trenches should have slopes of less than 45° rather than vertical sides.

34.10.4 POACHING, PLUNDERING OF NATURAL RESOURCES & INDISCRIMINATE KILLING OF ANIMALS

⇒ All labour or staff should be advised (induction) by means of environmental awareness training on the ecological significance of the area and its conservation importance.

⇒ Intentional killing of any faunal species (in particular invertebrates and snakes) should be avoided by means of awareness programmes presented to the labour force. The labour force should be made aware of the conservation issues pertaining to the taxa occurring on the study site. Any person found deliberately harassing any animal in any way should face disciplinary measures, following the possible dismissal from the site.

34.10.5 SECONDARY IMPACTS RELATED TO THE INFRASTRUCTURE ATTRACTING ANIMALS

⇒ Apply appropriate deterrent devices to prevent birds from nesting on important structures.

⇒ Monitor any nest-building activities and remove/trim nests that are a risk (fire risk or affecting the operations of the solar facilities) with the consent of the local Conservation Department. Trimming should only be conducted during the non-breeding season.

⇒ Apply nest boxes for owls along the perimeter of the facilities to assist with rodent control.

⇒ Apply appropriate space between consecutive PV panels to allow for sunlight to reach the basal vegetation.

⇒ Conduct regular screens to determine the occurrence/density of invader taxa (e.g. invader/alien rats and mice, domestic cats). If detected, a specialist in the field of pest control should be appointed to rectify the problem with the consent of the local Conservation Department.

⇒ No pets should be allowed on the premises, with specific reference to feral cats.

SECTION H: APPENDICES, BIBLIOGRAPHY AND SPECIALIST CV'S

APPENDIX 1: LIST OF PLANT SPECIES RECORDED WITHIN THE STUDY AREAS

Declared AIP species denoted with **
Species indicated in **bold** *denotes species of conservation concern*

Species Name	Family	Growth Form	Status/ Uses	Conservation / Invasive Status	Common Name
Abutilon species	Malvaceae	Herb	--	--	--
Acalypha species	Euphorbiaceae	Dwarf shrub	--	--	--
Achyranthes aspera L. var. *aspera*	Amaranthaceae	Herb	Naturalised exotic	Naturalised exotic. Not Evaluated	Burrweed (e), Grootklitsbossie (a)
Adenia fruticosa* Burtt Davy subsp. *fruticosa	Passifloraceae	Small tree	Poisonous fruit, edible leaves	Near Threatened (IUCN), Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	Sekhukhune Green-stem (e), Sekoekoenie-bobbejaangif (a)
Agave americana L. subsp. americana var. *americana**	Agavaceae	Succulent	Originally from Mexico. Sap is a potential irritant. Medicinal uses	Declared Invader - NEMBA (Category 2). CARA (Category 2). Not listed for Lesotho	American agave (e), Blougaringboom (a), Lekhala (s)
***Aloe burgersfortensis* Reynolds**	Asphodelaceae	Succulent	None	Least Concern (IUCN), Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	Burgersfort Aloe (e), Burgersfortaalwyn
***Aloe castanea* Schönland**	Asphodelaceae	Succulent	Harvested for ornamental purposes	Least Concern (IUCN), Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	Cat's-tail Aloe (e), Katstertaalwyn (a)
***Aloe* cf. *ammophila* Reynolds**	Asphodelaceae	Succulent	None	Least Concern (IUCN). Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	--
***Aloe globuligemma* Pole-Evans**	Asphodelaceae	Succulent	None	Least Concern (IUCN), Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	Knoppiesaalwyn (a)
Aloe marlothii* A.Berger subsp. *marlothii	Asphodelaceae	Succulent	Ornamental, heavily harvested	Least Concern (IUCN), Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	Mountain Aloe (e), Bergaalwyn (a)
***Aloe* species**	Asphodelaceae	Succulent	--	Least Concern (IUCN), Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	Aloe (e), Aalwyn (a)
Argemone ochroleuca Sweet subsp. *ochroleuca**	Papaveraceae	Perennial herb	Possible toxicity to animals and humans, medicinal uses, irritant	Declared Invader - NEMBA (Category 1B). CARA (Category 1). GBIF Listed. Listed for Lesotho	White-flowered Mexican poppy (e), Bloudissel (a), Hlaba-hlabane-e-putsoa (s)
Aristida adscensionis L.	Poaceae	Grass	Poor grazing potential, Increaser IIC	Least Concern (IUCN)	Annual Three-awn (e) Eenjarige Steekgras (a)
Aristida bipartita (Nees) Trin. & Rupr.	Poaceae	Grass	Unpalatable, indicator of degraded veld, Increaser IIC	Least Concern (IUCN)	Rolling grass (e), Grootrolgras (a)
Aristida congesta ssp. *barbicollis*	Poaceae	Grass	Poor grazing potential, Increaser IIC	Least Concern (IUCN)	Spreading Three-awn (e), Lossteekgras (a)

