(NC) 30/5/1/3/2/10199 MR

Boscia
ECOLOGICAL CONSULTING

ECOLOGICAL & WETLAND ASSESSMENT REPORT

RENAISSANCE RESOURCES (PTY) LTD

De Bad & At Last Mining Operation

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RENAISSANCE RESOURCES (PTY) LTD

Portion 2 (At Last) of the Farm No 232

Portion 2, 3, 4, 5 and 6 of the Farm De Bad 155

Districts of Barkly-Wes and Kimberley

Northern Cape Province

Ecological & Wetland Assessment Report in application for Environmental Authorisation related to a Mining Right Application ((NC) 30/5/1/3/2/10199 MR) that was lodged with the Department of Mineral Resources

September 2022

EXECUTIVE SUMMARY

Renaissance Resources (Pty) Ltd is proposing the mining of Diamonds on Portion 2 (At Last) of the Farm No 232, located within the Barkly-Wes District, as well as on Portion 2, 3, 4, 5 and 6 of the Farm De Bad 155, in the Kimberley District of the Northern Cape Province. Renaissance Resources has submitted a Mining Right application, which triggers the requirement to apply for Environmental Authorisation. This ecological and wetland assessment report considers the impacts that the proposed activities might have on the ecological integrity of the property. It describes the characteristics of terrestrial, aquatic and wetland habitats in the proposed mining area, identifies the source of impacts from the mining operation and assesses these impacts, as well as the residual impacts after closure.

A desktop study and field investigation were performed to obtain ecological and biodiversity information for the proposed study area and found that seven plant communities occur in the study area, including terrestrial and aquatic habitats. The Vaal River, ephemeral pans and drainage lines are all considered to be of very high sensitivity due to their vital ecological and hydrological functionality and significance, which is portrayed in the various sections of this report. The ephemeral pans and Vaal River, including their buffer zones, should ideally be marked as no-go areas.

The woodland on red sand hosts a dense population of *Vachellia erioloba* and is therefore of high sensitivity. The remaining pristine terrestrial habitats are of medium sensitivity, while the sensitivity of those areas already transformed by agriculture, is low.

The most profound impacts related to the proposed activities is expected to be in the form of cumulative habitat destruction, given the extensive history of mining and crop irrigation in the region. Direct and secondary impacts to water resources are also considered to be significant. Therefore, activities near these systems should be carefully planned to avoid disastrous implications.

If any of the protected plant species will be damaged or removed, permit applications regarding protected flora and/or nationally protected trees need to be lodged with the Northern Cape Department of Environment and Nature Conservation and/or Department of Agriculture, Forestry and Fisheries, three months prior to any removal of affected species.

To conclude, in my opinion, authorisation for the mining operation can be granted if the applicant commits to the adherence of effective avoidance, management, mitigation and rehabilitation measures.

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1. INTRODUCTION

1.1. Background information

Renaissance Resources (Pty) Ltd is proposing the mining of Diamonds on Portion 2 (At Last) of the Farm No 232, located within the Barkly-Wes District, as well as on Portion 2, 3, 4, 5 and 6 of the Farm De Bad 155, in the Kimberley District. The mining right area is located in the Northern Cape Province and the two sites will from heron be referred to as De Bad and At Last. De Bad lies approximately 16 km south of the town Schmidtsdrif, on the Olie Rivier gravel road that turns off from the N8, while At Last lies approximately 15 km west of Delportshoop, on the R370 gravel road towards Schmidtsdrif that turns off from the R31 (Figure 1). The total extent of the combined mining right area is ± 6 221 ha.

Renaissance Resources has submitted a Mining Right application, which triggers the requirement to apply for Environmental Authorisation. An ecological and wetland assessment is required to consider the impacts that the proposed activities might have on the ecosystems of the property and therefore Boscia Ecological Consulting has been appointed by the applicant to conduct an assessment and provide an ecological and wetland assessment report.

This assessment report describes the characteristics of terrestrial, aquatic and wetland habitats in the proposed mining area, identifies the biodiversity and species of conservation concern, identifies invasive and encroaching species and their distribution, indicates the source of impacts from the mining operation and assesses these impacts as well as the residual impacts after closure.

A variety of avoidance and mitigation measures associated with each identified impact are recommended to reduce the likely impact of the operation. Ecological responsibilities pertaining to relevant conservation legislation are also indicated. These should all be included in the BAR.

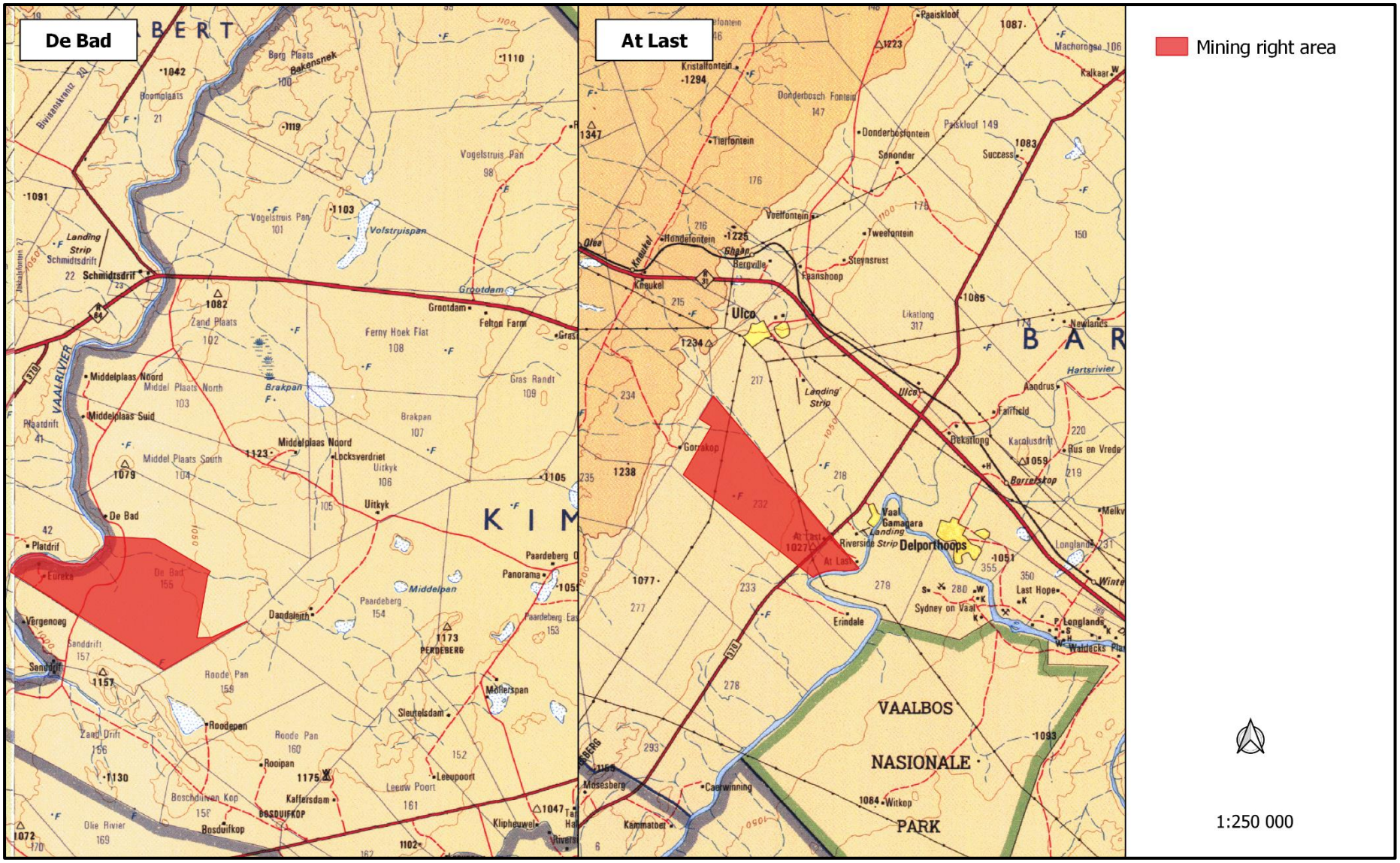


Figure 1. The location of the De Bad and At Last mining area sites are indicated in red.

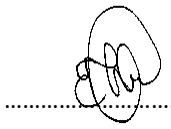
1.2. Scope of study

The specific terms of reference for the study include the following:

- conduct a desktop study and field investigation to identify and describe different ecological habitats (terrestrial, aquatic and wetland) and provide an inventory of biodiversity, i.e. communities/species/taxa and associated species of conservation concern within the environment that may be affected by the proposed activity;
- identify the relative ecological sensitivity of the project area;
- produce an assessment report that:
  - indicates identified habitats and fauna and flora species,
  - delineates and classifies wetlands,
  - indicates the ecological sensitivity of habitats and conservation values of species, including Wetland Health Assessment (PES), Wetland Ecological Importance and Sensitivity (EIS) and Wetland Functional Assessment (Eco-Services)
  - determines the potential impacts of the project on the ecological integrity,
  - provides mitigation measures and recommendations to limit project impacts,
  - indicates ecological responsibilities pertaining to relevant conservation legislation.

1.3. Details of the specialist consultant

Company Name	Boscia Ecological Consulting cc	**Registration No:**	2011/048041/23
Address	PostNet Suite 0216 Private Bag X37 Lynnwood Ridge 0040		
Contact Person	Dr Elizabeth (Betsie) Milne (Pr. Sci. Nat)		
Contact Details	Cell: 082 992 1261	Email: BosciaEcology@gmail.com	
Qualifications	Professional Natural Scientist - Ecological Science (Registration No: 131395) PhD Botany (Nelson Mandela Metropolitan University), Masters Environmental Management (University of the Free State), BTech Nature Conservation (Tshwane University of Technology)		

Declaration of independence	I, Elizabeth (Betsie) Milne, owner of Boscia Ecological Consulting, declare that I: • act as the independent specialist in this application; • regard the information contained in this report as it relates to my • specialist input/study to be true and correct; • do not have, and will not have any financial interest in the undertaking of the activity; other than the remuneration of work performed in terms of the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act; • have and will not have any vested interest in the activity proceedings; • have no, and will not engage in conflicting interest in the undertaking of the activities; • undertake to disclose to the component authority any material information that have or may have the potential to influence the decision of the competent authority, or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act; • will provide the competent authority with access to all information at my disposal regarding the study.  ……

1.4. Description of the proposed activity

The mining operation is based on diamond deposits that are restricted to the Rietputs alluvial terraces to the east (De Bad) and west (At Last) of the Vaal River, as well as Rooikoppie gravel (Figure 2). Deposits will be sampled by means of an opencast method using heavy earthmoving machinery.

Vegetated soil or overburden will be stripped, and the underlying gravels will be excavated, screened, and treated through a rotary plan plant before fed to a sorting plant for final recovery. The rough diamond product will then be removed for further beneficiation. No ore processing reagents are required or used in the treatment of the ore. Approximately 300 ha of surface area will be cleared for mining purposes over 10 years.

Mining activities will make use of existing roads where possible, but haul roads will also be created to access the mining areas. Supporting infrastructure include temporary office, workshop and ablution facilities with chemical toilets, storm water control berms, water tanks, fuel storage facility, wash bay, salvage yard, waste disposal site, a central processing plant and pipeline infrastructure.

2. METHODOLOGY

2.1. Data collection

The study comprised a combination of field and desktop surveys for data collection on fauna and flora to obtain a comprehensive data set for the assessment. The fieldwork component was conducted on 18 August 2022 and most data for the desktop assessment was obtained from the quarter degree squares that includes the study area (2824AC, 2824AD and 2824CC).

2.2. Flora

2.2.1. Field survey

For the field work component, satellite images were used to identify homogenous vegetation units within the proposed mining area.

Figure 2. The area on De Bad and At Last, where core mining activities are planned.

Representative sampling plots were allocated in these units and sampled with the aid of a GPS to characterise the species composition. The following quantitative data was collected:

- Species composition
- Species percentage cover
- Amount of bare soil and rock cover
- Presence of biotic and anthropogenic disturbances

Additional checklists of plant species were compiled during the surveys by traversing a linear route and recording species as they were encountered in each unit.

2.2.2. Desktop survey

For the desktop component, the South African National Vegetation Map (Mucina and Rutherford 2006) was used to obtain data on broad scale vegetation types, associated species and their conservation status. Furthermore, the South African National Biodiversity Institute's (SANBI) BGIS database as well as the respective Environmental Framework Documents were consulted to obtain information on biodiversity information for the Dikgatlong Local Municipality (NC092) of the Frances Baard District Municipality and Siyancuma Local Municipality (NC078) of the Pixley ka Seme District Municipality, in which the study area falls. Further searches were undertaken specifically for Red List plant species within the current study area. Historical occurrences of Red List plant species were obtained from the SANBI: POSA database (Figure 3). The IUCN conservation status of plants in the species list was also extracted from the SANBI database and is based on the Threatened Species Programme (SANBI 2020).

2.3. Fauna

2.3.1. Field survey

The faunal field survey was conducted concurrent with the vegetation survey. Habitats on site were assessed to compare with the habitat requirements of Red Data species. The presence of faunal species was determined using the following methods:

- Identification by visual observation,
- Identification of bird and mammal calls,
- Identification of signs (spoor, faeces, burrows, and nests).

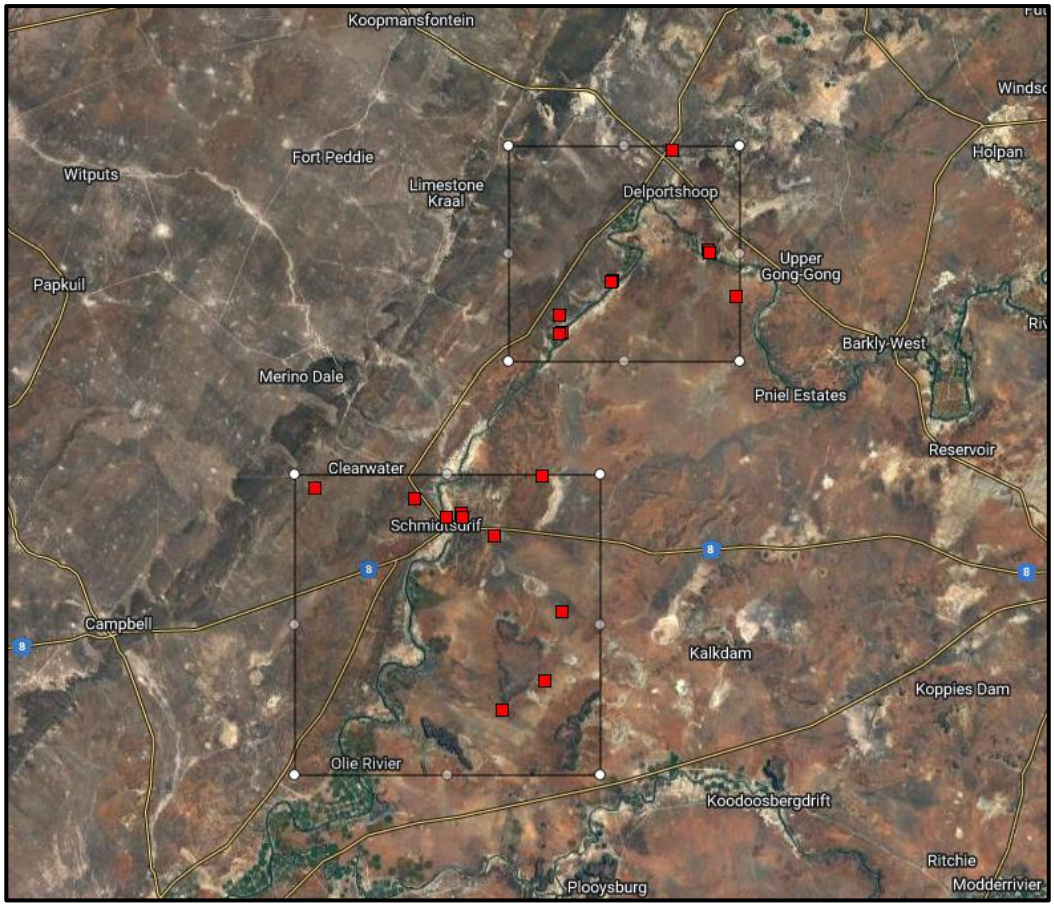


Figure 3. The extent of the map filter (large black square) applied on the POSA website to extract species information for the study area. The small red squares indicate historical data points.

2.3.2. Aquatic invertebrate cultures

To verify the presence of branchiopods, dry sediment was collected from the ephemeral pans on site. A hand spade was used to remove at least 1L of the top 5 cm at a minimum of three plots. Sub-samples were then inundated in containers for a minimum of 14 days in a semi-controlled environment with aeration, to simulate average habitat conditions for the region. All hatchlings were identified under the microscope to the lowest possible taxonomic rank.

Water quality variables (pH and Electrical Conductivity (uS/cm)) were measured after three days of inundation using a handheld multi meter.

2.3.3. Desktop survey

A lists of mammals, reptiles, amphibians, birds, fish, and invertebrates, which are likely to occur in the study area, were obtained based on distribution records from the literature, including Friedmann and Daly (2004) and Stuart and Stuart (2015) for mammals, Alexander and Marais (2007) and Bates et al. (2014) for reptiles, Du Preez and Carruthers (2009) for amphibians, Gibbon (2006) for birds, Kleynhans (2007) for fish and Thirion (2007), Picker et al. (2004) and Griffiths et al. (2015) for invertebrates. A map of important bird areas (BirdLifeSA 2015) was also consulted. Additional information on faunal distribution was extracted from the various databases hosted by the ADU web portal, http://adu.org.za, as well as from the Baboon Spider Atlas https://www.baboonspideratlas.co.za/, Freshwater Biodiversity Information System (FBIS) https://freshwaterbiodiversity.org/, and iNaturalist https://www.inaturalist.org/. The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site.

The likelihood of Red Data species occurring on site has been determined using the distribution maps in the Red Data reference books (Friedmann and Daly 2004, Minter et al. 2004, Bates et al. 2014, Taylor et al. 2015, ADU 2016) and comparing their habitat preferences with the habitats described from the field survey. The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria (IUCN 2019) and/or the various regional and national red data books/lists for the respective taxa.

2.4. Wetland assessment procedures

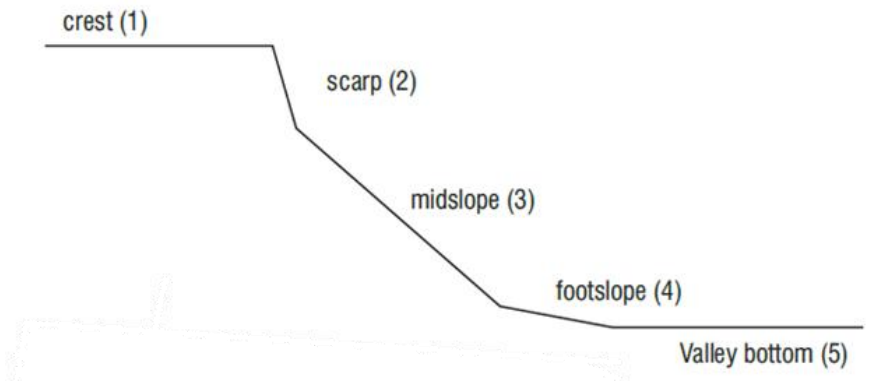
a) Wetland and riparian areas delineation

Wetlands and riparian areas were delineated according to methodology adapted from the delineation procedure as set out by Rountree et al. (2008). Even though the presence of all indicators included in this delineation procedure provides a logical, defensible, and technical basis for identifying an area as wetland or riparian area; these procedures were primarily developed for wetlands and riparian areas in mesic and humid regions. The soil and vegetation descriptors outlined in these procedures do not fully accommodate those wetland and riparian areas found in more arid regions.

Therefore, delineation of wetlands and riparian areas were performed by estimating their boundaries from satellite imagery and topographical maps, and then drawing it onto the site map, using clues such as topography, differences in colour, shading, texture, and elevation. These boundaries were then verified in the field. The field verification further considered topography, vegetation and alluvial soils or deposited material.

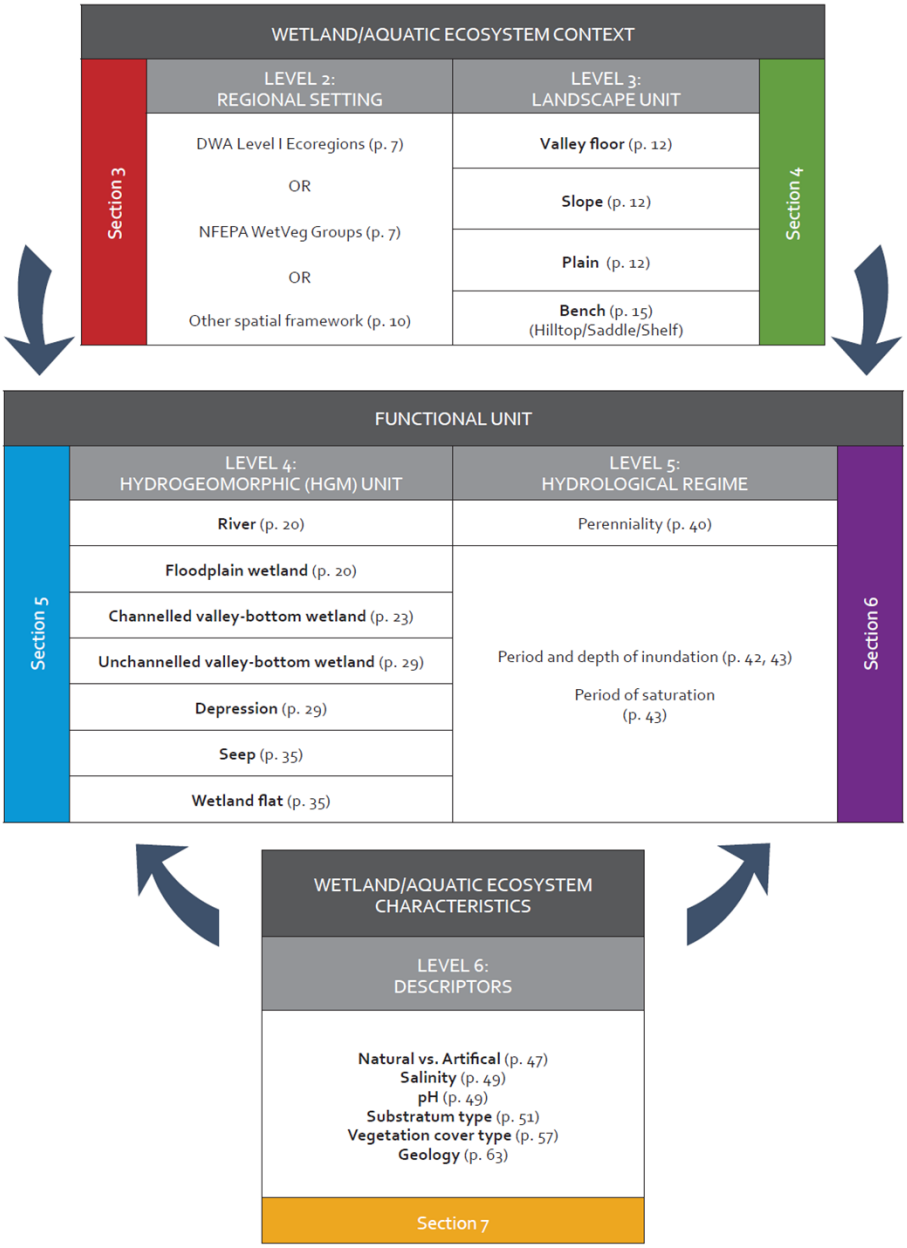
In terms of topography, terrain unit indicators were considered:

- **Terrain Unit Indicator** helps identifying those parts of the landscape where wetlands are most likely to occur. Typical terrain units are depicted below:



b) <u>Wetland Classification</u>

The wetlands were subsequently classified according to the classification procedure for inland systems (Level 2) developed by Ollis et al. (2013). The inland component of the Classification System has a tiered structure (see below diagram), which progresses from Regional Setting (Level 2) and Landscape Units (Level 3), to Hydrogeomorphic (HGM) Units at the finest spatial scale (Level 4). At Level 5, Inland Systems are distinguished from each other based on the hydrological regime and, in the case of open waterbodies, the inundation depth class. At Level 6, six 'descriptors' have been incorporated into the Classification System. These descriptors allow you to distinguish between aquatic ecosystems with different structural, chemical, and/or biological characteristics.

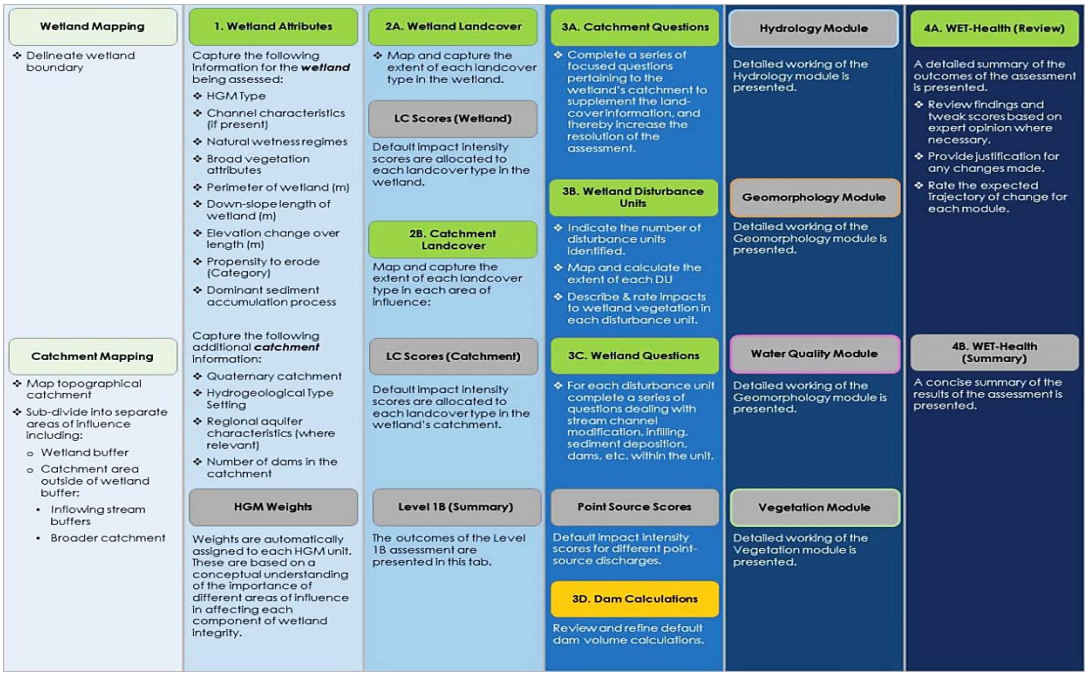


c) Wetland Health Assessment

A Present Ecological State (PES) assessment was conducted to establish baseline health for wetlands in the study area, based on WET-Health Version 2 (Macfarlane et al. 2020). The WET-Health tool is designed to assess the PES of a wetland by scoring the perceived deviation from a theoretical reference condition. The tool considers wetland PES to be a function of three core inter-related drivers, namely hydrology, geomorphology, and water quality. The biology of the wetland responds to changes in these drivers. The suite of tools developed for WET-Health Version 2 therefore assesses wetland PES based on four modules: (1) Hydrology, (2) Geomorphology, (3) Water quality, and (4) Vegetation:

Vegetation generally plays a central role in the biology of wetlands located in mesic and humid regions. However, in more arid environments, such as De Bad and At Last, wetlands are often naturally devoid of typical vegetation, especially if wetlands are ephemeral. Wet-Health Version 2 recognises that their recommended method may not adequately cater for every situation, and expert review and refinement of impact scores is encouraged based on additional information and expert interpretation. This is accommodated in the Level 2 assessments by allowing the assessor to review and moderate scores with appropriate justification. Therefore, an adapted Wet-Health level 2 assessment was conducted to determine the PES of wetlands on De Bad & At Last.

