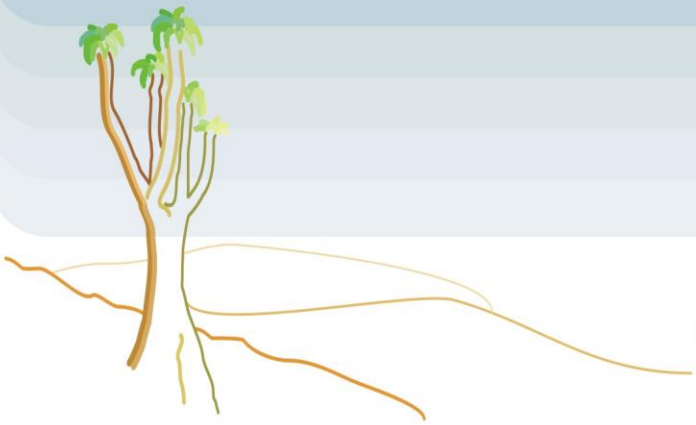


DPR
Ecologists & Environmental Services

# Report on the ecological and wetland assessment for the proposed Harmony Moab-Noligwa PV solar development situated near the town of Orkney, Free State Province.

July 2022


Prepared by:

**Darius van Rensburg**
Pr.Sci.Nat. 400284/13
T 083 410 0770
darius@dprecologists.co.za
P.O. Box 12726
Brandhof
9324

61 Topsy Smith Street
Langenhovenpark
9300


Prepared for:
Savannah Environmental (Pty) Ltd
P.O. Box 148
Sunninghill
Gauteng
2157

**DECLARATION OF INDEPENDENCE**

**DPR Ecologists and Environmental Services is an independent company and has no financial, personal or other interest in the proposed project, apart from fair remuneration for work performed in the delivery of ecological services. There are no circumstances that compromise the objectivity of the study.**

| | | | |
|---|---|---|---|
| **Report Version** | **Draft 1.0** | | |
| **Title** | **Report on the ecological and wetland assessment for the proposed Harmony Moab-Noligwa PV solar development situated near the town of Orkney, Free State Province.** | | |
| **Author** | **DP van Rensburg (Pr.Sci.Nat)** |  | **Jul'22** |

## Executive Summary

The study area is situated approximately 10 km east of the small town of Orkney and to the south of the settlement of Vaal Reefs (Appendix A: Map 1). The study area is fairly large and is dominated by undulating grassland plains with gentle slopes that generally slopes toward the north and east, toward lower lying watercourses and wetlands. The extent of the study area is approximately 1500 hectares. A significant portion of this development area has however been transformed by the existing mining plants and infrastructure. However, the majority of the area is still dominated by natural grassland with some disturbance also being evident. A large wetland area is also present in the eastern portion, with a few small depression wetlands also occurring in the southern portion.

The study area is still largely dominated by natural grassland and which can broadly be divided into a northern and southern portion where the northern portion is dominated by Vaal Reefs Dolomite Sinkhole Woodland and also north of a large tarred road while the southern portion is dominated by Vaal-Vet Sandy Grassland and situated south of the tarred road (Appendix A: Map 1).

The majority of the site still consists of natural grassland which is still in a fairly good condition (Appendix A: Map 1). The surroundings as well as significant portions of the site has been affected and transformed by historical mining operations. Being a mining area, this results in transformation and degradation of large portions of land. The cumulative impact of development and mining in this area is therefore high. The proposed solar development should therefore first consider the development of areas considered as already transformed and of low sensitivity. These include areas previously cleared for construction activities, portions transformed by ploughing for crop production and degraded areas associated with the mining operations which also includes areas of shallow excavations and rubble dumps. It is however inevitable that the development will also encroach into areas of natural grassland which will result in significant impacts.

Given the above descriptions of the natural vegetation the following areas of high sensitivity should be avoided as far as possible (Appendix A: Map 1 - 4):

- The Mispah Game Reserve covers a large portion of the southern portion of the site. This is a Private Nature Reserve which has been proclamated as a Protected Area (PA) under the National Environmental Management Protected Areas Act (NEMPAA of 2003). The area is listed as a Private Nature Reserve within the South Africa Protected & Conservation Areas Database (SAPAD) and was proclamated in 2001 (Notice 23 of 2001). Development within any protected area is highly unlikely since this is largely prevented by the NEMPAA and any management plan of the protected area. This PA has also been taken into account in determining the provincial and national conservation targets and development within this PA will also affect these conservation targets.
- Two large CBA 1 areas have been delineated by the Free State Biodiversity Management Plan. These CBA 1 areas have been identified as being crucial for meeting conservation targets for the Endangered Vaal-Vet Sandy Grassland occurring in this area but also to some extent the Vaal Reefs Dolomite Sinkhole Woodland in the area. These CBA 1 areas have been identified as being Irreplaceable in terms of meeting conservation targets.

- Portions of remaining Vaal-Vet Sandy Grassland also occur in the south east of the site but which do not form part of the Mispah Game Reserve or identified CBA areas. However, since this vegetation type is currently listed as Endangered (EN) these areas must still be afforded a High level of sensitivity. Development should investigate all alternatives to avoid this area and should only encroach into this area if no other alternative is available. This will however result in high impacts.
- A large wetland system transects the eastern portion of the site. This is clearly an importance water resource and will have a Very High level of sensitivity. It will not be possible to develop this system and should be completely excluded from development.

Since it is clear that the impact of the solar development will be high and will lead to irreversible transformation, the development area should be carefully determined, should focus on areas of lower sensitivity and should limit the extent of transformation as far as possible (Appendix A: Map 4). Current layout plans do indicate that areas of High Sensitivity are largely being avoided while mostly retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity.

Signs and tracks of mammals are fairly abundant on the site though the mammal population will be somewhat modified from the natural condition. Natural vegetation has a high carrying capacity for mammals which decreases significantly where mining or agriculture transforms this natural vegetation and in such transformed areas the mammal population is normally represented by a generalist mammal population. As indicated previously, the majority of this still consists of natural vegetation and accordingly the mammal population will also be largely natural in these areas.

It has been confirmed that Near Threatened Serval (*Leptailurus serval*) occurs in the development area it is clear that the proposed development will have a significant impact on it. According to the National Red List (2016) the several recommendations and mitigation should be implemented where this species will be affected.

The surface water features of the study area are dominated by a large valley bottom wetland system in the eastern portion of the site (Appendix A: Map 3). A few small depressions also occur in the south west of the site and within the Mispah Game Reserve.

Obligate wetland vegetation was utilised to determine the presence and border of wetland conditions (Appendix B). The vegetation survey indicated that obligate wetland vegetation dominates the valley bottom wetland system in the east of the site. The smaller depression wetlands in the south west of the site contained some obligate wetland vegetation though due to high levels of disturbance this was not as pronounced. However, soil samples conclusively confirmed the presence of wetland conditions in both the valley bottom wetland system and small depression wetlands (Appendix C). The large valley bottom wetland system in the east of the study area can be categorised as an unchanneled valley-bottom wetland (SANBI 2009).

Though the section of the wetland occurring on the site seems to still be largely intact and functional the upstream land uses, especially within the catchment will certainly have a significant impact on the wetland and is therefore likely to cause a significant level of modification of it. The survey has indicated that the valley bottom wetland system is affected by numerous impacts which result in a significant level of modification. A WET-Health determination was undertaken for the valley bottom wetland to determine its current condition

given the impacts affecting it (Appendix D). The results of the WET-Health indicated an overall Present Ecological State of Category C: Moderately Modified. This is considered relatively accurate given the largely transformed catchment and impacts on the wetland. The EI&S of the valley bottom wetland system has been rated as being Moderate.

A Risk Assessment for the proposed solar facility which will affect the valley bottom wetland system in the eastern portion of the site has been undertaken according to the Department of Water & Sanitation's requirements for risk assessment and the provisional Risk Assessment Matrix for Section 21(c) & (i) water use (Appendix E). In the event that development of solar facilities extends into the eastern portion of the site, these areas will be located in close proximity to this wetland system and in so doing are likely to result in some impacts on it, especially in terms of runoff and sedimentation (Appendix A: Map 3). However, current layout plans do indicate that the development will avoid the eastern portion of the development area which will significantly decrease the anticipated impact. The current layout plans indicate that portions of the development as well as associated grid connection powerline will be situated approximately 350 meters from this valley-bottom wetland system and given the clearance of vegetation and the large extent of the development is still likely to have an impact on it.

The large valley bottom wetland system is clearly the main wetland system in this area and is considered as still providing several essential functions and is therefore considered as highly sensitive and being of high conservation value (Appendix A: Map 3). Current layout plans do indicate that the eastern portion of the development area will be excluded though development will still occur within 350 meters of the edge of the wetland and is then still likely to have some impact on it. Given the distance between the wetland area and current development layout (approximately 350 meters), the anticipated risk will be low.

The impact significance has been determined and should development take place without mitigation it is anticipated that it will result in overall high impacts. This is a result of the largely natural condition of the area, the presence of areas of high conservation value and the fairly large extent of the proposed development (Appendix A: Map 4). Aspects which are expected to result in quite high impacts include the loss of the vegetation type in the area which includes Vaal-Vet Sandy Grassland (an Endangered system) as well as the loss of a large wetland system in the east of the site. Other moderate-high impacts also include the loss of protected plant species, increased infestation by exotic weeds, increased habitat fragmentation, the impact on mammals (which also includes a Near Threatened species) and the increased cumulative impact. Suitable mitigation as listed in previous paragraphs should enable the development to decrease many of these impacts to moderate levels. This will mostly be achieved by excluding areas of high conservation value as listed which will in turn decrease the severity of the impacts and will also decrease the extent and in so doing the anticipated impacts will be somewhat lower. Current layout plans do indicate that areas of High Sensitivity are being avoided while retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity. However, as indicated significant natural areas will still be transformed by the development and several of the impacts will remain significant especially the impacts on the vegetation type and biodiversity, the wetland system in the east of the site, habitat fragmentation, the mammal population in the area and the cumulative impact.

**Table of contents**

**Ecological and wetland assessment.**

## 1. INTRODUCTION

Natural vegetation is an important component of ecosystems. Some of the vegetation units in a region can be more sensitive than others, usually as a result of a variety of environmental factors and species composition. These units are often associated with water bodies, water transferring bodies or moisture sinks. These systems are always connected to each other through a complex pattern. Degradation of a link in this larger system, e.g. tributary, pan, wetland, usually leads to the degradation of the larger system. Therefore, degradation of such a water related system should be prevented.

Though vegetation may seem to be uniform and low in diversity it may still contain species that are rare and endangered. The occurrence of such a species may render the development unviable. Should such a species be encountered the development should be moved to another location or cease altogether.

South Africa has a large amount of endemic species and in terms of plant diversity ranks third in the world. This has the result that many of the species are rare, highly localised and consequently endangered. It is our duty to protect our diverse natural resources.

South Africa's water resources have become a major concern in recent times. As a water scarce country, we need to manage our water resources sustainably in order to maintain a viable resource for the community as well as to preserve the biodiversity of the system. Thus, it should be clear that we need to protect our water resources so that we may be able to utilise this renewable resource sustainably. Areas that are regarded as crucial to maintain healthy water resources include wetlands, streams as well as the overall catchment of a river system.

In order to better manage our water resources several guidelines and research sources have been developed. Amongst these are the National Freshwater Ecosystem Priority Areas for South Africa 2011 (NFEPA).

The human population has become a power-hungry system where non-renewable resources are being utilised at an alarming rate. These resources are nearing depletion and are often associated with some form of pollution (air-, water-, atmospheric pollution). The unlimited use of these non-renewable resources is not sustainable. In recent times people have become aware of this and are attempting to alleviate this by using renewable energy sources. This has become increasingly popular and are commonplace in many first world countries. Recently it has come to light that South Africa is optimally situated for solar power production. The use of solar power will alleviate the pressure experienced by Eskom, will reduce carbon emissions and will promote the use of renewable energies. The development of solar facilities should be encouraged. Solar parks do have their disadvantages. These include the use of fertile soil for power production rather than food supply and the disturbance and removal of natural vegetation.

The study area is situated approximately 10 km east of the small town of Orkney and to the south of the settlement of Vaal Reefs (Appendix A: Map 1). The study area is fairly large and is dominated by undulating grassland plains with gentle slopes that generally slopes toward the north and east, toward lower lying watercourses and wetlands. The extent of the study area is approximately 1500 hectares. A significant portion of this development area has however been

transformed by the existing mining plants and infrastructure. However, the majority of the area is still dominated by natural grassland with some disturbance also being evident. A large wetland area is also present in the eastern portion, with a few small depression wetlands also occurring in the southern portion.

A site visit was conducted on 24 to 26 May 2022. The entire proposed development area, including terrestrial and riparian areas, was surveyed over the period of several days. The site survey was conducted during late autumn and though vegetation was in the process of going dormant, late rains and no frost to date did allow for adequate vegetation identification and an active hydrological regime was present. This ensured accurate identification of watercourses and wetlands.

For the above reasons it is necessary to conduct an ecological and wetland assessment of an area proposed for development.

The report together with its recommendations and mitigation measures should be used to minimise the impact of the proposed solar development.

### 1.1 Background of the development

The following summary has been provided by the applicant and provides a brief description of the planned development:

Harmony Moab Khotsong Operations (Pty) Ltd is looking to supplement its energy supply by implementing Photovoltaic (PV) generation, aiding their transition to a more sustainable and environmentally friendly energy mix.

The development of a solar photovoltaic (PV) facility with a generating capacity of up to 100MW is proposed north of the Harmony Gold Moab Khotsong operations, approximately ~10km north of the town of Vierfontein within the Moqhaka Local Municipality and within the Fezile Dabi District Municipality, Free State Province.

The PV facility is located on:

- the Farm Anglo 593;
- Farm Hoekplaats 598;
- Farm Mispah 274;
- Portion 1 of Farm Zaaiplaats 190;
- Remaining Extent of Farm Doornkom Wes 446;
- Portions 1, 3, 4, 5, of Farm Chrystalkop 69;
- and the Remaining Extent of the Farm Zuiping 394,

The properties are owned by the Mine. The solar PV development will be known as Harmony Moab Khotsong Solar PV Facility.

The preferred site for the projects is on properties which are owned by Harmony Gold and are available for the proposed projects and is therefore deemed technically feasible by the project developer for such development to take place.

A project site considered to be technically suitable for the development of the solar PV facility, with an extent of approximately 1400ha, was identified. A development area of ~900ha was

demarcated within this project site and allows an adequate footprint (~450ha) for the installation of a solar PV facility with a contracted capacity of up to 100MW, while allowing for the avoidance of environmental site sensitivities.

The full extent of the project site is to be evaluated in the Basic Assessment process to identify sensitivities. Site-specific studies and assessments will delineate areas of potential sensitivity within the identified study area. Once constraining factors have been confirmed, the layout of the solar PV facility within the development area can be planned to avoid sensitive environmental areas and features.

The infrastructure associated with the 100MW solar PV facility will include:

- PV modules and mounting structures.
- Inverters and transformers a SCADA room, and maintenance room.
- Cabling between the project components, to be laid underground where practical.
- Access roads, internal roads and fencing around the development area.
- Temporary and permanent laydown areas.
- Grid connection infrastructure including an on-site facility substation and a switching substation to be connected to the existing:
    - Vaalreefs Eleven Substation via a 3km overhead power line (located in the eastern corner of the site);
    - Southvaal Plant Substation via an up to 1km overhead power line (located in the western corner of the site);
    - and to the Southvaal Substation via a 2km overhead power line (located in the northern corner of the site).

The site is accessible via the R76 from Viljoenskroon which is south of the proposed site.

**1.2 The value of biodiversity**

The diversity of life forms and their interaction with each other and the environment has made Earth a uniquely habitable place for humans. Biodiversity sustains human livelihoods and life itself. Although our dependence on biodiversity has become less tangible and apparent, it remains critically important.

The balancing of atmospheric gases through photosynthesis and carbon sequestration is reliant on biodiversity, while an estimated 40% of the global economy is based on biological products and processes.

Biodiversity is the basis of innumerable environmental services that keep us and the natural environment alive. These services range from the provision of clean water and watershed services to the recycling of nutrients and pollution. These ecosystem services include:

- Soil formation and maintenance of soil fertility.
- Primary production through photosynthesis as the supportive foundation for all life.
- Provision of food, fuel and fibre.
- Provision of shelter and building materials.
- Regulation of water flows and the maintenance of water quality.
- Regulation and purification of atmospheric gases.
- Moderation of climate and weather.

- Detoxification and decomposition of wastes.
- Pollination of plants, including many crops.
- Control of pests and diseases.
- Maintenance of genetic resources.

### 1.3 Value of wetlands and watercourses

Freshwater ecosystems provide valuable natural resources, which contributes toward economic, aesthetic, spiritual, cultural and many recreational values. Yet the integrity of freshwater ecosystems in South Africa is rapidly declining in recent times. This crisis is largely a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (the need to utilise these recourses between different stakeholders, i.e. individuals, communities, corporate and industrial) and institutional (Implementing appropriate governance and management). Water affects every activity and aspiration of human society and sustains all ecosystems.

Freshwater ecosystems provide many of our fundamental needs, enable important regulating ecosystem services, supports functional faunal and floral communities:

- Water for drinking and irrigation
- Food such as fish and water plants.
- Building material such as clay and reeds.
- Preventing floods and easing the impacts of droughts.
- Remove excess nutrients and toxic substances from water
- Rivers, wetlands and groundwater systems maintain water supplies and buffer the effects of storms, reducing the loss of life and property to floods.
- Riverbanks help to trap sediments, stabilise
- river banks and break down pollutants draining from the surrounding land.

### 1.4 Details and expertise of specialist

DPR Ecologists and Environmental Services (Pty) Ltd.
Darius van Rensburg *Pr. Sci. Nat.*
61 Topsy Smith
Langenhoven Park
Bloemfontein
9300
Tel: 083 410 0770
darius@dprecologists.co.za

Professional registration:
South African Council for Natural Scientific Professions No. (400284/13) (Ecological Science).

Membership with relevant societies and associations:
- South African Society of Aquatic Scientists (SASAQS0091)
- South African Association of Botanists
- South African Wetlands Society (3SLY4IG4)

Expertise:

- Qualifications: B.Sc. (Hons) Botany (2008), M.Sc. in Vegetation Ecology (2012) with focus on ephemeral watercourses.
- Vegetation ecologist with over 10 years experience of conducting ecological assessments.
- Founded DPR Ecologists & Environmental Services (Pty) Ltd in 2016.
- Has conducted over 200 ecological and wetland assessments for various developments.
- Regularly attend conferences and courses in order to stay up to date with current methods and trends:

  **2017:** Kimberley Biodiversity Symposium.
  **2018:** South African Association of Botanists annual conference.
  **2018:** National Wetland Indaba Conference.
  **2019:** SASS5 Aquatic Biomonitoring Training.
  **2019:** Society for Ecological Restoration World Congress 2019.
  **2019:** Wetland rehabilitation: SER 2019 training course.
  **2020:** Tools For Wetlands (TFW) training course.

## 2. SCOPE AND LIMITATIONS

- To evaluate the present state of the vegetation and ecological functioning of the area proposed for the solar development.
- To identify possible negative impacts that could be caused by the proposed clearing of vegetation and establishment of solar development.
    - Severity relates to the nature of the event, aspect or impact to the environment and describes how severe the aspects impact on the ecosystem.
    - Duration refers to the amount of time that the environment will be affected by the event, risk or impact, if no intervention e.g. remedial action takes place.
    - Extent refers to the spatial influence of an impact.
    - Frequency refers to how often the specific activity, related to the event, aspect or impact, is undertaken.
    - Probability refers to how often the activity/event or aspect has an impact on the environment.
- To provide a description of watercourses, wetlands and riparian vegetation included within the study area.
- Identify watercourses including rivers, streams, pans and wetlands and determine the presence of wetland conditions within these systems.
- Where wetland conditions have been identified the classification of the wetland system will be given.
- To evaluate the present state of the wetlands and riparian vegetation in close proximity to the site. The importance of the ecological function and condition will also be assessed.
- Determine the Present Ecological State (PES) and Ecological Importance & Sensitivity (EIS) for the watercourses in close proximity to operations.
- Conduct a risk assessment and determine the likelihood that watercourses and wetlands will be adversely affected by the development.

### 2.1 Vegetation

Aspects of the vegetation that will be assessed include:

- The vegetation types of the region with their relevance to the proposed site.
- The overall status of the vegetation on site.
- Species composition with the emphasis on dominant-, rare- and endangered species.

The amount of disturbance present on the site assessed according to:

- The amount of grazing impacts.
- Disturbance caused by human impacts.
- Other disturbances.

### 2.2 Fauna

Aspects of the fauna that will be assessed include:

- A basic survey of the fauna occurring in the region using visual observations of species as well as evidence of their occurrence in the region (burrows, excavations, animal tracks, etc.).

- The overall condition of the habitat.

### 2.3 Wetlands and watercourses

Aspects of the wetlands that will be assessed include:

- Identification and delineation of watercourses including rivers, streams, pans and wetlands.
- Determine the presence of wetland conditions and riparian vegetation using obligate wetland and riparian species.
- Describe watercourses and wetlands and importance relative to the larger system.
- Conduct habitat integrity assessment of perennial systems to inform the condition and status of watercourses.

### 2.4 Limitations

- Due to the season of the survey several bulbs, seasonal herbs and subterranean succulents may have been overlooked as leaves and flowers may be absent due to their seasonal or deciduous nature.
- Although a comprehensive survey of the site was done it is still likely that several species were overlooked.
- Smaller drainage lines may have been overlooked where a distinct channel or riparian vegetation is absent.
- Due to previous transformation and mining activities this may have altered soil layers and the morphology of drainage areas which would complicate the delineation of wetland and riparian areas.
- Due to time constraints only limited surveys of wetlands were done.
- Some animal species may not have been observed as a result of their nocturnal and/or shy habits.

## 3. METHODOLOGY

### 3.1 Several literature works were used for additional information.

General ecology:

- Red Data List (Raymondo *et al.* 2009).
- Vegetation types (Mucina & Rutherford 2006).
- NBA 2018: South African Inventory of Inland Aquatic Ecosystems (SAIIAE).
- NBA 2018 Technical Report: Inland Aquatic (Freshwater) Realm.
- NBA 2018 Technical Report Volume 1: Terrestrial Realm.
- National Freshwater Ecosystem Priority Areas 2011 (NFEPA).
- Strategic Water Source Areas 2018 (SWSA).
- SANBI (2011): List of threatened ecosystems.
- NEM:BA: List of threatened ecosystems and Threatened Or Protected Species (TOPS).
- Biodiversity Plan Free State Province (2018).

Vegetation:

- Red Data List (Raymondo *et al.* 2009).
- Vegetation types (Mucina & Rutherford 2006).
- Field guides used for species identification (Bromilow 1995, 2010, Coates-Palgrave 2002, Fish *et al* 2015, Gerber *et al* 2004, Gibbs-Russell *et al* 1990, Griffiths & Picker 2015, Manning 2009, Moffett 1997, Pooley 1998, 2003, Retief & Meyer 2017, Van Ginkel & Cilliers 2020, Van Ginkel *et al* 2011, Van Oudtshoorn 2004, Van Wyk & Malan 1998, Van Wyk & Van Wyk 1997, Venter & Joubert 1985).

Terrestrial fauna:

- Field guides for species identification (Smithers 1983, Child *et al* 2016, Cillié 2018).

Wetland methodology, delineation and identification:
Department of Water Affairs and Forestry 2004, 2005, 2008, Collins 2006, Duthie 1999, Kleynhans *et al* 2008, Marnewecke & Kotze 1999, Macfarlane, Ollis & Kotze 2020, Ollis *et al* 2013, Nel *et al* 2011, SANBI 2009.

### 3.2 Survey

The site was assessed by means of transects and sample plots. Observation w.r.t. the general ecology of the area includes:

- Noted species include rare and dominant species.
- The broad vegetation types present at the site were determined.
- The state of the environment was assessed in terms of condition, grazing impacts, disturbance by humans, erosion and presence of invader and exotic species.
- The state of the habitat was also assessed.

Ecological aspects surveyed and recorded includes:

- The overall ecology of an area including the diversity of species, uniformity or diversity of habitats and different vegetation communities.

- Identification and delineation of distinct vegetation communities ad habitats and the ecological drivers responsible for these distinct communities, i.e. soil, geology, topography, aspect, etc.
- A comprehensive plant species survey including the identification of protected, rare or threatened species.
- Any ecological process or function which is important to the ecosystem including ecological drivers such as fire, frost, grazing, browsing, etc. and any changes to these processes.

Animal species were also noted as well as the probability of other species occurring on or near the site according to their distribution areas and habitat requirements.
The state of the habitat was also assessed.

In order to provide a visually representative overview of the results obtained from the survey, site sensitivity mapping will also be done. This should indicate the relative importance of different ecological elements on the site as obtained from the survey. In general, these levels of sensitivity will include:

- Low Sensitivity – normally confined to areas that are completely transformed from the natural condition or degraded to such an extent that they are no longer representative of the natural ecosystem. Such areas will also no longer contain any ecological processes of importance relative to the surrounding areas, i.e. in some instances such as watercourses which are completely transformed but still provide important ecological functions, a low level of sensitivity will not apply.

- Moderate Sensitivity – normally applicable to areas that are still natural and therefore does still have some ecological importance but which do not contain elements of high conservation value and are not essential to the continued functioning of surrounding areas. Areas of Moderate Sensitivity usually require some mitigation but can be developed without resulting in high impacts.

- High Sensitivity – areas of high sensitivity contain one or more ecological elements which are considered of high conservation value. Such areas are normally preferred to be excluded from a development but where this is not possible, will require comprehensive mitigation and is also likely to result in high impacts.

- Very High Sensitivity – these areas are critical to the continued functioning of the ecosystem on and around the site. Development of such areas normally represent a fatal flaw and should be excluded from development. No manner of mitigation is able to decrease the anticipated impact in these areas.

All rivers, streams, pans and wetlands were identified and surveyed where they occurred in the study area. These systems were determined by use of topography (land form and drainage pattern) and riparian vegetation with limited soil sampling (Appendix B & C). The following outlines the process applied during the on-site survey in order to obtain all required data:

- Perform desktop overview of the study area utilising available resources (Section 3.1). From the desktop overview identify the different landscape forms, possible wetland areas, watercourses and their relative flow patterns. Using this information, identify transects and sample plots for possible on-site survey. This should be both

representative of the wetland or watercourse as a whole but should also include any prominent or significantly unique features.

- Possible sites identified during the desktop overview should be surveyed on-site. Where access is not possible or where desktop features are considered poor representatives of the wetland or watercourse the survey site or transect should be moved to another location, without compromising a comprehensive overview of the system.
- Where a lateral transect is taken of a watercourse this is done from the water's edge, across the marginal, lower and upper zones and extended across the floodplain until the edge of the riparian zone is reached.
- Where a transect is taken of a wetland system, this should preferably be taken across the entire wetland at its widest part or where it is most relevant to the proposed development, from the terrestrial surroundings, across the temporary, seasonal and perennial zones across the wetland.
- Soil samples are taken at 10 meter intervals along the survey transect, or where a distinct transition into a different zone is observed.
- A survey of the plant species within each distinct riparian or wetland zone is undertaken and includes the identification of obligate wetland species, riparian species, terrestrial species, exotic species and the general species composition and vegetation structure which allows for an accurate description of the watercourse or wetland.
- Visual survey of the general topography which substantiates the presence of riparian zones and wetland forms.
- Other general observations include any impacts observed, the overall ecosystem function, presence of fauna, surrounding land uses and the overall condition of the watercourse or wetland.
- Data is recorded by means of photographs with GPS coordinates taken at all relevant soil sampling sites and borders of riparian and wetland zones.