Species Name	Family	Growth Form	Status/ Uses	Conservation / Invasive Status	Common Name
Aristida congesta subsp. *congesta*	Poaceae	Grass	Poor grazing potential, indicator of poor habitat, Increaser IIC	Least Concern (IUCN)	Tassel Three-awn (e), Katstertsteekgras (a)
Aristida diffusa Trin. subsp. *burkei* (Stapf) Melderis	Poaceae	Grass	Unpalatable, possible indicator of overgrazing	Least Concern (IUCN)	Iron Grass (e), Ystergras (a)
Aristida rhiniochloa Hochst.	Poaceae	Grass	Poor grazing value, often in disturbed areas, sandy soils	Least Concern (IUCN)	Rough Three-awn (e), Skurwesteekgras (a)
Asparagus species	Asparagaceae	Shrub	--	--	Wild Asparagus (e), Katbos (a)
***Balanites maughamii* Sprague**	**Balanitaceae**	**Tree**	**Potentially poisonous parts for fish, fruits are edible, traditional and medicinal uses**	**Least Concern (IUCN), Protected Tree (National Forest Act, 1998)**	**Greenthorn (e), Groendoring (a)**
Bidens pilosa L.*	Asteraceae	Herb	Edible parts	Naturalised exotic, Not evaluated	Black-jack (e), Knapsekêrel (a)
Blepharis subvolubilis C.B.Clarke	Acanthaceae	Dwarf shrub	None	Least Concern (IUCN)	Eyelash flower (e)
Bolusanthus speciosus (Bolus) Harms	Fabaceae	Small tree	Roots used medicinally, traditional and practical uses	Least Concern (IUCN)	Elephant Wood (e), Tree Wisteria (e), Vanwykshout (a)
***Boscia albitrunca* (Burch.) Gilg & Gilg-Ben.**	**Capparaceae**	**Tree**	**Important fodder, traditional uses, traditional medicinal uses**	**Least Concern (IUCN), Protected Tree (National Forest Act, 1998)**	**Sheperd's Tree (e), Witgat (a), Matoppie (a), Mohlopi (ns)**
Boscia foetida Schinz subsp. *rehmanniana* (Pestal.) Toelken	Capparaceae	Small tree	Medicinal uses, browsing value	Least Concern (IUCN)	Bushveld Shepherd Tree (e), Stinkwitgat (a), Mopipi (ns)
Bothriochloa insculpta (A.Rich.) A.Camus	Poaceae	Grass	None	Least Concern (IUCN)	Pinhole Grass (e), Stippelgras (a)
Bulbostylis burchellii (Ficalho & Hiern) C.B.Clarke	Cyperaceae	Sedge	None	Least Concern (IUCN)	--
Carissa bispinosa (L.) Desf. ex Brenan	Apocynaceae	Shrub	Edible parts, medicinal uses	Least Concern (IUCN)	Forest num-num (e), Bosnoemnoem (a)
Catharanthus roseus (L.) G.Don*	Apocynaceae	Shrub	Traditional medicinal uses, originally from Madagascar	Declared invasive NEMBA Cat 1B	Madagascar periwinkle (e), Begraafplaasblom (a)
Cenchrus ciliaris L.	Poaceae	Grass	Palatable grazing species, Decreaser	Least Concern (IUCN)	Blue Buffalo Grass (e), Bloubuffelgras (a)
Cereus jamacuru (L.) Mill.*	Cactaceae	Succulent	Originally from South America, spines cause injuries, ornamental. Savanna and rocky ridges	Declared Invader - CARA (Category 1). NEMBA (Category 1B). Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998). Listed for Lesotho. GBIF listed	Queen of the night (e), Nagblom (a)
Chascanum species	Verbenaceae	Prostrate herb	--	--	--
Cissus cactiformis Gilg	Vitaceae	Climber	Traditional medicinal uses	Least Concern (IUCN)	Cactus vine (e)
Clematis hirsuta Perr. & Guill. var. *junodii* (Burtt Davy) W.T.Wang	Ranunculaceae	Climber	None	Least Concern (IUCN)	--
Cleome gynandra L.	Capparaceae	Herb	Edible parts	Least Concern (IUCN)	African Cabbage (e), Oorpeultjie (a)
Cleome species	Capparaceae	Herb	--	--	--
Combretum apiculatum Sond. subsp. *apiculatum*	Combretaceae	Tree	Traditional medicinal uses, seeds possibly poisonous but consumed by Brown-headed Parrots, leaves eaten by game, firewood	Least Concern (IUCN)	Red bushwillow (e), Rooibos (a), Mogoeleri (ss)