A Level 2 approach is a rapid but robust field-based wetland PES assessment that includes a series of separate modules, brought together in an integrated assessment:



The WET-Health tool uses algorithms to produce impact intensity scores for each module, which are then combined in a standardised manner to produce an overall impact intensity score for the assessed wetland. These intensity scores correlate to an overall ecological category:

Ecological Category	Description	Impact score	PES Score (%)
A	Unmodified, natural.	0 – 0.9	91% - 100%
B	Largely natural with few modifications / in good health. A small change in natural habitats and biota may have taken place but the ecosystem functions are still predominantly unchanged.	1 – 1.9	81% - 90%
C	Moderately modified / fair condition. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	2 – 3.9	61% - 80%
D	Largely modified / poor condition. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	4 – 5.9	41% - 60%
E	Seriously modified / very poor condition. The loss of natural habitat, biota and basic ecosystem functions is extensive.	6 – 7.9	21% - 40%
F	Critically modified / totally transformed. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota.	8 - 10	0 – 20%

Trajectory of Change classes and symbols used to describe the predicted nature of change in the state of a wetland from its present state given threats and vulnerability, are:

Trajectory class	Description	Symbol
Improve markedly	Likely to improve substantially over the next 5 years	↑↑
Improve	Likely to improve slightly over the next 5 years	↑
Remain stable	Likely to remain stable over the next 5 years	→
Deteriorate slightly	Likely to deteriorate slightly over the next 5 years	↓
Deteriorate markedly	Likely to deteriorate substantially	↓↓

d) Wetland Ecological Importance and Sensitivity

An Ecological Importance and Sensitivity (EIS) assessment was conducted by using methodology adapted from Duthie (1999). For this assessment procedure, a series of determinants are considered using a ranking scale of 0 to 4, i.e. Very high = 4; High = 3, Moderate = 2; Marginal/Low = 1; None = 0:

Determinant
PRIMARY DETERMINANTS
1. Rare & Endangered Species
2. Populations of Unique Species
3. Species/taxon Richness
4. Diversity of Habitat Types or Features
5 Migration route/breeding and feeding site for wetland species
6. Sensitivity to Changes in the Natural Hydrological Regime
7. Sensitivity to Water Quality Changes
8. Flood Storage, Energy Dissipation & Particulate/Element Removal
MODIFYING DETERMINANTS
9. Protected Status
10. Ecological Integrity

The median of the determinants is used to allocate an Ecological Management Class (EMC):

EIS Category	Mean range	EMC
Very high 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 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 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 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

e) Wetland Functional Assessment

To evaluate the ecosystem services supplied by the wetlands of the study area, an assessment was conducted according to guidelines provided in WET-EcoServices (Version 2) (Kotze et al. 2020). This assessment examines and rates the following services according to their degree of importance and the degree to which the service is provided:

Ecosystem services supplied by wetlands	**Indirect benefits**	**Regulating and supporting benefits**	Flood attenuation		The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
			Streamflow regulation		Sustaining streamflow during low flow periods
			Water quality enhancement benefits	Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters
				Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters
				Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters
				Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters
				Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation
			Carbon storage		The trapping of carbon by the wetland, principally as soil organic matter
	Direct benefits	**Biodiversity maintenance**			Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity
		Provisioning benefits	Provision of water for human use		The provision of water extracted directly from the wetland for domestic, agriculture or other purposes
			Provision of harvestable resources		The provision of natural resources from the wetland, including livestock grazing, craft plants, fish etc.
			Food for livestock		The provision of grazing for livestock
			Provision of cultivated foods		The provision of areas in the wetland favourable for the cultivation of foods
		Cultural benefits	Cultural and spiritual experience		Places of special cultural significance in the wetland, e.g. for baptisms or gathering of culturally significant plants
			Tourism and recreation		Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
			Education and research		Sites of value in the wetland for education or research

Score	**< 0.5**	**0.5 – 1.2**	**1.3 – 2.0**	**2.1 – 2.8**	**> 2.8**
Rating of the likely extent to which a benefit is being supplied	Low	Moderately low	Intermediate	Moderately high	High

f) Determining the recommended buffer zone

A buffer is required by the NWA to be assigned to all watercourses that fall within an area earmarked for development, to reduce the impacts to aquatic resources and protect the range of goods and services that these resources provide to society. The buffer zones for wetlands on site were determined according to guidelines set out in Macfarlane and Bredin (2017), accompanied by their Site-Based Wetland Buffer Model.

2.5. Sensitivity mapping and assessment

An ecological sensitivity map of the site was produced by integrating the information collected on site with the available ecological and biodiversity information available in the literature and various spatial databases.

The sensitivity mapping entails delineating different habitat units identified on the satellite images and assigning likely sensitivity values to the units based on their ecological properties, conservation value and the potential presence of species of conservation concern, as well as their probability of being affected by proposed activities.

The sensitivity of the different units identified in the mapping procedure increased with probability and was rated according to the following scale:

Low: Areas of natural or transformed habitat with a low sensitivity where there is likely to be a negligible impact on ecological processes and biodiversity. Most types of activities can proceed within these areas with little ecological impact.

Medium: Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact such as erosion low. Activities within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.

High: Areas of natural or transformed land where a high impact is anticipated due to the high biodiversity value, sensitivity or important ecological role of the area. These areas may contain or be important habitat for faunal species or provide important ecological services such as water flow regulation or forage provision. Activities within these areas are undesirable and should only proceed with caution as it may not be possible to mitigate all impacts appropriately.

Very High: Critical and unique habitats that serve as habitat for species of conservation concern, or perform critical ecological roles. These areas are essentially no-go areas for activities and should be avoided as much as possible.

2.6. Impact assessment and mitigation

The criteria used to assess the significance of the impacts are shown in Table 1. The different project activities and associated infrastructure were identified and considered in order to identify and analyse the various possible impacts. The limits were defined in relation to project characteristics. Those for severity, extent, duration and probability are subjective, based on rule-of-thumb and experience. Natural and existing mitigation measures were considered. These natural mitigation measures were defined as natural conditions, conditions inherent in the project design and existing management measures, which alleviate impacts. The Consequence value of the impacts was calculated by using the following formula:

$$\underset{\text{(Severity + Spatial Scope + Duration)}}{\textit{CONSEQUENCE}} \; X \; \underset{\text{(Frequency of activity + Frequency of impact)}}{\textit{PROBABILITY}}$$

Consequence of impacts is defined as follows:

Very Low: Impact would be negligible. Almost no mitigation and/or remedial activity would be needed, and any minor steps which might be needed would be easy, cheap and simple.

Low: Impact would have little real effect. Mitigation and/or remedial activity would be either easily achieved or little would be required or both.

Low – Medium: Impact would be real but not substantial within the bounds of those which could occur. Mitigation and/or remedial activity would be both feasible and fairly easily possible.

Medium – High: Impact would be real and rather substantial within the bounds of those which could occur. Mitigation and/or remedial activity would be feasible, but not necessarily possible without difficulty.

High: Impacts of substantial order. Mitigation and/or remedial activity would be feasible but difficult, expensive, time consuming or some combination of these.

Very High: Of the highest order possible within the bounds of impacts which could occur. There would be no possible mitigation and/or remedial activity to offset the impact at the spatial or time scale for which was predicted.

Table 1. Criteria used to assess the significance of the impacts.

Weight	Severity	Spatial scope (Extent)	Duration
5	Disastrous	Trans boundary effects	Permanent
4	Catastrophic / major	National / Severe environmental damage	Residual
3	High/ Critical / Serious	Regional effect	Decommissioning
2	Medium / slightly harmful	Immediate surroundings / local / outside mine fence	Life of operation
1	Minimal/potentially harmful	Slight permit deviation / on-site	Short term / construction (6 months – 1 yrs)
0	Insignificant / non-harmful	Activity specific / No effect / Controlled	Immediate (0 – 6 months)

Weight number		**1**	**2**	**3**	**4**	**5**
Frequency						
Probability	**Frequency of impact**	Highly unlikely	Rare	Low likelihood	Probable / possible	Certain
		Practically impossible	Conceivable but very unlikely	Only remotely possible	Unusual but possible	Definite
	Frequency of activity	Annually or less	6 monthly / temporarily	Infrequent	Frequently	Life of operation

CONSEQUENCE
(Severity + Spatial Scope + Duration)

PROBABILITY (Frequency of activity + Frequency of impact)															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Colour code	Significance rating	Value	**Negative impact** Management strategy	**Positive Impact** Management strategy
	VERY HIGH	126 – 150	Improve current management	Maintain current management
	HIGH	101 – 125	Improve current management	Maintain current management
	MEDIUM – HIGH	76 – 100	Improve current management	Maintain current management
	LOW – MEDIUM	51 – 75	Improve current management	Maintain current management
	LOW	26 – 50	Improve current management	Maintain current management
	VERY LOW	1 – 25	Improve current management	Maintain current management

2.7. Assumptions and limitations

The study took place during late winter, which is not an optimal time of the year. Although the area received good summer rainfall, most grasses and annuals were dormant during the time of the field survey. The vegetation was therefore not in a favourable state for the assessment at the time of the site visit. Furthermore, due to the brief duration of the surveys and the lack of seasonal coverage, the species list and wetland characterisation reflected in this report cannot be regarded as fully representative. Ideally, a site should be visited several times during different seasons to ensure that the variation in species presence and habitat conditions are captured. However, this is rarely possible due to time and cost constraints related to mining and prospecting right application processes, and due to the nature of ephemeral wetlands systems. The survey was nevertheless conducted in such a manner to ensure all representative communities were traversed and therefore is likely to have included most of the common and important species present.

The official guideline documents and tools currently available to assess wetlands in South Africa were mainly developed for- and best applied to the more temperate wetlands of South Africa. The suite of methodologies available to date do not provide for a comprehensive and accurate assessment of the ephemeral wetlands in South Africa. This is mainly because they are rarely wet and do not display those indicators typically used for wetland assessments in other parts of South Africa. These systems have also received little attention in terms of scientific research. Therefore, the nature of the wetland on site and the lack of fully applicable methodologies are regarded as a limiting factor to justify the impacts to- and sensitivity of these systems on site. Nevertheless, the methodology used for this assessment was adapted from those available in the official guidelines, based on specialist knowledge and experience to provide a comprehensive understanding of the wetland and associated impacts related to the mining activities. In addition to these standard assessment protocols, the invertebrate cultures that were run in the lab provided valuable insight into the biodiversity of the ephemeral pans, which enhanced the wetland assessment outcome.

De Bad was accessible during the time of the field survey, but no access was granted to visit At Last during this time. Therefore information relating to the ecology of At Last was extrapolated from nearby sites that have been surveyed in the past. The core area earmarked for mining on At Last has however already been completely transformed by agricultural activities and therefore the lack of access is not considered a significant limitation to this ecological assessment.

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1. Current and historic land use

De Bad and At Last are situated in a rural area, with major land uses in the region including mining and agriculture. According to AGIS, both sites are highly suitable for irrigation. De Bad falls within the Douglas East Potential Agricultural Area (PAA), with a B rating, while At Last falls within the Delportshoop PAA, with a D rating. The agricultural region is demarcated for cattle farming, with the grazing capacity estimated at 13 - 15 Ha/LSU. Currently, the property is used for agricultural activities, with extensive crop irrigation, especially along the river, while the remaining natural pastures are utilised by domestic stock. Existing infrastructure include homesteads, farm tracks, power lines and grazing camps, while large areas have been transformed for agriculture and evidence of historic mining activities are also visible (Figure 4).

3.2. Geology, soils, and topography

According to Bosch and Visser (1993) the geological features on the De Bad comprise Quaternary deposits, while Quaternary and Vaalian deposits are found on At Last (Figure 5). This geological map is however not entirely accurate, as it depicts De Bad to be largely covered by wind-blow sand. In reality, the slopes east of the Vaal River comprise Dwyka Tillites. Calcrete and surface limestone is present in the centre of the property, and alluvium is found along the river. Dolerite dykes and Kimberlite fissures are also present on De Bad (Figure 5). At Last primarily comprises calcrete, with alluvium along the river and major drainage systems. Siltstone, shale, quartzite, gritstone, and conglomerate from the Vryburg Formation of the Campbell Group (Griqualand West Sequence) occurs west of the public gravel road (Figure 5).

The topography of De Bad is characterised by plains with open low hills or ridges, with the slopes towards the river being classified as rolling or irregular plains with low hills or ridges. At Last is associated with plains with open high hills or ridges. Altitude ranges from 1 000 m above sea level along the river for both sites, to 1 020 – 1 046 m along the plains on De Bad and 1020 – 1080 m on At Last. The terrain is indicated by a gentle slope of around 1 % across the plains but increases slightly to 2 % towards the ridges that slope towards the river.

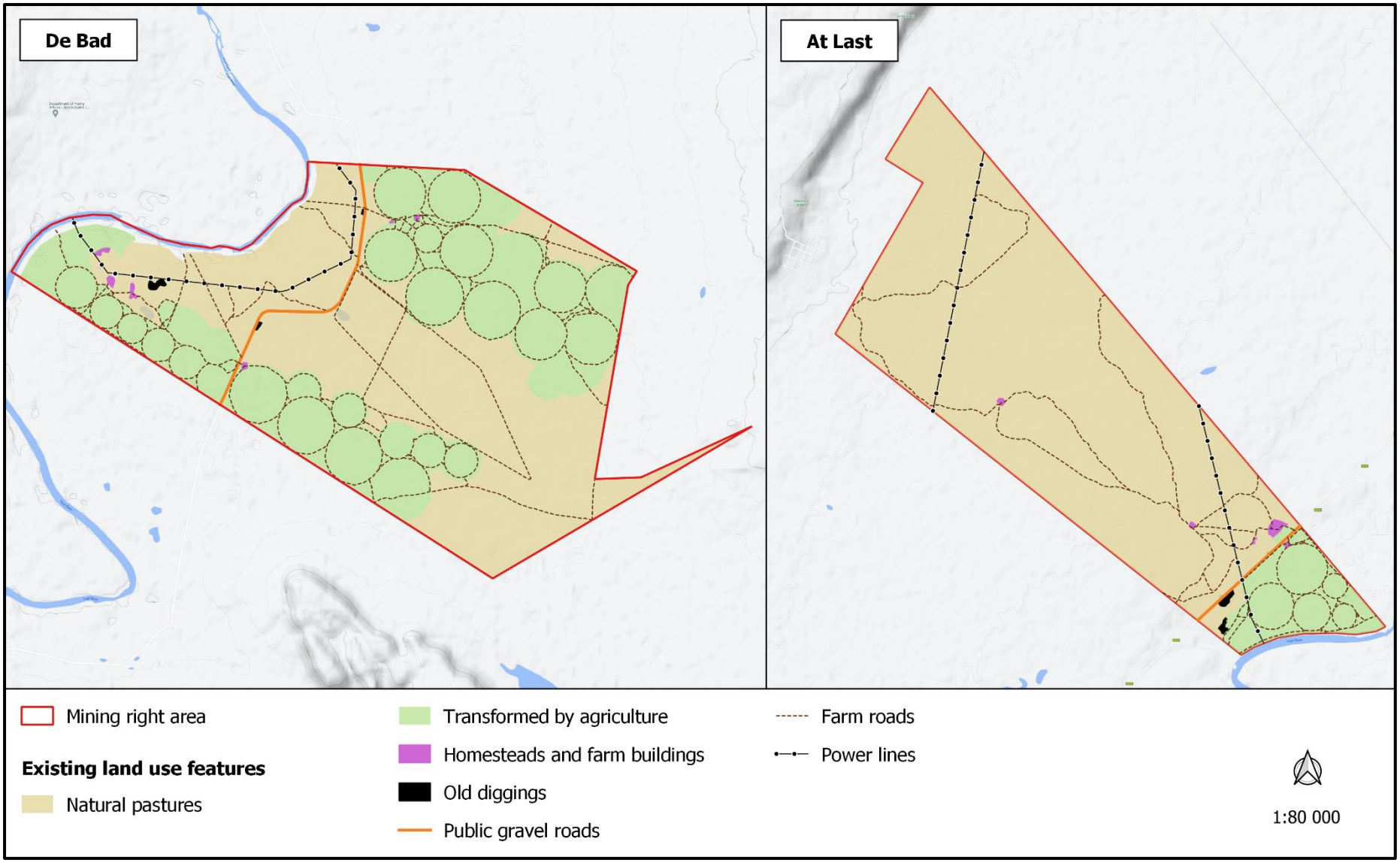


Figure 4. The existing land use features on the mining right area.

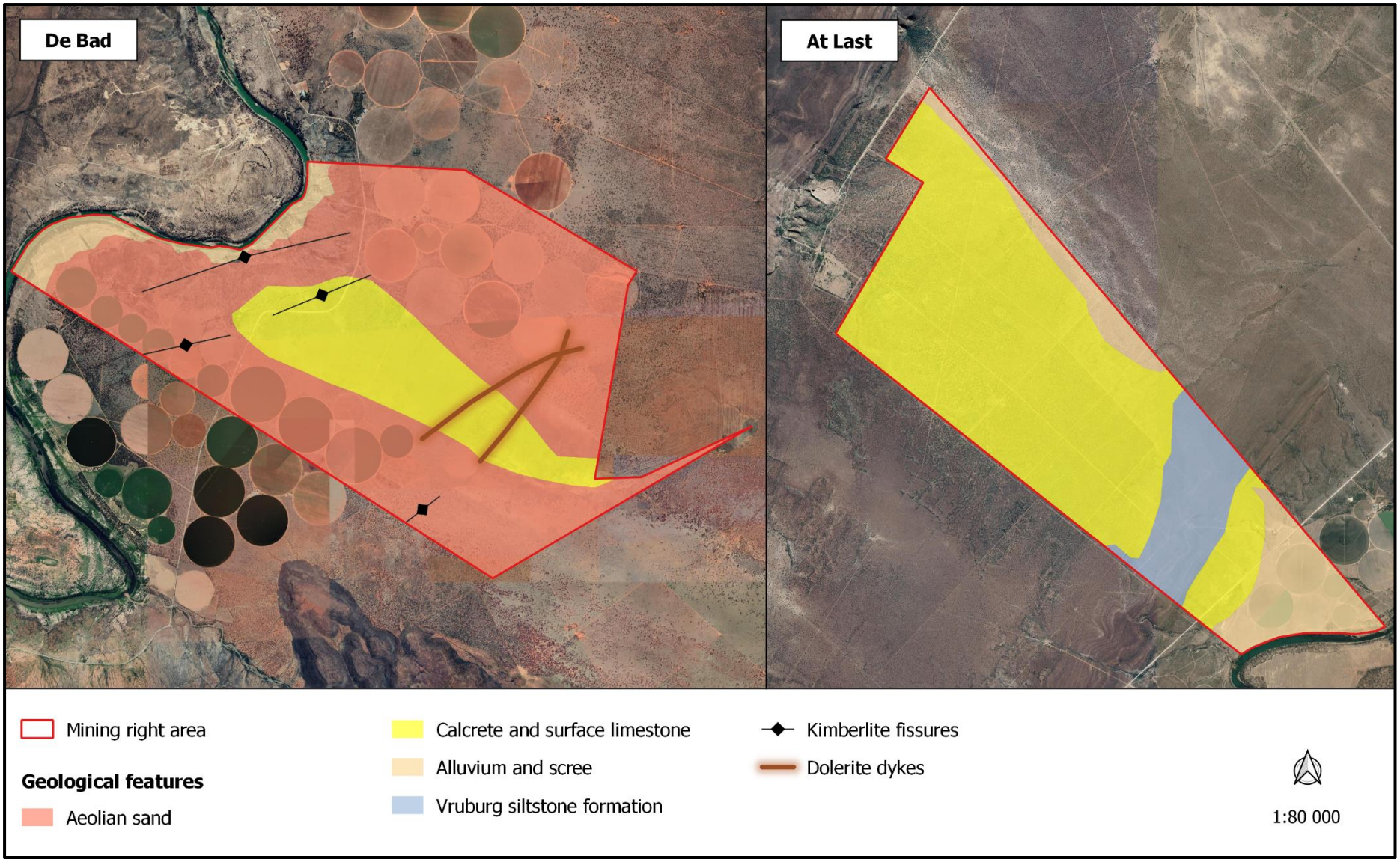


Figure 5. The distribution of geological features in the study area.

Land types include Fc7 and Ae15 on De Bad, and Fc5 and Dc5 on At Last (Figure 6 and Figure 7). Soils associated with the Fc5 and Fc7 land types are typically Glenrosa and/or Mispah forms, with lime generally present in the entire landscape. Dc5 land types include soils where prismacutanic and/or pedocutanic diagnostic horizons are dominant, but with one or more of vertic, melanic, red structured diagnostic horizons also being present. The Ae15 land type is associated with red-yellow apedal, freely drained soils, red, with a high base status and that are more than 300 mm deep, without dunes. The Vaal River is typically represented by terrain unit 5, while the plains are associated with terrain unit 4. The ridge slopes are presented by unit 3.

The generally level to gently sloping land of the plains produces low water erosion risk, but due to shifting sands being present it is highly susceptible to wind erosion. Erosion risks on the steeper slopes of the ridges are higher in terms of water erosion, and any pure sands found here will also be highly susceptible to wind erosion. The soils also have moderately high susceptibility for crusting and compaction.

3.3. Vegetation

3.3.1. Broad-scale vegetation patterns

The study area falls within the Savanna Biome (Mucina and Rutherford 2006). According to the vegetation map of Mucina and Rutherford (2012), the sites are represented by two broad-scale vegetation units, i.e. Kimberley Thornveld and Schmidtsdrif Thornveld (Figure 8). This vegetation map however does not reflect the true character of the site, because it has not been mapped at a very fine scale. Therefore, field-based classification of small-scale vegetation patterns are discussed in the next section.

Kimberley Thornveld is distributed in the North-West, Free State and Northern Cape Provinces at altitudes between 1 050 and 1 400 m. It is found in the Kimberley, Hartswater, Bloemhof and Hoopstad Districts, but is also within the Warrenton, Christiana, Taung, Boshof and Barkly West Districts. The unit is typically presented as slightly undulating sandy plains with a well-developed tree and shrub layer and an open grass layer. Andesitic lavas of the Allanridge Formation occur in the north and west, while fine-grained sediments of the Karoo Supergroup are found in the south and east. Soils are deep, sandy to loamy, and of the Hutton form. The most common land types are Ae and Ah.

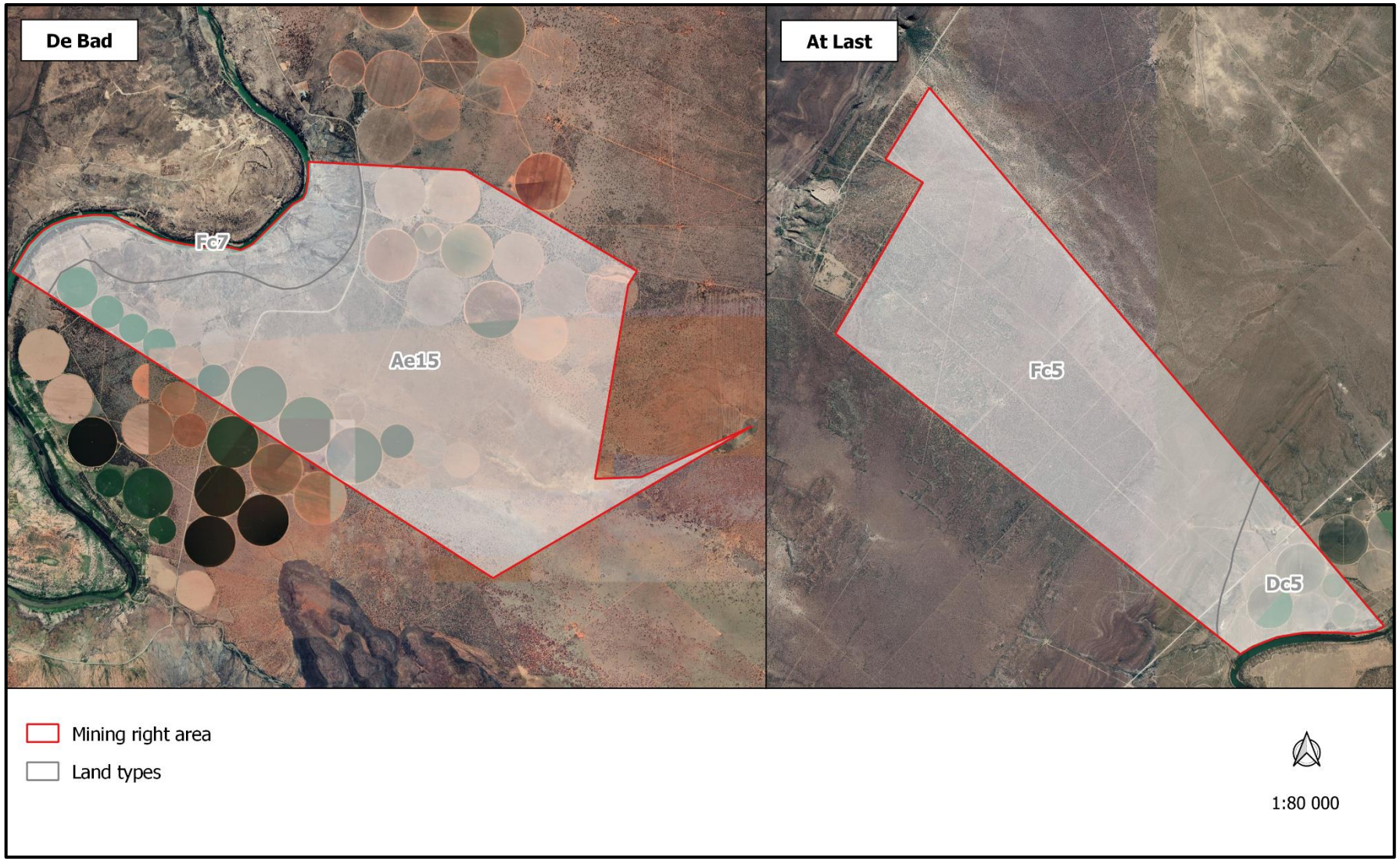


Figure 6. The distribution of land types in the study area.