Data obtained during the on-site survey is utilised to provide the following information on the system:

- Desktop overview and assimilation of information on the likely impacts and functioning of the wetland system.
    - Review all available spatial data and resources in order to provide an estimate of the likely impacts and condition of the wetland or watercourse system.
- Confirm the presence of the wetland or watercourse system and provide an estimate of its borders.
    - The border of wetland conditions or the edge of the riparian zone will be confirmed by using soil sampling, obligate wetland vegetation and topography. This will also include the delineation of any temporary, seasonal or perennial zones of wetness along wetlands and the marginal, lower, upper and riparian zones along watercourses.
- Provide a description of the wetland or watercourse.
    - Provide the hydrogeomorphic setting of the wetland, a longitudinal profile which will aid in determining the erodibility of the wetland and provide an overall description of the wetland and impacts affecting it.
    - Provide a general description of the lateral zonation of the watercourse banks including the marginal, lower, upper and riparian zones and a description of the riparian vegetation along the banks of the watercourse. This will also include the description of any impacts or modification of the watercourse.

- Assess the current condition of the wetland or watercourse.
    - Utilising information obtained from the assessments listed above, determine the condition of this portion of the wetland by applying the WET-Health 2 tool.
    - Utilising information obtained from the assessments listed above, determine the condition of the relevant section of the watercourse by applying the Index of Habitat Integrity (IHI) tool.
- Utilising all of the information obtained from the assessment, provide recommendations to mitigate anticipated impacts that the development will have.

The following guidelines and frameworks were also used to determine the presence of the rivers, streams, pans and wetlands in the study area:

- Department of Water Affairs and Forestry. 2005. A practical field procedure for identification and delineation of wetlands and riparian areas. Edition 1. Department of Water Affairs and Forestry, Pretoria.
- Marnewecke & Kotze 1999. Appendix W6: Guidelines for delineation of wetland boundary and wetland zones. In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

The following guidelines and frameworks were used to determine the sensitivity or importance of these identified watercourses or wetlands in the study area:

- Nel *et al.* (2011). Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

- Government of South Africa. 2008. National Protected Area Expansion Strategy for South Africa 2008: Priorities for expanding the protected area network for ecological sustainability and climate change adaptation. Government of South Africa, Pretoria.

- Duthie, A. 1999. Appendix W5: IER (floodplain and wetlands) determining the Ecological Importance and Sensitivity (EIS) and Ecological Management Class (EMC). In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

These guidelines provide the characteristics which can be utilised to determine if a wetland or watercourse is present and also aids in determining the boundary of these systems.

The following were utilised to inform the condition and status of watercourses:

- Kleynhans, C.J., Louw, M.D. & Graham, M. 2008. Module G: EcoClassification and EcoStatus determination in River EcoClassification: Index of Habitat Integrity. Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 377-08.

The following were utilised to inform the condition and status of wetlands:

- Macfarlane, D.M., Ollis, D.J. & Kotze, D.C. 2020. WET-Health (Version 2.0): a refined suite of tools for assessing the present ecological state of wetland ecosystems. WRC Report No. TT 820/20.

A Risk Assessment will be conducted for the proposed development in or near watercourses and wetlands in accordance with the Department of Water & Sanitation's requirements for risk assessment and the provisional Risk Assessment Matrix for Section 21(c) & (i) water use.

### 3.3 Criteria used to assess sites

The following criteria is also applied during the site survey to further inform the general sensitivity and conservation value of the site or specific elements on the site. These criteria were used to assess the site and determine the overall status of the environment.

#### 3.3.1 Vegetation characteristics

Characteristics of the vegetation in its current state. The diversity of species, sensitivity of habitats and importance of the ecology as a whole.

Habitat diversity and species richness: normally a function of locality, habitat diversity and climatic conditions.
Scoring: Wide variety of species occupying a variety of niches – 1, Variety of species occupying a single nich – 2, Single species dominance over a large area containing a low diversity of species – 3.

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species.
Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely – 3.

Ecological function: All plant communities play a role in the ecosystem. The ecological importance of all areas though, can vary significantly e.g. wetlands, drainage lines, ecotones, etc.
Scoring: Ecological function critical for greater system – 1, Ecological function of medium importance – 2, No special ecological function (system will not fail if absent) – 3.

Degree of rarity/conservation value:
Scoring: Very rare and/or in pristine condition – 1, Fair to good condition and/or relatively rare – 2, Not rare, degraded and/or poorly conserved – 3.

#### 3.3.2 Vegetation condition

The sites are compared to a benchmark site in a good to excellent condition. Vegetation management practises (e.g. grazing regime, fire, management, etc.) can have a marked impact on the condition of the vegetation.

Percentage ground cover: Ground cover is under normal and natural conditions a function of climate and biophysical characteristics. Under poor grazing management, ground cover is one of the first signs of vegetation degradation.
Scoring: Good to excellent – 1, Fair – 2, Poor – 3.

Vegetation structure: This is the ratio between tree, shrub, sub-shrubs and grass layers. The ratio could be affected by grazing and browsing by animals.

Scoring: All layers still intact and showing specimens of all age classes – 1, Sub-shrubs and/or grass layers highly grazed while tree layer still fairly intact (bush partly opened up) – 2, Mono-layered structure often dominated by a few unpalatable species (presence of barren patches notable) – 3.

Infestation with exotic weeds and invader plants or encroachers:
Scoring: No or very slight infestation levels by weeds and invaders – 1, Medium infestation by one or more species – 2, Several weed and invader species present and high occurrence of one or more species – 3.

Degree of grazing/browsing impact:
Scoring: No or very slight notable signs of browsing and/or grazing – 1, Some browse lines evident, shrubs shows signs of browsing, grass layer grazed though still intact – 2, Clear browse line on trees, shrubs heavily pruned and grass layer almost absent – 3.

Signs of erosion: The formation of erosion scars can often give an indication of the severity and/or duration of vegetation degradation.
Scoring: No or very little signs of soil erosion – 1, Small erosion gullies present and/or evidence of slight sheet erosion – 2, Gully erosion well developed (medium to large dongas) and/or sheet erosion removed the topsoil over large areas – 3.

### 3.3.3 Faunal characteristics

Presence of rare and endangered species: The actual occurrence or potential occurrence of rare or endangered species on a proposed site plays a large role on the feasibility of a development. Depending on the status and provincial conservation policy, presence of a Red Data species or very unique and sensitive habitats can potentially be a fatal flaw.
Scoring: Occurrence actual or highly likely – 1, Occurrence possible – 2, Occurrence highly unlikely.

### 3.4 Biodiversity sensitivity rating (BSR)

The total scores for the criteria discussed in section 3.3 were used to determine the biodiversity sensitivity ranking for the sites. On a scale of 0 – 30, five different classes are described to assess the biodiversity of the study area. The different classes are described in the Table 1:

Table 1: Biodiversity sensitivity ranking

| BSR | BSR general floral description | Floral score equating to BSR class |
|---|---|---|
| Totally transformed (5) | Vegetation is totally transformed or in a highly degraded state, generally has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area has lost its inherent ecological function. The area has no conservation value and potential for successful rehabilitation is very low. | 29 – 30 |
| Advanced Degraded (4) | Vegetation is in an advanced state of degradation, has a low level of species diversity, no species of concern and/or has a high level of invasive plants. The area's ecological function is seriously hampered, has a very low conservation value and the potential for successful rehabilitation is low. | 26 – 28 |
| Degraded (3) | Vegetation is notably degraded, has a medium level of species diversity although no species of concern are present. Invasive plants are present but are still controllable. The area's ecological function is still intact but may be hampered by the current levels of degradation. Successful rehabilitation of the area is possible. The conservation value is regarded as low. | 21 – 25 |
| Good Condition (2) | The area is in a good condition although signs of disturbance are present. Species diversity is high and species of concern may be present. The ecological function is intact and very little rehabilitation is needed. The area is of medium conservation importance. | 11 – 20 |
| Sensitive/Pristine (1) | The vegetation is in a pristine or near pristine condition. Very little signs of disturbance other than those needed for successful management are present. The species diversity is very high with several species of concern known to be present. Ecological functioning is intact and the conservation importance is high. | 0 - 10 |

## 4. ECOLOGICAL OVERVIEW OF THE SITE

For the purpose of this report the terrestrial ecology of the study area will first be discussed followed by a discussion of the watercourses and wetland systems.

### 4.1 Overview of ecology and vegetation types

Refer to the list of species encountered on the site in Appendix B.

According to Mucina & Rutherford (2006) the area consists of Vaal-Vet Sandy Grassland (Gh 10) and Vaal Reefs Dolomite Sinkhole Woodland (Gh 12). The former is currently listed as Endangered (EN) while the latter is Least Concern (LC) under the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004) (Appendix A: Map 1). The Vaal-Vet Sandy Grassland dominates the southern portion of the site and is visible as undulating grassland but characterised by fairly deep, sandy soils. These remaining natural portions of this grassland would also be regarded as being of high conservation value. The vegetation type is currently heavily affected by extensive transformation by agriculture, urban expansion and mining operations. The Vaal Reefs Dolomite Sinkhole Woodland dominates the northern portions of the site and is visible as undulating plains though here exposed low rocky ridges become evident, deeper sandy soils are absent and the grass composition also differs slightly by containing a higher proportion of sour grasses. The woodland component, associate with dolomite sinkholes is not well represented on the site although a few bush clumps were noted. This vegetation type is also heavily affected by transformation but not yet to such an extent as to warrant it being listed as a Threatened Ecosystem.

The Free State Province Biodiversity Management Plan (2015) has been published and has identified areas which are essential to meeting conservation targets for specific vegetation types, i.e. Critical Biodiversity Areas. The site in question is predominately listed as an Ecological Support Area 1 and 2 (ESA) which functions in support of the Vaal River which is situated approximately 1 km to the north of the site (Appendix A: Map 2). The development should therefore not result in compromising the functioning of this important system, i.e. increase runoff or degrade the area to such an extent that it influences the functioning of the Vaal River. Furthermore, the site also contains two prominent areas being regarded as Critical Biodiversity Areas 1 (CBA 1) situated in the centre and eastern portion of the site (Appendix A: Map 2). These CBA 1 areas have been identified as being crucial for meeting conservation targets for the Endangered Vaal-Vet Sandy Grassland occurring in this area but also to some extent the Vaal Reefs Dolomite Sinkhole Woodland in the area. These CBA 1 areas have been identified as being Irreplaceable, i.e. “A site that is irreplaceable or near-irreplaceable for meeting biodiversity targets. There are no or very few other options for meeting biodiversity targets for the features associated with the site. Such sites are therefore critical and they need to be maintained to ensure that features targets are achieved and that such features persist.” These portions of CBA’s occurring on the site will therefore have to be excluded from development in order to ensure they remain intact.

The study area is situated approximately 10 km east of the small town of Orkney and to the south of the settlement of Vaal Reefs (Appendix A: Map 1). The study area is fairly large and is dominated by undulating grassland plains with gentle slopes that generally slopes toward the north and east, toward lower lying watercourses and wetlands. The extent of the study area is approximately 1500 hectares. A significant portion of this development area has however been

transformed by the existing mining plants and infrastructure. However, the majority of the area is still dominated by natural grassland with some disturbance also being evident. A large wetland area is also present in the eastern portion, with a few small depression wetlands also occurring in the southern portion.

As previously indicated, the study area is still largely dominated by natural grassland and which can broadly be divided into a northern and southern portion where the northern portion is dominated by Vaals Reefs Dolomite Sinkhole Woodland and also north of a large tarred road while the southern portion is dominated by Vaal-Vet Sandy Grassland and situated south of the tarred road (Appendix A: Map 1).

The southern portion is dominated by grassland dominated by Vaal-Vet Sandy Grassland and which is largely still intact (Appendix A: Map 1). A significant portion also consists of Vaal Reefs Dolomite Sinkhole Woodland though the transition between these two vegetation types is gradual. Portions of the grassland has previously been transformed though the majority of these have again been able to re-establish a fairly natural grass layer. However, a few smaller portions are still visibly degraded and transformed and these include a large woodlot of invasive Bluegum (*Eucalyptus camaldulensis*), oxidation ponds associated with mining operations, greenhouses and a small portion previously used as stockpiling/construction area. A large wetland system is also situated in the south eastern portion of the site which is a natural and important system (Appendix A: Map 3). These wetland areas will all be assessed in detail in the wetland assessment section of the report. A large portion of this southern portion of the site has previously been proclamated as the Mispah Game Reserve which has been registered as a Protected Area (PA) under the National Environmental Management Protected Areas Act (NEMPAA of 2003) (Appendix A: Map 2). The area is listed as a Private Nature Reserve within the South Africa Protected & Conservation Areas Database (SAPAD) and was proclamated in 2001 (Notice 23 of 2001). Development within any protected area is highly unlikely since this is largely prevented by the NEMPAA and any management plan of the protected area.

Figure 1: Natural grassland dominate the southern portion of the site and consist of a dense grass cover with fairly deep sandy soils.

Figure 2: Another view of the natural grassland in the southern portion of the site.

Figure 3: A fairly large woodlot of invasive Bluegum does cause transformation of a substantial portion of the natural grassland.

Figure 4: A large wetland system occurs in the south eastern portion of the site.


Figure 5: Location and boundaries of the Mispah Game Reserve (Yellow) situated in the study area (Red).

The northern portion is also dominated by grassland but which consists almost exclusively of Vaal Reeds Dolomite Sinkhole Woodland (Appendix A: Map 1). This grassland is also largely natural though significant disturbance is associated with areas of shallow excavations and overgrazing by domestic livestock. Though Vaal Reefs Dolomite Sinkhole Woodland is under significant development pressure, it is also not currently listed as a Threatened Ecosystem and will therefore have a slightly lower conservation value than the southern portion. The Vaal Reefs Dolomite Sinkhole Woodland is characterised by a well-developed grass layer and much higher degree of surface rock as well as at least some bush clumps establishing around sinkholes. For the study area these sinkholes are rare with only a few small bush clumps occurring in the area. The north western portion is visibly degraded by high levels of overgrazing by domestic livestock and also a substantial area which was previously used for dumping of spoil and rubble and also contains shallow excavations.

Figure 6: Natural grassland in the northern portion of the site is also largely intact with a dense grass cover.

Figure 7: Bush clumps associated with sinkholes are quite rare.

Figure 8: A significant portion of the north west of the site contains shallow excavations with invasive trees having become established there.

From the above paragraphs it is clear that the study area is still largely natural and dominated by dense grassland. However, several areas are affected by transformation and impacts (Appendix A: Map 4). The most notable transformation of the area is associated with the Moab and Noligwa mining operations which include extensive operational plants, tailings dumps and associated infrastructure such as roads, pipelines and powerlines. Other additional areas of transformation also include:

- A large portion in the south east of the site has been ploughed and is being used for crop cultivation. This portion is completely transformed and covers an area of approximately 60 hectares.

- A small area of approximately 3 hectares in the south east of the site was previously cleared of vegetation and used as a stockpile or construction yard. This area has now re-established a grass layer but is visibly degraded.

- A small area of approximately 3 hectares in the south east consist of a complex of greenhouses which is clearly a transformed area.

- A large woodlot of approximately 20 hectares is situated in the south western portion of the site and consists of the invasive Bluegum (*Eucalyptus camaldulensis*). This area also forms part of the Mispah Game Reserve but is clearly transformed.

- Along the south western border of the study area, a large tailings dam is situated. This dam also seeps toward the north east and into the study area. This seepage area is clearly quite degraded, most probably as a result of high salt concentrations. This

results in the dominance of the dwarf shrub, *Stoebe plumosus*, a clear indicator of degraded grassland. Though these seepage areas are not necessarily transformed they are clearly quite degraded. This seepage area covers an area of approximately 7 hectares.

- A few oxidation ponds are situated along the northern border of the tailings dam situated along the south western border of the site. These and immediate surroundings has caused local transformation of the natural grassland and cover an area of approximately 30 hectares.

- A fairly large area (approximately 20 hectares) in the northern portion of the site consists of shallow excavations and dumps of rubble and spoil where invasive trees have also become established. These areas are completely transformed from the natural condition.

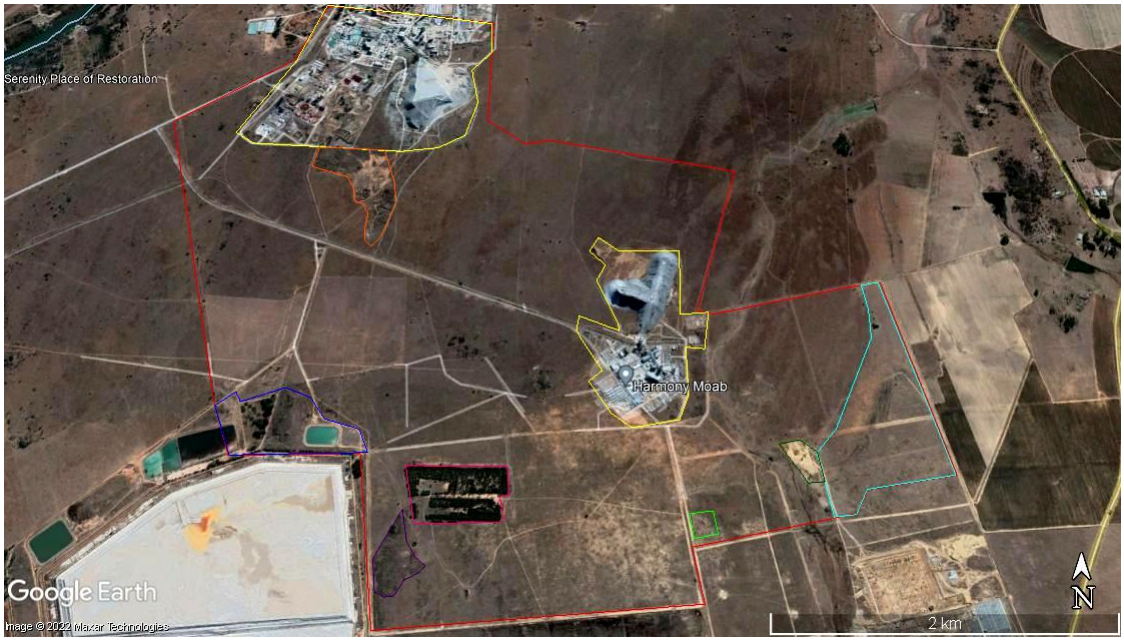



Figure 9: Relative areas of transformation in the study area (red) include; mining operations, plant and tailings (yellow), crop fields (light blue), stockpile area (dark green), greenhouses (light green), woodlot (pink), seepage (purple), oxidation ponds (blue) and excavations (orange) (Google Earth 2009).

Large portions of the area is also being utilised as communal grazing for domestic livestock. This does contribute toward significant impacts on the grassland vegetation and especially in the north western portion this leads to increased establishment of exotic weeds. This does however not lead to transformation of the vegetation but simply contributes toward disturbance.

The natural topography of the area is still largely intact and is dominated by undulating plains. Surface rock becomes more prominent in the northern portion and along low ridges while a few obscure sinkholes are also present. The topography has been modified in a few localised areas which include the mining operations and tailings areas, a cultivated field in the south east, a previous construction/stockpile area in the south east, oxidation ponds and surrounding disturbance in the south west and a large area of shallow excavations and rubble dumps in the northern portion of the site.

The site and the surrounding area is situated in a region experiencing moderate rainfall, with cold, dry winters and warm summers. Climate for the site can be extrapolated from rainfall and evaporation data from the weather station C2E004 (Potchefstroom). The site is located in an area with a rainfall of between 600 mm and 700 mm per annum with an average of 631.7 mm per year. Rainfall occurs largely as summer rainfall with an average annual evaporation of 1661 mm/annum. The surface water runoff in the area is therefore at least moderate which results in ample runoff for the area of between 20 - 50 mm according to a study by the Water Research Commission.

The study area is situated on geology associated with the Malmani Subgroup as well as the Vryheid Formation. The Malmani Subgroup forms part of the Chuniespoort Group of Transvaal Supergroup and is associated with dolomite, subordinate chert, minor carbonaceous shale, limestone and quartzite and this geology also corresponds to a large degree, with the Vaal Reeds Dolomite Sinkhole Woodland vegetation dominating the northern portion of the site. The Vryheid Formation forms part of the Ecca Group of the Karoo Supergroup and is associated with Fine- to coarse-grained sandstone and shale and this geology also corresponds to a large degree with the Vaal-Vet Sandy Grassland of the southern portion of the site.

As previously indicated, the terrestrial component of the study area, can roughly be divided into a northern and southern section largely based on a division between different vegetation types where the northern portion consists of Vaal Reefs Dolomite Sinkhole Woodland where a higher degree of surface rock is present with shallower soils while the southern portion consists of Vaal-Vet Sandy Grassland which contains deeper, sandy soils (Appendix A: Map 1). These areas are also roughly divided by a tarred road. These areas will be discussed separately in the below paragraphs and elements of conservation value indicated where these were observed.

**Southern portion (Vaal-Vet Sandy Grassland – Deeper sandy soils) (Appendix A: Map 1)**

The southern portion of the site, is still largely natural and dominated by a well-developed grass layer (Appendix A: Map 1). Areas of local transformation include the mining operations, oxidation ponds, agricultural crop fields, a woodlot of exotic trees and smaller areas of temporary transformation. In transformed areas the natural vegetation is clearly no longer present or consists of pioneer species while those areas that remain largely natural are still dominated by climax grasses indicating a fairly good condition. Exotic weeds are present and may also become abundant around disturbed or transformed areas. It is also notable that the southern portion contains a higher degree of sweet grassland (highly palatable grasses adapted to sandier soils). The boundary between the southern Vaal-Vet Sandy Grassland and northern Vaal Reefs Dolomite Sinkhole Woodland is also not clearcut and the two transitions into the other and may also occur as interspersed patches.

The vegetation composition in the southern portion confirms a largely natural vegetation type in a fairly good condition. The grass layer is dominated by climax grasses with a prominent herbaceous component also present. Climax grasses include *Themeda triandra, Triraphis andropogonoides, Eragrostis lehmanniana, Urelytrium agropyroides, Loudetia simplex, Anthephora pubescens, Brachiaria serrata, Digitaria eriantha* and *Eragrostis curvula*. Where disturbance is evident in areas which were previously cleared of vegetation or where other disturbances such as overgrazing has occurred, the grass layer does contain an increase in pioneer grasses such as *Cynodon dactylon, Pogonarthria squarrosa, Eragrostis gummiflua, Perotis patens* and *Aristida canescens*. Though these pioneer grasses would also be present in areas where the vegetation is in a good condition, an abundance does indicate disturbance as

was observed in some areas. A prominent herbaceous component is also present and includes *Helichrysum callicomum, Hermannia geniculata, Delosperma herbeum, Selago densiflora, Helichrysum caespititum, Selago burkei, Felicia muricata, Dicoma macrocephala, Ruschia hamata, Barleria macrostegia, Euphorbia striata, Helichrysum nudifolium* and *Ipomoea crassipes*. Where disturbance has occurred herbs such as *Polydora poskeana, Ursinia nana* and *Nidorella resedifolia* may also be locally abundant. The deeper sandy soils associated with this vegetation type also promote the establishment of geophytic species, i.e. plants with an underground storage organ. These include plants such as *Orthanthera jasminiflora, Trachyandra laxa, Boophone distichia, Acanthosicyos naudinianus, Pentharhinum insipidum, Raphionacme velutina, Babiana bainesii* and *Schixocarpus nervosus*. An unidentified orchid species, *Satyrium sp*. was also noted and though it cannot be identified to species level due to the absence of an inflorescence it is most likely of high conservation value. A protected succulent, *Aloe greatheadii* is also present as scattered clumps. It was noted that the dwarf shrub, *Stoebe plumosus*, was present in this grassland, where previous transformation has occurred or where high levels of disturbance is evident such as the seepage from the tailings dam in the south west of the site, that this species becomes dominant. This plant is a well known indicator of previously transformed grassland and can be used to indicate degraded areas. Exotic weeds were also prominent in areas of disturbance and included *Bidens bipinnata* and *Tagetes minuta*.

Many of the plants listed in the previous paragraph are also regarded as protected within the Free State Province (Appendix B). These include *Helichrysum spp., Euphorbia striata, Orthanthera jasminiflora, Boophone distichia, Pentharhinum insipidum, Schixocarpus nervosus, Satyrium sp., Raphionecma velutina, Babiana bainesii* and *Aloe greatheadii.* Where any of the herbaceous protected species will be affected by the development, permits will have to be obtained for their removal. Where the development will affect geophytic or succulent species, permits will also have to be obtained, but affected plants transplanted to adjacent areas where they will remain unaffected.

From the vegetation description of the southern portion of the site dominated by Vaal-Vet Sandy Grassland it would seem to be largely intact and in a fairly good condition (Appendix A: Map 1). Signs of disturbance are however also evident and areas where previous clearance of the vegetation had occurred are clearly degraded. The species diversity is moderate although the area does also contain a significant number of protected plant species which will contribute towards its conservation value (Appendix B). However, the vegetation here is dominated by Vaal-Vet Sandy Grassland, an Endangered (EN) vegetation type which would therefore have at least a High level of sensitivity (Appendix A: Map 4). In addition, several factors further contribute towards its conservation value which include the Mispah Game Reserve, a proclamated Protected Area (PA) and sections having been listed as Critical Biodiversity Area 1 (CBA 1) and are characterised as irreplaceable. This will contribute to an even higher level of sensitivity (Appendix A: Map 2 & 4).

Figure 10: A well-developed grassland dominated the southern portion of the site where sandy soils are also evident.

Figure 11: Another view of the extensive grassland in the southern portion of the site, note the undulating terrain.

Figure 12: Where higher levels of disturbance becomes evident, exotic weeds (red) are more abundant.

**Northern portion (Vaal Reeds Dolomite Sinkhole Woodland – Rocky outcrops) (Appendix A: Map 1)**

The northern portion of the site, is also still largely natural and dominated by a well-developed grass layer (Appendix A: Map 1). Here a few scattered bush clumps are also present, associated with dolomite sinkholes. Rocky outcrops are also present along the higher lying areas which also promote the establishment of shrubs. Areas of local transformation include the mining operations, tailing dumps and fairly extensive areas of shallow excavations and rubble dumps. In these transformed areas the natural vegetation has been quite heavily degraded and exotic and invasive weeds and trees are prominent. However, the majority of this portion is still largely natural and dominated by climax grasses indicating a fairly good condition. Large areas, especially the western portion of the site is also being used as communal grazing for domestic livestock and this does contribute to the establishment of exotic weeds. It is also notable that this portion contains a higher degree of sour grassland (unpalatable grasses dominate in rockier soils). The boundary between the southern Vaal-Vet Sandy Grassland and northern Vaal Reefs Dolomite Sinkhole Woodland is also not clearcut and the two transitions into the other and may also occur as interspersed patches.