Species Name	Family	Growth Form	Status/ Uses	Conservation / Invasive Status	Common Name
Combretum erythrophyllum (Burch.) Sond.	Combretaceae	Tree	Medicinal uses, ornamental in urban areas	Least Concern (IUCN)	River bushwillow (e), Vaderlandswilg (a)
Combretum hereroense Schinz	Combretaceae	Small tree	Firewood	Least Concern (IUCN)	Russet bushwillow (e), Kierieklapper (a)
Commelina africana	Commelinaceae	Herb	Medicinal properties	Least Concern (IUCN)	Yellow Wandering Jew (e), Geeleendagsblom (a)
Commelina erecta L.	Commelinaceae	Herb	None	Least Concern (IUCN)	--
Commiphora pyracanthoides Engl.	Burseraceae	Shrub	Edible parts, traditional uses	Least Concern (IUCN)	Common corkwood (e), Gewone kanniedood (a) Iminyela (z)
Croton gratissimus Burch. var. *gratissimus*	Euphorbiaceae	Tree	Medicinal uses, larval food for *Charaxes candiope candiope*	Least Concern (IUCN)	Lavender fever-berry (e), Laventelkoorsbessie (a)
Cucumis zeyheri Sond.	Cucurbitaceae	Prostrate herb	Edible parts	Least Concern (IUCN)	Wild Cucumber (e), Wildekomkommer (a)
Cymbopogon validus (Stapf) Stapf ex Burtt Davy	Poaceae	Grass	Thatching & weaving, low grazing potential	Least Concern (IUCN)	Giant Turpentine Grass (e), Reuse Terpentyngras (a)
Cynanchum viminale (L.) Bassi subsp. *viminale*	Apocynaceae	Climber	Medicinal uses, potentially poisonous	Least Concern (IUCN)	Viny milkweed (e), Melktou (a)
Cynodon dactylon (L.) Pers.	Poaceae	Grass	Indicator of disturbed areas, grazing potential	Least Concern (IUCN)	Common Couch Grass (e), Gewone kweekgras (a)
Cyphostemma species	Vitaceae	Climber	--	--	--
Dactyloctenium giganteum Fisher & Schweick.	Poaceae	Grass	Palatable grazing	Least Concern (IUCN)	Giant Crowfoot (e), Reuse Hoenderspoor (a)
Dalechampia galpinii Pax	Euphorbiaceae	Climber	Traditional medicinal uses	Least Concern (IUCN)	Lowveld Wildhop (e)
Datura stramonium L.*****	Solanaceae	Herb	Originally from Mexico, North America. Seed poisonous to animals and humans, medicinal uses	Declared Invader - CARA (Category 1), NEMBA (Category 1B), Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998). GBIF listed. Listed for Lesotho	Common thorn apple (e), Malpitte (a), Letjoi (s)
Dichanthium aristatum	Poaceae	Grass	Moderately palatable, indicator of heavy soils & degraded areas	Least Concern (IUCN)	Rainbow Vlei Grass (e), Reënboogvleigras (a)
Dichrostachys cinerea (L.) Wight & Arn. subsp. *africana* Brenan & Brummitt	Fabaceae	Small tree	Encroacher species, traditional medicinal uses, firewood, pods browsed extensively by game and stock	Least Concern (IUCN)	Small-leaved Sickle Bush (e), Kleinblaar-sekelbos (a), Ugagake (z)
Dicliptera species	Acanthaceae	Forb	--	--	--
Dicoma anomala Sond.	Asteraceae	Dwarf shrub	Medicinal uses	Least Concern (IUCN)	Maagbitterwortel (a)
Dicoma capensis	Asteraceae	Dwarf shrub	Medicinal uses	Least Concern (IUCN)	Koorsbossie (a)
Dicoma tomentosa Cass.	Asteraceae	Dwarf shrub	Often on overgrazed and trampled areas	Least Concern (IUCN)	Hairy Dicoma (e), Harige dicoma (a)
Digitaria eriantha Steud.	Poaceae	Grass	Weaving, palatable grazing grass, Decreaser	Least Concern (IUCN)	Finger grass (e), Finger gras (a)
Dombeya rotundifolia (Hochst.) Planch. var. *rotundifolia*	Malvaceae	Tree	Wood is used for traditional purposes, bark, roots and root is used medicinally	Least Concern (IUCN)	Wild Pear (e), Drolpeer (a)
Ehretia rigida (Thunb.) Druce subsp. *nervifolia* Retief & A.E.van Wyk	Ehretiaceae	Small tree	Roots are used medicinally	Least Concern (IUCN)	Puzzle Bush (e), Deurmekaarbos (a)