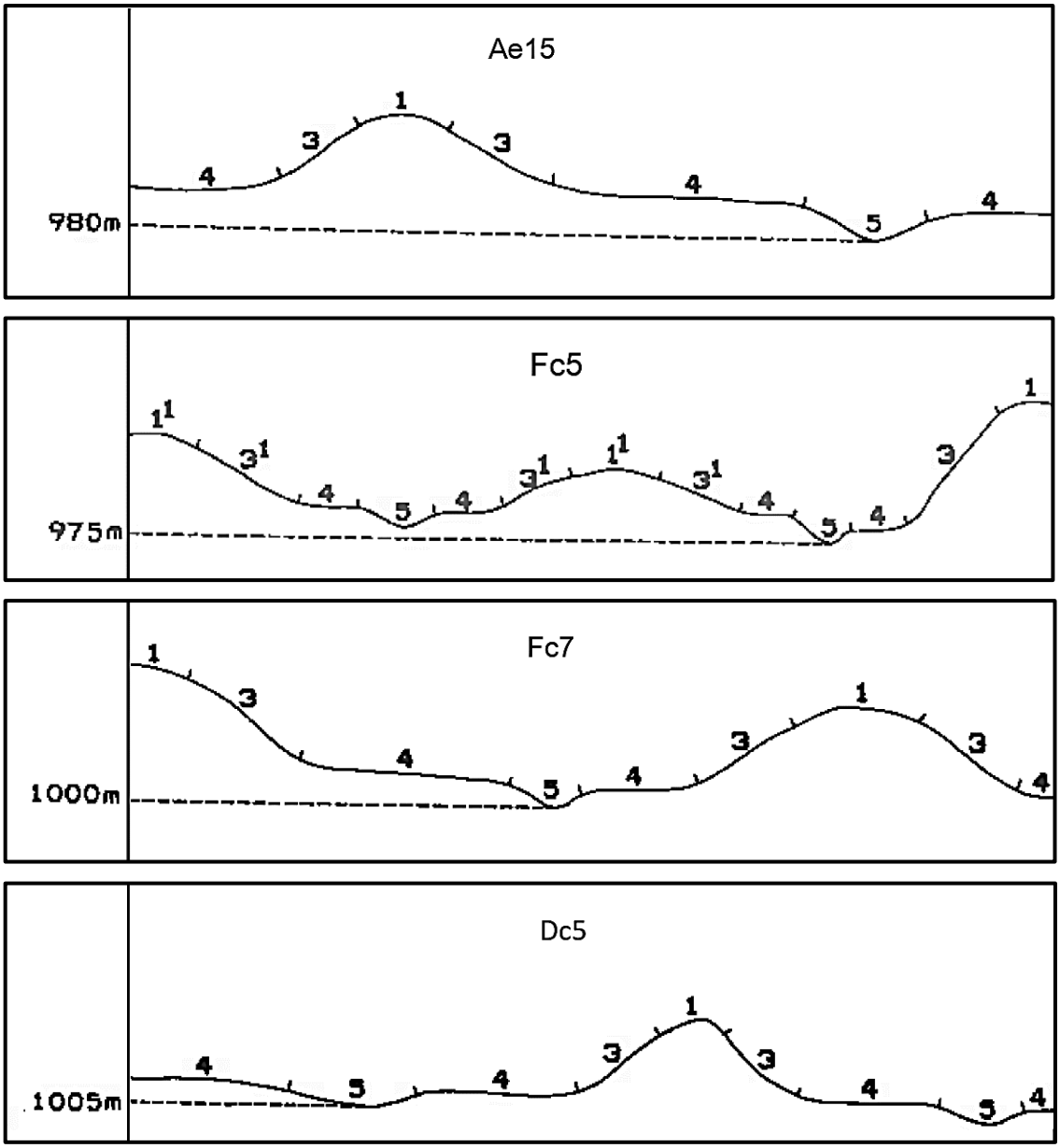


Figure 7. The land types and terrain units associated with the study area.

Figure 8. The broad-scale vegetation units (Mucina and Rutherford 2012) present in the study area.

The unit is classified as being least threatened, but 18 % has already been transformed, predominantly by cultivation. Only 2 % is currently conserved in statutory reserves and no endemic species are known from this unit. It is specifically prone to Acacia mellifera encroachment following overgrazing, but the occurrence and risk of erosion is very low.

Schmidtsdrif Thornveld is distributed in the Northern Cape, Free State and North-West Provinces at altitudes between 1 000 and 1 350 m. It stretches from the footslopes and midslopes to the southeast and below the Ghaap Plateau from around Douglas in the southwest via Schmidtsdrif towards Taung in the northeast. A small less typical section is found east of the Ghaap Plateau from Warrenton towards Hertzogville. The unit is typically presented as a closed shrubby thornveld dominated by *Senegalia mellifera* and *Vachellia tortilis*. Apart from grasses, bulbs and annual herbs are also prominent. The vegetation is very disturbed in some areas due to overgrazing by goats and other browsers. Dwyka diamictites and Ecca shales of the Karoo Supergroup are the most significant geological features in this unit, Shale and dolomite of the Schmidtsdrif Subgroup (Griqualand West Supergroup) are also present. Surface limestone occurs sporadically. The soils are well-drained, stony and shallow (< 0.3 m), with large angular rocks found on the surface. A soil-rock complex with Mispah soil form is typical, while the unit is mainly associated with the Ae and Dc land types. The unit is least threatened, with 13 % being transformed mainly by cultivation. A very small portion (0.2 %) used to be conserved in the de-proclaimed Vaalbos National Park, but it is no longer statutorily conserved. Erosion is very low to low. No endemic species are known from this unit and *Prosopis* spp. are significant alien invaders.

3.3.2. Fine-scale vegetation patterns

The proposed finer scale vegetation communities were delineated according to plant species correspondences and changes in soil structure. The vegetation of the study area can be divided into six distinct units (Figure 9), which are described below. These descriptions include unique characteristics and the dominant species found in each unit. A complete plant species list, including those species historically recorded in the region, is presented in Appendix 1. Areas that have already been transformed by agriculture are indicated on the map but will not be discussed further.

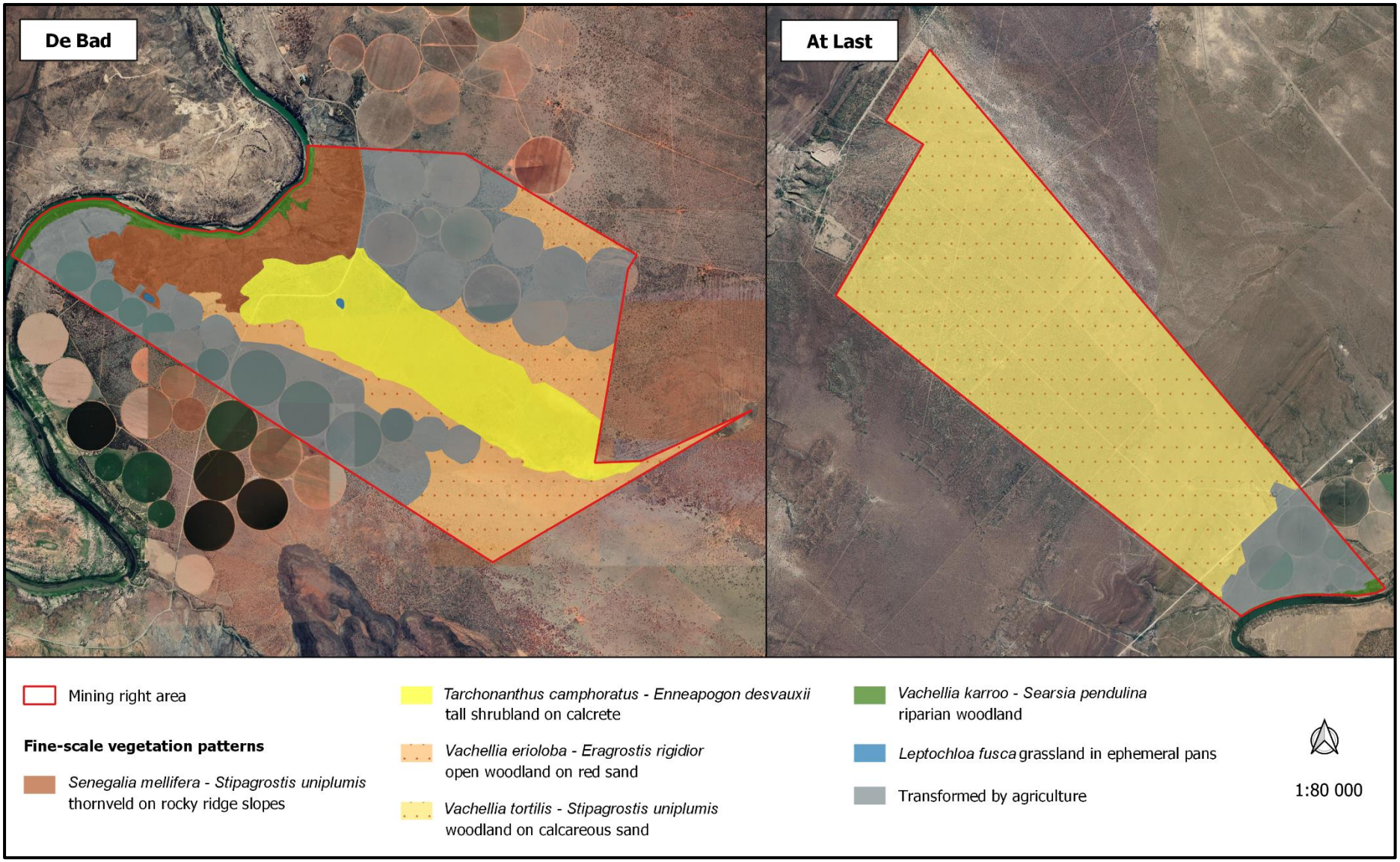


Figure 9. The distribution of fine-scale plant communities in the study area.

i) *Senegalia mellifera - Stipagrostis uniplumis* thornveld on rocky ridge slopes

This community occurs along the ridge slopes on De Bad (Figure 9). The vegetation is presented as thornveld with tall shrubs scattered in a grassy matrix (Figure 10). Much of this community has been degraded by historic land use activities. Red sand and rock constitute approximately 5 – 10 % of the ground cover. Crustose lichens and biological soil crusts are also conspicuus in some areas, but for most parts the latter has been destroyed by trampling.

The tall shrub layer is dominated by *Senegalia mellifera*, with *Grewia flava* also being very abundant. Other common tall shrubs include *Phaeoptilum spinosum, Tarchonanthus camphoratus, Ehretia rigida, Ziziphus mucronata* subsp*. mucronata, Gymnosporia buxifolia* and *Rhigozum trichotomum.* Trees, *Vachellia tortilis, V. erioloba* and *Olea europaea* subsp*. africana* are also scattered across the thornveld. Low shrubs include *Plinthus karooicus, Lycium cinereum, Pentzia incana, Lasiosiphon polycephalus, Leonotis pentadentata, Aptosimum marlothii, A. indivisum, Asparagus laricinus, Justicia incana, Melolobium candicans, Kleinia longiflora* and *Viscum rotundifolium.*

The grass layer is dominated by *Stipagrostis uniplumis,* but *Eragrostis lehmanniana* is also abundant. Other common grasses include *Fingerhuthia africana, Cenchrus ciliaris, Eragrostis echinochloidea, Heteropogon contortus, Enneapogon cenchroides* and *Aristida congesta subsp. barbicollis.*

Herbs include *Lessertia annularis, Helichrysum argyrosphaerum, Nemesia fruticans, Sebaea exigua* and *Oxalis lawsonii.* Succulents, *Aloe claviflora* and *A. grandidentata* are also found here.

The herbaceous weed *Bidens pilosa,* along with invasive *Prosopis* trees and shrubs are also common in this unit.

Figure 10. The thornveld on red sand and rock is represented by tall shrubs in a grassy matrix (top). Biological soil crusts (centre) and crustose lichens (bottom) are prevalent in places.

ii) *Tarchonanthus camphoratus - Enneapogon desvauxii* tall shrubland on calcrete

This community is associated with the calcrete and surface limestone deposits in the centre of De Bad (Figure 9). Here, the vegetation comprises tall shrubland within a grassy matrix, intermixed with low shrubs (Figure 11). It is found on shallow, rocky soil, which constitutes approximately 5% of the ground cover.

The tall shrub layer is dominated by *Tarchonanthus camphoratus,* but *Senegalia mellifera* is also abundant. Other common species include *Ziziphus mucronata* subsp. *mucronata*, *Rhigozum trichotomum, Grewia flava* and *Cadaba aphylla*. Low shrubs include *Justicia divaricata, Pentzia calcarea, Eriocephalus ambiguus, Felicia fascicularis, Lycium cinereum, Thesium hystrix* and *Rosenia humilis.*

The grassy matrix consists of a clear short- and tall grass component. *Enneapogon desvauxii* dominates the short-grass component, while *Aristida vestita* dominates the tall-grass component. Other common grasses include *Enneapogon cenchroides, Fingerhuthia africana, Cenchrus ciliaris, Eragrostis lehmanniana, E. echinochloidea, Heteropogon contortus* and *Themeda triandra.* Herbs include *Senecio consanguineus* and *Helichrysum argyrosphaerum.*

Figure 11. The tall shrubland on calcrete comprise tall shrubs found in a grassy matrix intermixed with low shrubs.

iii) *Vachellia erioloba - Eragrostis rigidior* open woodland on red sand

This community is restricted to deep red sand, which comprise the majority of De Bad, but most of it has been completely transformed for crop irrigation (Figure 9). Here, the vegetation is presented as an open woodland, where tall trees are scattered in an extensive grassland matrix (Figure 12). Bare ground constitutes approximately 5% of the ground cover.

Vachellia erioloba dominates the tree layer, with large adult individuals providing refugia for other tall shrubs, such as *Lycium hirsutum* and *Grewia flava*, the grass *Setaria verticillata*, as well as the herb *Senecio consanguineus*. *Senegalia mellifera* is also starting to encroach on the grassland.

The grassland is strongly dominated by *Eragrostis rigidior,* but *Eragrostis lehmanniana, E. pallens, Pogonarthria squarrosa* and *Stipagrostis uniplumis* is also common. Low shrubs found in the grassy matrix include *Lasiosiphon polycephalus, Selago densiflora* and *Plinthus karooicus.* Herbs include *Nemesia fruticans, Oxalis lawsonii* and *Lotononis laxa.* The bulb *Trachyandra bulbinifolia* is also found here.

Figure 12. The open woodland on red sand is represented by large, tall *Vachellia erioloba* trees sparsely scattered in an extensive grassy matrix.

iv) *Vachellia tortilis – Stipagrostis uniplumis* woodland on calcareous sand

This community covers most of At Last (Figure 9) and is found on sandy soil over rock, with calcrete being prevalent. The vegetation is presented as woodland, with tall trees scattered in a grassy matrix (Figure 13).

The tree layer is dominated by *Vachellia tortilis* and a secondary tall shrub layer, dominated by *Senegalia mellifera* has also encroached the matrix. Other trees and tall shrubs scattered across this community include *Boscia albitrunca, Diospyros lycioides, Grewia flava, Searsia burchellii, S. tridactyla, S. lancea, Tarchonanthus camphoratus, Ziziphus mucronata* and *Rhigozum obovatum.* Common low shrubs include *Pentzia calcarea, Felicia fascicularis, Lycium horridum, Asparagus glaucus, Viscum rotundifolium, Lasiosiphon polycephalus, Seddera capensis, Justicia divaricata* and *Jamesbrittenia tysonii*.

The grass layer is dominated by *Stipagrostis uniplumis*, but other common grasses include *Eragrostis echinochloidea, E. lehmanniana, Cenchrus ciliaris, Enneapogon cenchroides, Cymbopogon pospischilii, Themeda triandra, Aristida meridionalis, Setaria verticillata* and *Aristida congesta* subsp. *congesta*. The herb *Salvia disermas* is also found here.

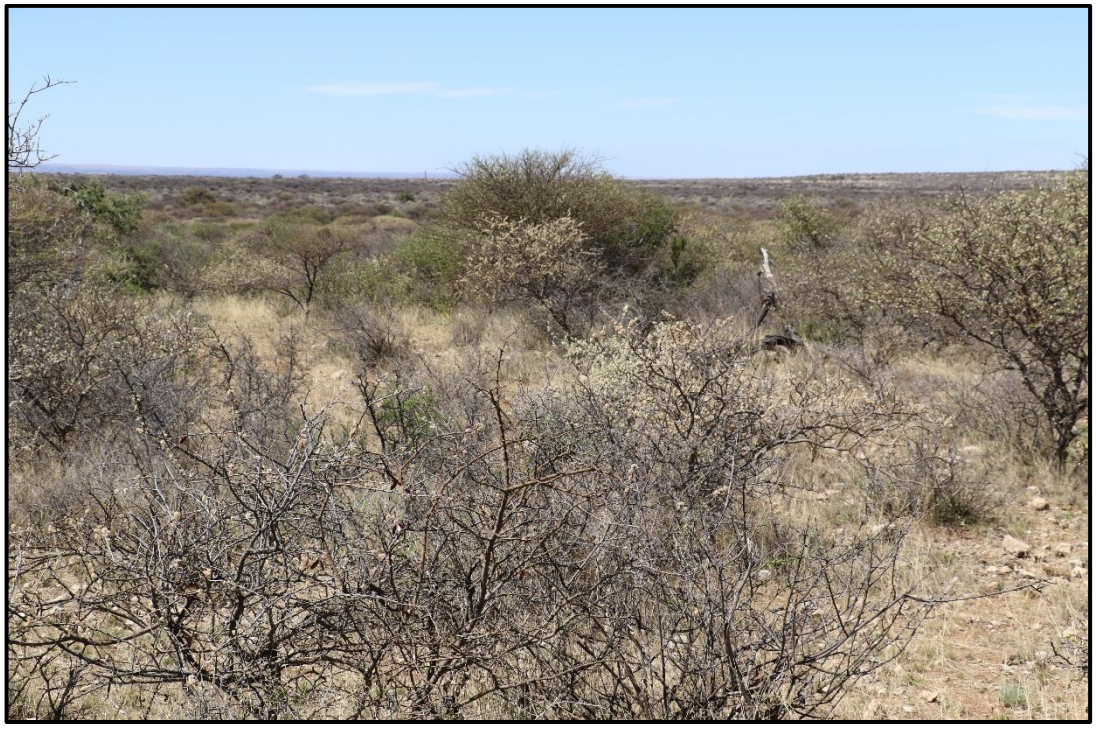


Figure 13. The woodland on calcareous soil comprises tall trees scattered in a grassy matrix, but a secondary tall shrub layer, dominated by *Senegalia mellifera* encroaches the matrix.

v) *Vachellia karroo - Searsia pendulina* riparian woodland

The riparian woodland lines the Vaal River on both De Bad and At Last (Figure 9). Although it is the main vegetation along the riverbank, it is broken up by bare areas and floodplains that have been degraded through land use activities and erosion (Figure 14). The woodland is fairly monotonous, and the vegetation seems to have been severely degraded, most likely by recent flooding events. *Vachellia karroo* dominates, but *Searsia pendulina, Lycium bosciifolium, Diospyros lycioides* subsp. *lycioides*, *Asparagus* sp., and *Eucalyptus camaldulensis* are also common woody components. The understory has been infested with *Bidens bipinnata* and *Argemone ochroleuca* in places. *Phragmites australis* is common along the water line, and the floodplains are dominated by the grass *Cynodon dactylon* and the bulb *Moraea pallida*.

Figure 14. Riparian woodland lines the banks of the Vaal River for most part (top), but the woodland is interrupted by eroded floodplains in places (bottom).

vi) *Leptochloa fusca grassland* in ephemeral pans

The ephemeral pans on De Bad (Figure 9) are occupied by monotonous grassland vegetation in the centre, with tall shrubs lining the periphery (Figure 15). *Leptochloa fusca* dominates the grassland, with *Eragrostis rigidior* occurring sporadically. The low shrub *Selago densiflora*, herb *Lotononis laxa* and bulb *Ornithogalum flexuosum* are also found here. The woody component lining the peripheries include *Diospyros lycioides* subsp. *lycioides*, *Ziziphus mucronata* subsp. *mucronata, Lycium bosciifolium* and *Grewia flava*. *Argemone ochroleuca* has infested the understory in places.

Figure 15. The ephemeral pans on site are occupied by grassland in the centre, with tall shrubs lining their peripheries.

3.3.3. Population of sensitive, threatened and protected plant species

The SANBI Red List provides information on the national conservation status of South Africa's indigenous plants, while the National Forests Act (No. 84 of 1998) (NFA) and the Northern Cape Nature Conservation Act (Act No. 9 of 2009) (NCNCA) restricts activities regarding sensitive plant species. Section 15 of the NFA prevents any person to cut, disturb, damage, destroy or remove any protected tree; or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister. Section 49 (1) and 50 (1) of the NCNCA states that no person may, without a permit pick, transport, possess, or trade in a specimen of a specially protected (Schedule 1) or protected (Schedule 2) plants. Furthermore, Section 51(2) states that no person may, without a permit, pick an indigenous plant (Schedule 3) in such manner that it constitutes large-scale harvesting.

Most species of the region are classified as least concern; a category which includes widespread and abundant taxa (Table 2). However, one species, i.e. *Salsola microtricha* is listed as "Data Deficient - Taxonomically Problematic" under the National Environmental: Biodiversity Act (Act No. 10 of 2004) (NEMBA). The genus *Salsola* needs taxonomic revision because its species are poorly defined and difficult to separate. Therefore, based on currently available data, the risk of extinction of this species cannot be assessed. This species was not encountered on site, but it has been recorded in the region in the past.

Species protected in terms of the National Forests (NFA) Act No 84 of 1998 include *Vachellia erioloba, V. haematoxylon* and *Boscia albitrunca* (Table 2). The latter species is also protected according to the NCNCA (Schedule 2). It was not recorded on De Bad but is expected to occur on At Last, in the pristine woodland to the west of the public gravel road, which has not been earmarked for mining.

Vachellia erioloba was most abundant in the woodland on red sand, where it was found at very high densities of 20 - 30 individual per hectare. Here, all size classes were also present, from saplings of 80 cm (h) x 60 cm (d) (Figure 16), all the way through to large mature adults of 5 m (h) x 15 m (d). It also occurred in the thornveld on rocky ridge slopes, but at very low densities of <1 individuals per hectare. Here, they primarily occurred as young adult trees of 3 m (h) x 2.5 m (d) (Figure 16). *Vachellia haematoxylon* was not recorded in the study area.

A photographic guide for species of conservation concern that occur on site is provided in Appendix 3.

Table 2. Plant species found in the region that are of conservation concern. Those recorded in the study area is highlighted in red.

FAMILY	Scientific name	Status	NFA	NCNCA
AIZOACEAE	*Titanopsis calcarea*			S2
AMARANTHACEAE	***Salsola microtricha***	**DDT**		
ASPHODELACEAE	*Aloe claviflora*			S2
	Aloe grandidentata			S2
	Bulbine abyssinica			S2
	Trachyandra bulbinifolia			S2
CAPPARACEAE	*Boscia albitrunca*		X	S2
CELASTRACEAE	*Gymnosporia buxifolia*			S2
FABACEAE	***Lessertia annularis***			S1
	Vachellia erioloba		X	
	Vachellia haematoxylon		X	
HYACINTHACEAE	*Ornithogalum flexuosum*			S2
	Ornithogalum nannodes			S2
IRIDACEAE	*Babiana hypogaea*			S2
	Moraea pallida			S2
OLEACEAE	*Olea europaea* subsp. *africana*			S2
OXALIDACEAE	*Oxalis lawsonii*			S2
SCROPHULARIACEAE	*Jamesbrittenia tysonii*			S2
	Nemesia fruticans			S2
	Nemesia lilacina			S2

Protected species in terms of Schedule 1 and 2 of the Northern Cape Nature Conservation (NCNCA) Act No. 9 of 2009 is listed in Table 2. All *Lessertia* species are protected in terms of Schedule 1, and *Lessertia annularis* was recorded in the thornveld on rocky ridge slopes.

Species protected in terms of Schedule 2 include *Olea europaea* subsp. *africana,* all Aizoaceae species previously included in the family Mesembryanthemaceae, all species in the family Asphodelaceae and Iridaceae, as well as all *Gymnosporia, Ornithogalum, Oxalis*, *Jamesbrittenia* and *Nemesia* species.

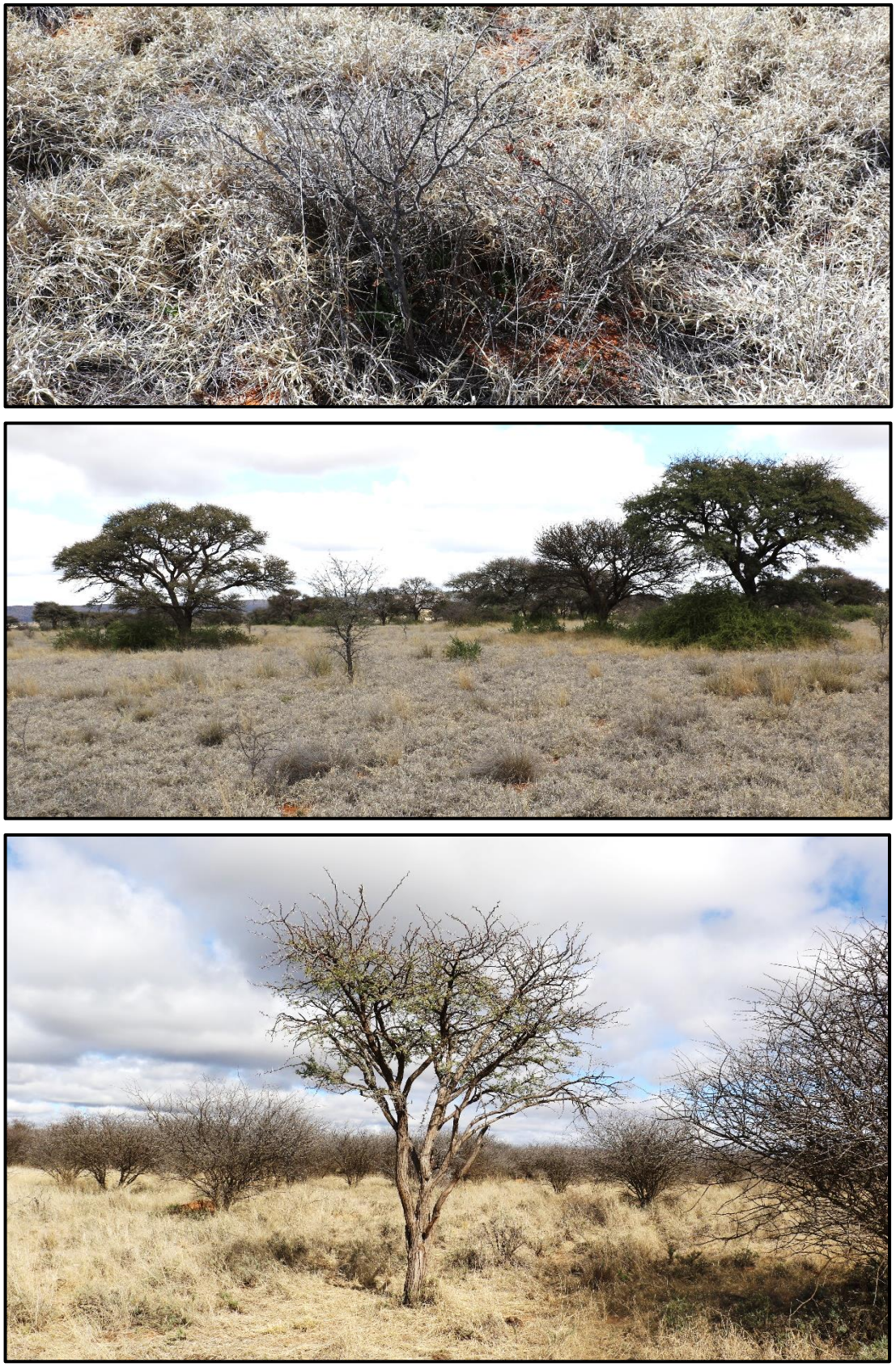


Figure 16. The protected tree *Vachellia erioloba* occurs at high densities from saplings to large trees in the open woodland on red sand (top and centre), while young trees are found sporadically in the thornveld on rocky ridge slopes.

3.3.4. Weeds and invader plant species

Weeds and invasive species are controlled in terms of the National Environmental Management: Biodiversity (NEMBA) Act 10 of 2004, the Conservation of Agricultural Resources (CARA) Act 43 of 1993, as well as the NCNCA (Schedule 6). These are species that do not naturally occur in a given area and exhibit tendencies to invade that area, and others; at the cost of locally indigenous species. To govern the control of such species, NEMBA and CARA have divided weeds and invader species into categories (see Table 3). All declared weeds and invasive species recorded in the study region are listed in Table 4, along with their categories according to CARA, NEMBA and NCNCA.

Table 3. The categorisation of weeds and invader plant species, according to NEMBA and CARA.