The vegetation in the northern portion confirms a largely natural vegetation type in a fairly good condition. The grass layer is dominated by climax grasses with a prominent herbaceous component also present. Climax grasses include *Hyparrhenia hirta, Harpochloa falx, Trachypogon spicatus, Cymbopogon pospischillii, Themeda triandra* and *Cymbopogon excavatus.* These are mostly sour grasses natural to this vegetation type and can be used to differentiate it from the Vaal-Vet Sandy Grassland to the south. Where disturbance is higher, such as overgrazed areas, the grass layer does contain an increase in pioneer grasses such as *Cynodon dactylon, Eragrosis gummiflua, Stipagrostis uniplumis* and *Sporobolus discosporus*. Though these pioneer grasses would also be present in areas where the vegetation is in a good condition, an abundance does indicate disturbance as was observed in some areas. A prominent herbaceous component is also present and includes *Helichrysum callicomum, Senecio coronatus, Limeum viscosum, Indigofera sp., Hilliardiella eleagnioides, Lasiosiphon sericocephalus, Vigna sp., Indigofera daleoides, Lippia scaberrima, Dicoma anomala* and *Chascanum pinnatifidum*. Where disturbance has occurred herbs such as *Acrotome inflata* and *Nidorella resedifolia* may also be locally abundant. The exposed rocky areas and shallower soils also promote the establishment of a variety of other growth forms such as dwarf shrubs, *Triumfetta sonderi,* ferns, *Pellaea calomelanos* and small succulents, *Crassula lanceolata, Crassula capitella* and *Kalanchoe rotundifolia*. As previously indicated, the vegetation type also integrates gradually with the Vaal-Vet Sandy Grassland and areas with deeper soils are also common. Here geophytic (plants with an underground storage organ) and suffrutices (plants with an extensive belowground stem network) species are also abundant and include *Hypoxis hemerocallidae, Ledebouria sp., Elephanthorrhiza elephantina, Pygmaeothamnus zeyheri, Chlorophytum sp., Babiana bainesii, Drimia platyphylla, Crinum graminicola, Raphionacme velutina* and *Ziziphus zeyheriana*. The rocky areas, including any rare sinkholes, also contribute to the establishment of small trees and shrubs which include *Gymnosporia buxiifolia, Asparagus larcinus, Ziziphus mucronata, Searsia pyroides, Celtis africana, Clematis brachiata, Vachellia erioloba, Vachellia karroo, Grewia flava* and *Searsia lancea*. Of these, *V. erioloba* (Camel Thorn) is also listed as a protected tree but is only represented by a few small specimens which therefore have a limited conservation value. The dwarf shrub, *Stoebe plumosus*, was present in this grassland and though it is a natural component of the grassland, can become abundant where disturbance is high. Exotic weeds can be abundant in disturbed areas and include *Physalis viscosa* and *Achyranthes aspera*.

Many of the plants listed in the previous paragraph are also regarded as protected within the Free State Province (Appendix B). These include *Helichrysum callicomum, Babiana bainesii, Crinum graminicola, Raphionacme velutina* and *Vachellia erioloba*. Where any of the herbaceous and tree protected species will be affected by the development, permits will have to be obtained for their removal. Where the development will affect geophytic or succulent species, permits will also have to be obtained, but affected plants transplanted to adjacent areas where they will remain unaffected.

As previously indicated, a large area is affected by shallow excavations and rubble dumps and here the vegetation has become dominated by weeds and invasive trees (Appendix B). Invasive trees are abundant and include *Melia azedarach, Eucalyptus camaldulensis, Gleditsia triacanthos, Nicotiana glauca, Acacia baileyana* and *Tamarix chinensis*. Invasive grasses such as *Pennisetum setaceum* and invasive succulents such as *Opuntia ficus-indica* are also abundant. Indigenous pioneer grasses are also abundant and include *Melinis repens* while a few indigenous trees have also become established including *Vachellia karroo* and *Searsia lancea*. As can be seen, this portion of the site is almost completely transformed and degraded while invasive plants are also likely to spread into the surrounding natural areas.

From the vegetation description of the northern portion of the site dominated by Vaal Reefs Dolomite Sinkhole Woodland it would seem to be largely intact and in a fairly good condition (Appendix A: Map 1). Areas of transformation are present, notably the mining plant and surrounding shallow excavations and rubble dumps while overgrazing may also lead to local disturbance in the north western portion of the site. The species diversity is moderate although the areas does also contain a significant number of protected plant species which will contribute towards its conservation value. Though the vegetation is subjected to significant transformation pressures it is not yet sufficient for it to be regarded as a Threatened Ecosystem. The northern portion of the site would therefore be regarded as generally of Moderate sensitivity. However, a significant portion has also been listed as Critical Biodiversity Area 1 (CBA 1) and has been identified as irreplaceable in terms of the biodiversity management plan (Appendix A: Map 2 & 4). These areas will therefore be regarded as having a very high conservation value since are considered as essential to meeting conservation targets for the respective vegetation types.

Figure 13: The northern portion of the site is also dominated by a well-developed grass layer.

Figure 14: Another view of the extensive grassland habitat in the northern portion of the site.

Figure 15: A few scattered bush clumps occur in the northern portion of the site around sinkholes and rocky outcrops.

Figure 16: Rocky outcrops promote the establishment of a variety of different growth forms.

Figure 17: Invasive trees dominate an area of shallow excavations and rubble dumps in the northern portion of the site.

**Conclusions**

From the description of the area given above it is clear that the majority of the site still consists of natural grassland which is still in a fairly good condition (Appendix A: Map 1). The surroundings as well as significant portions of the site has been affected and transformed by historical mining operations. Being a mining area, this results in transformation and degradation of large portions of land. The cumulative impact of development and mining in this area is therefore high. The proposed solar development should therefore first consider the development of areas considered as already transformed and of low sensitivity. These include areas previously cleared for construction activities, portions transformed by ploughing for crop production and degraded areas associated with the mining operations which also includes areas of shallow excavations and rubble dumps. It is however inevitable that the development will also encroach into areas of natural grassland which will result in significant impacts.

Given the above descriptions of the natural vegetation the following areas of high sensitivity should be avoided as far as possible (Appendix A: Map 1 - 4):

- The Mispah Game Reserve covers a large portion of the southern portion of the site. This is a Private Nature Reserve which has been proclamated as a Protected Area (PA) under the National Environmental Management Protected Areas Act (NEMPAA of 2003). The area is listed as a Private Nature Reserve within the South Africa Protected & Conservation Areas Database (SAPAD) and was proclamated in 2001 (Notice 23 of 2001). Development within any protected area is highly unlikely since this is largely prevented by the NEMPAA and any management plan of the protected area. This PA has also been taken into account in determining the provincial and national conservation targets and development within this PA will also affect these conservation targets.

- Two large CBA 1 areas have been delineated by the Free State Biodiversity Management Plan. These CBA 1 areas have been identified as being crucial for meeting conservation targets for the Endangered Vaal-Vet Sandy Grassland occurring in this area but also to some extent the Vaal Reefs Dolomite Sinkhole Woodland in the area. These CBA 1 areas have been identified as being Irreplaceable in terms of meeting conservation targets.
    - The development should therefore exclude these CBA areas from development.
    - Where no alternative is possible and development needs to encroach into these CBA areas, alternative CBA areas will have to be identified in order to still meet conservation targets. Given that these CBA areas have been identified as irreplaceable this will not be easily attainable.

- Portions of remaining Vaal-Vet Sandy Grassland also occur in the south east of the site but which do not form part of the Mispah Game Reserve or identified CBA areas. However, since this vegetation type is currently listed as Endangered (EN) these areas must still be afforded a High level of sensitivity. Development should investigate all alternatives to avoid this area and should only encroach into this area if no other alternative is available. This will however result in high impacts.

- A large wetland system transects the eastern portion of the site. This is clearly an important water resource and will have a Very High level of sensitivity. It will not be

possible to develop this system and should be completely excluded from development. A suitable buffer should also determined and retained around this wetland system. A detailed assessment of this wetland will be conducted in the wetland assessment section of the study.

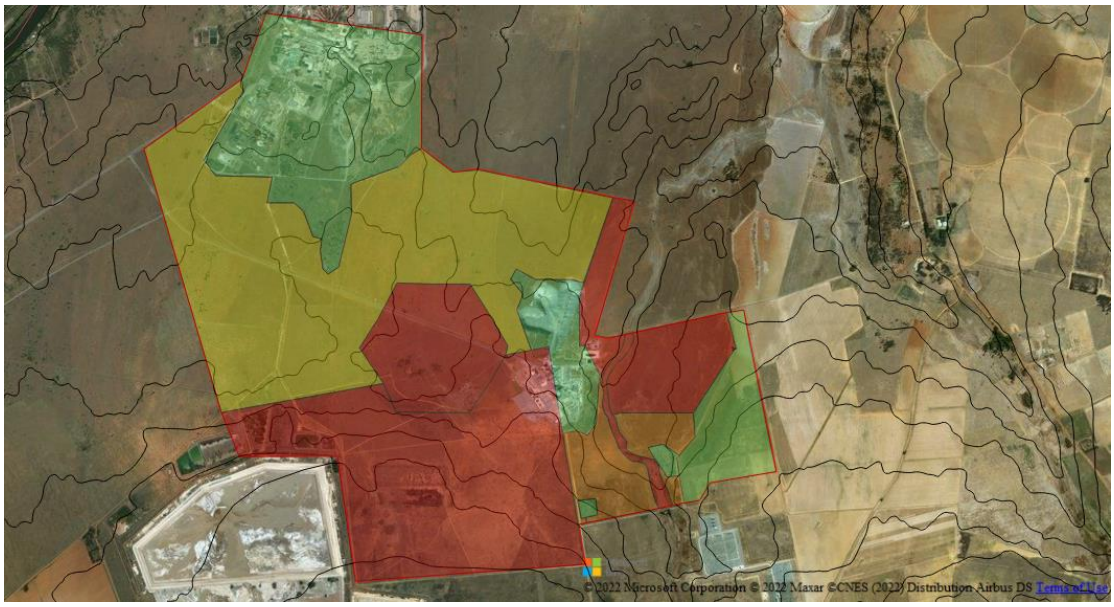



Figure 18: Areas of conservation importance include the Mispah Game Reserve, prominent CBA 1 area and a wetland system in the south eastern portion of the site (red). Remaining portions of Vaal-Vet Sandy Grassland are also of high conservation value (orange) while remaining natural grassland is at least of moderate importance (yellow). Areas regarded as transformed as indicated as green.

Since it is clear that the impact of the solar development will be high and will lead to irreversible transformation, the development area should be carefully determined, should focus on areas of lower sensitivity and should limit the extent of transformation as far as possible. Current layout plans do indicate that areas of High Sensitivity are largely being avoided while mostly retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity. Furthermore, numerous protected plant species has been identified in the study area (Appendix B). These include the protected succulent and geophytic species, *Euphorbia striata, Orthanthera jasminiflora, Boophone distichia, Pentharhinum insipidum, Schizocarpus nervosus, Satyrium sp., Raphionecma velutina, Babiana bainesii, Aloe greatheadii, Crinum graminicola,* and *Vachellia erioloba*. Where development will affect these species, the necessary permits should be obtained and a significant proportion of these transplanted to adjacent areas where they will remain unaffected. In addition, there are also a few protected herbaceous plants (*Helichrysum spp.*) and a few specimens of the protected *Vachellia erioloba* (Camel Thorn). Where any of these will require removal, the necessary permits should be obtained to do so.

In addition, the area also contains many invasive trees, especially in the transformed excavations in the northern portion of the site, and this will pose a risk of spreading into surrounding natural areas, especially as construction of the solar development will increase disturbance in the area (Appendix B). The proposed development will also have to implement a comprehensive monitoring and eradication programme to ensure that invasive plant species are removed from the area and prevented from re-establishing.

### 4.2 Overview of terrestrial mammals (actual & possible)

Signs and tracks of mammals are fairly abundant on the site though the mammal population will be somewhat modified from the natural condition. Natural vegetation has a high carrying capacity for mammals which decreases significantly where mining or agriculture transforms this natural vegetation and in such transformed areas the mammal population is normally represented by a generalist mammal population. As indicated previously, the majority of this still consists of natural vegetation and accordingly the mammal population will also be largely natural in these areas. The mammal population in natural areas would however still be somewhat modified as a result of the surrounding fragmentation of habitat which affects the population dynamics and migration of mammals. Other impacts such as roads, herding, trapping and the proximity of mining activities would also further impact on mammals, especially reclusive and rare mammals dependant on pristine habitats. Rare and endangered mammals are often reclusive and avoid areas in close proximity to human activities and are also dependant on habitat in pristine condition. The site would therefore have a significant impact on the likelihood of such rare and endangered species occurring in the area, there is however still a likelihood that remaining natural areas may harbour species of high conservation value.

Wetland and riparian habitats also generally provide a higher abundance of resources and subsequently are also able to sustain a diverse and large mammal population (Appendix A: Map 3). This will also be the case for the wetland system in the eastern portion of the site. Although surrounding mining operations and associated impacts will affect the mammals along the wetland as well, it will still be able to sustain a higher bio-load which in turn supports a larger mammal population and it is likely that the mammal population along the wetland will be substantial. Development in close proximity to this wetland will therefore have a significantly higher impact.

The mammal survey of the site was conducted by means of active searching, camera traps and recording any tracks or signs of mammals and actual observations of mammals. From the survey the following actual observations of mammals were recorded:

- Soil mounds of the Common Molerat (*Cryptomys hottentotus*) were common in most areas of the study area. This is a widespread species which has even become adapted to urban areas. It is a generalist species anticipated to occur in this area.

- Extensive colonies of Ground Squirrel (*Xerus inauris*) and Yellow Mongoose (*Cynictis penicillata*) occur in the study area. These are companion species which are widespread and common and found in most natural or disturbed habitats.

- Scat of Porcupines (*Hystrix africaeaustralis*) were noted in several areas. This is also a generalist species, widespread and common in almost all natural areas.

- Several burrows of small mammals were noted which could not be identified but do indicate a significant mammal population in the area.

- Several burrows and excavation of Aardvark (*Oryteropus afer*) occur in the study area. This is also a fairly widespread and common species but is highly reclusive and is also listed as a protected species and is therefore of significant conservation value.

- Several observations of Steenbok (*Raphicerus campestris*) and Common Duiker (*Sylvicapra grimmia*) were also made. These species are both widespread but confined to fairly natural or agricultural areas and generally avoid urban areas.

- Springhare (*Pedetes capensis*) is also common in the area and also indicate a significant prey base for larger carnivores. This species is widespread but confined to natural areas with deeper sandy soils.

- A Slender Mongoose (*Galerella sanguinea*) was also observed. Although also fairly widespread it is a less common species and requires natural vegetation in a fairly good condition. It also contributes toward and indicates a significant mammal diversity.

- Tracks of a large canid carnivore were observed which is likely that of a domestic dog associated with herding of livestock in this area. Herding dogs are also known to have a detrimental impact on the mammal population and will also have an additional impact on the already modified mammal population in the area.

- A Cape Hare (*Lepus capensis*) was also observed in the study area. This is also a widespread species but is dependent on open grassland habitats.

- A Serval (*Leptailurus serval*) was also observed in the western portion of the site. This is a rare species which is dependant on the close proximity of watercourses and wetlands. It is also Red Listed as a Near Threatened (NT) species due to the decline in suitable habitat.

These species identified on the site indicate a significant diversity, which although dominated by widespread and generalist species, also contain species of higher conservation value. This also indicates that although the mammal population will be somewhat modified, it remains likely that other species of high conservation value will still be present.

The most significant impact on mammals anticipated on the site itself is primarily concerned with the loss and fragmentation of available habitat. Transformation of the natural vegetation on the site will result in a decrease in the population size as available habitat decreases. Since it is inevitable that the development will involve the transformation of natural grassland this contributes significantly toward habitat loss which in turn will result in a high impact on the mammal population. This also indicates the need to take extra care in determining the development area, which should focus on areas of lower sensitivity, should exclude areas of high sensitivity and the wetland system in the eastern portion of the site and should limit the extent of transformation as far as possible. Current layout plans do indicate that areas of High Sensitivity are largely being avoided while mostly retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity.

It is also considered likely that several mammal species were overlooked during the survey and it may also be likely that other rare and endangered species may be present on the site.

Construction itself may also affect the mammal population and care should therefore be taken to ensure none of the faunal species on site is harmed. The hunting, capturing or harming in any way of mammals on the site should not be allowed. Voids and excavations may also act as

pitfall traps to fauna and these should continuously be monitored and any trapped fauna removed and released in adjacent natural areas.

Mammals species likely to occur on the site has been determined by means of FitzPatrick Institute of African Ornithology (2022).

Table 2: Red Listed mammals occurring or likely to occur in the study area (Child *et al* 2016).

| Scientific name | Common name | Status |
|---|---|---|
| *Damaliscus lunatus lunatus* | (Southern African) Tsessebe | **Vulnerable (VU)** |
| *Hippotragus equinus* | Roan Antelope | **Endangered (EN)** |
| *Pelea capreolus* | Vaal Rhebok | **Near Threatened (NT)** |
| *Atelerix frontalis* | Southern African Hedgehog | **Near Threatened (NT)** |
| *Felis nigripes* | Black-footed Cat | **Vulnerable (VU)** |
| *Leptailurus serval* | Serval | **Near Threatened (NT)** |
| *Hyaena brunnea* | Brown Hyena | **Near Threatened (NT)** |
| *Otomys auratus* | Southern African Vlei Rat (Grassland type) | **Near Threatened (NT)** |
| *Aonyx capensis* | African Clawless Otter | **Near Threatened (NT)** |
| *Mystromys albicaudatus* | African White-tailed Rat | **Vulnerable (VU)** |
| *Crocidura mariquensis* | Swamp Musk Shrew | **Near Threatened (NT)** |

The survey has indicated that though the mammal population will consist largely of widespread, generalist species, it remains possible that some of these Red Listed species may occur in the area. The Serval has already been confirmed to be present and it is therefore likely that other threatened mammals may also occur.

Table 3: Likely mammal species in the region.

| Family | Scientific name | Common name | Status |
|---|---|---|---|
| Bathyergidae | *Cryptomys hottentotus* | Southern African Mole-rat | Least Concern |
| Bovidae | *Aepyceros melampus* | Impala | Least Concern |
| | *Alcelaphus buselaphus caama* | Red Hartebeest | Least Concern |
| | *Antidorcas marsupialis* | Springbok | Least Concern |
| | *Connochaetes gnou* | Black Wildebeest | Least Concern |
| | *Connochaetes taurinus* | Blue Wildebeest | Least Concern |
| | *Damaliscus lunatus lunatus* | (Southern African) Tsessebe | **Vulnerable** |
| | *Damaliscus pygargus phillipsi* | Blesbok | Least Concern |
| | *Damaliscus pygargus pygargus* | Bontebok | Vulnerable |
| | *Hippotragus equinus* | Roan Antelope | **Endangered** |
| | *Hippotragus niger* | Sable Antelope | Least Concern |
| | *Kobus ellipsiprymnus* | Waterbuck | Least Concern |
| | *Oryx gazella* | Gemsbok | Least Concern |
| | *Pelea capreolus* | Vaal Rhebok | **Near Threatened** |

| | | | |
|---|---|---|---|
| | *Raphicerus campestris* | Steenbok | Least Concern |
| | *Redunca arundinum* | Southern Reedbuck | Least Concern |
| | *Redunca fulvorufula* | Mountain Reedbuck | Least Concern |
| | *Sylvicapra grimmia* | Bush Duiker | Least Concern |
| | *Syncerus caffer* | African Buffalo | Least Concern |
| | *Taurotragus oryx* | Common Eland | Least Concern |
| | *Tragelaphus angasii* | Nyala | Least Concern |
| | *Tragelaphus scriptus* | Bushbuck | Least Concern |
| | *Tragelaphus strepsiceros* | Greater Kudu | Least Concern |
| Canidae | *Canis mesomelas* | Black-backed Jackal | Least Concern |
| | *Otocyon megalotis* | Bat-eared Fox | Least Concern |
| | *Vulpes chama* | Cape Fox | Least Concern |
| Cercopithecidae | *Chlorocebus pygerythrus* | Vervet Monkey | Least Concern |
| | *Papio ursinus* | Chacma Baboon | Least Concern |
| Cervidae | *Dama dama* | Fallow Deer | Introduced |
| Equidae | *Equus quagga* | Plains Zebra | Least Concern |
| | *Equus zebra* | Mountain Zebra | |
| Erinaceidae | *Atelerix frontalis* | Southern African Hedgehog | **Near Threatened** |
| Felidae | *Caracal caracal* | Caracal | Least Concern |
| | *Felis catus* | Domestic Cat | Introduced |
| | *Felis nigripes* | Black-footed Cat | **Vulnerable** |
| | *Leptailurus serval* | Serval | **Near Threatened** |
| | *Panthera leo* | Lion | Least Concern |
| Giraffidae | *Giraffa giraffa giraffa* | South African Giraffe | Least Concern |
| Gliridae | *Graphiurus (Graphiurus) platyops* | Flat-headed African Dormouse | Data deficient |
| Herpestidae | *Atilax paludinosus* | Marsh Mongoose | Least Concern |
| | *Cynictis penicillata* | Yellow Mongoose | Least Concern |
| | *Herpestes sanguineus* | Slender Mongoose | Least Concern |
| | *Ichneumia albicauda* | White-tailed Mongoose | Least Concern |
| | *Suricata suricatta* | Meerkat | Least Concern |
| Hyaenidae | *Hyaena brunnea* | Brown Hyena | **Near Threatened** |
| | *Proteles cristata* | Aardwolf | Least Concern |
| Hystricidae | *Hystrix africaeaustralis* | Cape Porcupine | Least Concern |
| Leporidae | *Lepus capensis* | Cape Hare | Least Concern |
| | *Lepus saxatilis* | Scrub Hare | Least Concern |
| | *Pronolagus randensis* | Jameson's Red Rock Hare | Least Concern |
| Macroscelididae | *Elephantulus myurus* | Eastern Rock Elephant Shrew | Least Concern |
| Molossidae | *Chaerephon pumilus* | Little Free-tailed Bat | Least Concern |
| | *Tadarida aegyptiaca* | Egyptian Free-tailed | Least Concern |

| | | | |
|---|---|---|---|
| | | Bat | |
| Muridae | *Aethomys ineptus* | Tete Veld Aethomys | Least Concern |
| | *Aethomys namaquensis* | Namaqua Rock Mouse | Least Concern |
| | *Gerbilliscus brantsii* | Highveld Gerbil | Least Concern |
| | *Gerbilliscus leucogaster* | Bushveld Gerbil | Least Concern |
| | *Mastomys sp.* | Multimammate Mice | |
| | *Mastomys coucha* | Southern African Mastomys | Least Concern |
| | *Mastomys natalensis* | Natal Mastomys | Least Concern |
| | *Mus (Nannomys) indutus* | Desert Pygmy Mouse | Least Concern |
| | *Mus (Nannomys) minutoides* | Southern African Pygmy Mouse | Least Concern |
| | *Otomys auratus* | Southern African Vlei Rat (Grassland type) | **Near Threatened** |
| | *Rhabdomys pumilio* | Xeric Four-striped Grass Rat | Least Concern |
| Mustelidae | *Aonyx capensis* | African Clawless Otter | **Near Threatened** |
| | *Ictonyx striatus* | Striped Polecat | Least Concern |
| | *Mellivora capensis* | Honey Badger | Least Concern |
| Nesomyidae | *Dendromus melanotis* | Gray African Climbing Mouse | Least Concern |
| | *Mystromys albicaudatus* | African White-tailed Rat | **Vulnerable** |
| | *Saccostomus campestris* | Southern African Pouched Mouse | Least Concern |
| Orycteropodidae | *Orycteropus afer* | Aardvark | Least Concern |
| Pedetidae | *Pedetes capensis* | South African Spring Hare | Least Concern |
| Procaviidae | *Procavia capensis* | Cape Rock Hyrax | Least Concern |
| Rhinolophidae | *Rhinolophus clivosus* | Geoffroy's Horseshoe Bat | Least Concern |
| Sciuridae | *Paraxerus cepapi* | Smith's Bush Squirrel | Least Concern |
| | *Xerus inauris* | South African Ground Squirrel | Least Concern |
| Soricidae | *Crocidura mariquensis* | Swamp Musk Shrew | **Near Threatened** |
| | *Myosorex varius* | Forest Shrew | Least Concern |
| | *Suncus varilla* | Lesser Dwarf Shrew | Least Concern |
| Suidae | *Phacochoerus africanus* | Common Warthog | Least Concern |
| | *Potamochoerus larvatus koiropotamus* | Bush-pig (subspecies koiropotamus) | Least Concern |
| Thryonomyidae | *Thryonomys swinderianus* | Greater Cane Rat | Least Concern |

| | | | |
|---|---|---|---|
| Vespertilionidae | *Miniopterus natalensis* | Natal Long-fingered Bat | Least Concern |
| | *Myotis tricolor* | Temminck's Myotis | Least Concern |
| | *Neoromicia capensis* | Cape Serotine | Least Concern |
| Viveridae | *Genetta maculata* | Common Large-spotted Genet | Least Concern |
| | *Genetta genetta* | Common Genet | Least Concern |
| | *Genetta tigrina* | Cape Genet (Cape Large-spotted Genet) | Least Concern |

From historical records (Table 3) it is evident that the area contains a large amount of mammals and numerous Red Listed mammals. Many of the larger mammals are however historical records and would only be found within conservation areas, they are not of consequence to the development. The smaller Red Listed mammal species may still occur in the area, including the Black-footed Cat (*Felis nigripes*), Serval (*Leptailurus serval*), Southern African Vlei Rat (*Otomys auratus*), Hedgehog (*Atelerix frontalis*), Swamp Musk Shrew (*Crocidura ariquensis*), Brown Hyena (*Hyaena brunnea*), Cape Clawless Otter (*Aonyx capensis*) and African White-tailed Rat (*Mystromys albicaudatus*). As indicated, the Serval listed as Near Threatened (NT) has already been confirmed to occur on the site. It therefore remains likely some of the other Red Listed mammals may also occur in the area.

Since it has been confirmed that NT Serval occurs in the development area it is clear that the proposed development will have a significant impact on it. According to the National Red List (2016) the following recommendations and mitigation should be implemented where this species will be affected:

- Natural habitat should be conserved as far as possible. Managers and landowners must avoid wetland loss and should retain natural grassland areas in a good condition.

- The Serval population on the site should be monitored to determine abundance and trends and to determine the impact that development has on the population dynamics. Monitoring should also include the implementation of fixed camera traps for long term monitoring. Due to their specialised habitat requirements at small spatial scales, they may serve as a useful ecosystem indicator of the effect of habitat fragmentation in transformed landscapes.

- Monitoring of the Serval population must be introduced as a compliance measure in Environmental Impact Assessment reports.

- The development site should incorporate the long-term persistence of Serval and associated habitats into onsite biodiversity management practices. Buffer habitats could be modelled based on minimum wetland size and available cover.