Species Name	Family	Growth Form	Status/ Uses	Conservation / Invasive Status	Common Name
Elephantorrhiza praetermissa J.H.Ross	Fabaceae	Shrub	None	Least Concern (IUCN)	Sekhukhune Elephant-root (e), Sekhukhunebasboontjie (a)
Enneapogon cenchroides (Roem. & Schult.) C.E.Hubb.	Poaceae	Grass	Useful pioneer grass, moderately palatable	Least Concern (IUCN)	Nine-awned gras (e), Negenaaldgras (a)
Eragrostis capensis (Thunb.) Trin.	Poaceae	Grass	Moderate grazing potential	Least Concern (IUCN)	Heart-seed love grass (e), Hartjiesgras (a)
Eragrostis chloromelas Steud.	Poaceae	Grass	Edible parts, Increaser IIB	Least Concern (IUCN)	Curly leaf (e), Krulblaar (a)
Eragrostis lehmanniana Nees var. *lehmanniana*	Poaceae	Grass	Indicator of overgrazing, valuable grazing grass,	Least Concern (IUCN)	Lehman Love Grass (e), Lehmann-eragrostis (a), Knietjiesgras (a)
Eragrostis rigidior Pilg.	Poaceae	Grass	Important grazing grass in arid regions	Least Concern (IUCN)	Broad curly leaf (e), Breë Krulblaar (a)
Eriosema species	Fabaceae	Dwarf shrub	--	--	--
Euclea natalensis A.DC. subsp. *angustifolia* F.White	Ebenaceae	Shrub	Traditional and medicinal uses, edible parts	Least Concern (IUCN)	Bushveld hairy guarri (e), Bosveld harige guarrie (a)
Euclea species	Ebenaceae	Shrub	--	--	--
Euclea undulata Thunb.	Ebenaceae	Small tree	Firewood, edible fruit, traditional medicinal uses	Least Concern (IUCN)	Common Guarri (e), Gewone ghwarrie (a)
Eulophia petersii (Rchb.f.) Rchb.f.	Orchidaceae	Geophyte	None	Least Concern (IUCN), Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	--
Euphorbia cf. *lydenburgensis* Schweick. & Letty	Euphorbiaceae	Succulent	None	Least Concern (IUCN)	Lydenburg Milkweed (e), Lydenburg Melkbos (a)
Euphorbia ingens E.Mey. ex Boiss.	Euphorbiaceae	Succulent	Latex is toxic and caustic, used medicinally and as a fish poison	Least Concern (IUCN)	Giant euphorbia (e), Naboom (a)
Euphorbia schinzii Pax	Euphorbiaceae	Succulent	None	Least Concern (IUCN)	--
Euphorbia species	Euphorbiaceae	Succulent	--	--	--
Fingerhuthia africana Lehm.	Poaceae	Grass	Moderate grazing potential, Decreaser	Least Concern (IUCN)	Thimble grass (e), Vingerhoedgras (a)
Flaveria bidentis (L.) Kuntze*	Asteraceae	Herb	None	Declared Invader - NEMBA (Category 1B. AIP, 2016). Not GBIF listed. Not listed for CARA. Not listed for Lesotho.	Smelter's bush, Smelterbossie (a)
Gardenia volkensii K.Schum. subsp. *volkensii* var. *volkensii*	Rubiaceae	Tree	Fruit and root are used medicinally, traditional uses	Not evaluated (Least Concern)	Bushveld gardenia (e), Bosveldkatjiepiering (a)
Geigeria burkei Harv. subsp. *fruticulosa* Merxm.	Asteraceae	Dwarf shrub	Potentially poisonous	Least Concern (IUCN)	Vermeerbos (a)
Gossypium herbaceum subsp. *africanum*	Malvaceae	Herb	Traditional uses	Least Concern (IUCN)	Wild cotton (e), Wilde katoen (a)
Grewia bicolor Juss. var. *bicolor*	Malvaceae	Shrub	Medicinal uses, edible parts, highly variable	Least Concern (IUCN)	White-leaved Raisin (e), Witrosyntjie (a)
Grewia flava DC.	Malvaceae	Shrub	Edible parts, weaving, traditional uses, declared indicator of encroachment	Least Concern (IUCN)	Velvet Raisin (e), Fluweelrosyntjiebos (a)
Grewia flavescens Juss.	Malvaceae	Shrub	Edible parts, beer brewing	Least Concern (IUCN)	Bushman Raisin (e), Kruisbessie (a)
Grewia vernicosa Schinz	Malvaceae	Shrub	Generally on serpentine soils	Least Concern (IUCN)	Glossy Raisin (e), Glansrosyntjie (a)
Gymnosporia buxifolia (L.) Szyszyl.	Celastraceae	Small tree	Traditional uses, toxic parts, medicinal uses	Least Concern (IUCN)	Common spike-thorn (e), Gewone pendoring (a)