NEMBA		CARA	
1a	Listed invasive species that must be combatted or eradicated.	**1**	Plant species that must be removed and destroyed immediately. These plants serve no economic purpose and possess characteristics that are harmful to humans, animals and the environment.
1b	Listed invasive species that must be controlled.	**2**	Plant species that may be grown under controlled conditions. These plants have certain useful qualities and are allowed in demarcated areas. In other areas they must be eradicated and controlled.
2	Listed invasive species that require a permit to carry out a restricted activity within an area.	**3**	Plant species that may no longer be planted. These are alien plants that have escaped from, or are growing in gardens and are proven to be invaders. No further planting is allowed. Existing plants may remain (except those within the flood line, 30 m from a watercourse, or in a wetland) and must be prevented from spreading.
3	Listed invasive species that are subject to exemptions and prohibitions		

Table 4. A list of declared weeds and invasive species recorded in the study region.

Scientific name	Common name	CARA	NEMBA	NCNCA
Argemone ochroleuca	White-flowered Mexican poppy	1	1b	S6
Eucalyptus camaldulensis	River red gum	2	1b	S6
Lythrum hyssopifolia	Hyssop loosestrife	-	1b	-
Prosopis glandulosa	Honey mesquite	2	3	S6
Prosopis velutina	Velvet mesquite	2	3	S6

3.3.5. Indicators of bush encroachment

Bush encroacher species are controlled in terms of Regulation 16 of CARA; where land users of an area in which natural vegetation occurs and that contains communities of encroacher indicator plants are required to follow sound practices to prevent the deterioration of natural resources and to combat bush encroachment where it occurs. Declared indicators of bush encroachment in the Northern Cape, recorded in the study area, are listed in Table 5.

Table 5. A list of declared indicators of bush encroachment in the Northern Cape, which were recorded in the study area.

Scientific name	Common name
Grewia flava	Velvet Raisin
Rhigozum trichotomum	Three – thorn rhigozum
Senegalia mellifera subsp. detinens	Black thorn
Tarchonanthus camphoratus	Camphor bush
Vachellia karroo	Sweet thorn
Vachellia tortilis	Umbrella thorn

3.4. Faunal communities

According to Section 3(a) and 4(a) of the Northern Cape Nature Conservation (NCNCA) Act No. 9 of 2009, no person may, without a permit by any means hunt, kill, poison, capture, disturb, or injure any protected (Schedule 2) or specially protected (Schedule 1) wild animals. Furthermore, Section 12 (1) of NCNCA states that no person may, on a land of which he or she is not the owner, hunt a wild animal without the written permission from the landowner. According to the act “wild animal” means a live vertebrate or invertebrate animal, and the egg or spawn of such animal.

The landscape features on the De Bad & At Last site provides several habitat opportunities to faunal communities and wild animals likely to be found in the study area are discussed in their respective faunal groups below.

3.4.1. Mammals

As many as 59 terrestrial mammals and nine bat species have been recorded in the region (see Appendix 2), of which Vervet Monkey, Steenbok, Suricate, Slender Mongoose and Kudu were encountered during the site visit. Small rodent burrows and Black-backed Jackal scat were also observed (Figure 17).

Seven listed terrestrial mammal species and two listed bat species potentially occur in the area (Table 6). Virtually all mammals of the study area are protected; either according to Schedule 1, 2 or 3 of NCNCA (see Appendix 2). Those that are specially protected are also indicated in Table 6.

The African Straw-coloured Fruit-bat, Aardvark, Aardwolf, Cape Fox, Bat-eared Fox, African Striped Weasel, African Wildcat, Black-footed cat, Honey Badger, Striped Polecat and South African Hedgehog all have a high chance of occurring on site, given their wide habitat tolerances and preference for the dominant savanna habitat found on site. Cape Clawless Otter and Spotted-necked Otter also have a high likelihood to occur in the study area, but they are expected to be restricted to the Vaal River.

Table 6. A list of mammal species that are likely to be found in the study area, which are of conservation concern in terms of the international (IUCN) Red List and the 2016 Mammal Red List of South Africa Lesotho and Swaziland (EWT 2016). Their respective NCNCA schedule numbers are indicated in superscript.

Scientific name	Common name	IUCN Status	EWT 2016
[2]*Eidolon helvum*	African Straw-coloured Fruit-bat	**NT**	LC
[2]*Rhinolophus denti*	Dent's Horseshoe Bat	LC	**NT**
[1]*Orycteropus afer*	Aardvark	LC	LC
[1]*Smutsia temminckii*	Temminck's Ground Pangolin	**VU**	**VU**
[1]*Atelerix frontalis*	South African Hedgehog	LC	**NT**
[1]*Proteles cristatus*	Aardwolf	LC	LC
[1]*Felis silvestris cafra*	African Wild Cat	LC	LC
[1]*Felis nigripes*	Black-footed cat	**VU**	**VU**
[1]*Vulpes chama*	Cape Fox	LC	LC
[2]*Aonyx capensis*	Cape Clawless Otter	**NT**	**NT**
[1]*Hydrictis maculicollis*	Spotted-necked Otter	**NT**	**VU**
[1]*Hyaena brunnea*	Brown Hyena	**NT**	**NT**
[1]*Otocyon megalotis*	Bat-eared Fox	LC	LC
[1]*Ictonyx striatus*	Striped Polecat	LC	LC
[1]*Poecilogale albinucha*	African Striped Weasel	LC	**NT**
[1]*Mellivora capensis*	Honey Badger	LC	LC

Figure 17. Small rodent burrows (left) and black-backed jackal scat (right) were observed on site.

Dent's Horseshoe Bat has a low potential to be found on site. It prefers rocky outcrops and caves and no suitable roosting sites have been observed on site. Temminck's Ground Pangolin and Brown Hyaena also have a low potential to occur on site. Although their habitat requirements and natural distribution ranges overlap with that of the study area, they are both rather sensitive to anthropogenic habitat disturbances. Farm fences and the extensive agricultural activities on site are expected to restrict their occurrences across their natural distribution range in the area.

Problem animals (Schedule 4) confirmed on site are Vervet Monkey and Black-backed Jackal, but Caracal is also expected to occur in the study area.

3.4.2. Reptiles

The De Bad and At Last mining area lies within the distribution range of at least 55 reptile species (see Appendix 2). No listed species are known to occur in the area, but most reptiles of the study area are protected either according to Schedule 1 or 2 of NCNCA, except for agamas, geckos and skinks (Appendix 2). Specially protected species include *Karusasaurus polyzonus* (Southern Karusa Lizard) and *Chamaeleo dilepis dilepis* (Common Flap-neck Chameleon). The Karusa Lizard is a rock-dwelling species, while the Common Flap-neck Chameleon is typically found high up in bushes or trees (Figure 18).

Southern Karusa Lizard

Common Flap-neck Chameleon

Figure 18. Reptile species of conservation concern that are expected to occur in the study area.

Three species from the region are endemic to South Africa, i.e. *Homopus femoralis* (Greater Padloper), *Pachydactylus mariquensis* (Common Banded Gecko) and *Agama aculeata distanti* (Eastern Ground Agama).

3.4.3. Amphibians

Fifteen amphibian species are known from the region (Appendix 2). The Vaal River and ephemeral pans are considered to be the most important habitats for amphibians in the study area, as most frogs are dependent on water, specifically for breeding. Higher amphibian diversity is expected in these habitats, while the adults of those species which are relatively independent of water (Tandy's Sand Frog, Tremolo Sand Frog, Boettger's Caco, Karoo Toad) are likely to be common in the terrestrial habitats, where they normally aestivate under logs, stones and animal burrows during the dry season.

The Giant Bull Frog (*Pyxicephalus adspersus,* Figure 19) is listed as Near Threatened in the Southern African Frog Atlas and is protected according to Schedule 1 of the NCNCA. They prefer seasonal shallow grassy pans, vleis and other rain-filled depressions in open flat areas of grassland or savanna, but mainly remain buried up to 1 m underground until conditions become favourable. The site lies within the known distribution of this species, and the ephemeral pans on De Bad present ideal habitats for it.

All other amphibians of the study area are protected according to Schedule 2 of NCNCA (see Appendix 2).

Figure 19. The Giant Bull Frog's distribution range overlaps with that of the study area and is expected to be associated with the ephemeral pans on De Bad.

3.4.4. Avifauna

The study site does not fall within or near (<50 km) any of the Important Bird Areas (IBA) defined by Birdlife South Africa. A total number of 283 bird species have been recorded from the region (see Appendix 2), of which as many as 24 are listed and classified as Vulnerable, Near Threatened, Endangered or Critically Endangered (Table 7). Furthermore, all birds are protected either according to Schedule 1, 2 or 3 of NCNCA (Appendix 2). Those that are specially protected (Schedule 1) are also listed in Table 7. Plants in general, from grass tufts to shrubs and tall trees provide important micro-habitats to birds in the terrestrial habitats. The Vaal River and ephemeral pans further increases habitat opportunities to birds and therefore the study area is expected to host a diverse avifauna community.

Many of the species of conservation concern are expected to occur on site either by occasionally passing over, foraging or nesting. The most common listed bird species expected to occur in the terrestrial habitats on site include Ludwig's Bustard, Kori Bustard, Short-clawed Lark, Tawny Eagle, Martial Eagle, Secretarybird (Figure 20), while most of the specially protected (Schedule 1) owls and raptors are also expected to occur here. African Fish Eagle were heard calling from the Vaal River during the field survey and they usually occupy tall trees in the riparian woodland. The ephemeral pans might attract protected water birds such as Black-winged Pratincole, Yellow-billed Stork, Maccoa Duck, Lesser Flamingo, Greater Flamingo and Greater Painted-snipe; but only during wet seasons.

Table 7. Bird of conservation concern that are likely to occur on site.

Scientific name	Common name	IUCN	SA Red Data Book	NCNCA (S1)
Anthropoides paradiseus	Blue Crane	VU	NT	
Aquila rapax	Tawny Eagle	VU	EN	X
Aquila verreauxii	Black Eagle		VU	X
Ardeotis kori	Kori Bustard	NT	NT	X
Bubo africanus	Spotted Eagle Owl			X
Bubo lacteus	Giant Eagle Owl			X
Buteo rufofuscus	Jackal Buzzard			X
Buteo vulpinus	Steppe Buzzard			X
Caprimulgus europaeus	Eurasian Nightjar			X
Caprimulgus rufigena	Rufouscheeked Nightjar			X
Caprimulgus tristigma	Freckled Nightjar			X
Charadrius pallidus	Chestnutbanded Plover	NT	NT	X
Ciconia abdimii	Abdim's Stork		NT	
Ciconia nigra	Black Stork		VU	X
Circaetus pectoralis	Blackbreasted Snake Eagle			X
Circus maurus	Black Harrier	EN	EN	X
Circus pygargus	Montagu's Harrier			X
Circus ranivorus	African Marsh Harrier		EN	X
Coracias garrulous	Eurasian Roller		NT	
Cursorius rufus	Burchell's Courser		VU	
Elanus caeruleus	Black-shouldered Kite			X
Falco biarmicus	Lanner Falcon		VU	X
Falco naumanni	Lesser Kestrel			X
Falco peregrinus	Peregrine Falcon			X
Falco rupicolis	Rock Kestrel			X
Falco rupicoloides	Greater Kestrel			X
Glareola nordmanni	Blackwinged Pratincole	NT	NT	X
Glaucidium perlatum	Pearlspotted Owl			X
Gyps africanus	White-backed Vulture	CR	CR	X
Gyps coprotheres	Cape Vulture	EN	EN	X
Haliaeetus vocifer	African Fish Eagle			X
Leptoptilos crumeniferus	Marabou Stork		NT	X
Melierax canorus	Pale Chanting Goshawk			X
Melierax gabar	Gabar Goshawk			X
Milvus migrans	Black Kite			X
Mycteria ibis	Yellow-billed Stork		EN	X
Neotis ludwigii	Ludwig's Bustard	EN	EN	X
Oxyura maccoa	Maccoa Duck	VU	NT	
Phoenicopterus minor	Lesser Flamingo	NT	NT	X
Phoenicopterus ruber	Greater Flamingo		NT	X
Polemaetus bellicosus	Martial Eagle	EN	EN	X
Polihierax semitorquatus	Pygmy Falcon			X
Polyboroides typus	Gymnogene			X
Ptilopsis granti	Southern White-faced Owl			X
Rostratula benghalensis	Greater Painted-snipe			X
Sagittarius serpentarius	Secretarybird	EN	VU	X
Torgos tracheliotus	Lappet-faced Vulture	EN	EN	X
Tyto alba	Barn Owl			X

Ludwig's Bustard | Kori Bustard | Short-clawed Lark

Tawny Eagle | Martial Eagle | Secretarybird

Black-winged Pratincole | Yellow-billed Stork | Greater Painted-snipe

Maccoa Duck | Lesser Flamingo | Greater Flamingo

Figure 20. Bird species of conservation concern that are expected to occur in the study area.

3.4.5. Fish

In addition to those regulations in the NCNCA pertaining to wild animals, Section 32 and 33 of the NCNCA states that no person may, without a permit angle and not immediately release, catch, import, export, transport, keep, possess, breed, or trade in a specimen of a specially protected (Schedule 1) or protected (Schedule 2) fish. No fish are expected to occur in the ephemeral pans, even when filled, mainly due to their ephemerality. However, nine fish species are expected to be found in the Vaal River. These are listed in Table 8, along with their conservation status and sensitivity to physico-chemical and no-flow conditions.

Most of the fish species in the study area are listed as least concern, but the Vaal-orange Largemouth Yellowfish is listed ar **Near-Threatened**. It is endemic to the Orange-Senqu and Vaal River systems in the Orange-Senqu River Basin and although it is widespread in these systems and their tributaries, it is not abundant. It is being threatened by the continuous decline in water quality, the destruction of suitable spawning beds due to erosion, as well as a slow growth rate and late maturing with low fecundity. It prefers lotic systems, with clear water that has a gravel or sand bottoms. Juveniles feed on a wide variety of aquatic organisms while adults are mostly piscivorous and act as apex predators. Furthermore, all fish species of the study area are protected either according to Schedule 1 or 2 of the NCNCA. Specially protected (Schedule 1) species include the Vaal-orange Largemouth Yellowfish, Vaal-orange Smallmouth Yellowfish and Moggel.

Table 8. Fish species expected to occur in the Vaal River at the two sites, along with their IUCN status and sensitivity to physico-chemical and no-flow conditions (High = H, Moderate = M, Low = L). Their respective NCNCA schedule numbers are indicated in superscript.

Scientific Name	Common name	De Bad	At Last	IUCN	Phys-Chem	No-Flow
[2]*Barbus paludinosus*	Straightfin Barb	X			L	M
[2]*Barbus trimaculatus*	Threespot Barb	X			L	M
[2]*Clarias gariepinus*	Sharptooth catfish	X	X		L	L
[2]*Labeo capensis*	Orange River Mudfish	X	X		M	**H**
[1]*Labeo umbratus*	Moggel	X			M	**H**
[1]*Labeobarbus aeneus*	Vaal-orange Smallmouth Yellowfish	X	X		M	**H**
[1]*Labeobarbus kimberleyensis*	Vaal-orange Largemouth Yellowfish	X		**NT**	**H**	**H**
[2]*Pseudocrenilabrus philander*	Southern Mouthbrooder	X	X		L	L
[2]*Tilapia sparrmanii*	Banded Tilapia	X	X		L	L

3.4.6. Invertebrates

Invertebrates dominate inland habitats and play a significant role in the overall function of the ecosystem (Kremen et al. 1993, Weisser and Siemann 2004). In general, they are widely distributed and extremely diverse, which makes it almost impossible to list all species that may possibly occur on site without a dedicated study. Invertebrates have also not been surveyed as comprehensively as plants and mammals and therefore current available data on their distribution is much scarcer. Nevertheless, key morphospecies and species of conservation concern are discussed here, as well as the major habitats which delimit possible invertebrate communities on site.

Eight invertebrate species of the Northern Cape appear on the IUCN Red Data list of threatened species and are listed in Table 9. However, none of these species' distribution ranges overlap with that of the study area. In addition, those species that are specially protected according to Schedule 1 of the NCNCA include all Velvet worms as well as some baboon spider species, Stag Beetles and the Flightless Dung Beetle (Table 9). Of these, common Baboon Spiders (*Harpactira* sp.) have been recorded in the region (Figure 21).

All Rock- Creeping- and Burrowing Scorpions are protected according to Schedule 2 of the NCNCA, along with several beetles, butterflies and moths (Table 9). Of these, Burrowing and Rock Scorpions as well as some Gossamer-winged Butterflies, Skippers, Brush-footed Butterflies and Satyrs have the highest likelihood to be found on site. All other invertebrates from the class Insecta and Arachnida are protected according to Schedule 3 of the NCNCA.

Three major habitats delimit possible invertebrate communities in the study area:

i. **Terrestrial vegetation classified as Karoo for insect preference (Picker et al. 2004)**

   All of the terrestrial vegetation communities on site fall within this karoo habitat. Invertebrate communities associated with the karoo vegetation represent unique species assemblages, with an above-average representation of beetles, grasshoppers, flies, wasps and lacewings. The protected butterflies, scorpions and baboon spiders discussed above are expected to be associated with this habitat. Invertebrate activity during the site visit was low, but termitaria most likely belonging to *Trinervitermes trinervoides*, and scorpion burrows were observed (Figure 21).

Table 9. Invertebrate species found in the Northern Cape that are of conservation concern.

CLASS	ORDER	Scientific Name	Common name	Status
ARACHNIDA	MYGALOMORPHAE	*Ceratogyrus* spp.	Horned Baboon Spiders	S1
		Harpactira spp.	Common Baboon Spiders	S1
		Pterinochilus spp.	Goldenbrown Baboon Spiders	S1
	SCORPIONES	*Hadogenes* spp.	All Rock Scorpions	S2
		Opisthacanthus spp.	All Creeping Scorpions	S2
		Opistophthalmus spp.	All Burrowing Scorpions	S2
INSECTA	COLEOPTERA	*Circellium bacchus*	Flightless Dung Beetle	S1
		Colophon spp.	All Stag Beetles	S1
		Dromica spp.	Tiger Beetles (all species)	S2
		Graphipterus assimilis	Velvet Ground Beetle	S2
		Ichnestoma spp.	All Fruit Chafer Beetles	S2
		Manticora spp.	All Monster Tiger Beetles	S2
		Megacephala asperata	Tiger Beetle	S2
		Megacephala regalis	Tiger Beetle	S2
		Nigidius auriculatus	Stag Beetle	S2
		Oonotus adspersus	Stag Beetle	S2
		Oonotus interioris	Stag Beetle	S2
		Oonotus rex	Stag Beetle	S2
		Oonotus sericeus	Stag Beetle	S2
		Platychile pallida	Tiger Beetle	S2
		Prosopocoilus petitclerci	Stag Beetle	S2
		Prothyma guttipennis	Tiger Beetle	S2
	LEPIDOPTERA	*Lepidochrysops penningtoni*	Pennington's Blue	**DD**
		Lycaenidae	All Gossamer-winged Butterflies	S2
		Hepialidae	All Swift Moths	S2
		Hesperiidae	All Skippers	S2
		Nymphalidae	All Brush-footed Butterflies	S2
		Satyridae	All Satyrs	S2
	ORTHOPTERA	*Africariola longicauda*	Richtersveld Katydid	**VU**
		Alfredectes browni	Brown's Shieldback	**DD**
		Brinckiella serricauda	Serrated Winter Katydid	**DD**
		Brinckiella arboricola	Tree Winter Katydid	**EN**
		Brinckiella aptera	Mute Winter Katydid	**VU**
		Brinckiella karooensis	Karoo Winter Katydid	**VU**
		Brinckiella mauerbergerorum	Mauerberger's Winter Katydid	**VU**
ONYCHOPHORA			All Velvet worms	S1

Figure 21. The specially protected Common Baboon Spider (*Harpactira* sp.) has been recorded in the region (left), while termitaria most likely belonging to *Trinervitermes trinervoides* (centre), as well as scorpion burrows (right) were observed during the field survey.

ii. Ephemeral wetlands

Ephemeral wetlands (pans) host aquatic invertebrate species that are specifically adapted to ephemerality. Crustaceans in particular are specialists of these pans and dominate them. Their eggs lie dormant in the soil until the pans are inundated. They then hatch and mature rapidly to produce eggs that accumulate in the top few centimetres of the sediment. These eggs are heat and drought resistant and ensure the continued existence of species in a habitat. The egg banks are essentially the vault that contains the biodiversity of the aquatic habitat during times of drought. Any disturbances to the soil will expose the eggs to erosion and crushing, which will result in species losses and possible extinction. Not much is known about the species distribution or conservation status of species in the Northern Cape, but Spinicaudata (Clam shrimps) hatched from sediment collected on site. They usually co-occur with other crustaceans (Figure 22) such as Notostraca (Tadpole shrimps), Anostraca (Fairy shrimps), Cladocera (water fleas), Ostracoda (Seed shrimps) and Copepoda (Copepods). Within a few days after the wetlands are inundated a number of wetland birds will arrive to forage on the crustaceans as their main food source. If the pans remain wet enough the water birds will stay longer to start nesting and breeding. Therefore, the crustaceans are essential components in the food web. These pans also act as important breeding and feeding links to birds in terms of connectivity, by providing stepping-stone corridors in an arid landscape. The disturbance or destruction of these pans will not only impact the specialised pan invertebrate communities locally but will also have a regional and landscape-level effect.

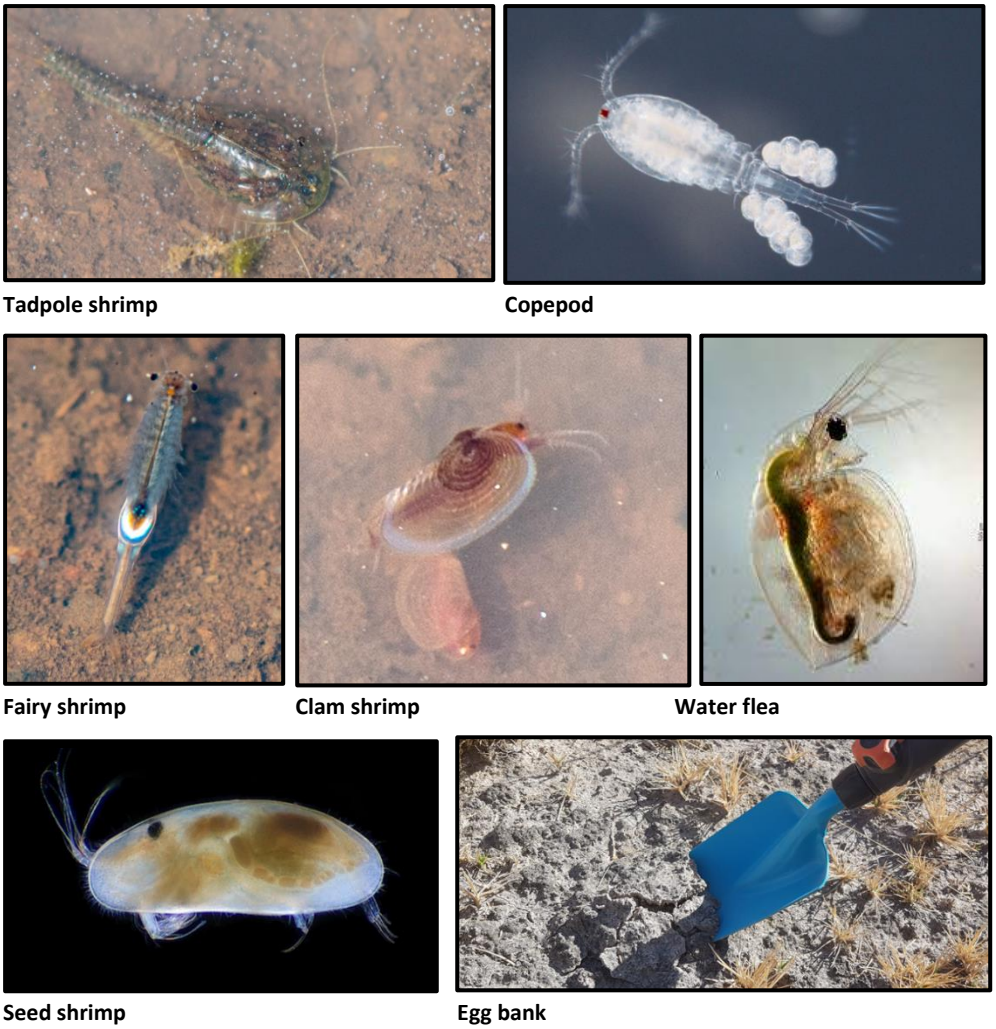


Figure 22. Crustacean taxa expected to be present in the pans on De Bad. The first few centimetres of the soil are where the egg bank occurs and any disturbances to this layer will expose the eggs to erosion and crushing, which might lead to major species losses.

iii. Vaal River

Invertebrates expected to be associated with the Vaal River include Flatworms, earthworms, leeches, freshwater crabs, mussels and prawn, basket clams, freshwater bivalve- and pulmonate snails, bladder snails, pond snails, prong-gilled mayflies, small squaregill mayflies and numerous other species of mayflies, jewel damselflies, narrowwinged damselflies, clubtail dragonflies, emerald dragonflies, skimmers dragonflies, grass moths, giant water bugs, water boatmen, water striders, water treaders, marsh treaders, creeping water bugs, water mites, sponges, water scorpions, backswimmers, pygmy backswimmers, riffle bugs, long-horned caddisflies, microcaddisflies, net-spinning caddisflies, diving beetles, riffle beetles, whirligig beetles, water scavenger beetles, long-toed water beetles, minute moss beetles, biting midges, meniscus midges, mosquitoes, house flies, black flies, horse flies, crane flies and nematoceran flies. generalist species like water boatmen, predaceous diving beetles, whirligig beetles, biting midges, non-biting midges and mosquitos.

3.5. Water resources

The National Water Act (36 of 1998) (NWA) provides a framework to protect water resources. According to this Act, a water resource includes a watercourse, surface water, estuary, or aquifer; whereas a water course includes:

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

Any reference to a watercourse includes its bed and banks and a water resource does not only include the water within the system, but also the entire water cycle; i.e. evaporation, precipitation, the habitats and processes.

The purpose of this Act (Section 2) is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors - (g) protecting aquatic and associated ecosystems and their biological diversity and (h) reducing and preventing pollution and degradation of water resources. No activity may take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

3.5.1. Water resources setting

De Bad and At Last fall within the Vaal D/S Bloemhof quaternary catchments C92A and C92B of the Lower Vaal Water Management Area (Figure 23). These quaternary catchments have been allocated a Present Ecological State (PES) of 'Moderately Modified' (C) by Delport and Mallory (2002) and information regarding their mean annual rainfall, evaporation potential and runoff is provided in Table 10.

According to The South African Inventory of Inland Aquatic Ecosystems (SAIIAE), De Bad and At Last fall within the Eastern Kalahari Bushveld Bioregion, where 1.3 % of the land area is covered by inland wetlands, including depressions, floodplains, seeps and valley-bottom wetland types (Van Deventer et al. 2019).