Figure 19: Tracks and signs of mammals on the site include clockwise from top left; Ground squirrels (*Xerus inauris*), burrow of an unidentified small mammal, a soil mound of the Common molerat (*Cryptomys hottentotus*), sighting of a Common Duiker (*Sylvicapra grimmia*), spoor of a Springhare (*Pdedetes capensis*), scat of Porcupine (*Hystrix africaeaustralis*), track of a small antelope and Burrow of an Aardvark (*Orycteropus afer*),.

Figure 20: The following mammals had been recorded by means of camera traps, from top to bottom; Slender Mongoose (*Galerella sanguinea*), Cape Hare (*Lepus capensis*), Steenbok (*Raphicerus campestris*) and Serval (*Leptailurus serval*).

### 4.3 Wetland Assessment

#### 4.3.1 Introduction

The surface water features of the study area are dominated by a large valley bottom wetland system in the eastern portion of the site (Appendix A: Map 3). A few small depressions also occur in the south west of the site and within the Mispah Game Reserve. The assessment will focus on the large valley bottom system, clearly being the most important and most likely to be affected by the development, though will also include an overview of the small depressions in the south west of the site.

As indicated, a large valley bottom wetland system occurs in the eastern portion of the site and will likely be affected by the proposed development (Appendix A: Map 3). This is a seasonal system which flows mostly during the rainy season but did still illustrate an active hydrological regime at the time of the survey. The wetland transects the site from south to north and

originates approximately 5 km to the south of the site. The catchment is also situated in agricultural areas used for crop production which will have a large impact on it though where it occurs on the site is still naturally functioning and provides ample wetland habitat which will provide unique habitats and will provide vital downstream ecological functions.

Three small depression wetlands are situated in the south west of the site and are included within the Mispah Game Reserve and are therefore highly unlikely to be affected by the development (Appendix A: Map 3). They will however be discussed in overview in order to provide a comprehensive ecological overview of the entire study area. These depressions are clearly affected by a tailings dam located approximately 350 meters to the west of these depressions and which cause seepage in the direction of these pans and which clearly has a high impact on them. These pans have become nutrient enriched which cause a large modification of their vegetation structure.

Current wetland resources including the National Wetland Map 5 (NWM 5) and the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) also indicate a few other wetland areas likely to occur in the area (Appendix A: Map 1). The survey also sampled these areas and confirmed that no wetland conditions are present in these areas. They do not form part of any watercourse, wetland or surface water feature and are therefore not relevant for the development. The results will however be included in overview in order to confirm that these areas were surveyed and confirmed to be devoid of wetland conditions.

The term watercourse refers to a river, stream, wetland or pan. The National Water Act (NWA, 1998) includes rivers, streams, pans and wetlands in the definition of the term watercourse. This definition follows:

Watercourse means:

- A river or spring.
- A natural channel in which water flows regularly or intermittently.
- A wetland, lake or dam into which water flows.
- 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.

### 4.3.2 Wetland indicators

Riparian habitat is an accepted indicator of watercourses used to delineate the extent of wetlands, rivers, streams and pans (Department of Water Affairs and Forestry 2005). The wetland systems on the site were delineated by use of topography (land form and drainage pattern) and obligate wetland vegetation with limited soil sampling (Appendix C). Due to time constraints and the extent of the study area soil samples were only taken along a few transects of the valley bottom wetland to confirm the presence of wetland conditions. The following guidelines and frameworks were used to determine and delineate the watercourses and wetlands in the study area:

- Department of Water Affairs and Forestry. 2005. A practical field procedure for identification and delineation of wetlands and riparian areas. Edition 1. Department of Water Affairs and Forestry, Pretoria.
- Marnewecke & Kotze 1999. Appendix W6: Guidelines for delineation of wetland boundary and wetland zones. In: MacKay (Ed.), H. Resource directed measures for

protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

Obligate wetland vegetation was utilised to determine the presence and border of wetland conditions (Appendix B). Due to time constraints soil samples were only taken within sample points within the small depression wetlands and along three lateral transects of the larger valley bottom wetland system to confirm the presence or absence of wetland conditions. Soil samples were investigated for the presence of anaerobic evidence which characterises wetland soils (Appendix C).

The vegetation survey indicated that obligate wetland vegetation dominates the valley bottom wetland system in the east of the site (Appendix A: Map 3). The smaller depression wetlands in the south west of the site contained some obligate wetland vegetation though due to high levels of disturbance this was not as pronounced (Appendix A: Map 3). However, soil samples conclusively confirmed the presence of wetland conditions in both the valley bottom wetland system and small depression wetlands. The area has a slight slope toward the Vaal River situated to the north of the site though in general the topography is fairly flat and dominated by undulating terrain. Coupled with a moderate rainfall and surface runoff this causes the formation of gentler flowing systems such as valley bottom wetlands and depressions, as apposed to faster flowing streams occurring in foothills and mountainous terrain.

### 4.3.3 Classification of wetland systems

The wetland conditions identified within the valley bottom wetland system and small depressions in the study area can be classified into a specific wetland type.

**The large valley bottom wetland system in the east of the study area can be categorised as an unchanneled valley-bottom wetland (SANBI 2009):**

"a mostly flat valley-bottom wetland area without a major channel running through it, characterised by an absence of distinct channel banks and the prevalence of diffuse flows, even during and after high rainfall events. Water inputs are typically from an upstream channel, as the flow becomes dispersed, and from adjacent slopes (if present) or groundwater. Water generally moves through the wetland in the form of diffuse surface flow and/or interflow (with some temporary containment of water in depressional areas), but the outflow can be in the form of diffuse or concentrated surface flow. Infiltration and evaporation from unchanneled valley-bottom wetlands can be significant, particularly if there are a number of small depressions within the wetland area. Horizontal, unidirectional diffuse surface-flow tends to dominate in terms of the hydrodynamics."

This is considered an accurate description of this wetland system in the east of the study area. It is situated in a lower lying shallow valley and though it is linear, it clearly does not contain a defined channel or channel banks. Furthermore, surface flow is clearly diffuse and not concentrated. The portion of this valley-bottom wetland situated on the site is still largely intact though it is clear that upstream and downstream of the site there are many pronounced impacts that will affect its functioning.

**The small depressions in the south west of the study area can be categorised as depression wetlands (SANBI 2009):**

"A depression wetland is a basin shaped area with a closed elevation contour with an increase in depth from the perimeter to the central areas that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent. Dominant water sources are precipitation, ground water discharge, interflow and (diffuse or concentrated) overland flow. For 'depressions with channeled inflow', concentrated overland flow is typically a major source of water for the wetland, whereas this is not the case for 'depressions without channeled inflow'. Dominant hydrodynamics are (primarily seasonal) vertical fluctuations. Depressions may be flatbottomed (in which case they are often referred to as 'pans') or round-bottomed (in which case they are often referred to as 'basins') and may have any combination of inlets and outlets or lack them completely. For 'exorheic depressions', water exits as concentrated surface flow while, for 'endorheic depressions', water exits by means of evaporation and infiltration."

This is an accurate description of these pans and their functioning. They are all circular forming a very shallow but discernible depression in the landscape (Appendix A: Map 3). These pans are all endorheic (without outflow).

### 4.2.4 Description of watercourses and wetlands

The study area contains the main, valley bottom wetland in the east of the site with a few small depression wetlands also occurring in the south west (Appendix A: Map 3). A short description of each of these will be provided below.

Obligate wetland vegetation was also used to determine the presence of wetland conditions. Obligate wetland species are confined to wetlands and are only able to occur in wetlands. They are therefore reliable indicators of wetland conditions. Field observations over time as well as the following sources were used to determine FW and OW species:

- Marnewecke, G. & Kotze, D. 1999. Appendix W6: Guidelines for delineation of wetland boundary and wetland zones. In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

- DWAF. 2008. Updated manual for the identification and delineation of wetlands and riparian areas, prepared by M.Rountree, A.L. Batchelor, J. MacKenzie and D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

- Van Ginkel, C.E. & Cilliers, C.J. 2020. Aquatic and wetland plants of Southern Africa. Briza Publications, Pretoria.

Table 2: Description of the individual watercourses and wetlands which forms part of the study area (Appendix A: Map 3) (FW – Facultative wetland species, OW – Obligate wetland species, * - Exotic species).

| **Watercourse name:** | **Coordinates of sampling:** | **Flow regime:** |
|---|---|---|
| #1 Unchanneled valley bottom wetland – Main wetland in the east of the site | S 26.992289°, E 26.808740°<br>S 26.988173°, E 26.805267°<br>S 26.982773°, E 26.807467° | Seasonal |
| **Description of watercourse:**<br>The largest and most significant surface water feature in the area. This valley bottom wetland is a large system which originates approximately 5 km to the south of the site and then flows into the Vaal River about 4 km to the north of the site. The wetland therefore transects the eastern portion of the site and flows from south to north through it. The wetland is clearly an unchanneled system which does not have a defined main channel and banks though flow is still unidirectional from south to north. The width of the wetland can also be quite broad and while varying in width over its course, may be as wide as 100 meters in some areas. The wetland is largely fed by the upper reaches while inflow from the side slopes are also likely. Development around this wetland is therefore also likely to directly affect it in terms of runoff generated by it and which will enter this system. Though this is a natural system it is clearly affected by several large impacts. The upstream catchment is utilised for agricultural crop production and these fields will undoubtedly contribute to significant impacts on the wetland. This will include increased surface runoff rates due to the absence of vegetation and high concentrations of fertiliser runoff as well as some herbicide and pesticide contamination. Other impacts also include several road crossings which will act as flow obstructions and large woodlots of exotic trees which will decrease the groundwater inflow into the wetland.<br><br>The wetland is clearly situated in a low lying shallow valley and in terms of topography clearly supports the formation of a wetland system and also aids in accurate delineation of the system. Vegetation within the wetland is also dominated by obligate wetland sedges and grasses which also confirm the presence of saturated soils. Surface water was still visible during the survey and also indicates that the system is at least seasonal in terms of its active hydrological regime. Soil samples also reliably confirm the presence of wetland conditions which indicate a seasonal zone of wetness within the wetland. | | |
| **Dominant plant species:**<br>Seepage wetland: *Setaria sphacelatum* (FW), *Eragrostis lappula* (OW), **Verbena bonariensis, *Veronica anagalis-aquatica, *Oenothera rosea, Agrostis lachnantha* (OW), *Scirpoides burkei.*<br><br>Wetland border: *Triumfetta soderi, Asparagus larcinus, Hyparrhenia hirta, Ziziphus mucronata, Eragrostis gummiflua, Cynodon dactylon, Hypoxis hemerocallidae* | | |
| **Protected plant species:**<br>None observed. | | |
| **Soil sample:** | | |

The wetland is clearly defined but clearly is devoid of a channel and banks. Here it is also quite narrow when passing through a rocky area.

The valley bottom wetland can become quite broad in some areas.

Wetland sedges and grasses dominate the wetland. Note the presence of surface water indicating it is at least seasonal.

View of the wetland from the surrounding area. It is clearly situated in a shallow valley with a linear flow pattern.

| **Watercourse name:** | **Coordinates of sampling:** | **Flow regime:** |
|---|---|---|
| #2 Depression wetlands – series of three small wetlands in south west of the site | S 26.997414°, E 26.787146° | Seasonal |

**Description of watercourse:**

A series of three quite small depression wetlands located in the south west of the site. These wetlands are all located adjacent to each other and have a diameter of approximately 80 meters. These wetland areas are clearly visible as shallow but distinct depressions in the landscape. They are mainly fed by runoff and groundwater inflow from the south west. A large tailings dam is also situated to the south west of these wetlands (approximately 350 meters) and it is clear that seepage from this tailings dam has a large effect on them. High salt concentrations are quite evident as a result of this seepage and the wetland itself is also modified by higher salt concentrations while the vegetation is also heavily degraded and dominated by exotic weeds. These wetland areas are however located in the south west of the site and within the Mispah Nature Reserve and if this reserve is excluded from development the three small depressions should also remain unaffected by default.

The small depression wetlands form shallow but distinct depressions in the landscape and the topography therefore promotes the establishment of wetland conditions. Vegetation within these depressions are however quite modified and dominated by exotic weeds. This is most likely a consequence of seepage from the adjacent tailings dam which causes elevated salt concentrations and nutrient enrichment. Soil samples do however conclusively confirm the

presence of wetland conditions which indicate a seasonal zone of wetness within the wetland.

**Dominant plant species:**
*Cyperus longus* (OW), **Tegetes minuta, *Bidens bipinnata.*

**Protected plant species:**
None observed.

**Soil sample:**

The small depression wetlands are clearly visible as depressions.

| **Watercourse name:** | **Coordinates of sampling:** | **Flow regime:** |
|---|---|---|
| #3 No wetland conditions | S 26.987061°, E 26.776743°<br>S 26.965037°, E 26.771725° | No wetland conditions |

**Description of watercourse:**
Current wetland resources including the National Wetland Map 5 (NWM 5) and the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) also indicate two additional wetland areas likely to occur in the area. The survey also sampled these areas and confirmed that no wetland conditions are present in these areas. They do not form part of any watercourse, wetland or surface water feature and are therefore not relevant for the development. The following results also confirm that these areas were surveyed and confirmed to be devoid of wetland conditions:

- A circular seepage wetland is indicated to the north of the tailings dam in the south west of the site. This area contains a slight slope and soils consist of deep sandy soils without any soil wetness indicators. Vegetation is also dominated by grasses and pioneer herbs and while significant disturbance is evident, wetland conditions are clearly absent. This area does not contain any seepage, does not form any prominent component of the local surface water drainage and does not form a wetland or watercourse.
- There is a probability indicated of an elongated watercourses system transecting the north western corner of the site. However, the on-site survey confirmed no wetland conditions occurring here and a channel or drainage line is also clearly absent.

Sampling to the north of the tailnigs dam confirm the absence of wetland conditions.

North western corner of the site contain no watercourse or wetland conditions.

### 4.3.5 Condition and importance of the affected wetland

The determination of the condition of the wetlands on the site will be confined to the large valley bottom wetland system in the eastern portion of the site. The small depressions wetlands in the south west of the site should remain unaffected by the development and will therefore not be relevant and their condition will not be determined. The valley bottom system in the east of the site is clearly the most prominent system and will likely be affected by the development. The determination of the condition of this wetland system is therefore also of importance. Therefore, a WET-Health determination will be done for this large valley bottom wetland system occurring on the site and should give an accurate indication of the current condition of the system and its vulnerability to impacts of the development. The WET-Health will be taken as representative of the Present Ecological State (PES) of this system (Appendix D).

Table 4 refers to the determination and categorisation of the Present Ecological State (PES; health or integrity) of various biophysical attributes of rivers relative to the natural or close to the natural reference condition. The purpose of the EcoClassification process is to gain insights and understanding into the causes and sources of the deviation of the PES of biophysical attributes from the reference condition. This provides the information needed to derive desirable and attainable future ecological objectives for the river (Kleynhans & Louw 2007).

Table 5 refers to the Ecological Importance and Sensitivity (EIS) of wetlands. "Ecological importance" of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. "Ecological sensitivity" refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The Ecological Importance and Sensitivity (EIS) provides a guideline for determination of the Ecological Management Class (EMC).

Table 4: Ecological categories for Present Ecological Status (PES).

| Ecological Category | Description |
|---|---|
| A | Unmodified, natural |
| B | Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged. |
| C | Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominately unchanged. |

| | |
|---|---|
| D | Largely modified. A large loss of natural habitat, biota and basic ecosystem function has occurred. |
| E | Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive. |
| 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. |

Table 5: Ecological importance and sensitivity categories.

| Ecological Importance and Sensitivity Category (EIS) | Range of Median | Recommended Ecological Management Class |
|---|---|---|
| Very High<br>Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. | >3 and <=4 | A |
| High<br>Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. | >2 and <=3 | B |
| Moderate<br>Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. | >1 and <=2 | C |
| Low/marginal<br>Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. | >0 and <=1 | D |

This wetland system has not been assessed by previous wetland spatial resources (Kleynhans 2000, Van Deventer *et al* 2018) and there is no baseline information available for it. The current assessment will therefore determine a baseline condition for this wetland and determine the degree of modification that surrounding impacts has caused on it. Though the section of the wetland occurring on the site seems to still be largely intact and functional the upstream land uses, especially within the catchment will certainly have a significant impact on the wetland and is therefore likely to cause a significant level of modification of it. Despite these modifications on the system, the wetland remains a sensitive system and any additional impacts on it should be prevented. There is a likelihood that the development will occur in close proximity to this wetland, in which case it will certainly have a significant impact on it, mostly in terms of increased runoff, erosion and sedimentation. Where development occurs in close proximity to this wetland, a comprehensive storm water management system will also have to be implemented in order to prevent runoff from the development from having any further negative effect on it.

As indicated above, the valley bottom wetland has been modified by significant impacts. A summary of the impacts will be provided in the following paragraphs.

A large portion of the upper catchment of the wetland is currently used for agricultural crop production. A significant cropfield is also situated to the east of the wetland on the site. These removed the natural vegetation which promotes runoff while decreasing infiltration and in so doing increases surface erosion. This mainly increase the sediment load being deposited within the wetland and may, to some degree, also increase erosion in the catchment also contributing towards further sediment deposition. Coupled with the crop cultivation will also be fertiliser, pesticide and herbicide runoff. This will mainly have an impact on nutrient load which may influence the wetland vegetation and aquatic component of the wetland. Other smaller impacts associated with agriculture may also contribute to some impacts on the wetland. These may include the farming homestead, general surface disturbances and a woodlot of exotic trees. The catchment also contains a network of small dirt roads and tracks and these would also have a significant impact on the wetland. These act as obstructions to flow and will affect the hydrology of the wetland.

A large electrical substation is situated immediately upstream of the site. This area is dominated by impenetrable surfaces which will prevent infiltration of surface flow and will thus increase runoff into the wetland. A portion of the substation also encroached into this wetland and will have a further impact on the hydrology of the wetland and will also contribute toward direct wetland loss.

Mining operations are also situated in close proximity to the west of the wetland system (approximately 150 meters). It is also quite likely that this will contribute at least some impacts on the wetland. Most probably in some form of contaminated runoff from the plant. One source which is evident is a small Waste Water Treatment Works (WWTW) associated with the mining operations and which is located quite close to it (approximately 80 meters) and this WWTW also discharges treated effluent directly into the wetland. This point source discharge will undoubtedly have a significant impact on the wetland.


Figure 21: A recent aerial image of the wetland (red) which also indicates the prominent impacts in the catchment (Google Earth 2022). The catchment is dominated by ploughed fields

(purple) while natural grassland is also abundant (green) and other land uses include exotic tree woodlots (blue) and mining and electrical substation (light blue).

Figure 22: Large portions of the catchment has been transformed by dryland crop production.

Figure 23: Large woodlots of exotic Bluegum (*Eucalyptus camaldulensis*) area also common in the catchment and will have an effect on evapotranspiration ad runoff.

Figure 24: The mining operations also occur in the catchment of the wetland (red) and will undoubtedly also contribute toward impacts on it.

From the above described impacts it should be clear that the valley bottom wetland system is affected by numerous impacts which result in a significant level of modification. A WET-Health determination was undertaken for the valley bottom wetland to determine its current condition given the impacts affecting it (Appendix D). The results of the WET-Health indicated an overall

Present Ecological State of Category C: Moderately Modified. This is considered relatively accurate given the largely transformed catchment and impacts on the wetland.

The EI&S of the valley bottom wetland system has been rated as being Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. This is mostly a result of the already modified condition of the wetland, though since it is a large system still providing several important functions the EI&S remains Moderate.

### 4.3.6 Buffer zone determination

As indicated in previous sections, the valley bottom wetland system is still largely intact and though at least moderately modified, it still provides many essential functions. Recent flooding in many regions of the country has highlighted the need to conserve wetlands which are natural flood attenuation systems and prevent flooding of downstream areas. The valley bottom wetland should be treated as a no-go area and no construction or operational activities including stockpiling, clearing, laydown areas, vehicle movement or any other associated activities should occur in or near this wetland system.

In addition, a suitable buffer for the valley bottom wetland system can be provided by using the Buffer Zone Tool for the Determination of Aquatic Impact Buffers and Additional Setback Requirements for Wetland Ecosystems (2014) (Appendix F). This determination was also done in conjunction with Macfarlane *et al* (2014). It should be noted however that the buffers determined by this model only caters for wetland systems and impacts associated with diffuse-source surface runoff. By using the above tools a suitable buffer of 21 meters from the edge of the wetland has been determined (Appendix A: Map 3).

### 4.3.7 Risk Assessment

A Risk Assessment for the proposed solar facility which will affect the valley bottom wetland system in the eastern portion of the site has been undertaken according to the Department of Water & Sanitation's requirements for risk assessment and the provisional Risk Assessment Matrix for Section 21(c) & (i) water use (Appendix E). In the event that development of solar facilities extends into the eastern portion of the site, these areas will be located in close proximity to this wetland system and in so doing are likely to result in some impacts on it, especially in terms of runoff and sedimentation (Appendix A: Map 3). However, current layout plans do indicate that the development will avoid the eastern portion of the development area which will significantly decrease the anticipated impact. Furthermore, the development needs to ensure that it is compliant with all relevant legislation, especially in terms of its water use which is governed by the National Water Act (Act no 36 of 1998) (NWA). According to this act and with special relevance to the General Authorisation regulations for section 21(c) or (i) water uses (Notice 509 of 2016), any development which falls within the regulated area of a wetland system, a 500 m radius from the delineated boundary (extent) of any wetland or pan, requires application for the necessary authorisation from the Department of Water and Sanitation (DWS). The current layout plans indicate that portions of the development as well as associated grid connection powerline will be situated approximately 350 meters from this valley-bottom wetland system and given the clearance of vegetation and the large extent of the development is still likely to have an impact on it.

Several small depressions occur in the western portion of the site though are included within the Mispah Game Reserve and the development is unlikely to encroach into this area and these depressions will then be located outside the regulated 500 meters boundary from the development, they are not rated in terms of this risk assessment (Appendix A: Map 3).

The large valley bottom wetland system is clearly the main wetland system in this area and is considered as still providing several essential functions and is therefore considered as highly sensitive and being of high conservation value (Appendix A: Map 3). Current layout plans do indicate that the eastern portion of the development area will be excluded though development will still occur within 350 meters of the edge of the wetland and is then still likely to have some impact on it. The wetland and buffer zone should be regarded as no-go areas and no construction or operational activities including stockpiling, clearing, laydown areas, vehicle movement or any other associated activities should occur in or near this wetland system. Given the distance between the wetland area and current development layout (approximately 350 meters), the anticipated risk will be low. However, since the catchment of the wetland lies largely within the proposed development area it will most likely have a significant impact on the runoff generated and inflow into the wetland. As a result, the development will have to implement a comprehensive storm water management system which should ensure that the surface runoff patterns are retained as is, especially pertaining to solar panels, and that the development does not contribute toward increased surface flow, erosion and any impacts on downslope areas.

Given the current layout plan, it is unlikely that infrastructure such as roads and powerlines will require crossing it and this was therefore not rated as a risk. However, should layout plans be modified and it become apparent that development will encroach in proximity to the wetland or other infrastructure require crossing this system, the impacts should be re-assessed and the risk matrix amended.

Low Risks: Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.

Mitigation as recommended as well as any additional mitigation recommended by other specialist studies should be implemented in order to alleviate the risks on the valley bottom wetland system.

For the complete risk assessment please refer to Appendix E.

| No. | Phases | Activity | Aspect | Impact | Risk Rating | Confidence level | Control measures |
|---|---|---|---|---|---|---|---|
| 1 | Mostly Construction Phase but also during operation | Construction of a solar facility | A large valley-bottom wetland system with high conservation value may be affected by the proposed development. | The construction of the facility may encroach into the wetland which will directly affect or may also impact on the catchment of the wetland which will then have an indirect impact on it. | **L** | **80** | Provided that recommendations are implemented and that the development not encroach nearer than the current indicated 350 meters in proximity to the wetland system and is treated as no-go area, the anticipated risk should remain low. As the development will still occur in relatively close proximity to it, it will also be important to implement a comprehensive storm water management system. |

## 5. ANTICIPATED IMPACTS

Anticipated impacts that the development will have is primarily concerned with the loss of habitat and species diversity but will also include impacts on the valley bottom wetland system forming part of the study area (Appendix A: Map 1 - 4).

The following impacts on the ecosystem, ecology and biodiversity will be assessed:

- Loss of vegetation and consequently habitat and species diversity as a result.
- Loss of protected, rare or threatened plant species.
- Impacts on watercourses, wetlands or the general catchment.
- The impact that the development will have on exotic weeds and invasive species, both current and anticipated conditions.
- Any increased erosion that the development may cause.
- Fragmentation of habitat, disruption of ecological connectivity and -functioning in terms of the surrounding areas.
- Impacts that will result on the mammal population on and around the site.
- Any significant cumulative impacts that the development will contribute towards.

Solar PV developments usually entail the removal of surface vegetation and may also involve modification of the surface topography. This therefore has a large impact in terms of the loss of vegetation, vegetation type and consequently habitat. As indicated from the discussion of the study area, the majority of the area still consists of natural grassland in a fairly good condition (Appendix A: Map 1). Where these areas of natural grassland will be affected by the development it will therefore result in significant impacts. The severity of this impact will also vary over the site in accordance with the differing conservation value of different portions of the site. As a result, the impact on the following areas of high conservation will be quite high (Appendix A: Map 4):

- The Mispah Game Reserve covers a large portion of the southern portion of the site. This is a Private Nature Reserve which has been proclamated as a Protected Area (PA) under the National Environmental Management Protected Areas Act (NEMPAA of 2003). The area is listed as a Private Nature Reserve within the South Africa Protected & Conservation Areas Database (SAPAD) and was proclamated in 2001 (Notice 23 of 2001). Development within any protected area is highly unlikely since this is largely prevented by the NEMPAA and any management plan of the protected area. This PA has also been taken into account in determining the provincial and national conservation targets and development within this PA will also affect these conservation targets.
- Two large CBA 1 areas have been delineated by the Free State Biodiversity Management Plan. These CBA 1 areas have been identified as being crucial for meeting conservation targets for the Endangered Vaal-Vet Sandy Grassland occurring in this area but also to some extent the Vaal Reefs Dolomite Sinkhole Woodland in the area. These CBA 1 areas have been identified as being Irreplaceable in terms of meeting conservation targets.
- Portions of remaining Vaal-Vet Sandy Grassland also occur in the south east of the site but which do not form part of the Mispah Game Reserve or identified CBA areas. However, since this vegetation type is currently listed as Endangered (EN) these areas must still be afforded a High level of sensitivity.

Should the development encroach into any of the above listed areas of high conservation value, the anticipated impact will be high (Appendix A: Map 4). The development should therefore, as far as possible, aim to avoid these areas in order to mitigate and decrease the anticipated impact. Current layout plans do indicate that areas of High Sensitivity are largely being avoided while mostly retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity. The remainder of the site, except areas as listed above, is dominated by Vaal Reefs Dolomite Sinkhole Woodland, a grassland vegetation type which, although it is also affected by significant transformation pressures, is not regarded as a Threatened Ecosystem and would therefore have a somewhat lower conservation value. However, the vegetation is still in a fairly good condition and still contains elements of conservation value. As a result, should development avoid areas of high conservation value and concentrate the development in these areas of moderate conservation value the impact will be lower but still significant. The solar development will also involve the clearance of a fairly large area and lead to irreversible transformation of the natural grassland and development should therefore be carefully planned, should focus on areas of lower sensitivity and should limit the extent of transformation as far as possible.