Species Name	Family	Growth Form	Status/ Uses	Conservation / Invasive Status	Common Name
Gymnosporia polyacantha (Sond.) Marais	Celastraceae	Shrub	None	Least Concern (IUCN)	--
Helichrysum species	Asteraceae	Herb	None	--	--
Hermannia species	Malvaceae	Dwarf shrub	--	--	--
Heteropogon contortus (L.) Roem. & Schult.	Poaceae	Grass	Moderate grazing potential, irritant	Least Concern (IUCN)	Spear grass (e), Assegaaigras (a)
Hibiscus cannabinus L.	Malvaceae	Herb	None	Least Concern (IUCN)	Indian Hemp-leaved Hibiscus (e), Wildestokroos (a)
Hibiscus microcarpus Garcke	Malvaceae	Herb	None	Least Concern (IUCN)	Tiny Wild Hibiscus (e), Wilde klein Hibuscus (a)
Holubia saccata Oliv.	Pedaliaceae	Herb	None	Least Concern (IUCN)	Sac Flower (e)
Hyparrhenia tamba (Steud.) Stapf	Poaceae	Grass	None	Least Concern (IUCN)	Berggras (a)
Hyperthelia dissoluta (Nees ex Steud.) Clayton	Poaceae	Grass	Thatching	Least Concern (IUCN)	Yellow Thatching Grass (e), Geeltamboekiegras (a)
Indigofera filipes Benth. ex Harv.	Fabaceae	Herb	None	Least Concern (IUCN)	--
Indigofera species	Fabaceae	Herb	--	--	--
Ipomoea species	Convolvulaceae	Prostrate herb	None	--	--
Jamesbrittanea aurantiaca	Scrophulariaceae	Herb	Colours & dyes	Least Concern (IUCN)	Cape Saffron (e), Saffraanbossie (a)
Jamesbrittenia burkeana (Benth.) Hilliard	Scrophulariaceae	Dwarf shrub	None	Least Concern (IUCN)	Bruinblommetjie (a)
Jasminum fluminense Vell. subsp. *fluminense*	Oleaceae	Climber	Along watercourses in dry country	Least Concern (IUCN)	Wild Jasmine (e), Wilde Jasmyn (a)
Justicia flava (Vahl) Vahl	Acanthaceae	Herb	None	Least Concern (IUCN)	Yellow Justicia (e), Geelgarnaalbos (a)
Kalanchoe luciae Raym.-Hamet subsp. *luciae*	Crassulaceae	Succulent	None	Least Concern (IUCN)	--
Kalanchoe paniculata Harv.	Crassulaceae	Succulent	None	Least Concern (IUCN)	Large Orange Kalanchoe (e), Hasieoor (a), Krimpsiektebossie (a)
Kalanchoe rotundifolia (Haw.) Haw.	Crassulaceae	Succulent	Medicinal uses, potentially poisonous	Least Concern (IUCN)	Nentakalanchoe (e), Nentabos (a)
Karomia speciosa (Hutch. & Corbishley) R.Fern.	Lamiaceae	Shrub	None	Least Concern (IUCN)	Southern Chinese-hats (e), Perssambreelblom (a)
Kirkia wilmsii Engl.	Kirkiaceae	Tree	Emergency water source	Least Concern (IUCN)	Mountain Kirkia (e), Bergsering (a)
Kleinia longiflora DC.	Asteraceae	Succulent	Traditional uses	Least Concern (IUCN)	Sjambokbos (a)
Kleinia stapeliiformis (E.Phillips) Stapf	Asteraceae	Succulent	Harvested for ornamental purposes	Least Concern (IUCN)	--
Kyphocarpa angustifolia (Moq.) Lopr.	Amaranthaceae	Herb	None	Least Concern (IUCN)	Silky Burweed (e)
Ledebouria species	Hyacinthaceae	Geophyte	--	--	--
Leonotis ocymifolia (Burm.f.) Iwarsson	Lamiaceae	Dwarf shrub	Medicinal uses, colours & dyes	Least Concern (IUCN)	Minaret Flower (e), Wildedagga (a)
Leucas species	Lamiaceae	Herb	--	--	--