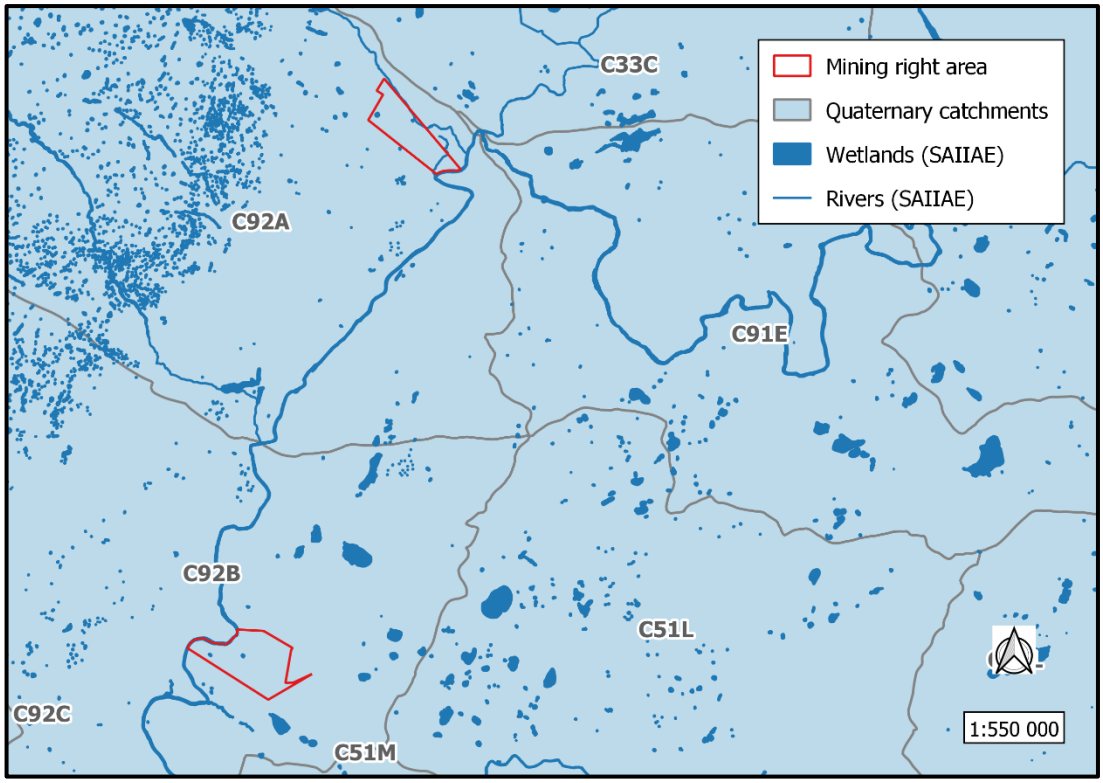


Figure 23. The locality of the proposed mining area in relation to the quaternary catchments of the Lower Vaal Water Management Area.

Table 10. Catchment characteristics for the Vaal D/S Bloemhof quaternary catchments in which the study area fall, as presented by Delport and Mallory (2002).

Mining site	Quaternary catchment	Catchment Area (km^2)	Mean Annual Rainfall (mm)	Mean Annual Evaporation (mm)	Mean Annual Runoff (10^6 m^3)
At Last	C92A	3 923	367	2 250	13.91
De Bad	C92B	1 979	331	2 225	5.02

The spatial extent according to the present ecological status per wetland type is depicted in Table 11. Depressional wetlands are most abundant in this bioregion, with the majority being severely modified. Most of the remaining wetland types in this Bioregion are also moderately- to severely modified.

According to SAIIAE, the study area comprises depressional wetlands as well as a river channel that lines De Bad in the west and At Last in the east. All of the depressional wetlands on site are classified as Least Concern, but the Vaal River is classified as Critically Endangered.

Table 11. Percentage of inland wetland spatial extent according to the present ecological status per wetland type of the Eastern Kalahari Bushveld Bioregion.

Wetland type	Total Extent (%)	% Natural or near-natural (A/B)	% Moderately modified (C)	% Heavily to severely/critically modified (D/E/F)
Depression	57.1	70.5	5.7	23.8
Floodplain	2.2	0.6	48.8	50.5
Seep	17.2	10	15.1	75
Valley-bottom	23.5	0.9	29.6	69.5

3.5.2. Watercourse delineation and classification

Two depressional wetlands, one river (Vaal River), and several drainage lines were identified on site. The wetland features associated with the Vaal River includes an active channel, floodplains, and riparian woodland (Figure 24). A minimum GIS buffer of 200 m is indicated here for the depressional wetlands and river features and the post-mitigation buffer requirements for the drainage lines are 20m. However, it is recommended that a conservative approach be opted for and that the pre-mitigation buffer width of 30m be adopted where possible.

The depressional wetlands covers a total area of ± 2.4 ha, with their entire surface areas falling within the boundaries of the mining right area. Their catchments cover a total area of ± 350 ha of which all fall within the study area (Figure 25). The active channel of the Vaal River lines the boundaries of At Last, but ± 29 ha falls within the boundaries of De Bad (Figure 24). No floodplains are found on At Last, while the floodplains on De Bad cover ± 13 ha (Figure 24). Riparian woodland occupies a total of ± 37 ha within the study area (Figure 24). The drainage lines flow from the plains and ridges, downwards towards the river of which a total combined length of ± 50 km occurs within the study area.

The two depressional wetlands are the main assessment units considered for this mining right area due to the fact that both fall within the areas earmarked for core mining activities. They are found on plains terrain and their Hydrogeomorphic Unit (HGMU) classification is described below, up to Level 6. The river and ephemeral drainage lines will not be further defined, but their buffer requirements should be honoured during the mining operation to minimise impacts to these systems.

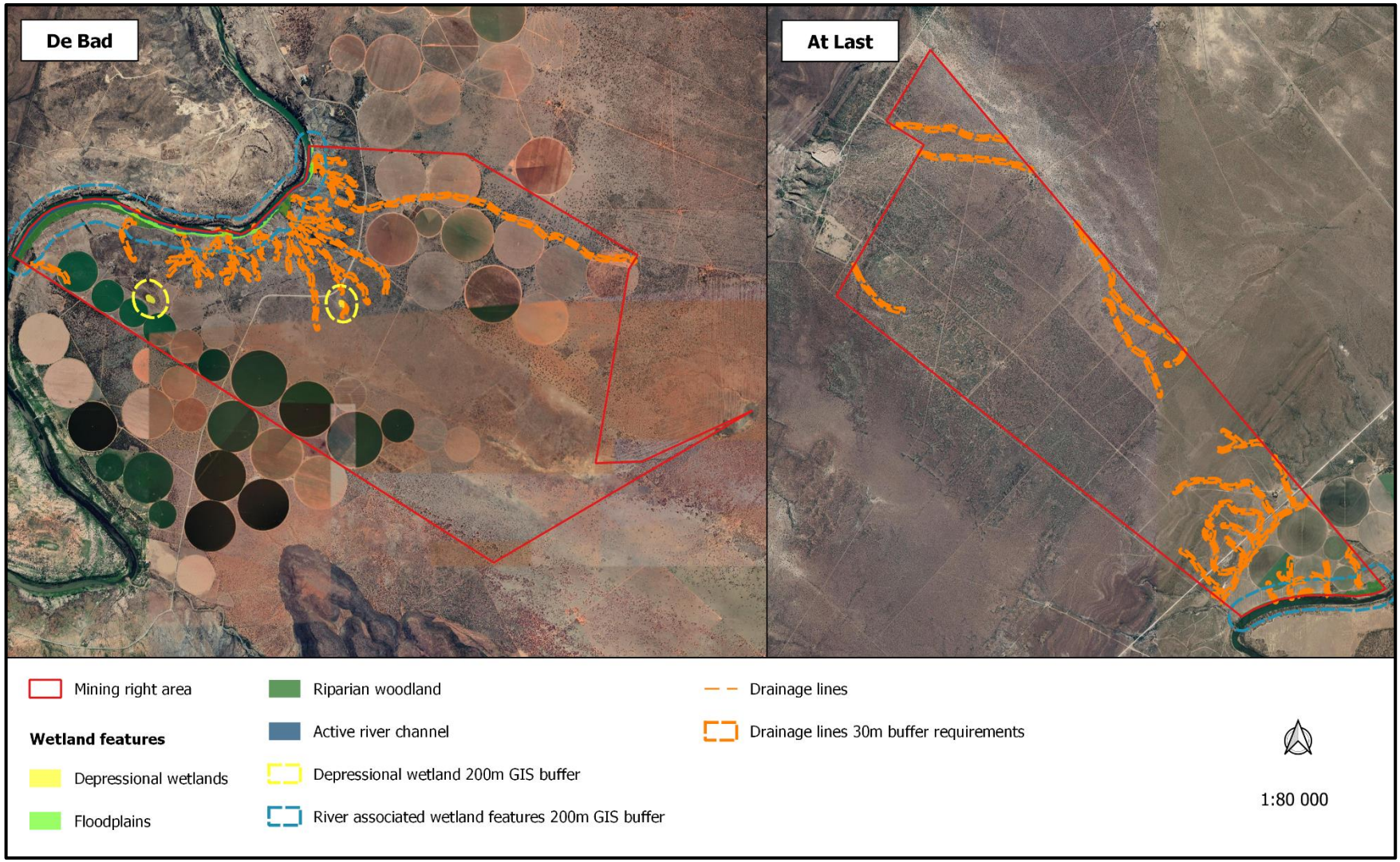


Figure 24. The delineation of watercourses in the mining right area, along with their GIS buffer requirements.

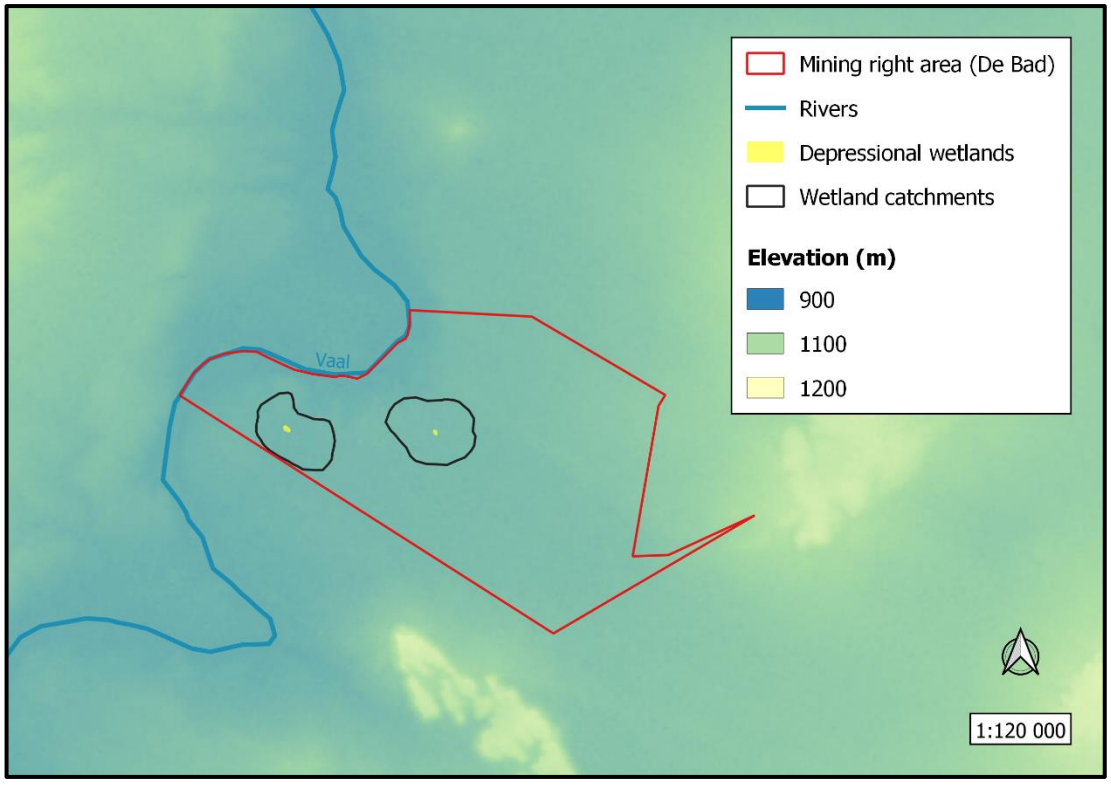


Figure 25. A digital elevation model, indicating the catchment areas of the depressional wetlands on De Bad.

HGMU1: NATURAL ENDORHEIC DEPRESSIONS

The wetlands are all classified as natural endorheic depressions (Figure 26 and Table 12), with high a confidence rating. Water enters the depressions primarily through direct precipitation and overland inflow. The wetlands are only filled after substantial summer rainfall events and are therefore intermittently and rarely inundated. The depressions have clear (turbidity < 100 NTU) and fresh (EC = 23 µS/cm) water, with neutral (6.8) pH. The soils are only intermittently saturated, and the soils do not show any soil wetness indicators. The substrata comprise sandy clay loam soils intermixed with some gravel (Figure 27). The depression floors are vegetated with grasses, bulbs and low-growing herbs, comprising indigenous species (Figure 27). The vegetation form is best described as grassland, dominated by facultative wetland species (*Leptochloa fusca*), intermixed with bulbs and mat forming herbs (Figure 27).

Table 12. Summary of the results for the application of Levels 1 to 6 of the Classification System (Ollis et al. 2013), to the depressional wetlands. Confidence ratings at each level are given in brackets.

Level 1	**Level 2**		**Level 3**	**Level 4: HGM Unit**		
System type	**DWA Ecoregion**	**Wetland Bioregion**	**Landscape Unit**	**4A**	**4B**	**4C**
INLAND	Southern Kalahari	Eastern Kalahari Bushveld	Plain (high)	Depression (high)	Endorheic (high)	Without channelled inflow (high)

Level 5: Hydroperiod		
5A	**5B**	**5C**
Intermittently inundated (high)	Intermittently saturated (high)	n/a

Level 6: Substratum type [Proportional rating (0-6)]											
Mineral soil (<10% organic carbon) (high)											
6A											**6B**
Bedrock	Boulders	Cobbles	**Pebbles /Gravel**	**Sandy soil**	Silt	**Clayey soil**	**Loamy soil**	Organic soil	Salt crust	Other	Sandy Clay Loam + gravel
0	0	0	**1**	**1**	0	**2**	**2**	0	0	0	

Level 6: Vegetation cover, Form & Status [Proportional rating (0-6)]					
6A		**6B**		**6C**	
Vegetation cover (high)		**Vegetation form** (high)			
Vegetated	**5**	Aquatic	0	n/a	
Unvegetated	**1**	**Herbaceous**	**5**	**Geophytes**	**1**
				Grasses	**4**
				Herbs/Forbs	**1**
				Sedges/Rushes	0
				Reeds	0
				Restios	0
				Palmiet	0
		Shrubs	**1**	n/a	
		Forest	0	n/a	

6D		**6E**		
Vegetation form (high)		**Vegetation status** (high)		
Aquatic	n/a			
Herbaceous	n/a	**Grasses**	**Indigenous**	**6**
			Alien	0
			Crop	0
		Herbs/Forbs	**Indigenous**	**6**
			Alien	0
			Crop	0
Shrubs	n/a	**Indigenous**		**6**
		Alien		0
		Crop		0
Forest	n/a			

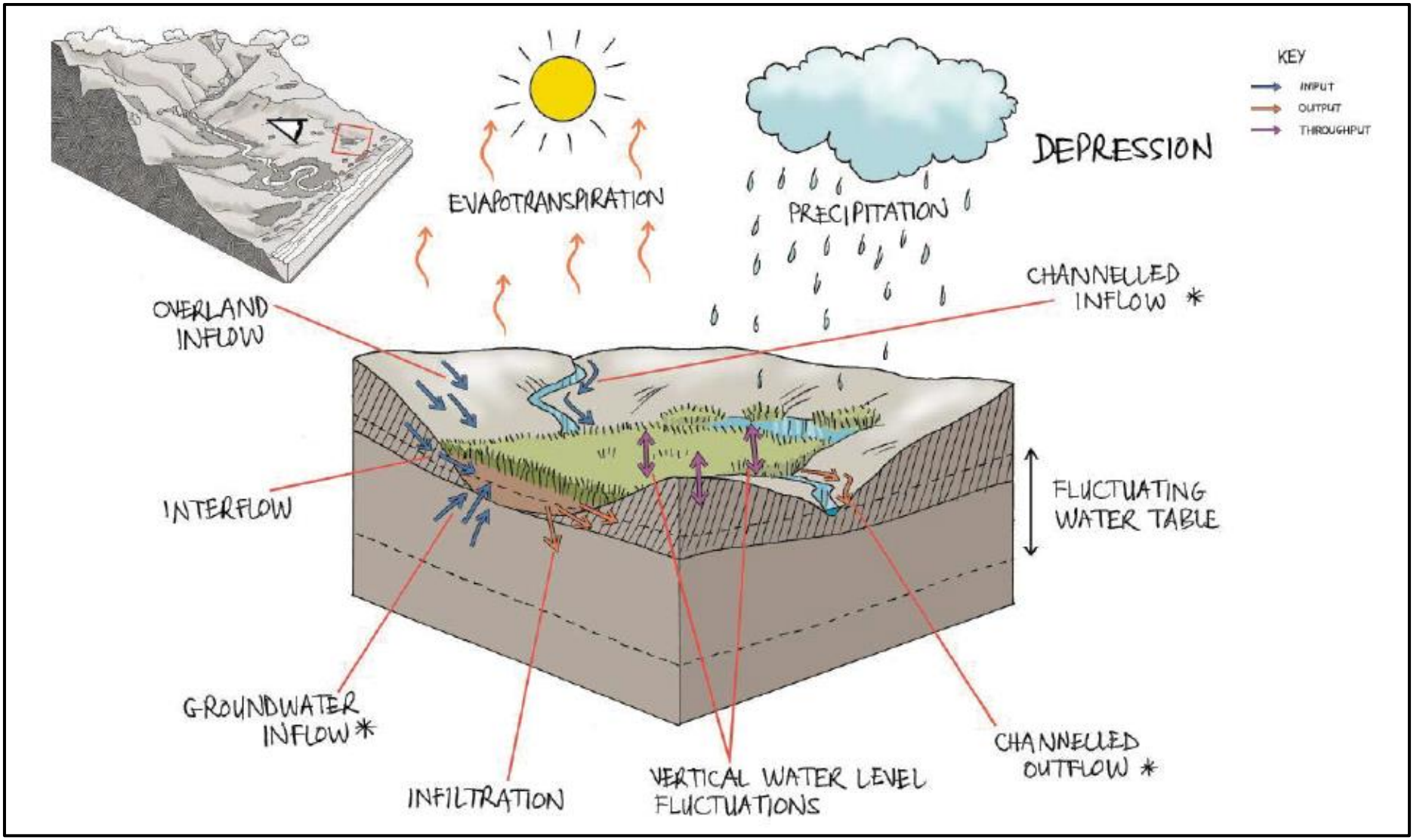


Figure 26. Conceptual illustration of a depression, showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis et al. 2013).

Figure 27. Key wetland descriptors for the depressional wetlands on De Bad. The substratum comprises of sandy clay loam soil (top). The wetland floor is vegetated by grassland, which is dominated by facultative wetland grass species *Leptochloa fusca* (centre), but mat forming herbs (bottom left) and bulbs (bottom right) are also present.

3.5.3. Wetland Health Assessment (PES)

Depression 1 is considered to be moderately modified (PES C, Table 13), i.e. loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. Depression 2 is considered to be largely natural (PES B, Table 13), i.e. a small change in natural habitats and biota may have taken place but the ecosystem functions are still predominantly unchanged. The two assessment units are indicated in Figure 28, including their 200m GIS buffers and catchment areas. Impact sources are described in Figure 29 and refined landcover categories are depicted in Figure 30.

For Pan 1, the natural hydrology and water quality have been most affected, while the natural geomorphology and vegetation are still considered to be unmodified. The most significant direct impacts occur from the adjacent crop irrigation activities, which falls within the buffer and catchment area. These increase the risk of pollution and artificial nutrient input to the pan, which ultimately affects the water quality. Indirect impacts include general surface disturbances, in the form of farm roads, that cut through the wetland buffer, altering its natural geomorphology and hydrologic regime. Farm buildings in the catchment area caused disturbances to the natural vegetation in increased the presence of alien invasive- and bush encroaching species in the catchment. Old mining activities have also altered the geomorphology further up in the catchment, increasing the risk of sedimentation to some degree.

Pan 2 remains largely unmodified and the only main impact to this system is the public gravel road and smaller farm roads that cut through its buffer and catchment. These alter its natural hydrologic regime, with secondary risk of sedimentation, which affects the natural water quality.

The current state of the hydrology, geomorphology, water quality and vegetation are expected to remain stable if no mining takes place within the buffer or catchment areas. However, if proposed mining activities proceed within the catchment area, the geomorphology and vegetation is likely to deteriorate slightly, while the hydrology and water quality is likely to deteriorate substantially. Mining within the buffer and wetland itself will have more serious implications, to the effect that the wetlands will most likely be destroyed.

Table 13. Summarised results of Wet-Health level 2 assessment (Macfarlane et al. 2020) to the depressional wetlands on De Bad.

	Wetlands PES Summaries			
Wetland name	**De Bad depressional wetland**			
Assessment Unit	**1**			
HGM type	Depression without flushing			
Areal extent (Ha)	1 Ha			
Final (adjusted) Scores				
PES Assessment	**Hydrology**	**Geomorphology**	**Water Quality**	**Vegetation**
Impact Score	2.2	1.9	2.6	1.5
PES Score (%)	78%	81%	74%	86%
Ecological Category	**C**	**B**	**C**	**B**
Trajectory of change (no mining)	→	→	→	→
Trajectory of change (mining)	↓↓	↓	↓↓	↓
Confidence (revised results)	High	High	High	High
Combined Impact Score	2.0			
Combined PES Score (%)	80%			
Combined Ecological Category	**C**			
Hectare Equivalents	0.8 Ha			

Wetland name	**De Bad depressional wetland**			
Assessment Unit	**2**			
HGM type	Depression without flushing			
Areal extent (Ha)	1 Ha			
Final (adjusted) Scores				
PES Assessment	**Hydrology**	**Geomorphology**	**Water Quality**	**Vegetation**
Impact Score	1.8	1.0	1.7	0.5
PES Score (%)	82%	90%	83%	95%
Ecological Category	**B**	**A**	**B**	**A**
Trajectory of change (no mining)	→	→	→	→
Trajectory of change (mining)	↓↓	↓	↓↓	↓
Confidence (revised results)	High	High	High	High
Combined Impact Score	1.3			
Combined PES Score (%)	87%			
Combined Ecological Category	**B**			
Hectare Equivalents	0.7 Ha			

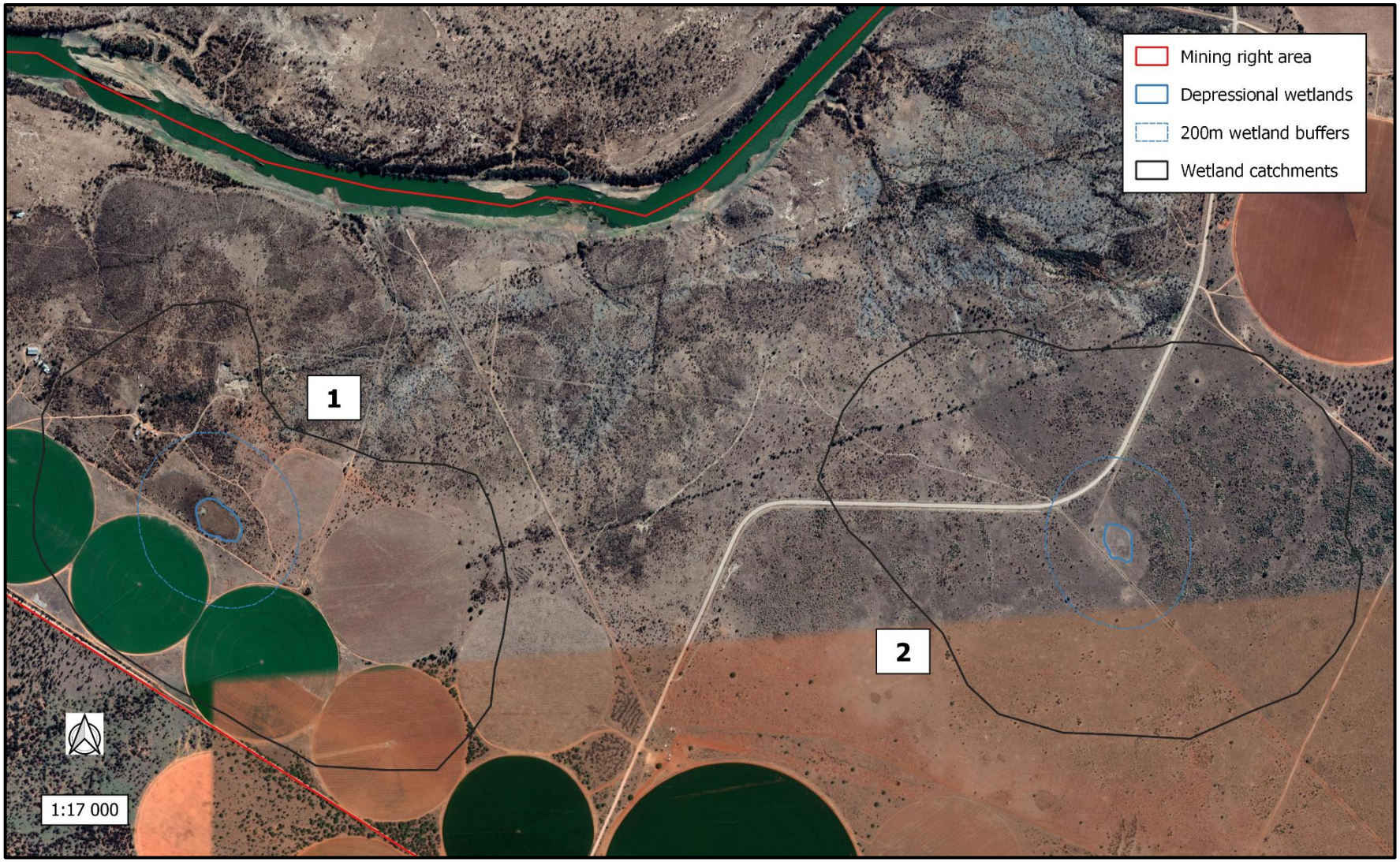


Figure 28. The depressional wetland assessment units on De Bad, indicating their 200m GIS buffer requirements and catchment areas.

Pan 1

Pan 2

Roads
A public gravel road without culverts cuts through the wetland buffer of depression 2 and farm roads traverse the buffers of both pans.

Source: External, secondary

Associated impacts:
- Impeded natural flow of runoff water
- Reduction in flood peaks
- Increased erosion and sedimentation

Irrigated crops
Extensive crop irrigation occurs in the catchment and buffer areas of Pan 1.

Source: External, direct

Associated impacts:
- Impeded natural flow of runoff water
- Reduction in flood peaks
- Increased erosion and sedimentation
- Loss of natural vegetation
- Artificial input of nutrients
- Pollution of water resource
- Change in water quality

Figure 29. Features impacting the PES of the De Bad depressional wetlands.

	**Homesteads and associated buildings** A number of farm buildings occur within the catchment of Pan 1. **Source:** External, secondary **Associated impacts:** - Impeded natural flow of runoff water - Reduction in flood peaks - Increased erosion and sedimentation - Increased spread of alien invasive vegetation and encroaching species
	**Mining** Historic mining activities occurred in the catchment of Pan 1. **Source:** External, secondary **Associated impacts:** - Impeded natural flow of runoff water - Reduction in flood peaks - Increased erosion and sedimentation - Spread of aliens and encroaching species

Figure 29 (cont.). Features impacting the PES of the De Bad depressional wetlands.