No Red Listed plant species could be identified on the site and the area is also not known to contain many such species though a few are still present in this region and a likelihood therefore remains that such a species may also be present on the site. However, given the large extent of the study area, it has been found to contain a fairly high number of protected plant species (Appendix B). These include the protected succulent and geophytic species, *Euphorbia striata, Orthanthera jasminiflora, Boophone distichia, Pentharhinum insipidum, Schizocarpus nervosus, Satyrium sp., Raphionecma velutina, Babiana bainesii, Aloe greatheadii, Crinum graminicola,* and *Vachellia erioloba*. Where development will affect these species, the necessary permits should be obtained and a significant proportion of these transplanted to adjacent areas where they will remain unaffected. In addition, there are also a few protected herbaceous plants (*Helichrysum spp.*) and a few specimens of the protected *Vachellia erioloba* (Camel Thorn). Where any of these will require removal, the necessary permits should be obtained to do so. Provided that this mitigation is successfully implemented, the anticipated impact should remain moderate to low.

A large valley bottom wetland system occurs in the eastern portion of the site and is likely to be affected by the development (Appendix A: Map 3). Solar developments are well known to have significant impacts on surface water features as a result of the rain shadow caused by the panels and the coupled runoff and infiltration patterns, erosion caused by these runoff patterns and disruption of surface watercourses. However, current layout plans do indicate that the development will avoid the eastern portion of the development area which will significantly decrease the anticipated impact. The necessary mitigation should still be implemented to ensure no indirect impacts affect the wetland system. Development within 500 meters of this wetland system will require authorisation from DWS. Refer to the risk assessment (Section 4.3.7) for a more detailed discussion on the likely risks and impacts that the development will have on it. Given the distance between the wetland area and current development layout (approximately 350 meters), the anticipated impact will be low. However, since the catchment of the wetland lies largely within the proposed development area it will most likely have a significant impact on the runoff generated and inflow into the wetland. As a result, the development will have to implement a comprehensive storm water management system which should ensure that the surface runoff patterns are retained as is, especially pertaining to solar

panels, and that the development does not contribute toward increased surface flow, erosion and any impacts on downslope areas.

As was observed during the survey of the study area it contains several exotic weed and invader species (Appendix B). In addition, development (especially construction) will increase disturbance and exacerbate conditions susceptible to the establishment of exotic weeds and invaders. Without mitigation this will significantly increase the establishment of exotics and is likely to spread into the surrounding areas. It is therefore recommended that weed control be judiciously and continually practised. Monitoring of weed establishment should form a prominent part of management of the development area. Where category 1 and 2 weeds occur, they require removal by the property owner according to the Conservation of Agricultural Resources Act, No. 43 of 1983 and National Environmental Management: Biodiversity Act, No. 10 of 2004.

As indicated, because solar PV developments result in the removal of vegetation, this reduces infiltration and promotes runoff. Coupled with the rain shadow caused by panels and the resulting dripline, this increases runoff and erosion. This may also have a moderate impact on the wetland system in the eastern portion of the site. In order to reduce this impact, the development should implement a comprehensive storm water management system which should ensure that the surface runoff patterns are retained as is, especially pertaining to solar panels, and that the development does not contribute toward increased surface flow, erosion and any impacts on downslope areas.

The region is affected by high levels of transformation as a result of both mining operations and agricultural crop production which results in high levels of habitat fragmentation and the disruption of ecosystem processes. The proposed development will also require the transformation of fairly large areas consisting of natural grassland in fairly good condition and will therefore also significantly contribute toward this impact. The only mitigation that can be applied to decrease this impact is to restrict development to areas being of low sensitivity and should limit the extent of transformation as far as possible. Despite this mitigation it is highly likely that areas of moderate sensitivity will still be included in the development area and the resulting impact on habitat loss, fragmentation and the disruption of ecological processes will remain significant.

The most significant impact on mammals anticipated on the site itself is primarily concerned with the loss and fragmentation of available habitat. Transformation of the natural vegetation on the site will result in a decrease in the population size as available habitat decreases. Since it is inevitable that the development will involve the transformation of natural grassland this contribute significantly toward habitat loss which in turn will result in a high impact on the mammal population. This also indicates the need to take extra care in determining the development area, which should focus on areas of lower sensitivity, should exclude areas of high sensitivity and the wetland system in the eastern portion of the site and should limit the extent of transformation as far as possible. Current layout plans do indicate that areas of High Sensitivity are largely being avoided while mostly retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity. Construction itself may also affect the mammal population and care should therefore be taken to ensure none of the faunal species on site is harmed. The hunting, capturing or harming in any way of mammals on the site should not be allowed. Voids and excavations may also act as pitfall traps to fauna and these should

continuously be monitored and any trapped fauna removed and released in adjacent natural areas.

As previously indicated, the area has a long history of transformation by mining and agricultural activities and the cumulative impact that this has had is extensive. This is also clearly evident in the degree to which the local vegetation types, Vaal-Vet Sandy Grassland and Vaal Reefs Dolomite Sinkhole Woodland is regarded as being affected by development pressures. The assessment has also indicated that the area is still dominated by natural grassland in fairly good condition (Appendix A: Map 1). Therefore, should the proposed development further increase vegetation and habitat loss of natural areas it will have a high cumulative impact. The only mitigation which may decrease the cumulative impact to some degree would be the exclusion of areas identified as having a high conservation value (See previous paragraphs). This would entail the preservation of at least a portion of the remaining natural areas though since the development will still result in significant transformation of natural areas, the cumulative impact will remain significant.

The impact significance has been determined and should development take place without mitigation it is anticipated that it will result in overall high impacts. This is a result of the largely natural condition of the area, the presence of areas of high conservation value and the fairly large extent of the proposed development (Appendix A: Map 4). Aspects which are expected to result in quite high impacts include the loss of the vegetation type in the area which includes Vaal-Vet Sandy Grassland (an Endangered system) as well as the loss of a large wetland system in the east of the site. Other moderate-high impacts also include the loss of protected plant species, increased infestation by exotic weeds, increased habitat fragmentation, the impact on mammals (which also includes a Near Threatened species) and the increased cumulative impact. Suitable mitigation as listed in previous paragraphs should enable the development to decrease many of these impacts to moderate levels. This will mostly be achieved by excluding areas of high conservation value as listed which will in turn decrease the severity of the impacts and will also decrease extent and in so doing the anticipated impacts will be somewhat lower. Current layout plans do indicate that areas of High Sensitivity are largely being avoided while mostly retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity. However, as indicated significant natural areas will still be transformed by the development and several of the impacts will remain significant especially the impacts on the vegetation type and biodiversity, the wetland system in the east of the site, habitat fragmentation, the mammal population in the area and the cumulative impact.

Please refer to Appendix G for the impact methodology.

| ***Nature:*** <br> **Loss of vegetation and consequently habitat and species diversity as a result.** |
| --- |
| **Impact description:** Solar PV developments usually entail the removal of surface vegetation and may also involve modification of the surface topography. This therefore has a large impact in terms of the loss of vegetation, vegetation type and consequently habitat. As indicated from the discussion of the study area, the majority of the area still consists of natural grassland in a fairly good condition (Appendix A: Map 1). Where these areas of natural grassland will be affected by the development it will therefore result in significant impacts. The severity of this impact will also vary over the site in accordance with the differing conservation value of different portions of the site. As a result, the impact on the following areas of high conservation will be quite high (Appendix A: Map 4): |

- The Mispah Game Reserve covers a large portion of the southern portion of the site. This is a Private Nature Reserve which has been proclamated as a Protected Area (PA) under the National Environmental Management Protected Areas Act (NEMPAA of 2003). The area is listed as a Private Nature Reserve within the South Africa Protected & Conservation Areas Database (SAPAD) and was proclamated in 2001 (Notice 23 of 2001). Development within any protected area is highly unlikely since this is largely prevented by the NEMPAA and any management plan of the protected area. This PA has also been taken into account in determining the provincial and national conservation targets and development within this PA will also affect these conservation targets.
- Two large CBA 1 areas have been delineated by the Free State Biodiversity Management Plan. These CBA 1 areas have been identified as being crucial for meeting conservation targets for the Endangered Vaal-Vet Sandy Grassland occurring in this area but also to some extent the Vaal Reefs Dolomite Sinkhole Woodland in the area. These CBA 1 areas have been identified as being Irreplaceable in terms of meeting conservation targets.
- Portions of remaining Vaal-Vet Sandy Grassland also occur in the south east of the site but which do not form part of the Mispah Game Reserve or identified CBA areas. However, since this vegetation type is currently listed as Endangered (EN) these areas must still be afforded a High level of sensitivity.

Should the development encroach into any of the above listed areas of high conservation value, the anticipated impact will be high (Appendix A: Map 4). The development should therefore, as far as possible, aim to avoid these areas in order to mitigate and decrease the anticipated impact. Current layout plans do indicate that areas of High Sensitivity are largely being avoided while mostly retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity. The remainder of the site, except areas as listed above, is dominated by Vaal Reefs Dolomite Sinkhole Woodland, a grassland vegetation type which, although it is also affected by significant transformation pressures, is not regarded as a Threatened Ecosystem and would therefore have a somewhat lower conservation value. However, the vegetation is still in a fairly good condition and still contains elements of conservation value. As a result, should development avoid areas of high conservation value and concentrate the development in these areas of moderate conservation value the impact will be lower but still significant. The solar development will also involve the clearance of a fairly large area and lead to irreversible transformation of the natural grassland and development should therefore be carefully planned, should focus on areas of lower sensitivity and should limit the extent of transformation as far as possible.

| | **Rating** | **Motivation** | **Significance** |
|---|---|---|---|
| ***Prior to Mitigation*** | | | |
| **Duration** | 5 | Permanent transformation of vegetation | **High Negative (95)** |
| **Extent** | 4 | Large development area | |
| **Magnitude** | 10 | Loss of a Threatened Ecosystem | |
| **Probability** | 5 | Impact is unavoidable | |
| ***Mitigation/Enhancement Measures*** | | | |
| ***Mitigation:***<br>Should development avoid areas of high conservation value and concentrate the development | | | |

| | | | |
|---|---|---|---|
| in these areas of moderate conservation value the impact will be lower but still significant. The solar development will also involve the clearance of a fairly large area and lead to irreversible transformation of the natural grassland and development should therefore be carefully planned, should focus on areas of lower sensitivity and should limit the extent of transformation as far as possible. | | | |
| ***Post Mitigation/Enhancement Measures*** | | | |
| **Duration** | 5 | Permanent transformation of vegetation | **High Negative (64)** |
| **Extent** | 3 | Decreased development extent though still significant | |
| **Magnitude** | 8 | Loss of natural areas must be regarded as significant | |
| **Probability** | 4 | Loss of natural areas unavoidable | |
| ***Cumulative impacts:***<br>The area has a long history of transformation by mining and agricultural activities and the cumulative impact that this has had is extensive. This is also clearly evident in the degree to which the local vegetation types, Vaal-Vet Sandy Grassland and Vaal Reefs Dolomite Sinkhole Woodland is regarded as being affected by development pressures. The assessment has also indicated that the area is still dominated by natural grassland in fairly good condition (Appendix A: Map 1). Therefore, should the proposed development further increase vegetation and habitat loss of natural areas it will have a high cumulative impact. The only mitigation which may decrease the cumulative impact to some degree would be the exclusion of areas identified as having a high conservation value (See previous paragraphs). This would entail the preservation of at least a portion of the remaining natural areas though since the development will still result in significant transformation of natural areas, the cumulative impact will remain significant. | | | |
| ***Residual Risks:***<br>The solar development will involve the clearance of a fairly large area and lead to irreversible transformation of the natural grassland and residual impacts will remain high. | | | |

| | | | |
|---|---|---|---|
| ***Nature:***<br>**Loss of protected, rare or threatened plant species.** | | | |
| **Impact description:** No Red Listed plant species could be identified on the site and the area is also not known to contain many such species though a few are still present in this region and a likelihood therefore remains that such a species may also be present on the site. However, given the large extent of the study area, it has been found to contain a fairly high number of protected plant species (Appendix B). These include the protected succulent and geophytic species, *Euphorbia striata, Orthanthera jasminiflora, Boophone distichia, Pentharhinum insipidum, Schizocarpus nervosus, Satyrium sp., Raphionecma velutina, Babiana bainesii, Aloe greatheadii, Crinum graminicola,* and *Vachellia erioloba*. Where development will affect these species, the necessary permits should be obtained and a significant proportion of these transplanted to adjacent areas where they will remain unaffected. In addition, there are also a few protected herbaceous plants (*Helichrysum spp.*) and a few specimens of the protected *Vachellia erioloba* (Camel Thorn). Where any of these will require removal, the necessary permits should be obtained to do so. Provided that this mitigation is successfully implemented, the anticipated impact should remain moderate to low. | | | |
| | **Rating** | **Motivation** | **Significance** |
| ***Prior to Mitigation*** | | | |
| **Duration** | 5 | Permanent loss of protected species | **High Negative (68)** |

| | | | |
|---|---|---|---|
| **Extent** | 4 | Large development area | |
| **Magnitude** | 8 | High likelihood for the loss of protected species | |
| **Probability** | 4 | Many protected species known to occur on the site and therefore probability is high | |
| ***Mitigation/Enhancement Measures*** | | | |
| ***Mitigation:***<br>Where development will affect these species, the necessary permits should be obtained and a significant proportion of these transplanted to adjacent areas where they will remain unaffected. In addition, there are also a few protected herbaceous plants (*Helichrysum spp.*) and a few specimens of the protected *Vachellia erioloba* (Camel Thorn). Where any of these will require removal, the necessary permits should be obtained to do so. Provided that this mitigation is successfully implemented, the anticipated impact should remain moderate to low. | | | |
| ***Post Mitigation/Enhancement Measures*** | | | |
| **Duration** | 5 | Permanent loss of protected species | **Moderate Negative (39)** |
| **Extent** | 2 | Decreased development extent maintained within areas of moderate sensitivity | |
| **Magnitude** | 6 | Loss of fewer protected species, provided mitigation is successfully implemented | |
| **Probability** | 3 | Probable that at least some protected species will be lost | |
| ***Cumulative impacts:***<br>The area has a long history of transformation by mining and agricultural activities and the cumulative impact with regards to the loss of protected species is extensive. This is also clearly evident in the degree to which the local vegetation types, Vaal-Vet Sandy Grassland and Vaal Reefs Dolomite Sinkhole Woodland is regarded as being affected by development pressures. The assessment has also indicated that the area is still dominated by natural grassland in fairly good condition (Appendix A: Map 1). Therefore, should the proposed development further increase vegetation and habitat loss of natural areas it will also further increase the cumulative loss of protected species. The only mitigation which may decrease the cumulative impact to some degree would be the exclusion of areas identified as having a high conservation value and also implementing the transplanting of at least a portion of protected species on the site. This would entail the preservation of at least a portion of the remaining protected though since the development will still result in significant transformation of natural areas, the cumulative loss of protected species will still remain significant. | | | |
| ***Residual Risks:***<br>Despite comprehensive mitigation (dependant on this mitigation being successfully implemented) a residual loss of some protected species is still unavoidable. | | | |

| |
|---|
| ***Nature:***<br>**Impacts on watercourses, wetlands or the general catchment.** |
| **Impact description:** A large valley bottom wetland system occurs in the eastern portion of the site and is likely to be affected by the development (Appendix A: Map 3). Solar developments are well known to have significant impacts on surface water features as a result of the rain shadow caused by the panels and the coupled runoff and infiltration patterns, erosion caused |

by these runoff patterns and disruption of surface watercourses. However, current layout plans do indicate that the development will avoid the eastern portion of the development area which will significantly decrease the anticipated impact. The necessary mitigation should still be implemented to ensure no indirect impacts affect the wetland system. Development within 500 meters of this wetland system will require authorisation from DWS. Refer to the risk assessment (Section 4.3.7) for a more detailed discussion on the likely risks and impacts that the development will have on it. Given the distance between the wetland area and current development layout (approximately 350 meters), the anticipated impact will be low.

| | **Rating** | **Motivation** | **Significance** |
|---|---|---|---|
| ***Prior to Mitigation*** | | | |
| **Duration** | 5 | Permanent transformation of wetland areas | **High Negative (95)** |
| **Extent** | 4 | Spill over of impacts into downstream areas | |
| **Magnitude** | 10 | Direct wetland loss | |
| **Probability** | 5 | Impact is unavoidable | |
| ***Mitigation/Enhancement Measures*** | | | |
| ***Mitigation:*** Refer to the risk assessment (Section 4.3.7) for a more detailed discussion on the likely risks and impacts that the development will have on it. Given the distance between the wetland area and current development layout (approximately 350 meters), the anticipated impact will be low. However, since the catchment of the wetland lies largely within the proposed development area it will most likely have a significant impact on the runoff generated and inflow into the wetland. As a result, the development will have to implement a comprehensive storm water management system which should ensure that the surface runoff patterns are retained as is, especially pertaining to solar panels, and that the development does not contribute toward increased surface flow, erosion and any impacts on downslope areas. | | | |
| ***Post Mitigation/Enhancement Measures*** | | | |
| **Duration** | 5 | Permanent transformation of at least the catchment of wetland areas | **Low Negative (22)** |
| **Extent** | 3 | Wetlands excluded from development though at least local impacts on wetland systems still anticipated | |
| **Magnitude** | 3 | Significant distance between development and wetland will decrease magnitude though some impacts still probable | |
| **Probability** | 2 | Given the distance between development and wetland area the probability will be lower | |
| ***Cumulative impacts:*** The area has a long history of transformation by mining and agricultural activities and the cumulative impact that this has had is extensive this also includes the impacts on wetlands in the area. The assessment has also indicated that the wetlands in the area are still largely intact (Appendix A: Map 1). Therefore, should the proposed development further increase wetland loss it will have a high cumulative impact. The only mitigation which may decrease the cumulative impact to would be the exclusion of wetland areas. This would entail the | | | |

| |
|---|
| preservation of wetland areas though since the development will still result in significant transformation of natural areas, a residual cumulative impact will also still remain. |
| ***Residual Risks:***<br>Should these wetland areas be excluded from the development and measures as indicated implemented the anticipated impact will be lower, i.e. impacts on the catchment will remain significant which will also result in some residual impact on the wetland areas. |

| | | | |
|---|---|---|---|
| ***Nature:***<br>**The impact that the development will have on exotic weeds and invasive species, both current and anticipated conditions.** | | | |
| **Impact description:** As was observed during the survey of the study area it contains several exotic weed and invader species (Appendix B). In addition, development (especially construction) will increase disturbance and exacerbate conditions susceptible to the establishment of exotic weeds and invaders. Without mitigation this will significantly increase the establishment of exotics and is likely to spread into the surrounding areas. It is therefore recommended that weed control be judiciously and continually practised. Monitoring of weed establishment should form a prominent part of management of the development area. Where category 1 and 2 weeds occur, they require removal by the property owner according to the Conservation of Agricultural Resources Act, No. 43 of 1983 and National Environmental Management: Biodiversity Act, No. 10 of 2004. | | | |
| | **Rating** | **Motivation** | **Significance** |
| ***Prior to Mitigation*** | | | |
| **Duration** | 4 | Long-term infestation | **High Negative (80)** |
| **Extent** | 4 | Spreading of infestation into neighbouring areas | |
| **Magnitude** | 8 | Infestation of a Threatened Ecosystem | |
| **Probability** | 5 | Impact is unavoidable | |
| ***Mitigation/Enhancement Measures*** | | | |
| ***Mitigation:***<br>It is recommended that weed control be judiciously and continually practised. Monitoring of weed establishment should form a prominent part of management of the development area. Where category 1 and 2 weeds occur, they require removal by the property owner according to the Conservation of Agricultural Resources Act, No. 43 of 1983 and National Environmental Management: Biodiversity Act, No. 10 of 2004. | | | |
| ***Post Mitigation/Enhancement Measures*** | | | |
| **Duration** | 3 | Limited duration if monitoring and eradication is maintained | **Moderate Negative (36)** |
| **Extent** | 3 | Limiting extent through monitoring and eradication | |
| **Magnitude** | 6 | Limited but unavoidable infestation | |
| **Probability** | 3 | Moderate probability remains | |
| ***Cumulative impacts:***<br>The area has a long history of transformation by mining and agricultural activities and significantly increases the cumulative impact of increased infestation by exotics. The assessment has also indicated that the area is still dominated by natural grassland in fairly good condition (Appendix A: Map 1). Therefore, should the proposed development further increase vegetation and habitat loss of natural areas and contribute to increased infestation it will have a high cumulative impact. The only mitigation which may decrease the cumulative | | | |

impact to some degree would be the exclusion of areas identified as having a high conservation value. This would entail the decrease in transformation and consequently the cumulative impact of exotic weed infestation, however, the cumulative impact will remain significant.

***Residual Risks:***
Without mitigation this will significantly increase the establishment of exotics and is likely to spread into the surrounding areas.

***Nature:***
**Any increased erosion that the development may cause.**

**Impact description:** As indicated, because solar PV developments result in the removal of vegetation, this reduces infiltration and promotes runoff. Coupled with the rain shadow caused by panels and the resulting dripline, this increases runoff and erosion. This may also have a moderate impact on the wetland system in the eastern portion of the site. In order to reduce this impact, the development should implement a comprehensive storm water management system which should ensure that the surface runoff patterns are retained as is, especially pertaining to solar panels, and that the development does not contribute toward increased surface flow, erosion and any impacts on downslope areas.

| | Rating | Motivation | Significance |
|---|---|---|---|
| ***Prior to Mitigation*** | | | |
| **Duration** | 4 | Permanent modification of surface topography | **Moderate Negative (56)** |
| **Extent** | 4 | Spreading of erosion into neighbouring areas | |
| **Magnitude** | 6 | Limited magnitude due to the flat topography | |
| **Probability** | 4 | Highly likely to take place | |
| ***Mitigation/Enhancement Measures*** | | | |
| ***Mitigation:*** In order to reduce this impact, the development should implement a comprehensive storm water management system which should ensure that the surface runoff patterns are retained as is, especially pertaining to solar panels, and that the development does not contribute toward increased surface flow, erosion and any impacts on downslope areas. | | | |
| ***Post Mitigation/Enhancement Measures*** | | | |
| **Duration** | 4 | Permanent modification of surface topography | **Moderate Negative (33)** |
| **Extent** | 3 | Limiting extent through storm water management | |
| **Magnitude** | 4 | Limited magnitude due to the flat topography | |
| **Probability** | 3 | Unlikely to occur as long as storm water management is maintained | |

***Cumulative impacts:***
The area has a long history of transformation by mining and agricultural activities and the cumulative impact (including surface erosion) that this has had is extensive. The assessment has also indicated that the area is still dominated by natural grassland in fairly good condition which will limit the current erosion (Appendix A: Map 1). Therefore, should the proposed development further increase vegetation and habitat loss of natural areas it have a further significant cumulative impact on erosion in the area. The only mitigation which may decrease

| |
|---|
| the cumulative impact to some degree would be the exclusion of areas identified as having a high conservation value. This would entail the decrease in transformation and consequently the cumulative impact of erosion, however, the cumulative impact will remain significant. |
| ***Residual Risks:***<br>Erosion may also have a significant impact on the wetland systems in the study area (including the Vaal River to the north of the site). |

| ***Nature:***<br>**Fragmentation of habitat, disruption of ecological connectivity and -functioning in terms of the surrounding areas.** | | | |
|---|---|---|---|
| **Impact description:** The region is affected by high levels of transformation as a result of both mining operations and agricultural crop production which results in high levels of habitat fragmentation and the disruption of ecosystem processes. The proposed development will also require the transformation of fairly large areas consisting of natural grassland in fairly good condition and will therefore also significantly contribute toward this impact. The only mitigation that can be applied to decrease this impact is to restrict development to areas being of low sensitivity and should limit the extent of transformation as far as possible. Despite this mitigation it is highly likely that areas of moderate sensitivity will still be included in the development area and the resulting impact on habitat loss, fragmentation and the disruption of ecological processes will remain significant. | | | |
| | **Rating** | **Motivation** | **Significance** |
| ***Prior to Mitigation*** | | | |
| **Duration** | 5 | Permanent loss and fragmentation of habitat | **High Negative (68)** |
| **Extent** | 4 | Large development area | |
| **Magnitude** | 8 | High impact due to fragmentation of a Threatened Ecosystem | |
| **Probability** | 4 | Highly likely to take place | |
| ***Mitigation/Enhancement Measures*** | | | |
| ***Mitigation:***<br>The only mitigation that can be applied to decrease this impact is to restrict development to areas being of low sensitivity and should limit the extent of transformation as far as possible. Despite this mitigation it is highly likely that areas of moderate sensitivity will still be included in the development area and the resulting impact on habitat loss, fragmentation and the disruption of ecological processes will remain significant. | | | |
| ***Post Mitigation/Enhancement Measures*** | | | |
| **Duration** | 5 | Permanent loss and fragmentation of habitat | **High Negative (64)** |
| **Extent** | 3 | Decreased development area, though still fairly large | |
| **Magnitude** | 8 | High impact due to fragmentation of a Threatened Ecosystem | |
| **Probability** | 4 | Highly likely to take place | |
| ***Cumulative impacts:***<br>The area has a long history of transformation by mining and agricultural activities and the cumulative impact that this has had is extensive. This is also clearly evident in the degree to which the local vegetation types, Vaal-Vet Sandy Grassland and Vaal Reefs Dolomite Sinkhole Woodland is regarded as being affected by development pressures. The assessment has also indicated that the area is still dominated by natural grassland in fairly good condition (Appendix | | | |

A: Map 1). Therefore, should the proposed development further increase vegetation and habitat loss of natural areas it will have a high cumulative impact on habitat fragmentation. The only mitigation which may decrease the cumulative impact to some degree would be the exclusion of areas identified as having a high conservation value (See previous paragraphs). This would entail the preservation of at least a portion of the remaining natural areas though since the development will still result in significant transformation of natural areas, the cumulative impact will remain significant.

***Residual Risks:***

The area is largely still dominated by natural grassland in fairly good condition and it is unavoidable that the development will result in transformation of a significant portion of natural grassland and consequently the residual impact on habitat fragmentation and the loss of ecosystem processes would remain significant.

***Nature:***

**Impacts that will result on the mammal population on and around the site.**

**Impact description:** The most significant impact on mammals anticipated on the site itself is primarily concerned with the loss and fragmentation of available habitat. Transformation of the natural vegetation on the site will result in a decrease in the population size as available habitat decreases. Since it is inevitable that the development will involve the transformation of natural grassland this contribute significantly toward habitat loss which in turn will result in a high impact on the mammal population. This also indicates the need to take extra care in determining the development area, which should focus on areas of lower sensitivity, should exclude areas of high sensitivity and the wetland system in the eastern portion of the site and should limit the extent of transformation as far as possible Current layout plans do indicate that areas of High Sensitivity are largely being avoided while mostly retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity.

| | **Rating** | **Motivation** | **Significance** |
|---|---|---|---|
| ***Prior to Mitigation*** | | | |
| **Duration** | 5 | Given the largely natural development area and permanent loss of habitat the duration will be permanent | **High Negative (76)** |
| **Extent** | 4 | Extensive loss of natural areas | |
| **Magnitude** | 10 | High given the largely natural mammal population and presence of Red Listed species | |
| **Probability** | 4 | High given the largely natural mammal population and loss of habitat | |

***Mitigation/Enhancement Measures***

***Mitigation:***

The development should focus on areas of lower sensitivity, should exclude areas of high sensitivity and the wetland system in the eastern portion of the site and should limit the extent of transformation as far as possible. Current layout plans do indicate that areas of High Sensitivity are largely being avoided while mostly retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity. Though this will still entail significant

impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity. Construction itself may also affect the mammal population and care should therefore be taken to ensure none of the faunal species on site is harmed. The hunting, capturing or harming in any way of mammals on the site should not be allowed. Voids and excavations may also act as pitfall traps to fauna and these should continuously be monitored and any trapped fauna removed and released in adjacent natural areas.