Species Name	Family	Growth Form	Status/ Uses	Conservation / Invasive Status	Common Name
Leucosphaera bainesii (Hook.f.) Gilg	Amaranthaceae	Dwarf Shrub	None	Least Concern (IUCN)	Perdebossie (a)
Melia azedarach L.*	Meliaceae	Tree	Originally from Asia, Australia. Poisonous seeds, ornamental	Declared Invader - CARA (Category 3), NEMBA (a. Category 1b b. Category 3 in urban areas). Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998). GBIF listed. Listed for Lesotho	Seringa (e), Persian lilac (e), Gewone sering (a)
Merwilla plumbea (Lindl.) Speta	Hyacinthaceae	Geophyte	Traditional uses, traditional medicinal uses	Near Threatened (IUCN). Protected Plant Schedule 12 (Limpopo Environmental Management Act 7 of 2003)	Large Blue Scilla (e), Blouslangkop (a)
Momordica balsamina L.	Cucurbitaceae	Climber	Rigorous climber, edible parts, traditional medicinal uses	Least Concern (IUCN)	Balsam Pear (e), Laloentjie (a), Balsam Peer (a)
Morus alba L.*	Moraceae	Tree	Originally from northern China, edible parts	Declared Invader - NEMBA (Category 3). GBIF listed. CARA Category 3. Listed for Lesotho	White mulberry (e) Moerbei (a)
Nicotiana glauca Graham*	Solanaceae	Shrub	Originally from South America. Poisonous to livestock	Declared Invader - CARA 2002 (Category 1), NEMBA – (Category 1B). GBIF listed. CARA Category 1. Listed for Lesotho	Wild Tobacco (e), Wildetabak (a), Koae (s)
Ocimum obovatum E.Mey. ex Benth. subsp. *obovatum*	Lamiaceae	Herb	None	Least Concern (IUCN)	Cat's Whiskers (e), Kat Baard (a)
Opuntia ficus-indica (L.) Mill.*	Cactaceae	Succulent	Originally from Mexico. Edible parts, medicinal uses. Cladodes poisonous when fed to cattle in large quantities, irritants	Declared Invader - NEMBA (Category 1B). CARA (Category 1). Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998). GBIF listed. Listed for Lesotho	Sweet Prickley pear (e), Turksvy (a), Torofeiee (s)
Opuntia humifusa (Raf.) Raf.*	Cactaceae	Succulent	Originally from Central America (south-western United States and Mexico)	Declared Invader - CARA 2002 – Category 1 NEMBA – Category 1B	Eastern Prickly Pear (e), Devil's Tongue (e)
Opuntia leucotricha DC.*	Cactaceae	Succulent	Originally from Mexico	Declared Invader - CARA 2002 – Category 1 NEMBA – Category 1B	Aaron's Beard Pricly Pear (e)
Panicum maximum Jacq.	Poaceae	Grass	None	Least Concern (IUCN)	Buffalo Grass (e), Gewone Buffelsgras (a)
Peltophorum africanum Sond.	Caesalpiniaceae	Tree	Medicinal properties	Least Concern (IUCN)	Weeping wattle (e), Huilboom (a)
Pennisetum clandestinum Chiov.*	Poaceae	Grass	Originally from northeast Africa. Ornamental and for ground cover, fodder, styptic	Declared Invader - NEMBA (Category 1B in protected areas and wetlands in which it does not already occur). Not GBIF listed. Not CARA listed. Listed for Lesotho	Kikuyu Grass (e), Kikoejoegras (a) Mohloa-tshepe
Pergularia daemia (Forssk.) Chiov. subsp. *daemia*	Apocynaceae	Climber	Medicinal uses	Least Concern (IUCN)	Bobbejaankambro (a), Kgaba
Perotis patens Gand.	Poaceae	Grass	Indicator of poor management, Decreaser IIC	Least Concern (IUCN)	Cat's Tail (e), Katstertgras (a)
Phragmites mauritianus Kunth	Poaceae	Hydrophilic	None	Least Concern (IUCN)	Lowveld Reed (e), Laveldfluitjiesriet (a)
Phyllanthus species	Euphorbiaceae	Shrub	--	--	--
Polydora poskeana (Vatke & Hildebr.) H.Rob.sens.lat.	Asteraceae	Herb	Medicinal uses	Least Concern (IUCN)	Vernonia (a)

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Populus x *canescens* (Aiton) Sm.*	Salicaceae	Tree	STI's, firewood, building material	Declared Invader - NEMBA (Category 2), CARA (Category 2). Originally from America, timber, Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998). GBIF listed. Not listed for Lesotho	Grey poplar (e), Gryspopulier (a), Populiri (s)
Pouzolzia mixta Solms	Urticaceae	Shrub	Traditional and traditional medicinal uses	Least Concern (IUCN)	Soap-nettle (e), Seepnetel (a)
Requienia sphaerosperma DC.	Fabaceae	Herb	None	Least Concern (IUCN)	--
Rhigozum brevispinosum Kuntze	Bignoniaceae	Shrub	None	Least Concern (IUCN)	Short-thorn pomegranate (e), Kortdoringgranaat (a)
Rhynchosia species	Fabaceae	Dwarf shrub	None	--	--
Rhynchosia totta (Thunb.) DC. var. *totta*	Fabaceae	Herb	Edible parts	Least Concern (IUCN)	Yellow Carpet Bean (e)
Ricinus communis L. var. *communis**	Euphorbiaceae	Shrub	Poisonous parts	Declared Invader - NEMBA (Category 2), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)	Castor-oil plant (e), Kasterolie (a)
Salix babylonica L.	Salicaceae	Tree	Non-endemic	Naturalised exotic, Not evaluated	Weeping willow (e), Treurwilger (a)
Sansevieria hyacinthoides (L.) Druce	Liliaceae	Perennial herb	Traditional uses	Least Concern (IUCN)	Mother-in-law's Tongue (e), Skoonma se tong (a)
Schizachyrium sanguineum (Retz.) Alston	Poaceae	Grass	Palatable grass, thatching, Increaser I	Least Concern (IUCN)	Red Atumn Grass (e), Rooiherfsgras (a)
Schkuhria pinnata (Lam.) Cabrera	Asteraceae	Herb	Medicinal uses, weed (S. America)	Naturalised exotic. Not Evaluated	Dwarf Marigold (e), Bitterbossie (a)
Schmidtia pappophoroides Steud.	Poaceae	Grass	Palatable grazing grass, Increaser	Least Concern (IUCN)	Sand Quick (e), Sandkweek (a)
Sclerocarya birrea (A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro	Anacardiaceae	Tree	Edible parts, traditional uses	Least Concern (IUCN), Protected Tree (National Forest Act, 1998)	Marula (e), Maroela (a)
Searsia pentheri (Zahlbr.) Moffett	Anacardiaceae	Small tree	None	Least Concern (IUCN)	Crow Berry (e), Gewone Kraaibessie (a)
Searsia pyroides Burch. var. *pyroides*	Anacardiaceae	Small tree	Edible parts, medicinal uses	Least Concern (IUCN)	Common wild currant (e), Gewone taaibos (a)
Selaginella dregei (C.Presl) Hieron.	Selaginaceae	Fern	Medicinal uses	Least Concern (IUCN)	Resurrection Plant (e)
Senecio pleistocephalus S.Moore	Asteraceae	Climber	None	Least Concern (IUCN)	Golden Garland Vine (e)
Senegalia erubescens (Welw. ex Oliv.) Kyal. & Boatwr.	Fabaceae	Small tree	None, irritant. Often regarded as an encroacher species	Least Concern (IUCN)	Blue Thorn (e), Blouhaak (a), Moloto (tw)
Senegalia galpinii (Burtt Davy) Seigler & Ebinger	Fabaceae	Tree	Ornamental in gardens	Least Concern (IUCN)	Monkey Thorn (e), Apiesdoring (a)
Senegalia mellifera (Vahl) Seigler & Ebinger subsp. *detinens* (Burch.) Kyal. & Boatwr.	Fabaceae	Small tree	Declared indicator of encroachment, medicinal uses, poison source	Least Concern (IUCN)	Black Thorn (e), Swarthaak (a)
Senegalia nigrescens (Oliv.) P.J.H.Hurter	Fabaceae	Tree	Tannin rich bark, important browse for game, Host plant for larvae of *Charaxes phaeus*. Often regarded as an encroacher species	Least Concern (IUCN)	Knob thorn (e), Knoppiesdoring (a), Mokala (tw)