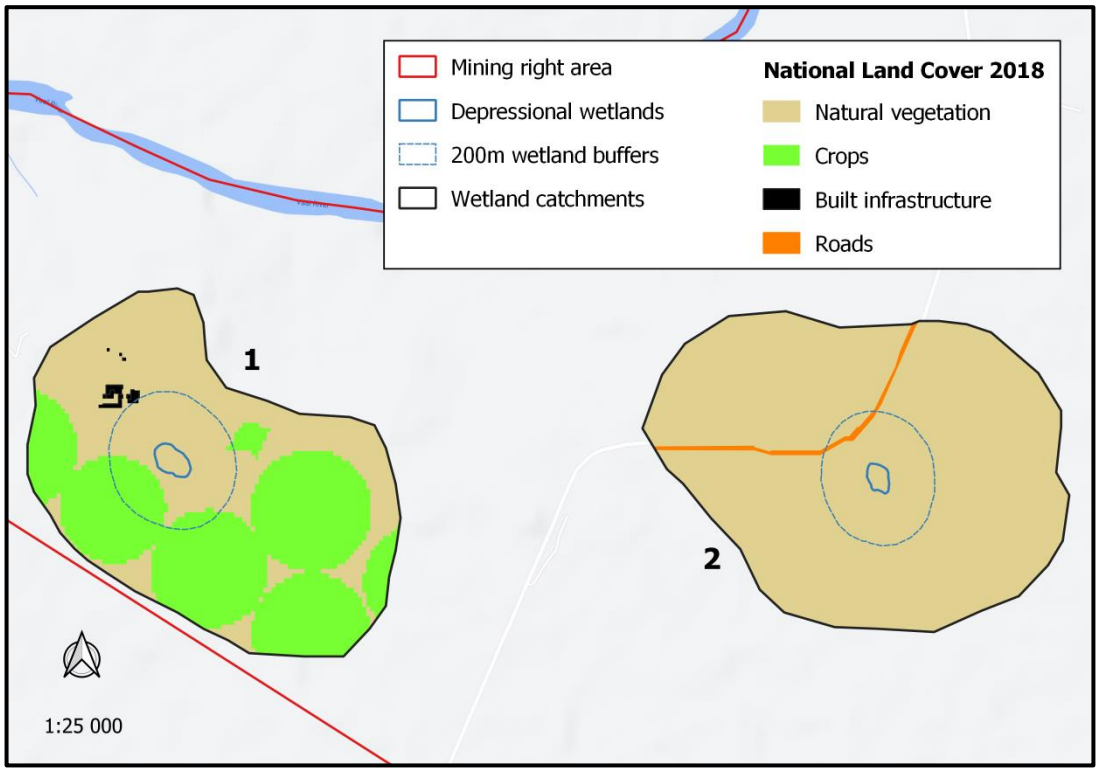


Figure 30. Refined landcover categories and disturbance units according to NLC2018, associated with the depressional wetlands on De Bad.

3.5.4. Wetland Ecological Importance and Sensitivity

The two depressions on De Bad have the same ecological characteristics and therefore were evaluated as a collective. These depressions are rated to have a High EIS (Table 14) and is considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. This assessment was mainly based on a "wet scenario" because the ecological importance of these watercourses will primarily only manifest during times of inundation. However, activities impacting the wetland during the dry phase has direct implications on its ability of to maintain the ecological integrity of the wet phase.

Table 14. Summary of the results for the application of an EIS assessment (Duthie 1999) to the depressions on De Bad.

DETERMINANT	SCORE	CONFIDENCE
PRIMARY DETERMINANTS		
1. Rare & Endangered Species	4	3
2. Populations of Unique Species	3	4
3. Species/taxon Richness	2	3
4. Diversity of Habitat Types or Features	1	4
5 Migration route/breeding and feeding site for wetland species	2	3
6. Sensitivity to Changes in the Natural Hydrological Regime	1	3
7. Sensitivity to Water Quality Changes	1	3
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	1	3
MODIFYING DETERMINANTS		
9. Protected Status	3	4
10. Ecological Integrity	3	4
TOTAL	**21**	
MEDIAN	**2.1**	
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**High**	

The Near Threatened Giant Bull Frog and a number of red listed water birds are expected to occur in the depressions when they are inundated. These include the Black-winged Pratincole, Yellow-billed Stork, Maccoa Duck, Lesser Flamingo and Greater Flamingo; all of which are Near Threatened or Endangered. Unfortunately, the depressions of the Northern Cape have not yet been comprehensively surveyed for invertebrates and therefore it is difficult to state with confidence which species are present on De Bad. However, the hatching trials revealed that clam shrimps are present in these pans.

Clam shrimps usually co-occur with other specialised branchiopod species, which are all highly unique to depressions. The egg-banks of these organisms are also found in the topsoil layers, which make them very vulnerable to modifications. The exact species richness hosted by these pans is however not known. Although a number of species are expected to occur in these habitats, they are only expected to have a moderate significance, as they are only expected to have significant taxa richness at a local scale. The depressions are also expected to be important breeding and feeding links in terms of connectivity, especially for wetland birds in South Africa during wet periods by providing stepping-stone corridors in an arid landscape.

The depressions are considered to have low sensitivity to changes in hydrology and water quality, because they flood infrequently (< annually). However, if these systems are inundated anthropogenically and for a prolonged period of time, they will lose their ability to sustain the unique aquatic communities, which are adapted for ephemerality, e.g. branchiopod eggs require periods of desiccation for their life cycles to complete. Furthermore, the depressions have marginal food storage, energy dissipation and element removal ability, mainly based on fairly low roughness associated with the vegetation in these habitats.

All watercourses are protected under the National Water Act, which reflects their importance for the conservation of ecological diversity at a national scale and therefore they have been considered to have high protected status. The depressions on De Bad have not been significantly affected by human activity, and therefore they are rated to still have high ecological integrity.

3.5.5. Wetland functional importance

The De Bad depressions scored very low on most of the typical ecosystem services provided by wetlands. They however scored very high in the maintenance of biodiversity (Table 15). Most of the regulating and supporting services provided by the depressions are compromised by the fact that the wetlands are strictly ephemeral. The facultative wetland grass species however increases its provision of food for livestock slightly, but not many people are dependent on this resource. The maintenance of biodiversity is attributable to the branchiopod communities that occur here.

Table 15. Summary of the results of a WET-EcoServices (Version 2) assessment (Kotze et al. 2020), to the De Bad & At Last wetland.

ECOSYSTEM SERVICE			Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	Refers to the effectiveness of wetlands at spreading out and slowing down storm flows and thereby reducing the severity of floods and associated impacts.	1.3	0.0	0.0	Very Low
	Stream flow regulation	Refers to the effectiveness of wetlands in sustaining flows in downstream areas during low-flow periods.	2.0	0.8	1.6	Moderately Low
	Sediment trapping	Refers to the effectiveness of wetlands in trapping and retaining sediments from sources in the catchment.	0.6	0.0	0.0	Very Low
	Erosion control	Refers to the effectiveness of wetlands in controlling the loss of soil through erosion.	1.0	0.0	0.0	Very Low
	Phosphate assimilation	Refers to the effectiveness of wetlands in retaining, removing or destroying nutrients and toxicants such as nitrates, phosphates, salts, biocides and bacteria from inflowing sources, essentially providing a water purification benefit.	2.4	0.0	0.9	Low
	Nitrate assimilation		2.7	0.0	1.2	Low
	Toxicant assimilation		2.9	0.0	1.4	Moderately Low
	Carbon storage	Refers to the ability of wetlands to act as carbon sinks by actively trapping and retaining carbon as soil organic matter.	1.3	0.0	0.0	Very Low
	Biodiversity maintenance	Refers to the contribution of wetlands to maintaining biodiversity through providing natural habitat and maintaining natural ecological processes.	**3.8**	**4.0**	**4.0**	**Very High**
PROVISIONING SERVICES	Water for human use	Refers to the ability of wetlands to provide a relatively clean supply of water for local people as well as animals	0.0	0.0	0.0	Very Low
	Harvestable resources	Refers to the effectiveness of wetlands in providing a range of harvestable natural resources including firewood, material for construction, medicinal plants and grazing material for livestock.	0.0	1.3	0.0	Very Low
	Food for livestock	Refers to the ability of wetlands to provide suitable vegetation as food for livestock.	3.0	0.3	1.7	Moderately Low
	Cultivated foods	Refers to the ability of wetlands to provide suitable areas for cultivating crops and plants for use as food, fuel or building materials.	1.8	0.0	0.3	Very Low
CULTURAL SERVICES	Tourism and Recreation	Refers to the value placed on wetlands in terms of the tourism related and recreational benefits provided.	0.9	0.0	0.0	Very Low
	Education and Research	Refers to the value of wetlands in terms of education and research opportunities, particularly concerning their strategic location in terms of catchment hydrology.	2.6	0.0	1.1	Low
	Cultural and Spiritual	Refers to the special cultural significance of wetlands for local communities	2.0	0.0	0.5	Very Low

The low scores for the provisional services are because the depressions lack the ability to directly supply water or medicinal plants and no crop farming, hunting or fishing is possible. The wetland is not used as a public tourism or recreation destination and is not associated with any cultural practises or beliefs. The site has also not been subject to research in the past and the fact that it is situated in a rural area, relatively far away from the nearest academic institution; lowers its importance for education and research.

3.5.6. Recommended wetland buffer zone

The aquatic buffer segments identified for the depressions on De Bad (Figure 31) have gentle sloping land and shallow sandy-loam textured soils with moderate permeability (Table 16). The depressions' buffer requirements are low in general, due to the arid climate, lack of organic soils, limited human use, as well as the low risks associated with the proposed activities compared to other mining operations. A pre-mitigation buffer width of 34 m is deemed acceptable to protect core wetland habitat and aquatic functioning from the operation. However, with mitigation, the final buffer requirements are 25 m.

Table 16. The recommended final aquatic impact buffer requirements for the De Bad depressions.

Buffer segments	Differentiating characteristics	Pre-mitigation width (m)	Post-mitigation width (m)
Buffer Segment for Pan 1 and 2	Slope: Very Gentle (0 - 2%) Vegetation: Good; Moderately robust vegetation with good interception potential (e.g. good condition tufted grass stands). Soil permeability: Moderately low; Deep moderately fine textured soils (e.g. loam & sandy clay loam) OR shallow (<30cm) moderately drained soils. Micro-topography: Dominantly uniform topography: Dominantly smooth topography with few/minor concentrated flow paths to reduce interception.	34	25

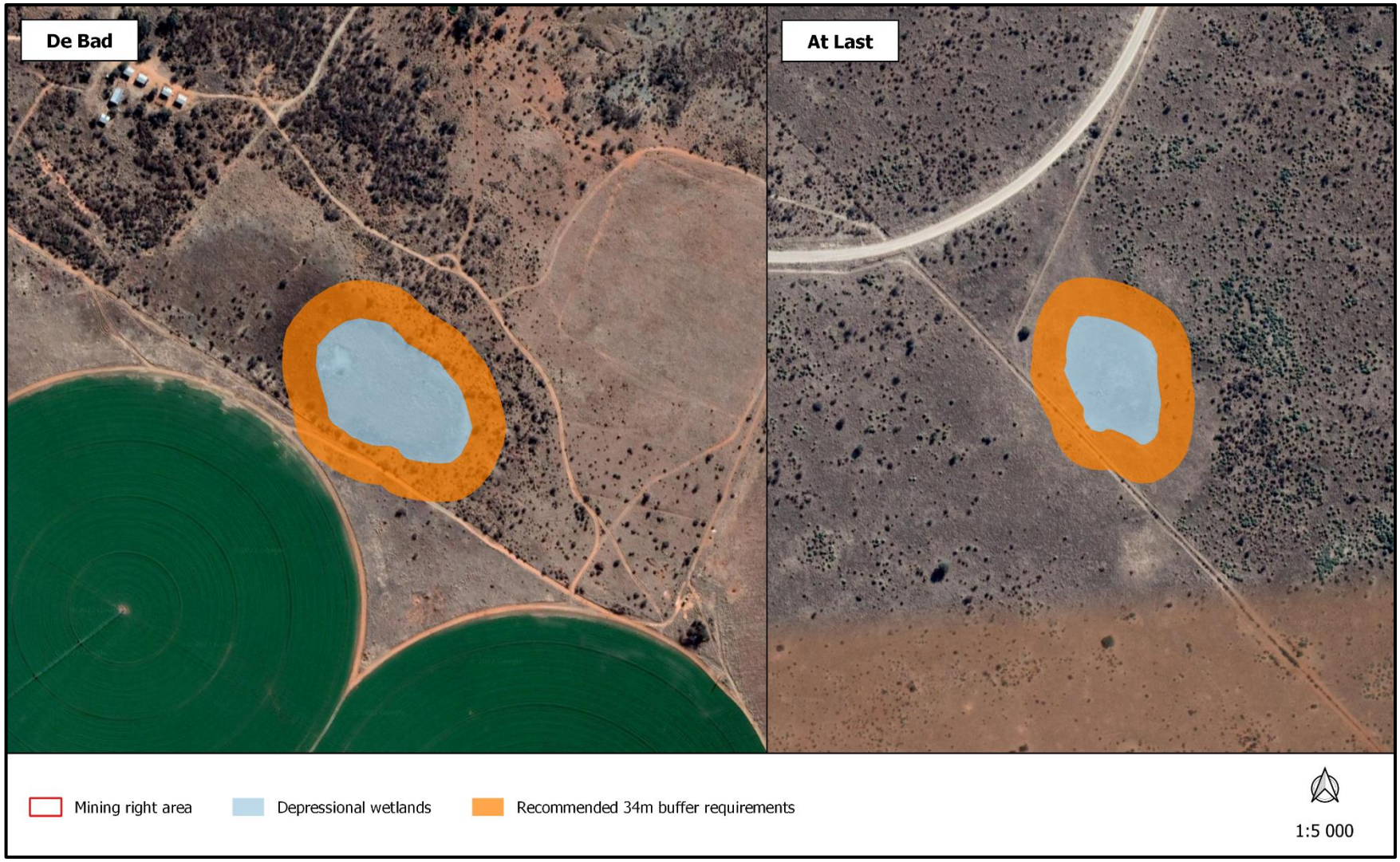


Figure 31. Final aquatic impact buffer requirements, including practical management considerations, for the valley-bottom wetland.

3.6. Critical biodiversity areas and broad-scale processes

The proposed mining site falls within critical biodiversity areas, as defined by the Northern Cape Critical Biodiversity Areas Map (Holness and Oosthuysen 2016). This map identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole. Most of De Bad comprises natural or transformed areas, but the local catchment of the Vaal River, south of the site comprise of *Critical Biodiversity Areas Two.* The remaining section of Vaal River on site, along with the ephemeral pans are classified as *Ecological Support Areas* (Figure 32). At Last mainly comprise of *Ecological Support Areas*, but an ephemeral tributary to the Vaal, including its buffer zone, lines the site's northern boundary and is classified as *Critical Biodiversity Areas One* (Figure 32).

According to the Mining and Biodiversity Guidelines (DENC et al. 2013) no areas on De Bad is considered important, but the ephemeral drainage line on At Last and a small section of the Vaal River buffer in the south have *Highest Biodiversity Importance*. These areas constitute the highest risk for mining (Figure 33). These guidelines were developed to identify and categorize biodiversity priority areas sensitive to the impacts of mining in order to support mainstreaming of biodiversity issues in decision making in the mining sector.

According to the National Web based Environmental Screening Tool the study area is considered to have sensitive environmental features (Figure 34). This tool is a geographically based web-enabled application which allows a proponent intending to apply for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014 (as amended), to screen their proposed site for any environmental sensitivity. According to this, De Bad and At Last are considered to be of low sensitivity based on the *Plant species Theme*. Both sites however have high and medium sensitivity based on the *Animal Species Theme.* The high sensitivity is attributed to suitable habitat the sites provide for the listed Lanner Falcon, while the medium sensitivity on both sites is associated with regional records of Caspian Tern, Secretarybird, Tawny Eagle, White-backed Vulture and Ludwig's Bustard. No suitable habitat however exists in the study area for Caspian Tern. Highly sensitive areas are also present on both sites in terms of the *Terrestrial Biodiversity Theme,* which is a direct function of the Northern Cape Critical Biodiversity Areas Map. The Vaal River and ephemeral pans have very high sensitivity in terms of the *Aquatic Biodiversity Theme,* while the eastern parts of At Last also very high sensitivity, as it falls within a freshwater ecosystem priority quinary catchment.

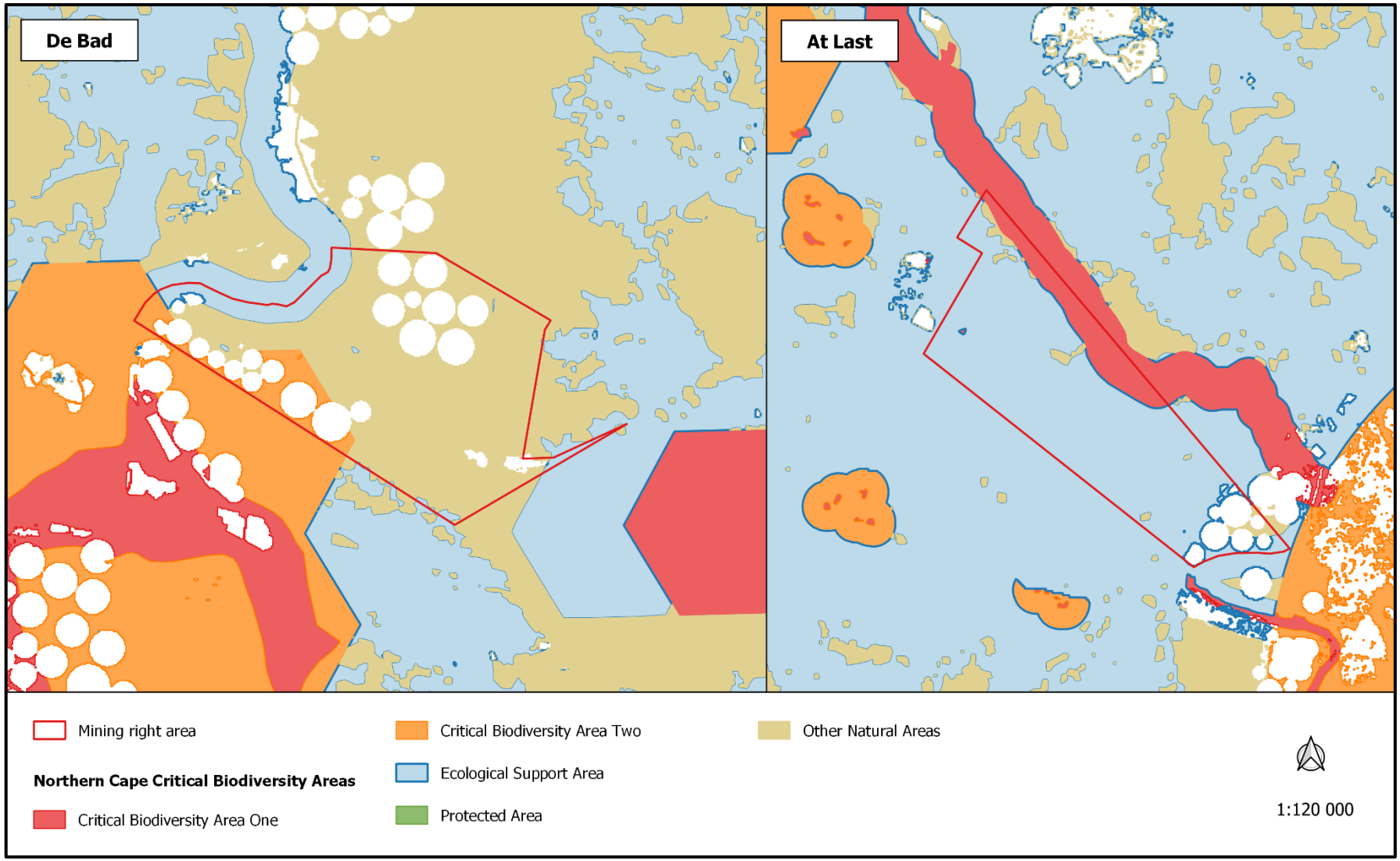


Figure 32. The study area in relation to the Northern Cape Critical Biodiversity Areas.

Figure 33. The study area in relation to the Mining and Biodiversity Guidelines.

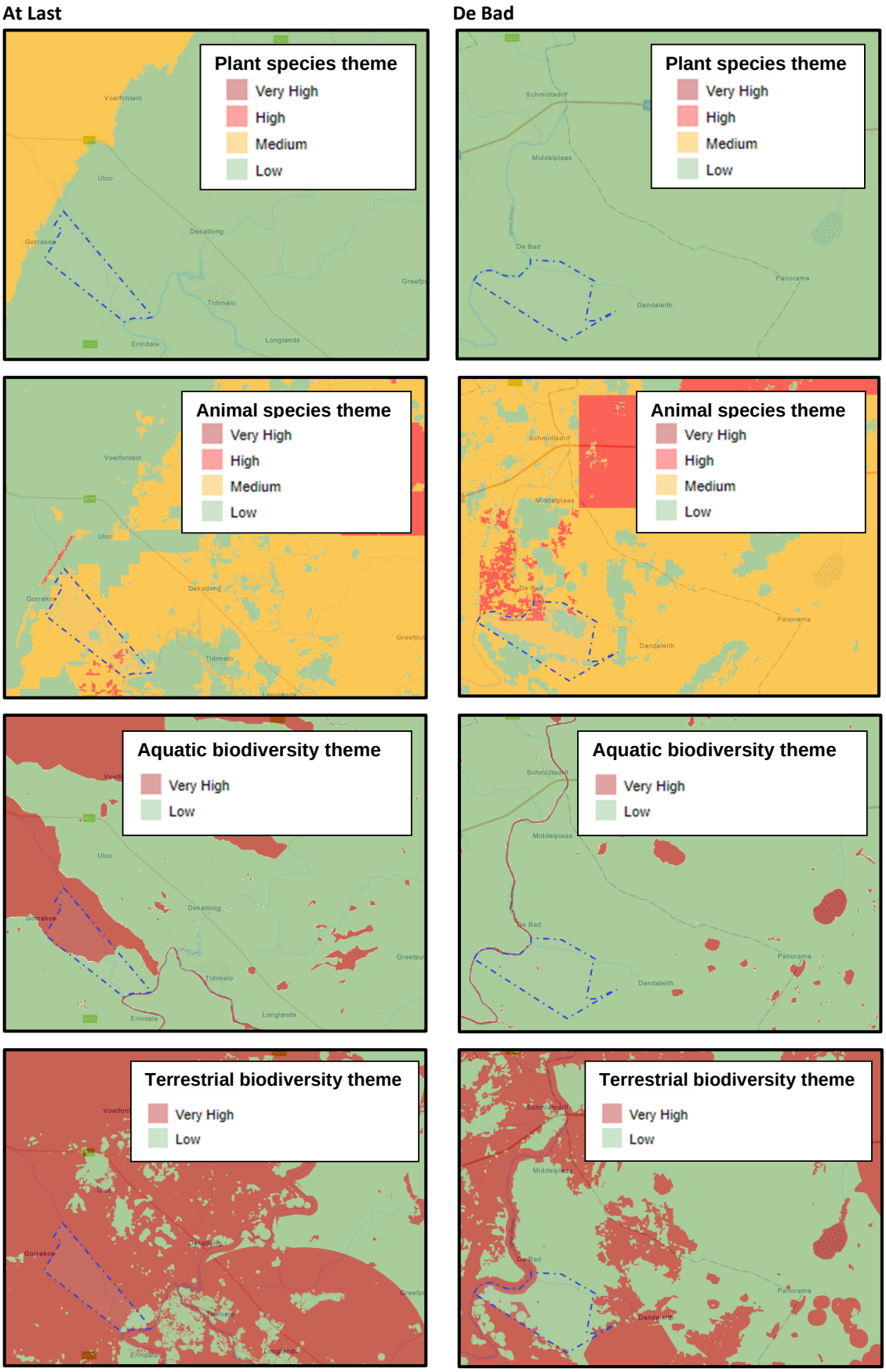


Figure 34. Environmental sensitivities in the study area, according to the National Web based Environmental Screening Tool.

According to the Pixley ka Seme Spatial Development Framework (relevant to De Bad) all rivers and wetlands, including a generic buffer of 100m, are regarded as ecological corridors. Their mandate is to conserve existing ecological corridors and rehabilitate any remnants of corridors. The Frances Baard Environmental Management Framework , relevant to At Last, considers all Critical Biodiversity Areas and Ecological Support Areas as Biodiversity Environmental Management Zones. These zones highlight environmentally significant areas that should be managed sustainably to safeguard terrestrial and aquatic biodiversity within the municipality.

The study area also falls within the Griqualand West Centre (GWC) of Endemism (Frisby et al. 2019) (Figure 35). This area has a high concentration of plant species with very restricted distributions, known as endemics (Van Wyk and Smith 2001). Relatively small disturbances in a centre of endemism may easily pose a serious threat to its many range-restricted species.

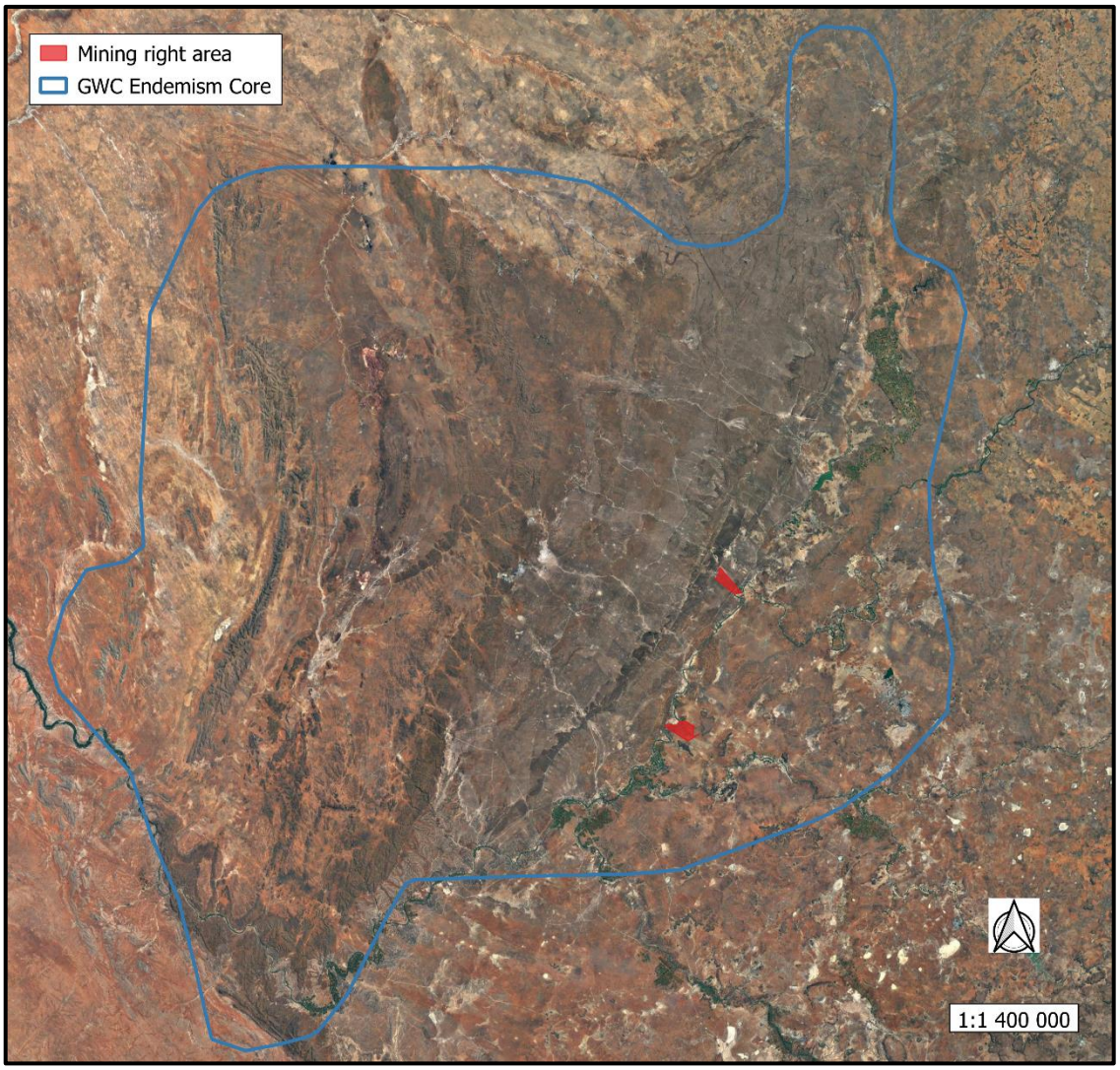


Figure 35. The De Bad & At Last study area in relation to the GWC core, according to Frisby et al. (2019).