Near Threatened Serval (*Leptailurus serval*) occurs in the development area it is clear that the proposed development will have a significant impact on it. According to the National Red List (2016) the following recommendations and mitigation should be implemented where this species will be affected:

- Natural habitat should be conserved as far as possible. Managers and landowners must avoid wetland loss and should retain natural grassland areas in a good condition.
- The Serval population on the site should be monitored to determine abundance and trends and to determine the impact that development has on the population dynamics. Monitoring should also include the implementation of fixed camera traps for long term monitoring. Due to their specialised habitat requirements at small spatial scales, they may serve as a useful ecosystem indicator of the effect of habitat fragmentation in transformed landscapes.
- Monitoring of the Serval population must be introduced as a compliance measure in Environmental Impact Assessment reports.
- The development site should incorporate the long-term persistence of Serval and associated habitats into onsite biodiversity management practices. Buffer habitats could be modelled based on minimum wetland size and available cover

***Post Mitigation/Enhancement Measures***

| | | | |
|---|---|---|---|
| **Duration** | 5 | Given the largely natural development area and permanent loss of habitat the duration will be permanent | **High Negative (72)** |
| **Extent** | 3 | Decreased development area, though still fairly large | |
| **Magnitude** | 10 | High given the largely natural mammal population and presence of Red Listed species | |
| **Probability** | 4 | High given the largely natural mammal population and loss of habitat | |

***Cumulative impacts:***

The area has a long history of transformation by mining, agriculture and urban expansion and the cumulative impact that this has had on the mammal population is extensive. Therefore, should the proposed development further encroach into natural areas it will have a further increased cumulative impact on the mammal population. The only mitigation which may decrease the cumulative impact to some degree would be the exclusion of areas identified as having a high conservation value. This would entail the preservation of at least a portion of the remaining natural areas though since the development will still result in significant transformation of natural areas, the cumulative impact on the mammal population will remain significant.

| |
|---|
| ***Residual Risks:***<br>Transformation of the indigenous vegetation on the site will result in a decrease in the mammal population size as available habitat decreases and consequently the residual impact will remain high. |

***Cumulative impact:***

As previously indicated, the area has a long history of transformation by mining and agricultural activities and the cumulative impact that this has had is extensive. This is also clearly evident in the degree to which the local vegetation types, Vaal-Vet Sandy Grassland and Vaal Reefs Dolomite Sinkhole Woodland is regarded as being affected by development pressures. The assessment has also indicated that the area is still dominated by natural grassland in fairly good condition (Appendix A: Map 1). Therefore, should the proposed development further increase vegetation and habitat loss of natural areas it will have a high cumulative impact. The only mitigation which may decrease the cumulative impact to some degree would be the exclusion of areas identified as having a high conservation value (See previous paragraphs). This would entail the preservation of at least a portion of the remaining natural areas though since the development will still result in significant transformation of natural areas, the cumulative impact will remain significant.

| | **Overall impact of the proposed project considered in isolation** | **Cumulative impact of the project and other projects in the area** |
|---|---|---|
| ***Extent*** | 4 | 4 |
| ***Duration*** | 5 | 4 |
| ***Magnitude*** | 10 | 8 |
| ***Probability*** | 5 | 4 |
| ***Significance*** | **High (95)** | **High (64)** |
| ***Status (positive or negative)*** | Negative | Negative |
| ***Reversibility*** | Irreversible | Irreversible |
| ***Irreplaceable loss of resources?*** | Yes | Yes |
| ***Can impacts be mitigated?*** | Yes – but limited | Yes – but limited |
| ***Confidence in findings:*** High | | |

***Mitigation:***

The only mitigation which may decrease the cumulative impact to some degree would be the exclusion of areas identified as having a high conservation value (See previous paragraphs). This would entail the preservation of at least a portion of the remaining natural areas though since the development will still result in significant transformation of natural areas, the cumulative impact will remain significant.

## 6. BIODIVERSITY SENSITIVITY RATING (BSR)

**Habitat diversity and species richness:**
The majority of the area is still dominated by natural vegetation and includes two different vegetation types, with a variety of habitats which include undulating plains, rocky outcrops, bush clumps, wetland areas and areas of deeper sandy soils. The habitat diversity in the area is therefore relatively high. Despite this high habitat diversity, species diversity remains moderate.

**Presence of rare and endangered species:**
No Red Listed plant species could be identified on the site and the area is also not known to contain many such species though a few are still present in this region and a likelihood therefore remains that such a species may also be present on the site. However, given the large extent of the study area, it has been found to contain a fairly high number of protected plant species (Appendix B). These include the protected succulent and geophytic species, *Euphorbia striata, Orthanthera jasminiflora, Boophone distichia, Pentharhinum insipidum, Schizocarpus nervosus, Satyrium sp., Raphionecma velutina, Babiana bainesii, Aloe greatheadii, Crinum graminicola,* and *Vachellia erioloba*.

**Ecological function:**
The ecological function of the site is still relatively intact though some modification is still evident. The site functions as habitat for a variety of fauna, supports specific vegetation types and the wetland systems forming part of the site also provides vital functions in terms of water transportation, wetland and aquatic habitats and bio-remediation. The majority of the area is still dominated by natural vegetation and therefore still retains the natural vegetation types, of which the Vaal-Vet Sandy Grassland is also an Endangered ecosystem (Appendix A: Map 1). As a result of this largely natural vegetation, the area also clearly still sustains a diverse mammal population which also includes Serval, a Near Threatened species. The wetland system in the east of the site has been shown to be moderately modified but is still considered a highly sensitive system (Appendix A: Map 3 & 4). Overall the ecological function of the study area is considered to be largely intact while also providing several important ecological functions.

**Degree of rarity/conservation value:**
The study area contains several areas of high conservation value and overall the site is rated as high (Appendix A: Map 1 - 4):

- The Mispah Game Reserve covers a large portion of the southern portion of the site. This is a Private Nature Reserve which has been proclamated as a Protected Area (PA) under the National Environmental Management Protected Areas Act (NEMPAA of 2003). The area is listed as a Private Nature Reserve within the South Africa Protected & Conservation Areas Database (SAPAD) and was proclamated in 2001 (Notice 23 of 2001). Development within any protected area is highly unlikely since this is largely prevented by the NEMPAA and any management plan of the protected area. This PA has also been taken into account in determining the provincial and national

conservation targets and development within this PA will also affect these conservation targets.

- Two large CBA 1 areas have been delineated by the Free State Biodiversity Management Plan. These CBA 1 areas have been identified as being crucial for meeting conservation targets for the Endangered Vaal-Vet Sandy Grassland occurring in this area but also to some extent the Vaal Reefs Dolomite Sinkhole Woodland in the area. These CBA 1 areas have been identified as being Irreplaceable in terms of meeting conservation targets.
- Portions of remaining Vaal-Vet Sandy Grassland also occur in the south east of the site but which do not form part of the Mispah Game Reserve or identified CBA areas. However, since this vegetation type is currently listed as Endangered (EN) these areas must still be afforded a High level of sensitivity.
- A large wetland system transects the eastern portion of the site. This is clearly an importance water resource and will have a Very High level of sensitivity.

**Percentage ground cover:**
Overall, the percentage vegetation cover is regarded as moderately modified. The area is dominated by natural grassland with a fairly high percentage vegetation cover. However, overgrazing in some areas does decrease this cover to some extent. Other areas of clear transformation such as the cultivated cropfields, mining operations and woodlots of exotic trees also contribute toward a decreased vegetation cover but given the large extent of the area the overall vegetation cover remains moderate.

**Vegetation structure:**
The area forms part of the Grassland Biome and should naturally therefore contain a well-developed grass layer and without any significant tree or shrub component being present. This is still largely the case on the site although areas of disturbance does increase the establishment of trees and shrubs though is restricted to fairly small areas.

**Infestation with exotic weeds and invader plants:**
In general, the natural areas in the study area are largely devoid of exotic weeds. However, where disturbance is present as well as those areas where transformation has occurred, exotic weeds and invasive trees have become established (Appendix B). These include *Bidens bipinnata, Tagetes minuta*, *Physalis viscosa, Achyranthes aspera*, *Melia azedarach, Eucalyptus camaldulensis, Gleditsia triacanthos, Nicotiana glauca, Acacia baileyana*, *Tamarix chinensis, Pennisetum setaceum* and *Opuntia ficus-indica.* Several of these are considered serious invasive species and it is important that a comprehensive eradication and monitoring programme be implemented.

**Degree of grazing/browsing impact:**
Several portions of the site, notably the north western portion is being utilised as communal grazing and browsing for domestic livestock and there is therefore no structured grazing regime or stocking levels. Overall the amount of overgrazing is therefore considered to be at least moderate.

**Signs of erosion:**
The area is not affected by any pronounced erosion though moderate erosion is visible along some roads and areas of disturbance.

**Terrestrial animals:**

Signs and tracks of mammals are fairly abundant on the site though the mammal population will be somewhat modified from the natural condition. Natural vegetation has a high carrying capacity for mammals which decreases significantly where mining or agriculture transforms this natural vegetation and in such transformed areas the mammal population is normally represented by a generalist mammal population. As indicated previously, the majority of this still consists of natural vegetation and accordingly the mammal population will also be largely natural in these areas. The mammal population in natural areas would however still be somewhat modified as a result of the surrounding fragmentation of habitat which affected the population dynamics and migration of mammals. Other impacts such as roads, herding, trapping and the proximity of mining activities would also further impact on mammals, especially reclusive and rare mammals dependant on pristine habitats. Rare and endangered mammals are often reclusive and avoid areas in close proximity to human activities and are also dependant on habitat in pristine condition. The site would therefore have a significant impact on the likelihood of such rare and endangered species occurring in the area, there is however still a likelihood that remaining natural areas may harbour species of high conservation value. The Serval has also already been confirmed to be present and it is therefore likely that other threatened mammals may also occur.

Table 6: Biodiversity Sensitivity Rating for the proposed solar development.

| | Low (3) | Medium (2) | High (1) |
|---|---|---|---|
| Vegetation characteristics | | | |
| Habitat diversity & Species richness | | 2 | |
| Presence of rare and endangered species | | 2 | |
| Ecological function | | | 1 |
| Uniqueness/conservation value | | | 1 |
| | | | |
| Vegetation condition | | | |
| Percentage ground cover | | 2 | |
| Vegetation structure | | | 1 |
| Infestation with exotic weeds and invader plants or encroachers | | 2 | |
| Degree of grazing/browsing impact | | 2 | |
| Signs of erosion | | 2 | |
| | | | |
| Terrestrial animal characteristics | | | |
| Presence of rare and endangered species | | | 1 |
| Sub total | 0 | 12 | 4 |
| Total | | 16 | |

## 7. BIODIVERSITY SENSITIVITY RATING (BSR) INTERPRETATION

Table 7: Interpretation of Biodiversity Sensitivity Rating.

| Site | Score | Site Preference Rating | Value |
|---|---|---|---|
| Harmony Moab-Noligwa PV Solar | 16 | Good condition | 2 |

## 8. DISCUSSION AND CONCLUSION (Appendix A: Map 1 - 4)

The site proposed for PV solar development has been rated as being in a Good Condition. This is a result of the area still being dominated by natural grassland in a fairly good condition. Areas of high conservation value and important ecological function also contribute toward this (Appendix A: Map 4). Given that the development will inevitably require the transformation of a significant portion of these natural areas, it will result in a significant level of impact.

The study area is situated approximately 10 km east of the small town of Orkney and to the south of the settlement of Vaal Reefs (Appendix A: Map 1). The study area is fairly large and is dominated by undulating grassland plains with gentle slopes that generally slopes toward the north and east, toward lower lying watercourses and wetlands. The extent of the study area is approximately 1500 hectares. A significant portion of this development area has however been transformed by the existing mining plants and infrastructure. However, the majority of the area is still dominated by natural grassland with some disturbance also being evident. A large wetland area is also present in the eastern portion, with a few small depression wetlands also occurring in the southern portion.

According to Mucina & Rutherford (2006) the area consists of Vaal-Vet Sandy Grassland (Gh 10) and Vaal Reefs Dolomite Sinkhole Woodland (Gh 12). The former is currently listed as Endangered (EN) while the latter is Least Concern (LC) under the National List of Threatened Ecosystems (Notice 1477 of 2009) (National Environmental Management Biodiversity Act, 2004) (Appendix A: Map 1). The Vaal-Vet Sandy Grassland dominated the southern portion of the site and is visible as undulating grassland but characterised by fairly deep, sandy soils. These remaining natural portions of this grassland would also be regarded as being of high conservation value. The vegetation type is currently heavily affected by extensive transformation by agriculture, urban expansion and mining operations. The Vaal Reefs Dolomite Sinkhole Woodland dominates the northern portions of the site and is visible as undulating plains though here exposed low rocky ridges become evident, deeper sandy soils are absent and the grass composition also differs slightly by containing a higher proportion of sour grasses. The woodland component, associate with dolomite sinkholes are not well represented on the site although a few bush clumps were noted. This vegetation type is also heavily affected by transformation but not yet to such an extent as to warrant it being listed as a Threatened Ecosystem.

The Free State Province Biodiversity Management Plan (2015) has been published and has identified areas which are essential to meeting conservation targets for specific vegetation types, i.e. Critical Biodiversity Areas. The site in question is predominately listed as an Ecological Support Area 1 and 2 (ESA) which functions in support of the Vaal River which is situated approximately 1 km to the north of the site (Appendix A: Map 2). The development should therefore not result in compromising the functioning of this important system, i.e. increase runoff or degrade the area to such an extent that it influences the functioning of the Vaal River. Furthermore, the site also contains two prominent areas being regarded as Critical Biodiversity Areas 1 (CBA 1) situated in the centre and eastern portion of the site (Appendix A: Map 2). These CBA 1 areas have been identified as being crucial for meeting conservation

targets for the Endangered Vaal-Vet Sandy Grassland occurring in this area but also to some extent the Vaal Reefs Dolomite Sinkhole Woodland in the area. These CBA 1 areas have been identified as being Irreplaceable, i.e. "A site that is irreplaceable or near-irreplaceable for meeting biodiversity targets. There are no or very few other options for meeting biodiversity targets for the features associated with the site. Such sites are therefore critical and they need to be maintained to ensure that features targets are achieved and that such features persist." These portions of CBA's occurring on the site will therefore have to be excluded from development in order to ensure they remain intact.

The study area is still largely dominated by natural grassland and which can broadly be divided into a northern and southern portion where the northern portion is dominated by Vaals Reefs Dolomite Sinkhole Woodland and also north of a large tarred road while the southern portion is dominated by Vaal-Vet Sandy Grassland and situated south of the tarred road (Appendix A: Map 1). The southern portion is dominated by grassland dominated by Vaal-Vet Sandy Grassland and which is largely still intact. A significant portion also consists of Vaal Reefs Dolomite Sinkhole Woodland though the transition between these two vegetation types is gradual. Portions of the grassland has previously been transformed though the majority of these have again been able to re-establish a fairly natural grass layer. However, a few smaller portions are still visibly degraded and transformed and these include a large woodlot of invasive Bluegum (*Eucalyptus camaldulensis*), oxidation ponds associated with mining operations, greenhouses and a small portion previously used as stockpiling/construction area. The northern portion is also dominated by grassland but which consists almost exclusively of Vaal Reeds Dolomite Sinkhole Woodland. This grassland is also largely natural though significant disturbance is associated with areas of shallow excavations and overgrazing by domestic livestock. Though Vaal Reefs Dolomite Sinkhole Woodland is under significant development pressure, it is also not currently listed as a Threatened Ecosystem and will therefore have a slightly lower conservation value than the southern portion. The Vaal Reefs Dolomite Sinkhole Woodland is characterised by a well-developed grass layer and much higher degree of surface rock as well as at least some bush clumps establishing around sinkholes. The north western portion is visibly degraded by high levels of overgrazing by domestic livestock and also a substantial area which was previously used for dumping of spoil and rubble and also contains shallow excavations.

From the description of the area given above it is clear that the majority of the site still consists of natural grassland which is still in a fairly good condition (Appendix A: Map 1). The surroundings as well as significant portions of the site has been affected and transformed by historical mining operations. Being a mining area, this results in transformation and degradation of large portions of land. The cumulative impact of development and mining in this area is therefore high. The proposed solar development should therefore first consider the development of areas considered as already transformed and of low sensitivity. These include areas previously cleared for construction activities, portions transformed by ploughing for crop production and degraded areas associated with the mining operations which also includes areas of shallow excavations and rubble dumps. It is however inevitable that the development will also encroach into areas of natural grassland which will result in significant impacts.

Given the above descriptions of the natural vegetation the following areas of high sensitivity should be avoided as far as possible (Appendix A: Map 1 - 4):

- The Mispah Game Reserve covers a large portion of the southern portion of the site. This is a Private Nature Reserve which has been proclamated as a Protected Area

(PA) under the National Environmental Management Protected Areas Act (NEMPAA of 2003). The area is listed as a Private Nature Reserve within the South Africa Protected & Conservation Areas Database (SAPAD) and was proclamated in 2001 (Notice 23 of 2001). Development within any protected area is highly unlikely since this is largely prevented by the NEMPAA and any management plan of the protected area. This PA has also been taken into account in determining the provincial and national conservation targets and development within this PA will also affect these conservation targets.

- Two large CBA 1 areas have been delineated by the Free State Biodiversity Management Plan. These CBA 1 areas have been identified as being crucial for meeting conservation targets for the Endangered Vaal-Vet Sandy Grassland occurring in this area but also to some extent the Vaal Reefs Dolomite Sinkhole Woodland in the area. These CBA 1 areas have been identified as being Irreplaceable in terms of meeting conservation targets.
    - The development should therefore exclude these CBA areas from development.
    - Where no alternative is possible and development needs to encroach into these CBA areas, alternative CBA areas will have to be identified in order to still meet conservation targets. Given that these CBA areas have been identified as irreplaceable this will not be easily attainable.

- Portions of remaining Vaal-Vet Sandy Grassland also occur in the south east of the site but which do not form part of the Mispah Game Reserve or identified CBA areas. However, since this vegetation type is currently listed as Endangered (EN) these areas must still be afforded a High level of sensitivity. Development should investigate all alternatives to avoid this area and should only encroach into this area if no other alternative is available. This will however result in high impacts.

- A large wetland system transects the eastern portion of the site. This is clearly an importance water resource and will have a Very High level of sensitivity. It will not be possible to develop this system and should be completely excluded from development.

Since it is clear that the impact of the solar development will be high and will lead to irreversible transformation, the development area should be carefully determined, should focus on areas of lower sensitivity and should limit the extent of transformation as far as possible (Appendix A: Map 4). Current layout plans do indicate that areas of High Sensitivity are largely being avoided while mostly retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity. Furthermore, numerous protected plant species has been identified in the study area (Appendix B). These include the protected succulent and geophytic species, *Euphorbia striata, Orthanthera jasminiflora, Boophone distichia, Pentharhinum insipidum, Schizocarpus nervosus, Satyrium sp., Raphionecma velutina, Babiana bainesii, Aloe greatheadii, Crinum graminicola,* and *Vachellia erioloba*. Where development will affect these species, the necessary permits should be obtained and a significant proportion of these transplanted to adjacent areas where they will remain unaffected. In addition, there are also a few protected herbaceous plants (*Helichrysum spp.*) and a few specimens of the protected *Vachellia erioloba* (Camel Thorn). Where any of these will require removal, the necessary permits should be obtained to do so.

In addition, the area also contains many invasive trees, especially in the transformed excavations in the northern portion of the site, and this will pose a risk of spreading into surrounding natural areas, especially as construction of the solar development will increase disturbance in the area (Appendix B). The proposed development will also have to implement a comprehensive monitoring and eradication programme to ensure that invasive plant species are removed from the area and prevented from re-establishing.

Signs and tracks of mammals are fairly abundant on the site though the mammal population will be somewhat modified from the natural condition. Natural vegetation has a high carrying capacity for mammals which decreases significantly where mining or agriculture transforms this natural vegetation and in such transformed areas the mammal population is normally represented by a generalist mammal population. As indicated previously, the majority of this still consists of natural vegetation and accordingly the mammal population will also be largely natural in these areas. The mammal population in natural areas would however still be somewhat modified as a result of the surrounding fragmentation of habitat which affected the population dynamics and migration of mammals. Other impacts such as roads, herding, trapping and the proximity of mining activities would also further impact on mammals, especially reclusive and rare mammals dependant on pristine habitats. Rare and endangered mammals are often reclusive and avoid areas in close proximity to human activities and are also dependant on habitat in pristine condition. The site would therefore have a significant impact on the likelihood of such rare and endangered species occurring in the area, there is however still a likelihood that remaining natural areas may harbour species of high conservation value.

The most significant impact on mammals anticipated on the site itself is primarily concerned with the loss and fragmentation of available habitat. Transformation of the natural vegetation on the site will result in a decrease in the population size as available habitat decreases. Since it is inevitable that the development will involve the transformation of natural grassland this contribute significantly toward habitat loss which in turn will result in a high impact on the mammal population. This also indicates the need to take extra care in determining the development area, which should focus on areas of lower sensitivity, should exclude areas of high sensitivity and the wetland system in the eastern portion of the site and should limit the extent of transformation as far as possible. Current layout plans do indicate that areas of High Sensitivity are largely being avoided while mostly retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity.

Since it has been confirmed that Near Threatened Serval (*Leptailurus serval*) occurs in the development area it is clear that the proposed development will have a significant impact on it. According to the National Red List (2016) the following recommendations and mitigation should be implemented where this species will be affected:

- Natural habitat should be conserved as far as possible. Managers and landowners must avoid wetland loss and should retain natural grassland areas in a good condition.

- The Serval population on the site should be monitored to determine abundance and trends and to determine the impact that development has on the population dynamics. Monitoring should also include the implementation of fixed camera traps for long term monitoring. Due to their specialised habitat requirements at small spatial scales, they

may serve as a useful ecosystem indicator of the effect of habitat fragmentation in transformed landscapes.

- Monitoring of the Serval population must be introduced as a compliance measure in Environmental Impact Assessment reports.

- The development site should incorporate the long-term persistence of Serval and associated habitats into onsite biodiversity management practices. Buffer habitats could be modelled based on minimum wetland size and available cover.

The surface water features of the study area are dominated by a large valley bottom wetland system in the eastern portion of the site (Appendix A: Map 3). A few small depressions also occur in the south west of the site and within the Mispah Game Reserve.

As indicated, a large valley bottom wetland system occurs in the eastern portion of the site and will likely be affected by the proposed development (Appendix A: Map 3). This is a seasonal system which flows mostly during the rainy season but did still illustrate an active hydrological regime at the time of the survey. The wetland transects the site from south to north and originates approximately 5 km to the south of the site. The catchment is also situated in agricultural areas used for crop production which will have a large impact on it though where it occurs on the site is still naturally functioning and provides ample wetland habitat which will provide unique habitats and will provide vital downstream ecological functions.

Current wetland resources including the National Wetland Map 5 (NWM 5) and the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) also indicate a few other wetland areas likely to occur in the area (Appendix A: Map 1). The survey also sampled these areas and confirmed that no wetland conditions are present in these areas. They do not form part of any watercourse, wetland ort surface water feature and are therefore not relevant for the development. The results will however be included in overview in order to confirm that these areas were surveyed and confirmed to be devoid of wetland conditions.

Obligate wetland vegetation was utilised to determine the presence and border of wetland conditions (Appendix B). The vegetation survey indicated that obligate wetland vegetation dominates the valley bottom wetland system in the east of the site. The smaller depression wetlands in the south west of the site contained some obligate wetland vegetation though due to high levels of disturbance this was not as pronounced. However, soil samples conclusively confirmed the presence of wetland conditions in both the valley bottom wetland system and small depression wetlands (Appendix C). The large valley bottom wetland system in the east of the study area can be categorised as an unchanneled valley-bottom wetland (SANBI 2009).

The determination of the condition of the wetlands on the site will be confined to the large valley bottom wetland system in the eastern portion of the site (Appendix A: Map 3). The small depressions wetlands in the south west of the site should remain unaffected by the development and will therefore not be relevant and their condition will not be determined. Therefore, a WET-Health determination will be done for this large valley bottom wetland system occurring on the site and should give an accurate indication of the current condition of the system and its vulnerability to impacts of the development. The WET-Health will be taken as representative of the Present Ecological State (PES) of this system (Appendix D).

Though the section of the wetland occurring on the site seems to still be largely intact and functional the upstream land uses, especially within the catchment will certainly have a significant impact on the wetland and is therefore likely to cause a significant level of modification of it. The survey has indicated that the valley bottom wetland system is affected by numerous impacts which result in a significant level of modification. A WET-Health determination was undertaken for the valley bottom wetland to determine its current condition given the impacts affecting it (Appendix D). The results of the WET-Health indicated an overall Present Ecological State of Category C: Moderately Modified. This is considered relatively accurate given the largely transformed catchment and impacts on the wetland. The EI&S of the valley bottom wetland system has been rated as being Moderate.

A Risk Assessment for the proposed solar facility which will affect the valley bottom wetland system in the eastern portion of the site has been undertaken according to the Department of Water & Sanitation's requirements for risk assessment and the provisional Risk Assessment Matrix for Section 21(c) & (i) water use (Appendix E). In the event that development of solar facilities extends into the eastern portion of the site, these areas will be located in close proximity to this wetland system and in so doing are likely to result in some impacts on it, especially in terms of runoff and sedimentation (Appendix A: Map 3). However, current layout plans do indicate that the development will avoid the eastern portion of the development area which will significantly decrease the anticipated impact. The current layout plans indicate that portions of the development as well as associated grid connection powerline will be situated approximately 350 meters from this valley-bottom wetland system and given the clearance of vegetation and the large extent of the development is still likely to have an impact on it.

The large valley bottom wetland system is clearly the main wetland system in this area and is considered as still providing several essential functions and is therefore considered as highly sensitive and being of high conservation value (Appendix A: Map 3). Current layout plans do indicate that the eastern portion of the development area will be excluded though development will still occur within 350 meters of the edge of the wetland and is then still likely to have some impact on it. Given the distance between the wetland area and current development layout (approximately 350 meters), the anticipated risk will be low.