Species Name	Family	Growth Form	Status/ Uses	Conservation / Invasive Status	Common Name
Senegalia senegal (L.) Britton var. *leiorhachis* (Brenan) Kyal. & Boatwr.	Fabaceae	Tree	None	Least Concern (IUCN)	Slender Three-hook Thorn (e), Slaploot (a), Muunga-thuda (v)
Senna didymobotrya (Fresen.) H.S.Irwin & Barneby*	Fabaceae	Herb	Ornamental, originally from tropical Africa	Declared Invader - CARA 2002 (Category 1). NEMBA (a. 1B in Eastern Cape, KwaZulu-Natal, Limpopo, Mpumalanga and Western Cape. b. Not listed elsewhere). CARA 2002	Peanut butter cassia (e), Grondboontjiebotterkassia (a)
Senna italica Mill. subsp. *arachoides* (Burch.) Lock	Fabaceae	Herb	Medicinal uses	Least Concern (IUCN)	Wild senna (e), Elandsertjie (a)
Sesamum triphyllum Welw. ex Asch. var. *triphyllum*	Pedaliaceae	Herb	Edible parts, essential oils	Least Concern (IUCN)	Wild sesame (e), Brandboontjie (a)
Sesbania bispinosa (Jacq.) W.Wight var. *bispinosa*	Fabaceae	Shrub	Exotic species, often in moist areas, marshes. Originally from India, China, Iran. Edible parts	Currently unlisted	Prickly Sesban
Sesbania punicea (Cav.) Benth.*	Fabaceae	Tree	Originally from S. America. Leaves, flowers, seeds poisonous	Declared Invader - NEMBA (Category 1B). CARA (Category 1). Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998).	Red Sesbania (e), Rooisesbania (a)
Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. *torta* (Stapf) Clayton	Poaceae	Grass	None	Least Concern (IUCN)	Small Creeping Foxtail (e), Kleinkuipmannagras (a)
Sida alba L.	Malvaceae	Herb	None	Least Concern (IUCN)	Spiny Sida (e), Stekeltaaiman (a)
Sida cordifolia L.	Malvaceae	Herb	None	Least Concern (IUCN)	Flannel Weed (e), Hartblaartaaiman / Verdompsterk (a)
Sida species	Malvaceae	Herb	--	--	--
Smilax anceps Willd.	Smilacaceae	Climber	Medicinal uses, irritant	Least Concern (IUCN)	Thorny Rope (e), Doringtou (a)
Solanum elaeagnifolium Cav.*	Solanaceae	Dwarf shrub	Weed	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)	Silver-leaf bitter apple (e)
Sphenostylis angustifolia Sond.	Fabaceae	Prostrate herb	None	Least Concern (IUCN)	Wild sweetpea (e), Wilde-ertjie (a)
Sporobolus iocladosa (Trin.) Nees	Poaceae	Grass	Decreaser	Least Concern (IUCN)	Pan Dropseed (e), Panfynsaadgras (a)
Sporobolus pyramidalis P.Beauv.	Poaceae	Grass	Unpalatable, indicator of overgrazing, Decreaser IIC	Least Concern (IUCN)	Catstail Dropseed (e), Katstert-fynsaadgras (a)
Stapelia gettliffei R.Pott	Apocynaceae	Succulent	None	Least Concern (IUCN), Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	Carrion Flower (e), Aasblom (a)
Stapelia gigantea N.E.Br.	Apocynaceae	Succulent	Traditional medicinal uses	Least Concern (IUCN), Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)	Giant Carrion Flower (e), Reuseaasblom (a)
Sterculia rogersii N.E.Br.	Sterculiaceae	Tree	Traditional uses, edible seeds	Least Concern (IUCN)	Star-chestnut (e), Sterkastaiing (a), Mukakate (v)
Stipagrostis hirtigluma (Steud.) De Winter subsp. *patula* (Hack.) De Winter	Poaceae	Grass	None	Least Concern (IUCN)	Blue Bushman Grass (e), Blouboesmangras (a)