Finally, the study area falls within a region where one of South Africa's largest economically most important alluvial diamond deposits are found (Figure 36), i.e. along the Orange and Vaal Rivers (Gresse 2003). The most significant crop irrigation in the Northern Cape also stretches along these rivers (Durand 2006). These factors increase the proposed operation's cumulative impacts.

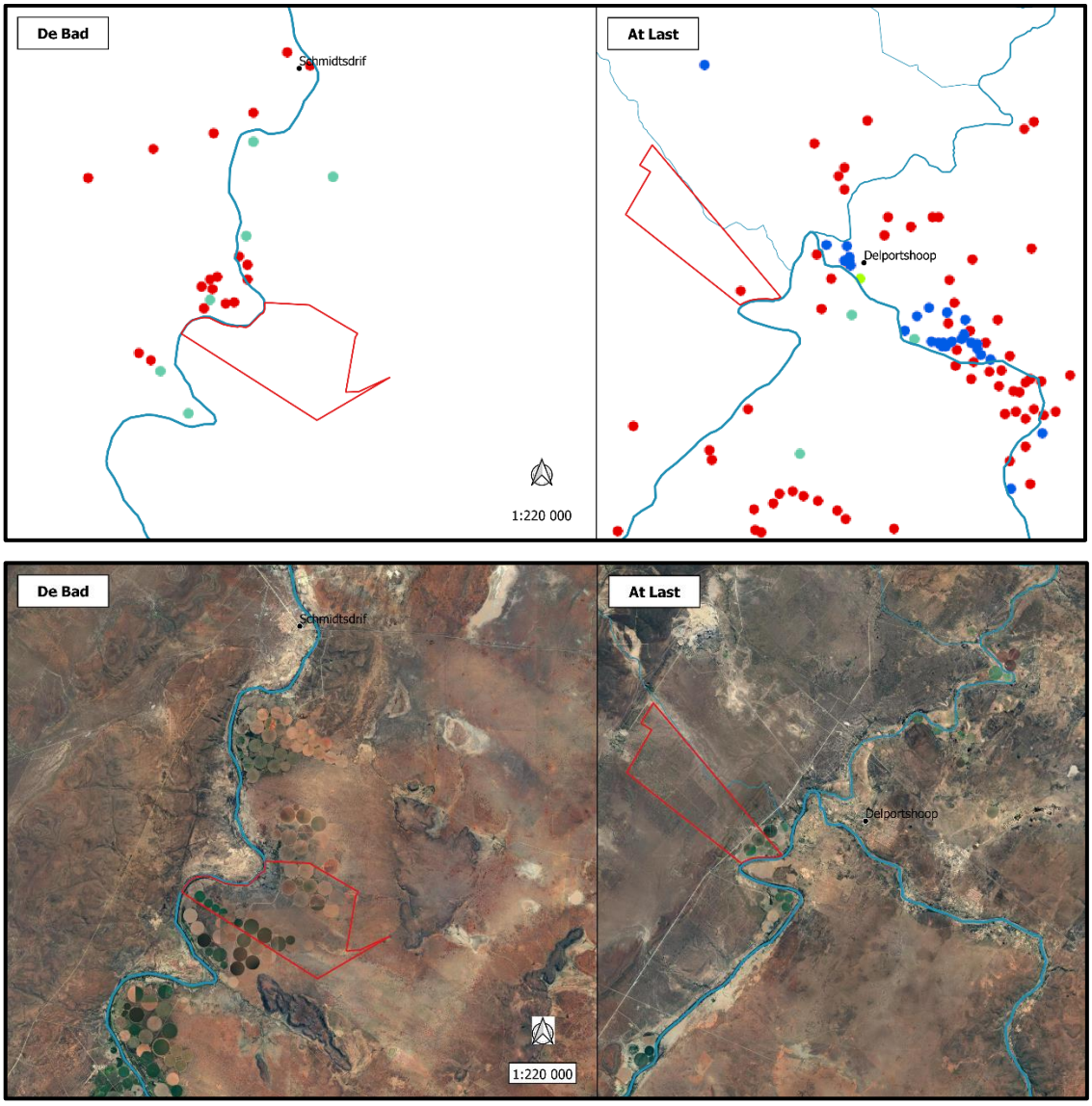


Figure 36. The distribution of mining properties (top) and crop irrigation (bottom) along the Vaal River.

3.7. Site sensitivity

The sensitivity map for the De Bad and At Last mining sites is illustrated in Figure 37. The Vaal River, ephemeral pans, and all drainage lines are considered to be of **very high** sensitivity due to their vital ecological and hydrological functionality and significance. These freshwater systems are also protected in terms of the National Water Act (Act No 36 of 1998) and regarded as important features for the conservation of biodiversity and broad-scale ecological processes. These units are essentially no-go areas.

The woodland on red sand is considered to be of **high** sensitivity, primarily because of the widespread and dense occurrence of nationally protected *Vachellia erioloba*. Although these units are not regarded as no-go areas, activities should only proceed with caution as it may not be possible to mitigate all impacts appropriately.

The remaining pristine plains and ridges on De Bad and At Last are considered to be of **medium** sensitivity. Some land use disturbances are visible, but the natural vegetation remains intact. Species of conservation concern also occur in these habitats, but impacts are likely to be largely local. Activities within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.

Those areas already transformed by agriculture are of **low** sensitivity. There is likely to be a negligible impact on ecological processes and biodiversity in these areas and most types of activities can proceed within these areas with little ecological risk.

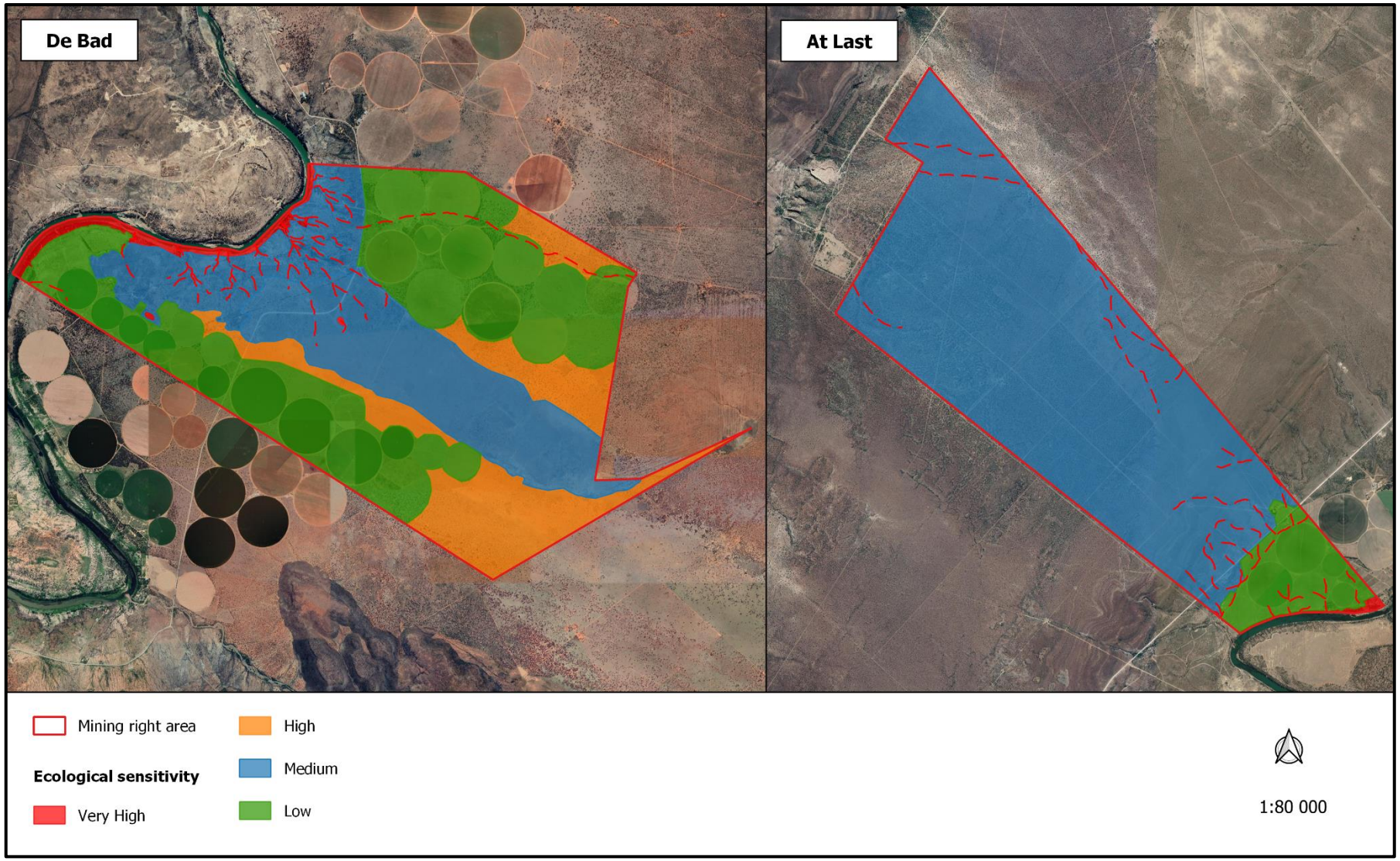


Figure 37. A sensitivity map for the De Bad and At Last mining sites.

4. ECOLOGICAL IMPACT ASSESSMENT

In this section, all potential impacts and associated risk factors that may be generated by the Renaissance operation are identified and described. A detailed analysis of each impact is provided in Table 17. The impacts are assessed in terms of the relevant ecological aspects and each impact is associated with an outline of specific mitigation measures, which with proper implementation, monitoring, and auditing, will serve to reduce the significance of the impact.

4.1. Topography, soil erosion and associated degradation of landscapes

4.1.1. Alteration of soil character and quality

Source of the impact

During clearing of an area for the excavation of minerals, construction of infrastructure and roads, stockpiling, oil and petrochemical spills.

Description of the impact

Topsoil contains living organisms and seed banks that provide ecological resilience against disturbances, and any disturbances to the intact soil profile will change its ability to sustain natural ecological functioning. Vehicles and mining equipment may potentially leak hazardous fluids on the soil surface, which will cause soil pollution. Apart from the direct disturbances caused by the mining activities, soil compaction by dump loads as well as heavy machinery and vehicles will causes a decrease in large pores, and subsequently the water infiltration rate into soil.

Mitigation and monitoring

- Topsoil needs to be removed and stored separately during mining and the construction of roads, infrastructure, and stockpile areas.
- These topsoil stockpiles must be kept as small as possible to prevent compaction and the formation of anaerobic conditions.
- Topsoil must be stockpiled for the shortest possible timeframes to ensure that the quality of the topsoil is not impaired.
- Topsoil must not be handled when the moisture content exceeds 12 %.
- Topsoil stockpiles must by no means be mixed with sub-soils.
- The topsoil should be replaced as soon as possible on to the disturbed areas, thereby allowing for the re-growth of the seed bank contained within the topsoil.

Table 17. A detailed analysis of ecological impacts identified for the De Bad and At Last mining operation.

	IMPACT	Phase			Extent	Duration	Severity	Probability	Significance	Significance after Mitigation
		C	O	D						
Soil	Alteration of soil character and quality	✓	✓	✓	On-site (1)	Residual (4)	High (3)	Certain for life of operation (10)	Medium - High (80)	Low-Medium
	Loss of topsoil and soil fertility	✓	✓	✓	On-site (1)	Residual (4)	High (3)	Certain for life of operation (10)	Medium - High (80)	Low-Medium
	Increase in soil erosion	✓	✓		Local (2)	Decommissioning (3)	Medium (2)	Possible, frequently (8)	Low - Medium (56)	Low
Flora	Loss of indigenous vegetation	✓	✓		On-site (1)	Residual (4)	High (3)	Certain for life of operation (10)	Medium – High (80)	Low-Medium
	Loss of Red data and/or protected floral species	✓	✓		On-site (1)	Residual (4)	Major (4)	Possible for life of operation (9)	Medium - High (81)	Low-Medium
	Introduction or spread of alien species	✓	✓	✓	Local (2)	Residual (4)	Medium (2)	Possible, infrequent (7)	Low-Medium (56)	Very low
	Bush encroachment	✓	✓	✓	On-site (1)	Residual (4)	Minimal (1)	Possible, infrequent (7)	Low (42)	Very low
Fauna	Habitat fragmentation	✓	✓		Regional (3)	Residual (4)	High (3)	Certain for life of operation (10)	Medium - High (100)	Low-Medium
	Disturbance, displacement and killing of fauna	✓	✓	✓	Local (2)	Decommissioning (2)	High (3)	Certain, for life of operation (70)	Low-Medium (70)	Low

Table 17 (cont.). A detailed analysis of ecological impacts identified for the De Bad and At Last mining operation.

	IMPACT	Phase			Extent	Duration	Severity	Probability	Significance	Significance after Mitigation
		C	O	D						
Water resources	Alteration/destruction of watercourses	✓	✓		Regional (3)	Permanent (5)	High (3)	Possible, life of operation (9)	Medium - High (99)	Low-Medium
	Siltation of surface water	✓	✓	✓	Regional (3)	Decommissioning (3)	Medium (2)	Possible, infrequent (7)	Low-Medium (56)	Low
Cumulative	Compromise of broadscale ecological processes	✓	✓		Regional (3)	Residual (4)	High (3)	Certain for life of operation (10)	Medium - High (100)	Low-Medium

- For restoration of the affected areas without topsoil, soils can be sourced from other sustainable areas and chemically changed to match with the surrounding environment.
- To restore areas where compacted soil occurs, a ripper blade or deep plow can be pulled across the affected area to alleviate compaction.
- Encourage the growth of natural plant species in all affected areas by sowing indigenous seeds or by planting seedlings and succulent cuttings.
- Vehicles and machinery should be regularly serviced and maintained.
- Refuelling and vehicle maintenance must take place in well demarcated areas and over suitable drip trays to prevent soil pollution.
- Drip trays must be available on site and installed under all stationary vehicles.
- Spill kits to clean up accidental spills must be well-marked and available on site.
- Workers must undergo induction to ensure they are prepared for rapid clean-up procedures.
- Any soil or area that is contaminated must be cleaned immediately by removing the soil and disposing it as hazardous waste in the correct manner.

4.1.2. Loss of soil fertility

Source of the impact

During clearing of an area for the excavation of minerals, construction of infrastructure and roads, stockpiling.

Description of the impact

Topsoil contains living organisms that naturally regulate the ecological functioning of a habitat. Therefore, any disturbances to the intact soil profile can result in soil sterilisation which will directly affect vegetation communities. Apart from the direct disturbances caused by the mining activities, loss of soil fertility can also occur through soil compaction by dump loads as well as heavy machinery and vehicles.

Mitigation and monitoring

- Topsoil needs to be removed and stored separately during mining and the construction of roads, infrastructure and stockpile areas.
- These topsoil stockpiles must be kept as small as possible to prevent compaction and the formation of anaerobic conditions.
- Topsoil must be stockpiled for the shortest possible timeframes to ensure that the quality of the topsoil is not impaired.
- Topsoil must not be handled when the moisture content exceeds 12 %.

- Topsoil stockpiles must by no means be mixed with sub-soils.
- The topsoil should be replaced as soon as possible on to the disturbed areas, thereby allowing for the re-growth of the seed bank contained within the topsoil.
- For restoration of the affected areas without topsoil, soils can be sourced from other sustainable areas and chemically changed to match with the surrounding environment.
- To restore areas where compacted soil occurs, a ripper blade or deep plow can be pulled across the affected area to alleviate compaction.
- Encourage the growth of natural plant species in all affected areas by sowing indigenous seeds or by planting seedlings and succulent cuttings.

4.1.3. Soil erosion

Source of the impact

During clearing of an area for the excavation of minerals, construction of infrastructure and roads, stockpiling, natural events.

Description of the impact

Vegetation will be stripped for construction of new roads, infrastructure, and excavations. As a result, these areas will be bare, and susceptible to wind and water erosion. Furthermore, any topsoil-, overburden- and ore stockpiles can be eroded by wind, rain, and flooding. Exposed sediments in the watercourses can be carried away during runoff causing downstream sediment deposition. Any leaking pipes can also cause additional water erosion.

Mitigation and monitoring

- Bare ground exposure should always be minimised in terms of the surface area and duration.
- Re-establishment of plant cover on disturbed areas must take place as soon as possible once activities in the area have ceased.
- No new roads, infrastructure or mining areas should be developed over the drainage lines.
- Disturbances during the rainy season should be monitored and controlled.
- Any potential run-off from exposed ground should be controlled with flow retarding barriers.
- Regular monitoring during the mining operation should be carried out to identify areas where erosion is occurring; followed by appropriate remedial actions.

4.2. Vegetation and floristics

4.2.1. Loss of indigenous vegetation

Source of the impact

During clearing of an area for the excavation of minerals, construction of infrastructure and roads, stockpiling.

Description of the impact

The Renaissance mining activities are expected to destroy a large area of natural habitat, especially on De Bad. It is expected that the ecological functioning and biodiversity will take many years to fully recover. Furthermore, vehicle traffic and mining activities generate lots of dust which can reduce the growth success and seed dispersal of many small plant species in the adjacent areas.

Mitigation and monitoring

- Implement best practise principles to minimise the footprint of transformation, by keeping to existing roads and earmarked areas where possible.
- Implement effective avoidance measures to limit any activities in the highly sensitive areas, by applying the no-go principles.
- Ensure measures for the adherence to a maximum speed limit of 40 km/h to minimise dust fallout and associated effects on plants in the adjacent pristine areas.
- Encourage the growth of natural plant species in all affected areas by sowing indigenous seeds or by planting seedlings.
- The setup of a small nursery is advisable to maximise translocation and re-establishment efforts of affected areas.
- Apply for permits to authorise the clearance of indigenous plants from DENC at least three months before such activities will commence.

4.2.2. Loss of Red data and/or protected floral species

Source of the impact

Removal of listed or protected plant species during clearing of an area for the excavation of minerals, construction of infrastructure and roads, stockpiling. Intentional removal of listed or protected plant species for non-mine related purposes, e.g., firewood collection or illegal succulent trade.

Description of the impact

There are a number of plant species of conservation concern present in the Mining Right area, including the nationally protected *Vachellia erioloba* and provincially protected *Aloe claviflora*, *A. grandidentata, Trachyandra bulbinifolia, Gymnosporia buxifolia, Lessertia annularis, Ornithogalum flexuosum, Moraea pallida, Olea europaea* subsp. *africana, Oxalis lawsonii, Jamesbrittenia tysonii* and *Nemesia fruticans.* Therefore, it is likely that the mining operation could potentially have an impact on these species if their local populations are destroyed. Furthermore, any illegal harvesting of firewood from *V. erioloba* or succulents and bulbs for ornamental purposes or trade, by staff, contractors or secondary land users could have devastating effects on the population of these species.

Mitigation and monitoring

- The footprint areas of the mining activities must be scanned for Red Listed and protected plant species prior to any destructive activities by means of a search-and-rescue operation.
- It is recommended that these plants are identified and marked prior to intended activity. These plants should ideally be incorporated into the design layout and left in situ. However, due to the nature of the proposed mining activities they will most likely all be removed or relocated (if possible). The relevant permits from DENC/DAFF should be applied for at least three months before such activities will commence.
- The setup of a small nursery is advisable to maximise translocation and re-establishment efforts of all the rescued plants.
- A management plan should be implemented to ensure proper establishment of ex situ individuals and should include a monitoring programme for at least two years after re-establishment to ensure successful translocation.
- The designation of an environmental officer is recommended to render guidance to the staff and contractors with respect to suitable areas for all related disturbance and must ensure that all contractors and workers undergo Environmental Induction prior to commencing with work on site. The environmental induction should occur in the appropriate languages for the workers who may require translation.
- All those working on site must be educated about the conservation importance of the flora occurring on site as well as the legislation relating to protected species.
- Employ regulatory measures to ensure that no illegal harvesting takes place.

4.2.3. Introduction or spread of alien species

Source of the impact

During clearing of an area for the excavation of minerals, construction of infrastructure and roads, stockpiling, improper rehabilitation practises. Existing populations.

Description of the impact

Several invasive species (*Argemone ochroleuca, Eucalyptus camaldulensis, Lythrum hyssopifolia* and *Prosopis* spp.) and a high density of naturalised exotics (*Bidens* spp.,) occur within and around the study area. Anthropogenic disturbances to natural vegetation, especially the clearance of large areas of land, provide the opportunity for alien plants to increase. This is due to their opportunistic nature of dispersal and establishing in disturbed areas. If alien plants establish in disturbed areas, it may cause an impact beyond the boundaries of the mining site. These alien species are thus a threat to surrounding natural vegetation and can result in the decrease of biodiversity as well as reduction in the ecological value and land use potential of the area. Therefore, if alien species are not controlled and managed, their propagation into new areas could have a high impact on the surrounding natural vegetation in the long term. With proper mitigation, the impacts can be substantially reduced.

Mitigation and monitoring

- Implement best practise principles to minimise the footprint of transformation, by keeping to existing roads and earmarked areas where possible.
- Mechanical methods of control should be implemented pro-actively as soon as alien species start to emerge.
- Regular follow-up monitoring of invasive control areas needs to be implemented to ensure effective eradication.
- Encourage proper rehabilitation of disturbed areas through soil restoration and reseeding of indigenous plant species.

4.2.4. Encouraging bush encroachment

Source of the impact

During clearing of an area for the excavation of minerals, construction of infrastructure and roads, stockpiling, improper rehabilitation practises. Existing populations.

Description of the impact

Bush encroachment is a natural phenomenon characterised by the excessive expansion of certain shrub species at the expense of other plant species. While general clearing of the area and mining activities destroy natural vegetation, bush encroaching plants can increase due to their aggressive nature in disturbed areas. If encroaching plants establish in disturbed areas, it may lower the potential for future land use and decrease biodiversity. *Senegalia mellifera, Grewia flava*, *Rhigozum trichotomum, Tarchonanthus camphoratus* and *Vachellia karroo* already indicate high levels of encroachment on site. However, the removal of these species during mining activities may potentially reduce their abundance and therefore mining could have a positive effect on bush encroachment.

Mitigation and monitoring

- Mechanical methods of control should be implemented pro-actively when encroaching species form dense stands.
- Regular follow-up monitoring of encroached control areas needs to be implemented to ensure effective eradication.
- Encourage proper rehabilitation of disturbed areas through soil restoration and reseeding of indigenous plant species.

4.3. Fauna

4.3.1. Habitat fragmentation

Source of the impact

During clearing of an area for the excavation of minerals, construction of infrastructure and roads, stockpiling.

Description of the impact

Fragmentation of habitats typically leads to the loss of migration corridors, in turn resulting in degeneration of the affected population's genetic make-up. This can be in the form of small-scale fragmentation for reptiles, amphibians, and invertebrates, to more large-scale fragmentation that hinder dispersal of birds and plants. It also includes the destruction of burrows, tunnels, and chambers as well as the degradation of ephemeral aquatic habitats. Small-scale fragmentation disconnects breeding and foraging links, increasing stress and energy budget deficits, which is especially taxing on animals living in arid environments.

Larger scale fragmentation results in a subsequent loss of genetic variability between meta-populations occurring within the study site. Pockets of fragmented natural habitats hinder the growth and development of populations. The mining activities is expected to result in the loss of connectivity and fragmentation of natural micro-habitats primarily on a local scale, but if the ephemeral pans are destroyed then this will have a regional effect on the branchiopod population as well as the migratory birds that feed on them.

Mitigation and monitoring

- All activities associated with the mining operation must be planned, where possible to encourage faunal dispersal and should minimise dissection or fragmentation of any important faunal habitat type.
- The footprint areas of the mining activities must be scanned for any nests and dens prior to any destructive activities by means of a search-and-rescue operation.
- It is recommended that nests and dens are identified and marked prior to intended activity and should be incorporated into the design layout and left in situ. However, due to the nature of the proposed mining activities they will most likely be destroyed. The relevant permits from DENC should be applied for at least three months before such activities will commence.
- The extent of the earmarked area should be demarcated on site layout plans. No staff, contractors or vehicles may leave the demarcated area except those authorised to do so.
- Those pristine areas surrounding the earmarked area that are not part of the demarcated area should be considered as a no-go zone for employees, machinery or even visitors.
- No new roads should be created across any of the watercourses.
- No mining should take place in the drainage lines, ephemeral pans or within the river buffer. If this is unavoidable, a water use license to alter the beds and banks of the watercourses should be obtained from DWS prior to such activities.
- Employ sound rehabilitation measures to restore characteristics of all affected terrestrial and aquatic habitats.

4.3.2. Disturbance, displacement and killing of fauna

Source of the impact

Vegetation clearing; increase in noise and vibration; human and vehicular movement on site resulting from mining activities; excavations.

Description of the impact

The site provides suitable habitat for several species of conservation concern, as discussed in the various faunal taxon groups in this report. The proposed mining activities could lead to the death and displacement of some of these species. The transformation of natural habitats will result in the loss of micro-habitats, affecting individual species and ecological processes. This will result in the displacement of faunal species that depend on such habitats, e.g., birds that nest in trees or animals residing in holes in the ground, among rocks or underneath plants. Increased noise and vibration will disturb and possibly displace wildlife. Fast moving vehicles cause road kills of small mammals, birds, reptiles, amphibians, and many invertebrates. Intentional killing of snakes, reptiles, and owls will negatively affect their local populations.

Mitigation and monitoring

- Careful planning of the operation is needed to avoid the destruction of pristine habitats and minimise the overall disturbance footprint.
- The extent of the mining activities should be demarcated on site layout plans, and no personnel or vehicles may leave the demarcated area except if authorised to do so. Areas surrounding the earmarked site should be managed as a no-go zone.
- The footprint areas of the mining activities must be scanned for any protected faunal species prior to any destructive activities by means of a search-and-rescue operation.
- If any of the protected wildlife species are directly threatened by habitat destruction or displacement during the mining operation, then the relevant permits from DENC should be obtained followed by the relevant mitigation procedures stipulated in the permits.
- It is recommended that these individuals be rescued and relocated by a registered professional prior to intended activities.
- No mining should take place in the drainage lines, pans or near the river and no new roads should be created across these water resources. If this is unavoidable, a water use license to alter the beds and banks of each earmarked watercourse should be obtained from DWS prior to such activities.
- Everyone on site must undergo environmental induction for awareness on not capturing or harming species that are often persecuted out of superstition and to be educated about the conservation importance of the fauna occurring on site.
- All reptiles, amphibians, bird nests and small mammal litters that are exposed during the clearing operations should be captured for later release or translocation by a qualified expert.
- Employ measures that ensure adherence to a maximum speed limit of 40 km/h as well as driving mindfully on site to lower the risk of animals being killed on the roads or elsewhere in the mining area.

4.4. Water resources

4.4.1. Alteration/destruction of watercourses

Source of the impact

During excavation of minerals, construction of infrastructure and roads, stockpiling.

Description of the impact

During mining activities there is a possibility that the watercourses on site (i.e., ephemeral pans, Vaal River and drainage lines) might be altered or indirectly affected. This includes direct mining within the watercourses as well as development of roads, infrastructure or stockpiles within their channels, catchment areas, or buffer zones. Such activities can completely change the hydrologic regime or habitat conditions of the watercourses, which will not only compromise their ecological functioning, but also have downstream effects.

Mitigation and monitoring

- All activities associated with the mining operation must be planned to avoid any disturbances to the watercourses and their buffer zones.
- No new roads should be created across the watercourses and no mining should take place in these systems. If this is unavoidable, a water use license to alter the beds and banks of each earmarked watercourse should be obtained from DWS prior to such activities.
- Employ sound rehabilitation measures to restore characteristics of all affected watercourses.

4.4.2. Siltation of surface water

Source of the impact

During clearing of an area for the excavation of minerals, construction of infrastructure and roads, stockpiling, natural events.