The impact significance has been determined and should development take place without mitigation it is anticipated that it will result in overall high impacts. This is a result of the largely natural condition of the area, the presence of areas of high conservation value and the fairly large extent of the proposed development (Appendix A: Map 4). Aspects which are expected to result in quite high impacts include the loss of the vegetation type in the area which includes Vaal-Vet Sandy Grassland (an Endangered system) as well as the loss of a large wetland system in the east of the site. Other moderate-high impacts also include the loss of protected plant species, increased infestation by exotic weeds, increased habitat fragmentation, the impact on mammals (which also includes a Near Threatened species) and the increased cumulative impact. Suitable mitigation as listed in previous paragraphs should enable the development to decrease many of these impacts to moderate levels. This will mostly be achieved by excluding areas of high conservation value as listed which will in turn decrease the severity of the impacts and will also decrease the extent and in so doing the anticipated impacts will be somewhat lower. Current layout plans do indicate that areas of High Sensitivity are largely being avoided while mostly retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity. However, as indicated significant natural areas will still be transformed by the development and several of the impacts will remain

significant especially the impacts on the vegetation type and biodiversity, the wetland system in the east of the site, habitat fragmentation, the mammal population in the area and the cumulative impact.

## 9. RECOMMENDATIONS

- Since it is clear that the impact of the solar development will be high and will lead to irreversible transformation, the development area should be carefully determined, should focus on areas of lower sensitivity and should limit the extent of transformation as far as possible. Current layout plans do indicate that areas of High Sensitivity are largely being avoided while mostly retaining development within areas of Moderate Sensitivity. Though this will still entail significant impacts, it will be significantly lower as opposed to the inclusion of areas of High Sensitivity.

- The survey has indicated several areas that are considered highly sensitive and with a high conservation value and should be excluded from development as far as possible (Appendix A: Map 1 - 4):

    - The Mispah Game Reserve covers a large portion of the southern portion of the site. This is a Private Nature Reserve which has been proclamated as a Protected Area (PA) under the National Environmental Management Protected Areas Act (NEMPAA of 2003).
    - Two large CBA 1 areas have been delineated by the Free State Biodiversity Management Plan. These CBA 1 areas have been identified as being crucial for meeting conservation targets for the Endangered Vaal-Vet Sandy Grassland occurring in this area but also to some extent the Vaal Reefs Dolomite Sinkhole Woodland in the area. These CBA 1 areas have been identified as being Irreplaceable in terms of meeting conservation targets.
        - The development should therefore exclude these CBA areas from development.
        - Where no alternative is possible and development needs to encroach into these CBA areas, alternative CBA areas will have to be identified in order to still meet conservation targets. Given that these CBA areas have been identified as irreplaceable this will not be easily attainable.
    - Portions of remaining Vaal-Vet Sandy Grassland also occur in the south east of the site but which do not form part of the Mispah Game Reserve or identified CBA areas. However, since this vegetation type is currently listed as Endangered (EN) these areas must still be afforded a High level of sensitivity. Development should investigate all alternatives to avoid this area and should only encroach into this area if no other alternative is available. This will however result in high impacts.
    - A large wetland system transects the eastern portion of the site. This is clearly an importance water resource and will have a Very High level of sensitivity. It will not be possible to develop this system and should be completely excluded from development and a 21 meter buffer around it also maintained (Appendix A: Map 3).

- The following recommendations and mitigation measures should be implemented in order to manage impacts on the valley bottom wetland in the east of the site (Appendix A: Map 3):

    - The wetland system as delineated should be completely excluded from the development area in order to ensure no impacts on it occurs (Appendix A: Map 3).
    - The wetland should be regarded as no-go area and no construction or operational activities including stockpiling, clearing, laydown areas, vehicle movement or any other associated activities should occur in or near this wetland.
    - Given the current layout plan, it is unlikely that infrastructure such as roads and powerlines will require crossing it and this was therefore not rated as a risk. However, should layout plans be modified and it become apparent that development will encroach in proximity to the wetland or other infrastructure require crossing this system, the impacts should be re-assessed and the risk matrix amended.
    - The development should design and implement a comprehensive storm water management system in order to manage runoff and prevent erosion which will affect the wetland system.
    - The storm water management system should include design of erosion prevention structures such as soakaways, attenuation areas and dissipation structures.
    - All structures and mitigation measures should be maintained throughout the lifetime of the development.
    - It will be important to implement a monitoring programme so that any changes to the valley bottom wetland system can be identified quickly before it leads to irreversible changes. This monitoring programme should include, at least during the construction phase, a bi-annual biomonitoring of the affected wetland. This should be conducted by a suitable qualified wetland specialist.
    - The necessary authorisations should be obtained from the Department of Water and Sanitation (DWS).

- As discussed in the report, the study area contains numerous protected species (Appendix B). These consist of protected trees, herbaceous species, succulents and geophytes. The following recommendations should be followed for protected species:

    - Where protected tree species (*Vachellia erioloba* – Camel Thorn) will be affected by the development, permits should be obtained from the relevant authority to remove them.
    - Where protected succulent/geophytic species will be affected by development, permits should be obtained and these transplanted to adjacent areas where they will remain unaffected.
    - These species are cryptic and inconspicuous and it is recommended that a walkthrough survey be conducted prior to an area being cleared. This should include identification and marking of all protected plants in such an area and should be performed by an ecologist or botanist.
    - The transplanting of these species should be overseen by an ecologist, botanist or other suitably qualified person.
    - Monitoring of the success of establishment should also be undertaken.

- Construction may affect the mammal population and care should therefore be taken to ensure none of the faunal species on site is harmed. The hunting, capturing or harming in any way of mammals on the site should not be allowed.

- Voids and excavations may also act as pitfall traps to fauna and these should continuously be monitored and any trapped fauna removed and released in adjacent natural areas. This should include mammals, reptiles and amphibians.

- In the event of poisonous snakes or other dangerous animals encountered on the site an experienced and certified snake handler or zoologist must remove these animals from the site and re-locate them to a suitable area.

- Near Threatened Serval (*Leptailurus serval*) occurs in the development area it is clear that the proposed development will have a significant impact on it. According to the National Red List (2016) the following recommendations and mitigation should be implemented where this species will be affected:

    - Natural habitat should be conserved as far as possible. Managers and landowners must avoid wetland loss and should retain natural grassland areas in a good condition.
    - The Serval population on the site should be monitored to determine abundance and trends and to determine the impact that development has on the population dynamics. Monitoring should also include the implementation of fixed camera traps for long term monitoring. Due to their specialised habitat requirements at small spatial scales, they may serve as a useful ecosystem indicator of the effect of habitat fragmentation in transformed landscapes.
    - Monitoring of the Serval population must be introduced as a compliance measure in Environmental Impact Assessment reports.
    - The development site should incorporate the long-term persistence of Serval and associated habitats into onsite biodiversity management practices. Buffer habitats could be modelled based on minimum wetland size and available cover.

- Due to the susceptibility of disturbed areas, it is recommended that weed control be judiciously and continually practised. Monitoring of weed establishment should form a prominent part of management of the development area and should be extended into the operational phase.

- Adequate monitoring of weed establishment and their continued eradication must be maintained (Appendix B). Where category 1 and 2 weeds occur, they require removal by the property owner according to the Conservation of Agricultural Resources Act, No. 43 of 1983 and National Environmental Management: Biodiversity Act, No. 10 of 2004.

- No littering must be allowed and all litter must be removed from the site.

- Construction should be confined to the site area and should not encroach into adjacent areas.

- After construction has ceased all construction waste should be removed from the area.

- Monitoring of construction including weed establishment and erosion should take place.

## 10. REFERENCES


Bromilow, C. 1995. Problem Plants of South Africa. Briza Publications CC, Cape Town.

Bromilow, C. 2010. Problem plants and alien weeds of South Africa. Briza Publications CC, Cape Town.

Child MF, Roxburgh L, Do Linh San E, Raimondo D, Davies-Mostert HT, editors. The 2016 Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Cillié, B. 2018. Mammal guide of Southern Africa. Briza Publications CC, Pretoria.

Coates-Palgrave, M. 2002. Keith Coate-Palgrave Trees of Southern Africa, edn 3, imp. 4 Random House Struik (Pty.) Ltd, Cape Town.

Collins, N.B. 2005. Wetlands: The basics and some more. Free State Department of Tourism, Environmental and Economic Affairs.

Conservation of Agricultural Resources Act, 1983 (ACT No. 43 OF 1983) Department of Agriculture.

Department of Water Affairs and Forestry. 2005. A practical field procedure for identification and delineation of wetlands and riparian areas. Edition 1. Department of Water Affairs and Forestry, Pretoria.

Duthie, A. 1999. Appendix W5: IER (floodplain and wetlands) determining the Ecological Importance and Sensitivity (EIS) and Ecological Management Class (EMC). In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

Department of Water Affairs and Forestry. 2005. A practical field procedure for identification and delineation of wetlands and riparian areas, Edition 1. Department of Water Affairs and Forestry, Pretoria.

Duthie, A. 1999. Appendix W5: IER (floodplain and wetlands) determining the Ecological Importance and Sensitivity (EIS) and Ecological Management Class (EMC). In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

DWAF. 2008. Updated manual for the identification and delineation of wetlands and riparian areas, prepared by M.Rountree, A.L. Batchelor, J. MacKenzie and D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

Fish, L., Mashau, A.C., Moeaha, M.J. & Nembudani, M.T. 2015. Identification guide to the southern African grasses. An identification manual with keys, descriptions and distributions. *Strelitzia* 36. South African National Biodiversity Institute, Pretoria.

FitzPatrick Institute of African Ornithology (2022). mammalmap Virtual Museum. Accessed at https://vmus.adu.org.za/?vm=mammalmap on 2022-07-04.
Gerber, A., Cilliers, C.J., Van Ginkel, C. & Glen, R. 2004. Easy identification of aquatic plants. Department of Water Affairs, Pretoria.

Government of South Africa. 2008. National Protected Area Expansion Strategy for South Africa 2008: Priorities for expanding the protected area network for ecological sustainability and climate change adaptation. Government of South Africa, Pretoria.

Germishuizen, G. & Meyer, N.L. (eds) 2003. Plants of Southern Africa: an annotated checklist. *Strelitzia* 14. National Botanical Institute, Pretoria.

Gibbs Russell, G.E., Watson, L., Koekemoer, M., Smook, L., Barker, N.P., Anderson, H.M. & Dallwitz, M.J. 1990. Grasses of Southern Africa. Memoirs of the Botanical Survey of South Africa No. 58. Botanical Research Institute, South Africa.

Google Earth V 7.3.4.8642. 2009-2022. Moab Plant, Orkney, South Africa. S 26.987502°, E 26.799377°. Eye alt. 7.07 km. Digital Globe 2022. http://www.earth.google.com (June 2022).

Government of South Africa. 2008. National Protected Area Expansion Strategy for South Africa 2008: Priorities for expanding the protected area network for ecological sustainability and climate change adaptation. Government of South Africa, Pretoria.

Griffiths, C., Day, J. & Picker, M. 2015. Freshwater Life: A field guide to the plants and animals of southern Africa. Penguin Random House South Africa (Pty) Ltd, Cape Town.

Kleynhans, C.J. 2000. Desktop estimates of the ecological importance and sensitivity categories (EISC), default ecological management classes (DEMC), present ecological status categories (PESC), present attainable ecological management classes (present AEMC), and best attainable ecological management class (best AEMC) for quaternary catchments in South Africa. DWAF report, Institute for Water Quality Studies, Pretoria, South Africa.

Kleynhans, C.J. & Louw, M.D. 2007. Module A: EcoClassification and EcoStatus determination in River EcoClassification: Manual for EcoStatus Determination (version 2). Joint water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 329/08.

Kleynhans, C.J., Louw, M.D. & Graham, M. 2008. Module G: EcoClassification and EcoStatus determination in River EcoClassification: Index of Habitat Integrity (Section 1, Technical Manual). Joint Water Research Commission and Department of Water Affaris and Forestry Report. WRC Report No. TT 377-08.

Le Maitre, D.C., Seyler, H., Holland, M., Smith-Adao, L., Nel, J.L., Maherry, A. and Witthüser, K. (2018) Identification, Delineation and Importance of the Strategic Water Source Areas of South Africa, Lesotho and Swaziland for Surface Water and Groundwater. Report No. TT 743/1/18, Water Research Commission, Pretoria.

Macfarlane, D.M., Ollis, D.J. & Kotze, D.C. 2020. WET-Health (Version 2.0): a refined suite of tools for assessing the present ecological state of wetland ecosystems. WRC Report No. TT 820/20.

Manning, J. 2009. Field Guide to Wild Flowers. Struik Nature, Cape Town.

Marnewecke, G. & Kotze, D. 1999. Appendix W6: Guidelines for delineation of wetland boundary and wetland zones. In: MacKay (Ed.), H. Resource directed measures for protection of water resources: wetland ecosystems. Department of Water Affairs and Forestry, Pretoria.

Moffett, R. 1997. Grasses of the Eastern Free State: Their description and uses. UNIQWA, the Qwa-Qwa campus of the University of the North, Phuthadittjhaba.

Mucina, L. & Rutherford, M.C. (eds.) 2006. The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19.South African National Biodiversity Institute, Pretoria.

National Environmental Management: Biodiversity Act (10/2004): National list of ecosystems that are threatened and in need of protection. Government Notice 1002 of 2011, Department of Environmental Affairs.

National Environmental Management: Biodiversity Act (10/2004): Publication of lists of critically endangered, endangered, vulnerable and protected species. Government Notice 151 of 2007, Department of Environmental Affairs.

National Water Act (Act No. 36 of 1998). Republic of South Africa.

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. (2011). Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

Ollis, D.J., Snaddon, C.D., Job, N.M. & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. *SANBI Biodiversity Series 22*. South African National Biodiversity Institute, Pretoria.

Pooley, E. 1998. A field guide to wild flowers: Kwazulu-Natal and the Eastern Region. Natal Flora Publications Trust, Durban.

Raymondo, D. Van Staden, L. Foden, W. Victor, J.E. Helme, N.A. Turner, R.C. Kamundi, D.A. Manyama, P.A. (eds.) 2009. Red List of South African Plants. *Strelitzia* 25. South African National Biodiversity Institute, Pretoria.

Retief, E. & Meyer, N.L. 2017. Plants of the Free State: Inventory and identification guide. *Strelitzia* 38. South African National Biodiversity Institute, Pretoria.

SANBI. 2009. Further Development of a Proposed National Wetland Classification System for South Africa. Primary Project Report. Prepared by the Freshwater Consulting Group (FCG) for the South African National Biodiversity Institute (SANBI).

Smithers, R.H.N. 1983. The mammals of the Southern African Subregion. University of Pretoria, Pretoria.

Strahler, A.N. 1952. Hyposometric (area-altitude) analysis of erosional topology. *Geological Society of American Bulletin* 63 (11): 1117-1142.

Van Deventer, H., Smith-Adao, L., Mbona, N., Petersen, C., Skowno, A., Collins, N.B., Grenfell, M., Job, N., Lötter, M., Ollis, D., Scherman, P., Sieben, E., Snaddon, K. 2018. South African Inventory of Inland Aquatic Ecosystems. South African National Biodiversity Institute, Pretoria. Report Number: CSIR report number CSIR/NRE/ECOS/IR/2018/0001/A; SANBI report number http://hdl.handle.net/20.500.12143/5847.

Van Ginkel, C.E. & Cilliers, C.J. 2020. Aquatic and wetland plants of Southern Africa. Briza Publications, Pretoria.

Van Ginkel, C.E., Glen, R.P., Gordon-Grey, K.D., Cilliers, C.J., Musaya, M. & Van Deventer, P.P. 2011. Easy Identification of some South African Wetland Plants. WRC Report No. TT 479/10.

Van Oudtshoorn, F. 2004. Gids tot Grasse van Suider-Afrika. Briza Publications, Pretoria.

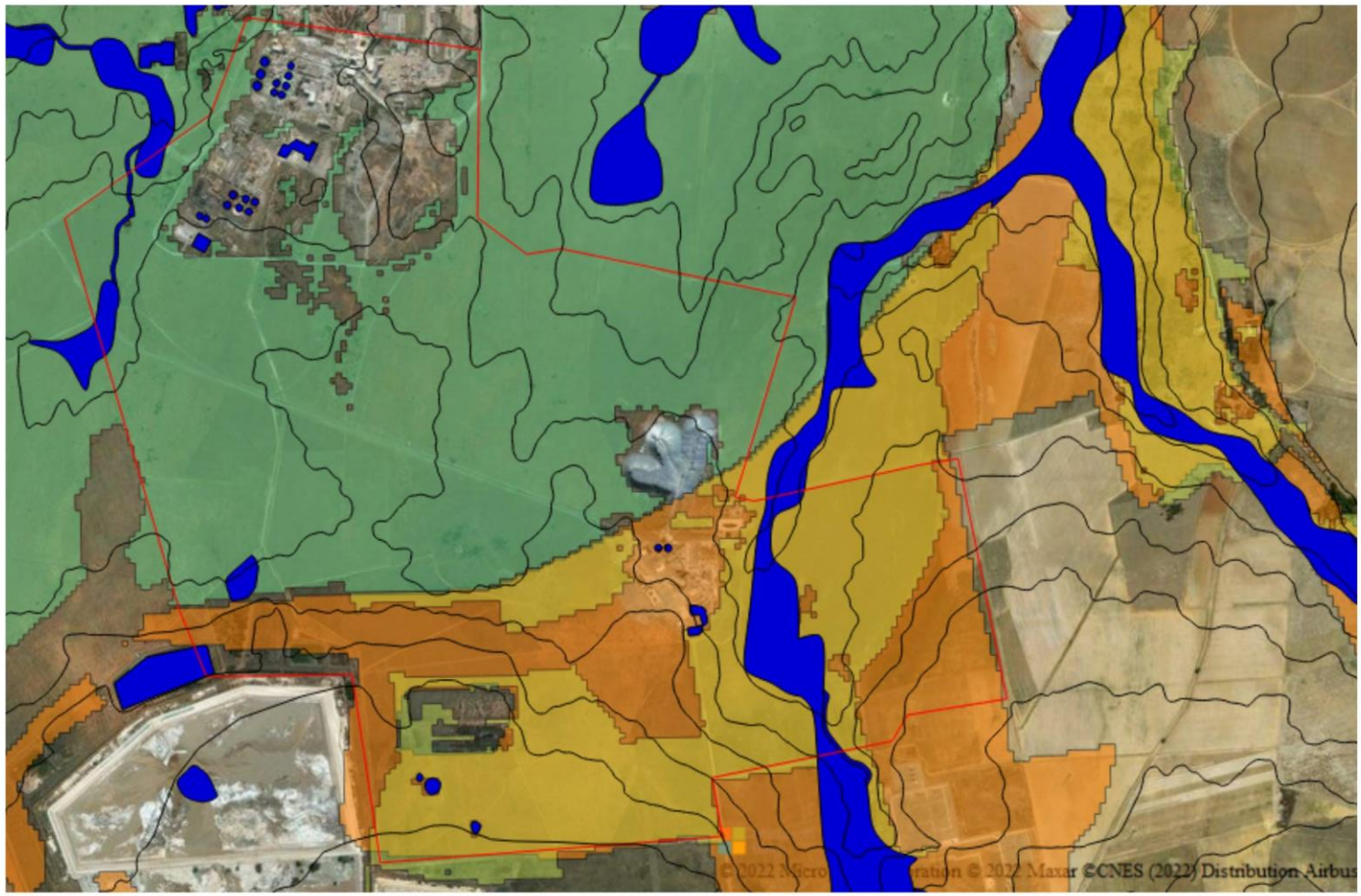
Van Wyk, B. & Malan, S. 1998. Field guide to the wild flowers of the Highveld. Struik Publishers, Cape Town.

Van Wyk, B. & Van Wyk, P. 1997. Field guide to trees of Southern Africa. Struik Publishers, Cape Town.

Venter, H.J.T. & Joubert, A.M. 1985. Climbers, trees and shrubs of the Orange Free State. P.J. de Villiers Publishers, Bloemfontein.

## Annexure A: Maps

## Locality map for the proposed Harmony Moab-Noligwa Plant PV solar development situated near the town of Orkney, Free State Province.




**Preparred for:**
Savannah Environmental (Pty) Ltd
P.O. Box 148
Sunninghill
2157

**Legend:**

- Study area
- Surface contours
- Probable Wetlands
- Threatened Ecosystems
- Vaal-Vet Sandy Grassland
- Vaal Reefs Dolomite Sinkhole Woodland

**Map Information**

**Spheroid**: WGS 84

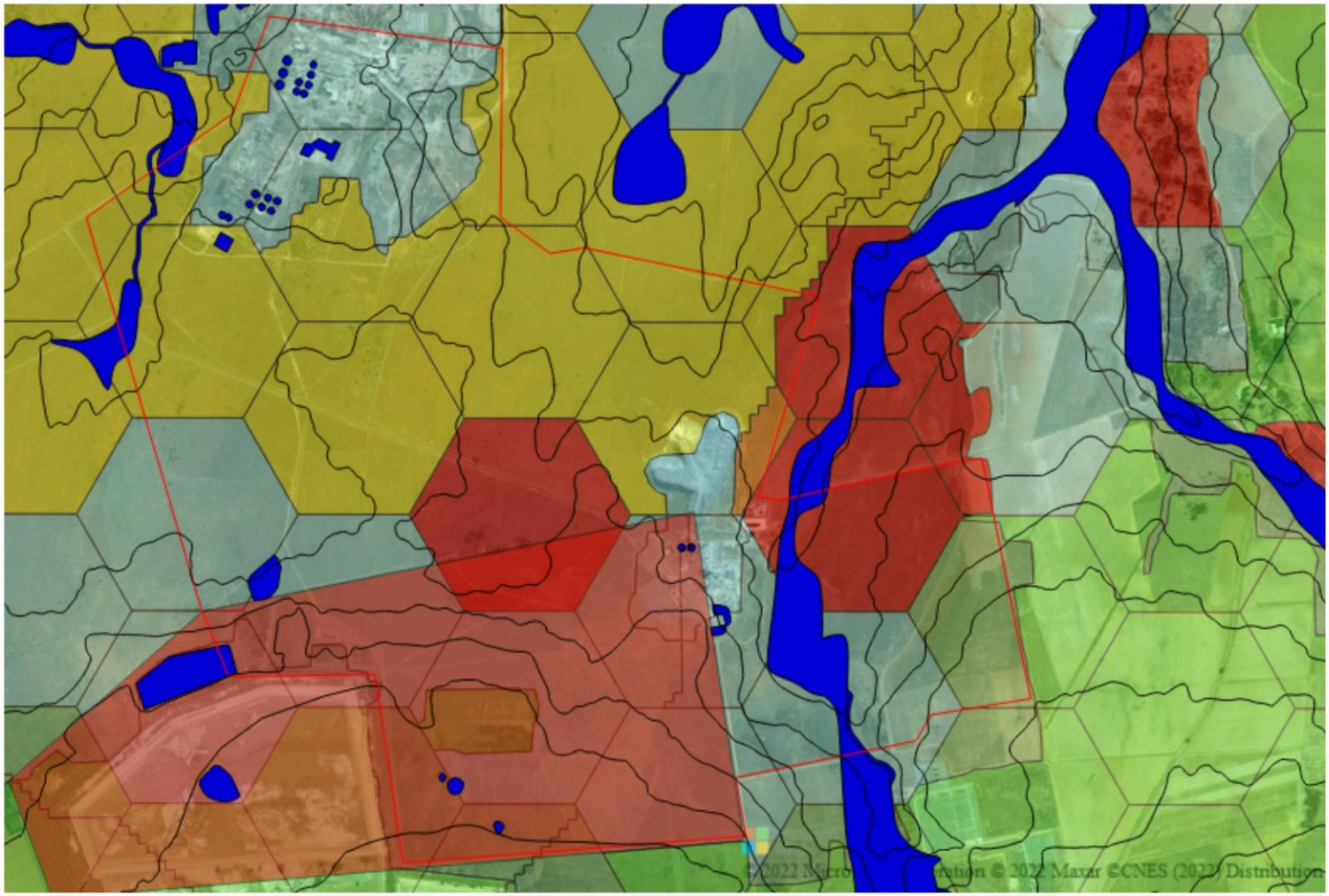
Quantum GIS

**Scale:** 1:37 000

DPR Ecologists
**Contact Darius van Rensburg at:**
darius@dprecologists.co.za
P.O. Box 12726, Brandhof, 9324
**Tel**: 083 410 0770

Map 1: Locality map of the proposed Harmony Moab-Noligwa Plant PV solar development near the town of Orkney. The areas of remaining natural vegetation is indicated and it is notable that the majority of the site still consists of natural vegetation. Note also the the southern portion of the site is dominated by Vaal-Vet Sandy Grassland which is listed as a Threatened Ecosystem and is considered as Endanagered. The northern portion of the site is dominated by Vaal Reefs Dolomite Sinkhole Woodland. The probability of wetlands and watercoourses occurring in the area is also indicated by the National Wetland Map 5 and SAIIE wetland probability map. The large wetland area indiacted in the eastern portion fo the site is notable.

## Free State Biodiversity Plan map for the proposed Harmony Moab-Noligwa Plant PV solar development situated near the town of Orkney, Free State Province.




**Preparred for:**
Savannah Environmental (Pty) Ltd
P.O. Box 148
Sunninghill
2157

**Legend:**

- Study area
- Surface contours
- Probable Wetlands
- Critical Biodiversity Area 1
- Critical Biodiversity Area 2
- Ecological Support Area 1
- Ecological Support Area 2
- Degraded
- Other
- Mispah Game Reserve

**Map Information**

**Spheroid**: WGS 84

Quantum GIS

**Scale:** 1:37 000

DPR Ecologists
**Contact Darius van Rensburg at:**
darius@dprecologists.co.za
P.O. Box 12726, Brandhof, 9324
**Tel**: 083 410 0770

Map 2: Free State Biodiversity Plan map of the proposed Harmony Moab-Noligwa Plant PV solar development near the town of Orkney. The majority of the area is regarded as Ecological Support Areas 1 & 2 and aids in support of the Vaal River system to the north. The support function should be preserved by the development. Significant areas regarded as Critical Biodiversity Areas in the east and central portions of the site aim to preserve important vegetation types and area essential to meeting conservation targets. These areas will have a high conservation value and should be avoided by development. The Mispah Game Reserve is also indicated and covers a large portion of the south of the site. The area has been proclamated as a Protected Area under the National Environmental Management Protected Areas Act.

## Wetland delineation map for the proposed Harmony Moab-Noligwa Plant PV solar development situated near the town of Orkney, Free State Province.