Species Name	Family	Growth Form	Status/ Uses	Conservation / Invasive Status	Common Name
Stylochaeton natalensis Schott	Araceae	Geophyte	Root and leaves used for traditional medicinal purposes	Least Concern (IUCN)	Bushveld Arum (e), Bosvelld Varkoor (a)
Tagetes minuta L.	Asteraceae	Herb	Originally from S. America. Essential oils, colours & dyes. Irritant	Not NEM:BA listed. GBIF listed. Listed for Lesotho	Khaki Weed (e), Kakiebos (a), Lechuchutha (s)
Tecoma stans (L.) Juss. ex Kunth var. *stans**	Bignoniaceae	Shrub	Ornamental	Declared Invader - CARA 2002 (Category 1). NEMBA (Category 1B)	Yellow elder (e), Geelklokkies (a)
Tephrosia species	Fabaceae	Herb	None	--	--
Terminalia prunioides M.A.Lawson	Combretaceae	Small tree	Traditional uses	Least Concern (IUCN)	Purple-pod Cluster-leaf (e), Sterkbas (a), Nshashantsawu (ts)
Tetradenia brevispicata (N.E.Br.) Codd	Lamiaceae	Dwarf shrub	None	Least Concern (IUCN)	Small-leaved Ginger-bush (e)
Themeda triandra Forssk.	Poaceae	Grass	Palatable grazing, Decreaser	Least Concern (IUCN)	Red grass (e), Rooigras (a)
Tragia dioica Sond.	Euphorbiaceae	Herb	None	Least Concern (IUCN)	Brandnetel (a)
Tribulus terrestris L.	Zygophyllaceae	Prostrate herb	Medicinal uses	Least Concern (IUCN)	Common Dubbeltjie (e), Gewone Dubbeltjie (a)
Tricholaena monachne (Trin.) Stapf & C.E.Hubb.	Poaceae	Grass	Moderate grazing potential, Increaser IIC	Least Concern (IUCN)	Blue-seed grass (e), Blousaadgras
Typha capensis (Rohrb.) N.E.Br.	Typhaceae	Hydrophilic	Edible parts, medicinal uses	Naturalised exotic. Cosmopolitan weed, Not evaluated	Bulrush (e), Papkuil (a)
Urochloa mosambicensis (Hack.) Dandy	Poaceae	Grass	Edible parts, palatable grazing grass	Least Concern (IUCN)	Bushveld signal grass (e), Bosveldbeesgras (a)
Vachellia exuvialis (I.Verd.) Kyal. & Boatwr.	Fabaceae	Small tree	None	Least Concern (IUCN)	Flaky Thorn (e), Skilferbas-doring (a)
Vachellia grandicornuta (Gerstner) Seigler & Ebinger	Fabaceae	Small tree	Regarded as an encroacher species	Least Concern (IUCN)	Horned thorn (e), Horingdoring (a), Masaoka (tw)
Vachellia nilotica (L.) P.J.H.Hurter & Mabb. subsp. *kraussiana* (Benth.) Kyal. & Boatwr.	Fabaceae	Tree	Dyes and tans, traditional and medicinal uses	Least Concern (IUCN)	Scented-pod Thorn (e), Lekkerruikpeul (a)
Vachellia tortilis (Forssk.) Gallaso & Banfi subsp. *heteracantha* (Burch.) Kyal. & Boatwr.	Fabaceae	Tree	Medicinal uses (bark). Often regarded as an encroacher species	Least Concern (IUCN)	Curly-pod Acacia (e), Haak-en-steek (a), Isishoba (z)
Volkameria glabra (E.Mey.) Mabb. & Y.W.Yuan	Lamiaceae	Tree	Traditional and medicinal uses. Flowers attract birds and butterflies	Least Concern (IUCN)	Smooth Tinderwood (e), Bitterblaar (a)
Waltheria indica L.	Sterculiaceae	Herb	None	Least Concern (IUCN)	Meidebossie (a)
Xanthium strumarium L.*	Asteraceae	Dwarf shrub	None	Declared Invader - CARA 2002 (Category 1). Proposed legislation: NEMBA (Category 1B).	Large cocklebur (e), Kankerroos (a)
Ximenia caffra Sond. var. *caffra*	Olacaceae	Small tree	Edible parts	Least Concern (IUCN)	Large Sourplum (e), Grootsuurpruim (a)
Zinnia peruviana (L.) L.	Asteraceae	Perennial herb	Naturalised weed (South America)	Not Evaluated	Wildejakopregop (a)
Ziziphus mucronata Willd. subsp. *mucronata*	Rhamnaceae	Small tree	Edible parts, traditional medicinal uses, traditional uses	Least Concern (IUCN)	Buffalo-thorn (e), Blinkblaar-wag-'n-bietjie (a)