**Preparred for:**
Savannah Environmental (Pty) Ltd
P.O. Box 148
Sunninghill
2157

**Legend:**

- Study area
- Surface contours
- Delineated Wetland Areas
- 21-meter buffer
- Wetland sampling points

**Map Information**

**Spheroid**: WGS 84

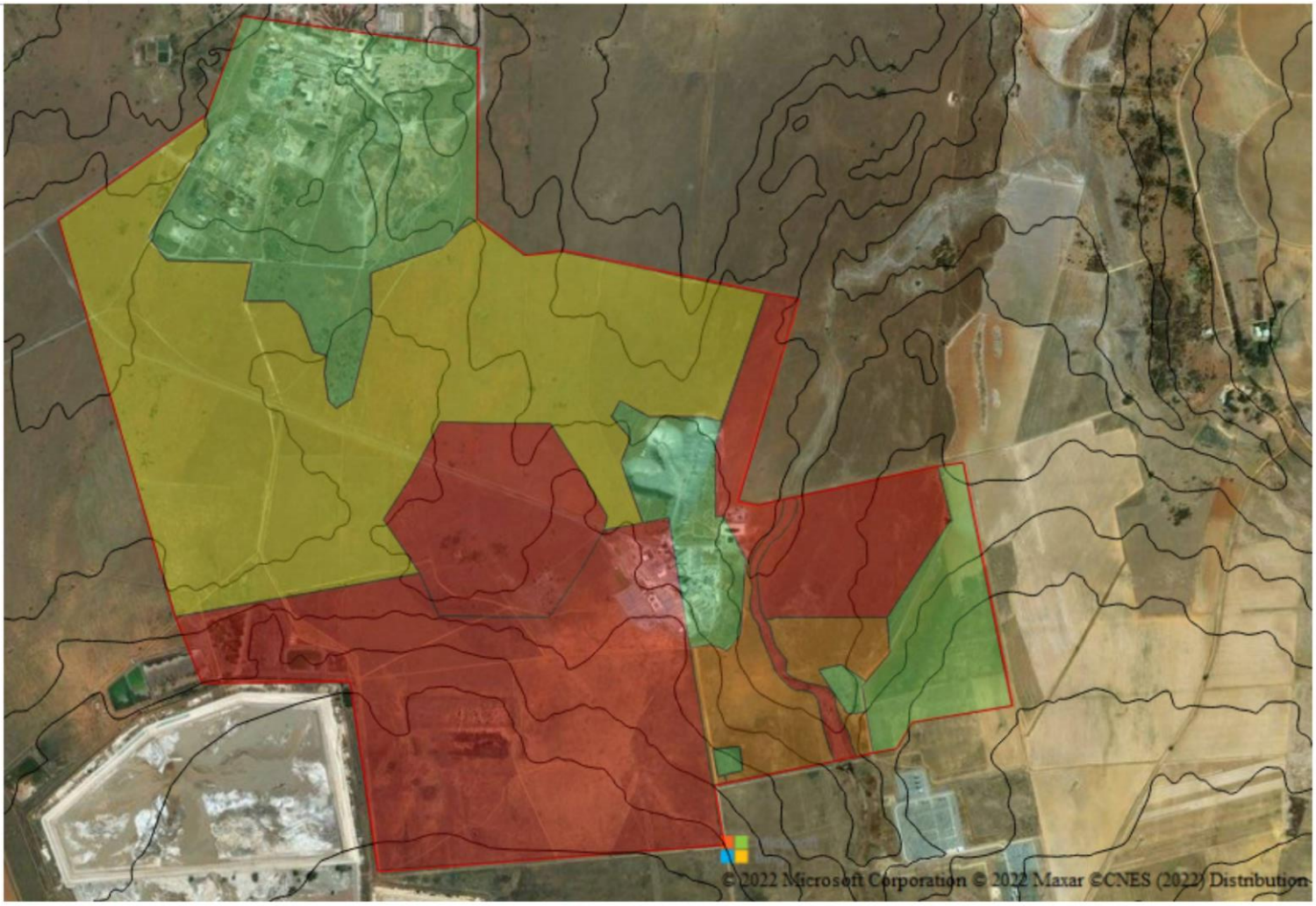
Quantum GIS

**Scale:** 1:37 000

DPR Ecologists
**Contact Darius van Rensburg at:**
darius@dprecologists.co.za
P.O. Box 12726, Brandhof, 9324
**Tel**: 083 410 0770

Map 3: Wetland delineation map of the proposed Harmony Moab-Noligwa Plant PV solar development near the town of Orkney. A large unchanneled valley bottom wetland system is situated in the eastern portion of the site and transects it from south to north. Three small depression wetlands are also located in the south west of the site. These wetland areas should all be excluded from the development and a 21 meter buffer also retained around them where the development occurs in close proximity. The wetland sampling points are also indicated.

## Sensitivity delineation map for the proposed Harmony Moab-Noligwa Plant PV solar development situated near the town of Orkney, Free State Province.




**Preparred for:**
Savannah Environmental (Pty) Ltd
P.O. Box 148
Sunninghill
2157

**Legend:**

- Study area
- Surface contours
- Very High Sensitivity
- High Sensitivity
- Moderate Sensitivity
- Low Sensitivity

**Map Information**

**Spheroid**: WGS 84

Quantum GIS

**Scale:** 1:37 000

DPR Ecologists
**Contact Darius van Rensburg at:**
darius@dprecologists.co.za
P.O. Box 12726, Brandhof, 9324
**Tel**: 083 410 0770

Map 4: Sensitivity map of the proposed Harmony Moab-Noligwa Plant PV solar development near the town of Orkney. Areas of Very High sensitivity consist of the Mispah Game Reserve, Critical Biodiversity Areas and the wetland system in the east of the site. One area of High sensitivity in the east of the site includes the remaining portions of Vaal-Vet Sandy Grassland, an Endangered vegetation type and therefore of high conservation value. The remaining natural areas in the northern portion of the site consists of Vaal Reeds Dolomite Sinkhole Woodland and although it is not currently a threatened ecosystem, as a natural area, it remains at least Moderately sensitive. Areas of Low sensitivity are transformed and include the mining operations, greenhouses, cultivated fields and areas of vegetation clearance.

**Appendix B: Species list**

Species indicated with an * are exotic.

Protected species are coloured orange and Red Listed species red.

| Species | Growth form |
|---|---|
| **Acacia baileyana* | Tree |
| **Achyranthes aspera* | Herb |
| **Bidens bipinnata* | Herb |
| **Eucalyptus camaldulensis* | Tree |
| **Gleditsia triacanthos* | Tree |
| **Melia azedarach* | Tree |
| **Nicotiana glauca* | Tree |
| **Oenothera rosea* | Herb |
| **Opuntia ficus-indica* | Succulent |
| **Pennisetum setaceum* | Grass |
| **Physalis viscosa* | Herb |
| **Tagetes minuta* | Herb |
| **Tamarix chinensis* | Tree |
| **Verbenia bonariensis* | Herb |
| **Veronica anagalis-aquatica* | Herb |
| *Acanthosicyos naudinianus* | Creeper |
| *Acrotome inflata* | Herb |
| *Agrostis lachnantha* | Grass |
| *Aloe greatheadii* | Succulent |
| *Anthephora pubescens* | Grass |
| *Aristida canescens* | Grass |
| *Asparagus larcinus* | Shrub |
| *Babiana bainesii* | Geophyte |
| *Barleria macrostegia* | Herb |
| *Boophone distichia* | Geophyte |
| *Brachiaria serrata* | Grass |
| *Celtis africana* | Tree |
| *Chascanum pinnatifidum* | Herb |
| *Chlorophytum sp.* | Geophyte |
| *Citrillus lanatus* | Creeper |
| *Clematis brachiata* | Climber |
| *Conyza podocephala* | Herb |
| *Crassula capitella* | Succulent |
| *Crassula lanceolata* | Succulent |
| *Crinum graminicola* | Geophyte |
| *Cybopogon pospischillii* | Grass |
| *Cymbopogon excavatus* | Grass |
| *Cynodon dactylon* | Grass |
| *Cyperus longus* | Sedge |
| *Delosperma herbeum* | Succulent |

| | |
|---|---|
| *Dicoma anomala* | Herb |
| *Dicoma macrocephala* | Herb |
| *Digitaria eriantha* | Grass |
| *Drimia platyphylla* | Geophyte |
| *Elephanthorrhiza elephantina* | Suffrutex |
| *Eragrostis curvula* | Grass |
| *Eragrostis gummiflua* | Grass |
| *Eragrostis lappula* | Grass |
| *Eragrostis lehmanniana* | Grass |
| *Euphorbia striata* | Succulent |
| *Felicia muricata* | Dwarf shrub |
| *Gomphrena celosioides* | Herb |
| *Grewia flava* | Shrub |
| *Gymnosporia buxiifolia* | Shrub |
| *Haplocarpha falx* | Grass |
| *Helichrysum caespititum* | Herb |
| *Helichrysum callicomum* | Herb |
| *Helichrysum nudifolium* | Herb |
| *Hermannia coccocarpa* | Herb |
| *Hermannia geniculata* | Herb |
| *Hilliardiella eleagnioides* | Herb |
| *Hyparrhenia hirta* | Grass |
| *Hypoxis hemerocallidae* | Geophyte |
| *Indigofera daleoides* | Herb |
| *Indigofera sp.* | Herb |
| *Ipmoea sp.* | Herb |
| *Ipomoea crassipes* | Herb |
| *Kalanchoe rotundifolia* | Succulent |
| *Lasiosiphon sericocephalus* | Herb |
| *Ledebouria sp.* | Geophyte |
| *Limeum viscosum* | Herb |
| *Lippia scaberrima* | Herb |
| *Loudetia simplex* | Grass |
| *Melinis repens* | Grass |
| *Nidorella resedifolia* | Herb |
| *Nolletia sp.* | Dwarf shrub |
| *Orthanthera jasminiflora* | Creeper |
| *Pellaea calomelanos* | Fern |
| *Pentarrhinum insipidum* | Geophyte |
| *Perotis patens* | Grass |
| *Pogonarthria squarrosa* | Grass |
| *Polydora poskeana* | Herb |
| *Pygmaeothamnus zeyheri* | Suffrutex |
| *Raphionacme velutina* | Geophyte |
| *Ruschia hamata* | Succulent |
| *Satyrium sp.* | Geophyte |

| | |
|---|---|
| *Schizocarpus nervosus* | Geophyte |
| *Scirpoides burkei* | Sedge |
| *Searsia lancea* | Tree |
| *Searsia pyroides* | Shrub |
| *Selago burkei* | Herb |
| *Selago densiflora* | Herb |
| *Senecio coronatus* | Herb |
| *Setaria sphacelatum* | Grass |
| *Sporobolus discosporus* | Grass |
| *Stipagrostis uniplumis* | Grass |
| *Stoebe plumosus* | Dwarf shrub |
| *Tephrosia sp.* | Herb |
| *Themeda triandra* | Grass |
| *Trachyandra laxa* | Geophyte |
| *Trachypogon spicatus* | Grass |
| *Tribulus terrestris* | Herb |
| *Triraphis andropogonoides* | Grass |
| *Triumfetta sonderi* | Herb |
| *Urelythrium agropyroides* | Grass |
| *Ursinia nana* | Herb |
| *Vachellia erioloba* | Tree |
| *Vachellia karroo* | Tree |
| *Vigna sp.* | Herb |
| *Ziziphus mucronata* | Tree |
| *Ziziphus zeyheriana* | Suffrutex |

## Appendix C: Soil Samples

Obligate wetland vegetation was utilised to determine the presence and border of wetlands. Soil samples were used to confirm the wetland conditions in the study area. Soil samples were taken at approximately 10 meter intervals. Soil samples were investigated for the presence of anaerobic evidence which characterises wetland soils.

Within wetlands the hydrological regime differs due to the topography and landscape. For instance; a valley bottom wetland would have a main channel that is below the water table and consequently permanently saturated, i.e. permanent zone of wetness. As you move away from the main channel the wetland would become dependent on flooding in order to be saturated. As a result along this hydrological regime areas of permanent saturation, seasonal and temporary saturation would occur. At some point along this gradient the saturation of the soil would be insufficient to develop reduced soil conditions and therefore will not be considered as wetland.

Within wetland soils the pores between soil particles are filled with water instead of atmosphere. As a result available oxygen is consumed by microbes and plantroots and due to the slow rate of oxygen diffusion oxygen is depleted and biological activity continues in anaerobic conditions and this causes the soil to become reduced.

Reduction of wetland soils is a result of bacteria decomposing organic material. As bacteria in saturated soils deplete the dissolved oxygen they start to produce organic chemicals that reduce metals. In oxidised soils the metals in the soil give it a red, brown, yellow or orange colour. When these soils are saturated and metals reduced the soil attains a grey matrix characteristic of wetland soils.

Within this reduction taking place in the wetland soils there may be reduced matrix, redox depletions and redox concentrations. The reduced matrix is characterised by a low chroma and therefore a grey soil matrix. Redox depletions result in the grey bodies within the soil where metals have been stripped out. Redox concentrations result in mottles within the grey matrix with variable shape and are recognised as blotches or spots, red and yellow in colour.

Soil wetness indicator is used as the primary indicator of wetlands. The colour of various soil components are often the most diagnostic indicator of hydromorphic soils. Colours of these components are strongly influenced by the frequency and duration of soil saturation. Generally, the higher the duration and frequency of saturation in a soil profile, the more prominent grey colours become in the soil matrix.

Coloured mottles, another feature of hydromorphic soils, are usually absent in permanently saturated soils and are at their most prominent in seasonally saturated soils, becoming less abundant in temporarily saturated soils until they disappear altogether in dry soils (Collins 2005).

The following soil wetness indicators can be used to determine the permanent, seasonal and temporary wetness zones. The boundary of the wetland is defined as the outer edge of the temporary zone of wetness and is characterised by a minimal grey matrix (<10%), few high chroma mottles and short periods of saturation (less than three months per year). The seasonal zone of wetness is characterised by a grey matrix (>10%), many low chroma mottles and significant periods of wetness (at least three months per year). The permanent zone of wetness

is characterised by a prominent grey matrix, few to high chroma mottles, wetness all year round and sulphuric odour (rotten egg smell).

According to convention hydromorphic soil must display signs of wetness within 50 cm of the soil surface (DWAF 2005).

## Appendix D: Index of Habitat Integrity (IHI)/WET-Health Summary

For the complete WET-Health please contact the author of this report.

| Wetland Attributes | |
|---|---|
| The information in this sheet must be captured before continuing with any other aspects of the assessment. Not capturing all the information required will lead to errors in the spreadsheet calculations, which will prevent a final outcome being obtained. | |
| Wetland Name | Moab-Noligwa Valley-Bottom Wetland |
| Assessment Unit Name / No. | 1 |
| Assessor | DP van Rensburg |
| Date of Assessment | 25/05/2022 |
| HGM Type (Basic) | Unchannelled VB wetland |
| | UVB |
| HGM Type (Refined) | Unchannelled VB wetland |
| | UVB |
| Conceptual model | Water and sediment inputs from the topographically defined catchment are assumed to emanate largely from the catchment upstream of the wetland, with limited lateral inputs. For the the purposes of geomorphic and water quality assesments, a weighting of 70% is therefore allocated to impacts associated with the upstream catchment whereas impacts associated with lateral inputs only contribute 30% to final catchment impact scores. For the hydrological assessment, weightings are based on the relative extent of contributing areas rather than default weightings. |
| Wetland size (Ha) | 50 |
| Upslope catchment size (Ha) | 2551 |
| Quaternary Catchment[1] | C24B |
| MAR (Mm3) | 0.0 |
| MAR per unit area (m3/Ha) | 0.0 |
| MAP (mm) | 587 |
| PET (mm) | 1750 |
| MAP:PET ratio | 0.3 |
| Vulnerability Factor | 1.0 |
| Hydrogeological Type Setting[2] | Karst landscape |
| Connectivity of wetland to a regional aquifer | No connection |
| Change in groundwater levels in the regional aquifer | |
| Water quality of regional aquifer | |
| Channel characteristics (if present) | |
| Natural wetness regimes | Dominated by seasonally saturated soils |
| Broad vegetation attributes | Dominated by obligate wetland grasses and sedges. Exotic weeds common but not abundant. |
| Number of dams in the catchment | 0 |
| Average surface area of dams (m2) | 0 |
| Perimeter of wetland (m) | 10800 |
| Perimeter-to-area ratio (m/ha) | 216.0 |
| Down-slope length of wetland (m) | 3600 |
| Elevation change over length (m) | 22 |
| Longitudinal Slope (%) | 0.6% |
| Propensity to erode (Category)[3] | Moderate |
| Propensity to erode (Score) | 0.8 |
| Dominant sediment accumulation process | Clastic |

# WET-Health Level 2 assessment: PES Summary

This worksheet provides an overall summary of the WET-Health Assessment that can be used for reporting purposes

| | Wetland PES Summary | | | |
|---|---|---|---|---|
| Wetland name | Moab-Noligwa Valley-Bottom Wetland | | | |
| Assessment Unit | 1 | | | |
| HGM type | Unchannelled VB wetland | | | |
| Areal extent (Ha) | 50.0 Ha | | | |

| Unadjusted (modelled) Scores | | | | |
|---|---|---|---|---|
| PES Assessment | Hydrology | Geomorphology | Water Quality | Vegetation |
| Impact Score | 3.7 | 3.4 | 3.7 | 2.3 |
| PES Score (%) | 63% | 66% | 63% | 77% |
| **Ecological Category** | **C** | **C** | **C** | **C** |
| **Combined Impact Score** | 3.3 | | | |
| **Combined PES Score (%)** | 67% | | | |
| **Combined Ecological Category** | **C** | | | |
| **Hectare Equivalents** | 33.3 Ha | | | |
| **Confidence (modelled results)** | RATE-TO-HIGH: Field-based assessment including information about the regional a | | | |

| Final (adjusted) Scores | | | | |
|---|---|---|---|---|
| PES Assessment | Hydrology | Geomorphology | Water Quality | Vegetation |
| Impact Score | 4.9 | 3.4 | 3.7 | 2.3 |
| PES Score (%) | 51% | 66% | 63% | 77% |
| **Ecological Category** | **D** | **C** | **C** | **C** |
| Trajectory of change | | | | |
| Confidence (revised results) | Not rated | Not rated | Not rated | Not rated |
| **Combined Impact Score** | 3.7 | | | |
| **Combined PES Score (%)** | 63% | | | |
| **Combined Ecological Category** | **C** | | | |
| **Hectare Equivalents** | 31.4 Ha | | | |

## Appendix E: Risk Assessment Matrix

**RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)**

**Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP REGISTERED PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE**

| | | | | | Severity | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | Confidence level | Control Measures |
| 1 | Mostly Construction Phase but also during operation | Construction of a solar facility | A large valley-bottom wetland system with high conservation value may be affected by the proposed development. | The construction of the facility may encroach into the wetland which will directly affect or may also impact on the catchment of the wetland which will then have an indirect impact on it. | 1 | 2 | 1 | 1 | 1.25 | 2 | 2 | 5.25 | 2 | 1 | 5 | 2 | 10 | 52.5 | L | 80 | Provided that recommendations are implemented and that the development not encroach nearer than the current indicated 350 meters in proximity to the wetland system and is treated as no-go area, the anticipated risk should remain low. As the development will still occur in relatively close proximity to it, it will also be important to implement a comprehensive storm water management system. |

## Appendix F: Buffer Zone Determination

| Name of Assessor | Darius van Rensburg | Project Details | Harmony Moab-Noligwa Solar Facility | Date of Assessment | 25/05/2022 |
|---|---|---|---|---|---|

## Step 1: Define objectives and scope of assessment and determine the most appropriate level of assessment

| Level of assessment | Site-based |
|---|---|

## Step 2: Map and categorize water resources in the study area

| Approach used to delineate the wetland boundary? | Site-based delineation | Wetland type | Unchannelled valley-bottom |
|---|---|---|---|

## Step 3: Refer to the DWA management objectives for mapped water resources or develop surrogate objectives

| | | |
|---|---|---|
| Present Ecological State | C | Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. |
| Ecological importance & sensitivity | Medium | Features that are considered to be ecologically important and sensitive at a local scale. The functioning and/or biodiversity of these features is not usually sensitive to anthropogenic disturbances. They typically play a small role in providing ecological services at the local scale. |
| Management Objective | Maintain | |

## Step 4: Assess the risks from proposed developments and define mitigation measures necessary for protecting mapped water resources in the study area

### Assess threats of planned activities on water resources and determine desktop buffer requirements

| | | | |
|---|---|---|---|
| Proposed development / activity | Sector | Service infrastructure | Land use relating to the provision of all necessary utility services such as communication, municipal waste handling facilities and associated transfer pipeline infrastructure for fuels and water. |
| | Sub-Sector | Above-ground communication/power (electricity) infrastructure | Above-ground infrastructure designed for the transfer of power (electricity cables) or data (telephone lines). |

| Climatic factors | MAP Class | 601 - 800mm | Rainfall Intensity | Zone 2 |
|---|---|---|---|---|

| Overall size | Size of the wetland relative to (as a percentage of) its catchment | Average slope of the wetland's catchment | The inherent runoff potential of the soil in the wetland's catchment | The extent to which the wetland (HGM) setting is generally characterized by sub-surface water input |
|---|---|---|---|---|
| (51-300 ha) | Intermediate (6-10%) | 3-5% | Moderately low | Intermediate (The remaining HGM types) |
| **Perimeter to area ratio** | **Vulnerability of the HGM type to sediment accumulation** | **Vulnerability of the site to erosion given the site's slope and size** | **Extent of open water, particularly water that is naturally clear** | **Sensitivity of the vegetation to burial under sediment** |
| Moderately low | Hillslope seep, Valley head seep, Unchannelled valley bottom | Moderate (Vulnerability score :4-5) | High (>9% of the area) | Intermediate |
| **Peat versus mineral soils** | **Inherent level of nutrients in the landscape: is the wetland and its catchment underlain by sandstone?** | **Sensitivity of the vegetation to increased availability of nutrients** | **Sensitivity of the vegetation to toxic inputs, changes in acidity & salinization** | **Natural wetness regimes** |
| Mineral | Partially | Intermediate (e.g. short vegetation with moderate natural plant diversity) | Intermediate (e.g. moderate natural plant diversity) | Dominated by seasonally saturated soils |
| **Natural salinity levels** | **Level of domestic use** | **Mean Annual Temperature** | Note: See the guideline document for further information on the rationale for indicator selection and how these attributes affect the sensitivity of wetlands to lateral inputs. | |
| Naturally low saline levels | Low | Zone 3 (16.9 - 18.2 Deg C) | | |

| Buffer attributes | Buffer Segment 1 | Buffer Segment 2 | Buffer Segment 3 | Buffer Segment 4 |
|---|---|---|---|---|
| **Slope of the buffer** | Gentle (2.1 - 10%) | | | |
| **Vegetation characteristics (Construction phase)** | High: Dense vegetation, with good basal cover (e.g. natural grass stands) | | | |
| **Vegetation characteristics (Operational phase)** | Low: Sparse vegetation cover with large areas of bare soil | | | |
| **Soil permeability** | High: Deep well-drained soils (e.g. sand and loamy sand). | | | |
| **Topography of the buffer zone** | Dominantly uniform topography: Dominantly smooth topography with few/minor concentrated flow paths to reduce interception. | | | |
| | **Buffer Segment 1** | **Buffer Segment 2** | **Buffer Segment 3** | **Buffer Segment 4** |
| **Final aquatic impact buffer requirements (including practical management considerations)** | | | | |
| **Construction Phase** | **21** | **Not Assessed** | **Not Assessed** | **Not Assessed** |
| **Operational Phase** | **15** | **Not Assessed** | **Not Assessed** | **Not Assessed** |
| **Final aquatic impact buffer requirement** | **21** | **Not Assessed** | **Not Assessed** | **Not Assessed** |

**Appendix G: Impact methodology**

Direct, indirect and cumulative impacts associated with the projects must be assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5;
- The **magnitude**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- the **status**, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the *degree* to which the impact can be *mitigated.*

The **significance** is calculated by combining the criteria in the following formula:

S=(E+D+M)P

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),

» 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
» > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

Assessment of impacts must be summarised in the following table format. The rating values as per the above criteria must also be included. Complete a table and associated ratings for **each** impact identified during the assessment.

***<u>Example</u> of Impact table summarising the significance of impacts (with and without mitigation)***

| | | | |
|---|---|---|---|
| ***Nature:***<br>**[Outline and describe fully the impact anticipated as per the assessment undertaken]** | | | |
| **Impact description:** The impact will occur due to added pressure on the availability of housing located in the local community. This may contribute to increased levels of competition in the temporary housing market. | | | |
| | **Rating** | **Motivation** | **Significance** |
| ***Prior to Mitigation*** | | | |
| **Duration** | Short-term (1) | The construction period will last for less than one year | **Low Negative (18)** |
| **Extent** | Local (1) | Pressure will only be added on the local municipality to provide housing for outsourced construction workers | |
| **Magnitude** | Low (4) | The increase in demand for affordable accommodation should not be extensive as workers will primarily be sourced from the local communities. | |
| **Probability** | Probable (3) | The possibility of the impact on the provision of affordable accommodation is very low | |
| ***Mitigation/Enhancement Measures*** | | | |
| ***Mitigation:***<br>"Mitigation", means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.<br>• Provide a description of how these mitigation measures will be undertaken keeping the above definition in mind. | | | |
| ***Post Mitigation/Enhancement Measures*** | | | |
| **Duration** | Short-term (1) | Pressure will only be added on the local municipality to provide housing for outsourced construction workers. | **Low Positive (8)** |
| **Extent** | Local (1) | The increase in demand for affordable accommodation should be mitigated if external construction crews are provided with onsite accommodation. | |
| **Magnitude** | Minor (2) | The possibility of the impact on the | |

| | | | |
|---|---|---|---|
| | | provision of affordable accommodation is very low. | |
| **Probability** | Improbable (2) | A reduced amount of pressure will be added on the local municipality to provide housing for outsourced construction workers. | |
| ***Cumulative impacts:***<br>"Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities. | | | |
| ***Residual Risks:***<br>"Residual Risk", means the risk that will remain after all the recommended measures have been undertaken to mitigate the impact associated with the activity (Green Leaves III, 2014). | | | |

**Assessment of Cumulative Impacts**

As per requirements of the EIA Regulations, specialists are required to assess the cumulative impacts. In this regard, please refer to the methodology below that will need to be used for the assessment of Cumulative Impacts.

"Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities[1].

The role of the cumulative assessment is to test if such impacts are relevant to the proposed project in the proposed location (i.e. whether the addition of the proposed project in the area will increase the impact). This section should address whether the construction of the proposed development will result in:

» Unacceptable risk
» Unacceptable loss
» Complete or whole-scale changes to the environment or sense of place
» Unacceptable increase in impact

The specialist is required to conclude if the proposed development will result in any unacceptable loss or impact considering all the projects proposed in the area.

***Example of a cumulative impact table:***
***Nature:*** Complete or whole-scale changes to the environment or sense of place (example)

| ***Nature:***<br>**[Outline and describe fully the impact anticipated as per the assessment undertaken]** | | |
|---|---|---|
| | **Overall impact of the proposed project considered in isolation** | **Cumulative impact of the project and other projects in the area** |

[1] Unless otherwise stated, all definitions are from the 2014 EIA Regulations, as amended, GNR 326

| | | |
|---|---|---|
| ***Extent*** | Low (1) | Low (1) |
| ***Duration*** | Medium-term (3) | Long-term (4) |
| ***Magnitude*** | Minor (2) | Low (4) |
| ***Probability*** | Improbable (2) | Probable (3) |
| ***Significance*** | **Low (12)** | **Low (27)** |
| ***Status (positive or negative)*** | Negative | Negative |
| ***Reversibility*** | High | Low |
| ***Irreplaceable loss of resources?*** | Yes | Yes |
| ***Can impacts be mitigated?*** | Yes | Yes |
| ***Confidence in findings:*** High. | | |
| ***Mitigation:***<br>"Mitigation", means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.<br>Provide a description of how these mitigation measures will be undertaken keeping the above definition in mind. | | |