Description of the impact

Vegetation will be stripped in preparation for the mining areas and associated infrastructure. These bare areas will be susceptible to water erosion without plants to stabilise the soil, creating potential sediment source zones. High runoff events could potentially cause the drainage lines, pans and Vaal River to be filled with silt from mining areas if the sediment source zones lie along the drainage paths towards these watercourses. This may lead to changes in hydrologic regime or character of the watercourses on site, and downstream.

Mitigation and monitoring

- Bare ground exposure should always be minimised in terms of the surface area and duration.
- Re-establishment of plant cover on disturbed areas must take place as soon as possible once activities in the area have ceased.
- No new roads, infrastructure or mining areas should be developed over watercourses.
- Disturbances during the rainy season should be monitored and controlled.
- Any potential run-off from exposed ground should be controlled with flow retarding barriers.
- Regular monitoring during the mining operation should be carried out to identify areas where erosion is occurring; followed by appropriate remedial actions.

4.5. Broad-scale ecological processes

Source of the impact

Clearing of vegetation and disturbance during the construction of roads and mining activities; alterations to watercourse habitat characteristics.

Description of the impact

Transformation of intact habitat on a cumulative basis would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations. The vast extent of mining and agricultural activities in the region have already transformed large natural landscapes and the proposed mining activities will add to the fragmentation of habitats on a landscape level. Habitat alterations will also destroy connectivity of vital ecological corridors of aquatic food webs in the ephemeral pans, which could have cascading effects on a regional level.

Mitigation and monitoring

- Implement best practise principles to minimise the footprint of transformation.
- No new roads should be created across the watercourses and no mining should take place in the watercourses or their buffers. If this is unavoidable, a water use license to alter the beds and banks of each earmarked watercourse should be obtained from DWS prior to such activities.
- Employ sound rehabilitation measures to restore characteristics of all affected habitats.

5. CONCLUSION, RECOMMENDATIONS AND OPINION REGARDING AUTHORISATION

Seven plant communities occur in the study area, including terrestrial and aquatic habitats. The Vaal River, ephemeral pans and drainage lines are all considered to be of very high sensitivity due to their vital ecological and hydrological functionality and significance, which is portrayed in the various sections of this report. The ephemeral pans and Vaal River, including their buffer zones, should ideally be marked as no-go areas.

The woodland on red sand hosts a dense population of *Vachellia erioloba* and is therefore of high sensitivity. The remaining pristine terrestrial habitats are of medium sensitivity, while the sensitivity of those areas already transformed by agriculture, is low.

The most profound impacts related to the proposed activities is expected to be in the form of cumulative habitat destruction, given the extensive history of mining and crop irrigation in the region. Direct and secondary impacts to water resources are also considered to be significant. Therefore, activities near these systems should be carefully planned to avoid disastrous implications. If any of the protected plant species will be damaged or removed, permit applications regarding protected flora and/or nationally protected trees need to be lodged with the Northern Cape Department of Environment and Nature Conservation and/or Department of Agriculture, Forestry and Fisheries, three months prior to any removal of affected species.

To conclude, in my opinion, authorisation for the mining operation can be granted if the applicant commits to the adherence of effective avoidance, management, mitigation and rehabilitation measures.

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APPENDICES

APPENDIX 1

Plant species list

FAMILY	SPECIES	STATUS	NFA	NCNCA
ACANTHACEAE	*Dicliptera leistneri*	LC		
	Justicia divaricata	LC		
	Justicia incana	LC		
AIZOACEAE	*Plinthus karooicus*	LC		
	Titanopsis calcarea	LC		**S2**
AMARANTHACEAE	*Chenopodium hederiforme* var. *undulatum*	LC		
	Salsola microtricha	**DDT**		
ANACARDIACEAE	*Searsia burchellii*	**LC**		
	Searsia lancea	**LC**		
	Searsia pendulina	LC		
	Searsia tridactyla	LC		
ASPARAGACEAE	*Asparagus glaucus*	LC		
	Asparagus laricinus	LC		
ASPHODELACEAE	***Aloe claviflora***	LC		**S2**
	Aloe grandidentata	LC		**S2**
	Bulbine abyssinica	LC		**S2**
	Trachyandra bulbinifolia	LC		**S2**
ASTERACEAE	*Arctotis leiocarpa*	LC		
	Bidens bipinnata	**Nat. Exotic**		
	Bidens pilosa	**Nat. Exotic**		
	Chrysocoma ciliata	LC		
	Cineraria lyratiformis	LC		
	Dicoma capensis	LC		
	Eriocephalus ambiguus	LC		
	Felicia fascicularis	LC		
	Gazania krebsiana subsp. *arctotoides*	LC		
	Helichrysum arenicola	LC		
	Helichrysum argyrosphaerum	LC		
	Hirpicium echinus	LC		
	Kleinia longiflora	LC		
	Laggera decurrens	LC		
	Nolletia chrysocomoides	LC		
	Oedera humilis	LC		
	Osteospermum muricatum subsp. *muricatum*	LC		
	Pentzia calcarea	LC		
	Pentzia incana	LC		
	Senecio consanguineus	LC		
	Senecio windhoekensis	LC		
	Tarchonanthus camphoratus	**Encr.**		
BIGNONIACEAE	*Rhigozum obovatum*	LC		
	Rhigozum trichotomum	**Encr.**		
BORAGINACEAE	*Anchusa riparia*	LC		
	Ehretia rigida	LC		
	Heliotropium lineare	LC		
	Lithospermum cinereum	LC		
CAMPANULACEAE	*Wahlenbergia androsacea*	LC		
CAPPARACEAE	***Boscia albitrunca***	LC	**X**	**S2**
	Cadaba aphylla	LC		

FAMILY	SPECIES	STATUS	NFA	NCNCA
CELASTRACEAE	*Gymnosporia buxifolia*	LC		S2
CLEOMACEAE	*Cleome rubella*	LC		
COMMELINACEAE	*Commelina livingstonii*	LC		
CONVOLVULACEAE	*Seddera capensis*	LC		
CUCURBITACEAE	*Kedrostis crassirostrata*	LC		
CYPERACEAE	*Pseudoschoenus inanis*	LC		
	Schoenoplectus tabernaemontani	Nat. Exotic		
EBENACEAE	*Diospyros lycioides* subsp. *lycioides*	LC		
EUPHORBIACEAE	*Euphorbia serpens*	Nat. Exotic		
FABACEAE	*Cullen tomentosum*	LC		
	Indigofera alternans var. *alternans*	LC		
	Lessertia annularis	LC		S1
	Lotononis laxa	LC		
	Melolobium candicans	LC		
	Prosopis glandulosa	Decl. Inv.		
	Prosopis velutina	Decl. Inv.		
	Senegalia mellifera subsp. *detinens*	Encr.		
	Vachellia erioloba	LC	X	
	Vachellia haematoxylon	LC	X	
	Vachellia karroo	Encr.		
	Vachellia tortilis	Encr.		
GENTIANACEAE	*Sebaea exigua*	LC		
HYACINTHACEAE	*Ornithogalum flexuosum*	LC		S2
	Ornithogalum nannodes	LC		S2
IRIDACEAE	*Babiana hypogaea*	LC		S2
	Moraea pallida	LC		S2
LAMIACEAE	*Leonotis pentadentata*	LC		
	Salvia disermas			
LYTHRACEAE	*Lythrum hyssopifolia*	Decl. Inv.		
MALVACEAE	*Corchorus asplenifolius*	LC		
	Grewia flava	Encr.		
	Melhania rehmannii	LC		
	Pavonia burchellii	LC		
MYRTACEAE	*Eucalyptus camaldulensis*	Decl. Inv.		
NYCTAGINACEAE	*Phaeoptilum spinosum*	LC		
OLEACEAE	*Olea europaea* subsp. *africana*	LC		S2
OPHIOGLOSSACEAE	*Ophioglossum polyphyllum* var. *polyphyllum*	LC		
	Ophioglossum reticulatum	LC		
OROBANCHACEAE	*Cycnium tubulosum* subsp. *tubulosum*	LC		
OXALIDACEAE	*Oxalis lawsonii*	LC		S2
PAPAVERACEAE	*Argemone ochroleuca*	Decl. Inv.		
PHYLLANTHACEAE	*Phyllanthus maderaspatensis*	LC		
PLUMBAGINACEAE	*Dyerophytum africanum*	LC		
POACEAE	*Aristida congesta* subsp. *barbicollis*	LC		
	Aristida congesta subsp. *congesta*	LC		
	Aristida meridionalis	LC		
	Aristida vestita	LC		
	Cenchrus ciliaris	LC		

FAMILY	SPECIES	STATUS	NFA	NCNCA
POACEAE	*Centropodia glauca*	LC		
	Cymbopogon pospischilii	LC		
	Dichanthium annulatum var. *papillosum*	LC		
	Echinochloa jubata	LC		
	Enneapogon cenchroides	LC		
	Enneapogon desvauxii	LC		
	Enneapogon scoparius	LC		
	Eragrostis cilianensis	LC		
	Eragrostis echinochloidea	LC		
	Eragrostis lehmanniana	LC		
	Eragrostis pallens	LC		
	Eragrostis rigidior	LC		
	Fingerhuthia africana	LC		
	Heteropogon contortus	LC		
	Leptochloa fusca	LC		
	Oropetium capense	LC		
	Phragmites australis	LC		
	Pogonarthria squarrosa	LC		
	Setaria verticillata	LC		
	Stipagrostis hirtigluma subsp. *patula*	LC		
	Stipagrostis uniplumis	LC		
	Themeda triandra	LC		
	Tricholaena monachne	LC		
RHAMNACEAE	*Ziziphus mucronata* subsp. *mucronata*	LC		
RUBIACEAE	*Cordylostigma virgatum*	LC		
	Kohautia cynanchica	LC		
SANTALACEAE	*Thesium hystrix*	LC		
	Viscum rotundifolium	LC		
SCROPHULARIACEAE	*Aptosimum indivisum*	LC		
	Aptosimum marlothii	LC		
	Jamesbrittenia tysonii	LC		**S2**
	Nemesia fruticans	LC		**S2**
	Nemesia lilacina	LC		**S2**
	Peliostomum leucorrhizum	LC		
	Selago densiflora	LC		
SOLANACEAE	*Lycium bosciifolium*	LC		
	Lycium cinereum	LC		
	Lycium hirsutum	LC		
	Lycium horridum	LC		
THYMELAEACEAE	*Lasiosiphon polycephalus*	LC		
ZYGOPHYLLACEAE	*Roepera lichtensteiniana*	LC		

APPENDIX 2

Fauna species list

LIST OF MAMMALS

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	EWT 2016	Habitat	Potential of occurrence
CHIROPTERA	[2]*Eidolon helvum*	African Straw-coloured Fruit-bat	**NT**	LC	Wide habitat tolerance.	High
	[2]*Neoromicia capensis*	Cape Serotine Bat	LC	LC	Wide habitat tolerance. Arid grassland, bushveld and *Acacia* woodland. Roost under tree bark.	High
	[3]*Miniopterus natalensis*	Natal Long-fingered Bat	LC	LC	Roosts in caves or mine shafts, but also crevices and holes in trees.	High
	[2]*Nycteris thebaica*	Egyptian Slit-faced Bat	LC	LC	Savanna species with wide habitat tolerance. Roosts in caves, mine adits, aardvark holes, rock crevices and hollow trees in open woodland.	High
	[2]*Pipistrellus hesperidus*	Dusk Pipistrelle	LC	LC	Wide habitat tolerance, but nearby open water is important.	High
	[2]*Rhinolophus clivosus*	Geoffroy's Horseshoe Bat	LC	LC	Wide habitat tolerance.	High
	[2]*Rhinolophus denti*	Dent's Horseshoe Bat	LC	**NT**	Arid savanna habitats. Roosts in caves and crevices in rocky outcrops, and abandoned mines.	Low
	[2]*Rhinolophus darlingi*	Darling's Horseshoe Bat	LC	LC	Savanna habitats.	High
	[2]*Tadarida aegyptiaca*	Egyptian Free-tailed Bat	LC	LC	Wide habitat tolerance.	High

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	EWT 2016	Habitat	Potential occurrence
CHRYSOCHLORIDAE	[2]*Chlorotalpa sclateri*	Sclater's Golden Mole	LC	LC	Restricted to high-altitude grasslands, scrub and forested kloofs in the Nama Karoo and Grassland biomes of South Africa.	Moderate
CROSCELIDIDAE	[2]*Elephantulus myurus*	Eastern Rock Sengi	LC	LC	Savanna and grassland on rocky outcrops or koppies that provide sufficient cracks and holes for shelter.	High
TUBULENTATA	[1]*Orycteropus afer*	Aardvark	LC	LC	Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil.	High
HYRACOIDEA	[2]*Procavia capensis*	Rock Hyrax	LC	LC	Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies.	Moderate

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	EWT 2016	Habitat	Potential occurrence
LAGOMORPHA	[2]*Lepus capensis*	Cape Hare	LC	LC	Dry, open regions, with palatable bush and grass.	High
	[2]*Lepus saxatilis*	Scrub Hare	LC	LC	Common in agriculturally developed areas, especially in crop-growing areas or in fallow lands where there is some bush development.	High
	[2]*Pronolagus rupestris*	Smith's Red Rock Rabbit	LC	LC	Rocky slopes and the tops of rocky outcrops of mountains and hills, where grass or scrub vegetation occurs.	Low
PHOLIDOTA	[1]*Manis temminckii*	Ground Pangolin	**VU**	**VU**	Various woodland and savannah habitats, although largely confined to protected areas and well-managed livestock and wildlife farms.	Low

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	EWT 2016	Habitat	Potential occurrence
RODENTIA	[2]*Hystrix africaeaustralis*	Cape Porcupine	LC	LC	Catholic in habitat requirements.	High
	[2]*Xerus inauris*	South African Ground Squirrel	LC	LC	Open terrain with a sparse bush cover and hard substrate.	High
	[2]*Pedetes capensis*	Springhare	LC	LC	Occurs widespread: open sandy ground, sandy scrub, overgrazed grassland, edges of vleis and dry river beds.	High
	[2]*Graphiurus ocularis*	Spectacled Dormouse	LC	LC	Rocky habitats, but also trees.	High
	[2]*Rhabdomys pumilio*	Four-striped Grass Mouse	LC	LC	Essentially a grassland species, occurs in wide variety of habitats where there is good grass cover.	High
	[2]*Mus minutoides*	Pygmy Mouse	LC	LC	Wide habitat tolerance.	High
	[3]*Mus musculus*	House Mouse	LC	Not listed	Wide habitat tolerance.	High

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	EWT 2016	Habitat	Potential occurrence
RODENTIA	[2]*Mastomys coucha*	Southern Multimammate Mouse	LC	LC	Wide habitat tolerance.	High
	[2]*Mastomys natalensis*	Natal Multimammate Mouse	LC	LC	Wide habitat tolerance.	High
	[2]*Aethomys namaquensis*	Namaqua Rock Rat	LC	LC	Catholic habitat requirements, but prefer rocky hills, outcrops or boulder-strewn hillsides.	Low
	[2]*Otomys unisulcatus*	Karoo Bush Rat	LC	LC	Shrub and fynbos associations in areas with rocky outcrops Tend to avoid damp situations but exploit the semi-arid Karoo through behavioural adaptation.	Low
	[3]*Rattus rattus*	House Rat	LC	Not listed	Primarily commensal, but also found in a variety of natural and semi-natural habitats	High
	[2]*Saccostomus campestris*	Pouched Mouse	LC	LC	Savanna woodland.	High
	[2]*Desmodillus auricularis*	Cape Short-eared Gerbil	LC	LC	Tend to occur on hard ground, unlike other gerbil species, with some cover of grass or karroid bush.	High

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	EWT 2016	Habitat	Potential occurrence
RODENTIA	[2]*Gerbillurus paeba*	Hairy-footed Gerbil	LC	LC	Gerbils associated with Nama and Succulent Karoo preferring sandy soil or sandy alluvium with a grass, scrub or light woodland cover.	High
	[2]*Gerbilliscus leucogaster*	Bushveld Gerbil	LC	LC	Predominantly associated with light sandy soils or sandy alluvium.	High
	[2]*Gerbilliscus brantsii*	Highveld Gerbil	LC	LC	Sandy soils or sandy alluvium with some cover of grass, scrub or open woodland.	High
	[2]*Malacothrix typica*	Gerbil Mouse	LC	LC	Predominantly in Nama and Succulent Karoo biomes, where mean annual rainfall is 150-500 mm.	High
PRIMATES	[4]*Cercopithecus pygerythrus*	Vervet Monkey	LC	LC	Savanna and open woodland, but is extremely adaptable and versatile species able to persist in secondary and/or highly fragmented vegetation.	Confirmed
	[4]*Papio ursinus*	Chacma Baboon	LC	LC	Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges.	Moderate

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	EWT 2016	Habitat	Potential occurrence
EULIPOTYPHLA	[2]*Crocidura cyanea*	Reddish-Grey Musk Shrew	LC	LC	Occurs in relatively dry terrain, with a mean annual rainfall of less than 500 mm. Occur in karroid scrub and in fynbos often in association with rocks.	High
	[2]*Suncus varilla*	Lesser Dwarf Shrew	LC	LC	Generally associated with termite mounds, grassland habitat.	High
ERINACEOMORPHA	[1]*Atelerix frontalis*	South African Hedgehog	LC	**NT**	Found in a variety of savanna and grassland habitat types and require ample ground cover for nesting and foraging.	High
CARNIVORA	[1]*Proteles cristata*	Aardwolf	LC	LC	Common in the 100-600mm rainfall range of country, Nama-Karoo, Succulent Karoo Grassland and Savanna biomes.	High
	[4]*Caracal caracal*	Caracal	LC	LC	Caracals tolerate arid regions, occur in semi-desert and karroid conditions.	High
	[1]*Felis silvestris*	African Wildcat	LC	LC	Wide habitat tolerance.	High

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	EWT 2016	Habitat	Potential occurrence
CARNIVORA	[1]*Felis nigripes*	Black-footed cat	**VU**	**VU**	Dry, open savanna, grasslands and Karoo semi-desert with sparse shrub and tree cover. Prefers hollowed out abandoned termite mounds or dens dug out by other animals.	High
	[2]*Genetta genetta*	Common Genet	LC	LC	Occur in open arid habitats.	High
	[2]*Suricata suricatta*	Suricate	LC	LC	Open arid country with hard and stony substrate. Occur in Nama- and Succulent Karoo but also fynbos.	Confirmed
	[2]*Cynictis penicillata*	Yellow Mongoose	LC	LC	Semi-arid country on a sandy substrate.	High
	[2]*Herpestes sanguineus*	Slender mongoose	LC	LC	Wide habitat tolerance.	Confirmed
	[2]*Herpestes pulverulentus*	Cape Grey Mongoose	LC	LC	Wide habitat tolerance.	High
	[2]*Atilax paludinosus*	Water mongoose	LC	LC	Mainly restricted to riparian habitats, wherever there is suitable vegetation cover and water in close proximity.	High

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	EWT 2016	Habitat	Potential occurrence
CARNIVORA	[1]*Vulpes chama*	Cape Fox	LC	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub.	High
	[4]*Canis mesomelas*	Black-backed Jackal	LC	LC	Wide habitat tolerance.	Confirmed
	[2]*Aonyx capensis*	Cape Clawless Otter	**NT**	**NT**	Rivers, marshes, dams and lakes; dry stream beds if pools of water exist.	High
	[1]*Hydrictis maculicollis*	Spotted-necked Otter	**NT**	**VU**	Larger rivers or rivers with permanent pools; lakes, dams and well-watered swamps.	High
	[1]*Hyaena brunnea*	Brown Hyena	**NT**	**NT**	Found in dry areas, generally with annual rainfall of 100 - 700 mm, particularly along the coast, semi-desert, open scrub and open woodland savanna.	Low
	[1]*Otocyon megalotis*	Bat-eared Fox	LC	LC	Open country with mean annual rainfall of 100-600 mm.	High
	[1]*Poecilogale albinucha*	African Striped Weasel	LC	**NT**	Wide habitat tolerance, but most common in grassland areas.	High

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	EWT 2016	Habitat	Potential occurrence
CARNIVORA	[1]*Ictonyx striatus*	Striped Polecat	LC	LC	Widely distributed throughout the sub-region.	High
	[1]*Mellivora capensis*	Honey Badger	LC	**NT**	Wide habitat tolerance.	High
CETARTIODACTYLA	[2]*Oreotragus oreotragus*	Klipspringer	LC	LC	Rocky and mountainous terrain	Low
	[2]*Raphicerus campestris*	Steenbok	LC	LC	Inhabits open country.	Confirmed
	[2]*Sylvicapra grimmia*	Common Duiker	LC	LC	Presence of bushes are important.	High
	[2]*Thagelaphus strepciceros*	Greater Kudu	LC	LC	Mixed scrub woodland on lowlands, hills, and mountains.	Confirmed

LIST OF REPTILES

Reptiles protected according to NCNCA are indicated with their respective Schedule no. in superscript.

Family	Scientific name	Common name	SURICATA
AGAMIDAE	[3]*Agama aculeata aculeata*	Western Ground Agama	LC
	[3]*Agama aculeata distanti*[E]	Eastern Ground Agama	LC
	[3]*Agama atra*	Southern Rock Agama	LC
AMPHISBAENIDAE	[3]*Monopeltis infuscata*	Dusky Worm Lizard	LC
	[3]*Monopeltis mauricei*	Maurice's Worm Lizard	LC
CHAMAELEONIDAE	[1]*Chamaeleo dilepis dilepis*	Common Flap-neck Chameleon	LC
COLUBRIDAE	[3]*Crotaphopeltis hotamboeia*	Red-lipped Snake	LC
	[2]*Dasypeltis scabra*	Rhombic Egg-eater	LC
	[3]*Dispholidus typus*	Boomslang	LC
	[2]*Philothamnus semivariegatus*	Spotted Bush Snake	LC
CORDYLIDAE	[1]*Karusasaurus polyzonus*	Southern Karusa Lizard	LC
ELAPIDAE	[3]*Elapsoidea sundevallii media*	Sundevall's Garter Snake	LC
	[3]*Naja nivea*	Cape Cobra	LC
GEKKONIDAE	[3]*Chondrodactylus bibronii*	Bibron's Gecko	LC
	[3]*Lygodactylus capensis capensis*	Common Dwarf Gecko	LC
	[3]*Pachydactylus capensis*	Cape Gecko	LC
	[3]*Pachydactylus mariquensis*[E]	Common Banded Gecko	LC
	[3]*Ptenopus garrulus garrulus*	Common Barking Gecko	LC
GERRHOSAURIDAE	[3]*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	LC
LACERTIDAE	[2]*Meroles squamulosus*	Common Rough-scaled Lizard	LC
	[2]*Nucras holubi*	Holub's Sandveld Lizard	LC
	[2]*Nucras intertexta*	Spotted Sandveld Lizard	LC
	[2]*Pedioplanis lineoocellata lineoocellata*	Spotted Sand Lizard	LC
	[2]*Pedioplanis namaquensis*	Namaqua Sand Lizard	LC
LAMPROPHIIDAE	[3]*Aparallactus capensis*	Black-headed Centipede-eater	LC
	[3]*Atractaspis bibronii*	Bibron's Stiletto Snake	LC
	[3]*Xenocalamus bicolor bicolor*	Bicoloured Quill-snouted Snake	LC
	[2]*Boaedon capensis*	Brown House Snake	LC
	[2]*Lamprophis aurora*	Aurora Snake	LC
	[2]*Lycodonomorphus rufulus*	Brown Water Snake	LC
	[2]*Lycophidion capense capense*	Cape Wolf Snake	LC
	[3]*Psammophis brevirostris*	Short-snouted Grass Snake	LC
	[3]*Psammophis notostictus*	Karoo Sand Snake	LC
	[3]*Psammophis trinasalis*	Fork-marked Sand Snake	LC
	[3]*Psammophylax tritaeniatus*	Striped Grass Snake	LC

LIST OF REPTILES (continued)

Reptiles protected according to NCNCA are indicated with their respective Schedule no. in superscript.

Family	Scientific name	Common name	SURICATA
LAMPROPHIIDAE	[2]*Prosymna bivittata*	Two-striped Shovel-snout	LC
	[2]*Pseudaspis cana*	Mole Snake	LC
LEPTOTYPHLOPIDAE	[3]*Leptotyphlops scutifrons*	Peter's Thread Snake	LC
PELOMEDUSIDAE	[3]*Pelomedusa subrufa*	Marsh Terrapin	LC
SCINCIDAE	*Acontias occidentalis*	Savanna Legless Skink	LC
	Afroablepharus wahlbergii	Wahlberg's Snake-eyed Skink	LC
	Trachylepis capensis	Cape Skink	LC
	Trachylepis punctatissima	Speckled Rock Skink	LC
	Trachylepis punctulata	Speckled Sand Skink	LC
	Trachylepis spilogaster	Kalahari Tree Skink	LC
	Trachylepis sulcata sulcata	Western Rock Skink	LC
	Trachylepis varia	Variable Skink	LC
	Trachylepis variegata	Variegated Skink	LC
TESTUDINIDAE	[2]*Homopus femoralis*[E]	Greater Padloper	LC
	[3]*Psammobates oculifer*	Serrated Tent Tortoise	LC
	[3]*Stigmochelys pardalis*	Leopard Tortoise	LC
TYPHLOPIDAE	[3]*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake	LC
VARANIDAE	[2]*Varanus albigularis albigularis*	Southern Rock Monitor	LC
	[2]*Varanus niloticus*	Nile Monitor	LC
VIPERIDAE	[3]*Bitis arietans arietans*	Puff Adder	LC

LIST OF AMPHIBIANS

Amphibians protected according to NCNCA are indicated with their respective Schedule no. in superscript.

Family	Scientific name	Common name	IUCN status
BUFONIDAE	[2]*Amietophrynus poweri*	Western Olive Toad	LC
	[2]*Amietophrynus rangeri*	Raucous Toad	LC
	[2]*Bufo gutturalis*	Guttural Toad	LC
	[2]*Poyntonophrynus vertebralis*	Southern Pygmy Toad	LC
	[2]*Vandijkophrynus gariepensis*	Karoo Toad	LC
HYPEROLIIDAE	[2]*Kassina senegalensis*	Bubbling Kassina	LC
PHRYNOBATRACHIDAE	[2]*Phrynobatrachus natalensis*	Snoring Puddle Frog	LC
PIPIDAE	[2]*Xenopus laevis*	Common Platanna	LC
PYXICEPHALIDAE	[2]*Cacosternum boettgeri*	Boettger's Caco	LC
	[2]*Amietia quecketti*	Common River Frog	LC
	[2]*Amietia fuscigula*	Cape River Frog	LC
	[1]*Pyxicephalus adspersus*	Giant Bullfrog	**NT**
	[2]*Tomopterna cryptotis*	Tremolo Sand Frog	LC
	[2]*Tomopterna tandyi*	Tandy's Sand Frog	LC

LIST OF BIRDS

Birds protected according to NCNCA are indicated with their respective Schedule no. in superscript

Scientific name	Common name	IUCN status	SA Red Data Book
[2]*Acrocephalus baeticatus*	African Marsh Warbler		
[2]*Acrocephalus gracilirostris*	Lesser Swamp-warbler		
[2]*Actitis hypoleucos*	Common Sandpiper		
[2]*Actophilornis africanus*	African Jacana		
[2]*Alcedo cristata*	Malachite Kingfisher		
[2]*Alopochen aegyptiacus*	Egyptian Goose		
[2]*Amadina erythrocephala*	Redheaded Finch		
[2]*Amaurornis flavirostris*	Black Crake		
[2]*Anas capensis*	Cape Teal		
[2]*Anas erythrorhyncha*	Redbilled Teal		
[2]*Anas hottentota*	Hottentot Teal		
[2]*Anas smithii*	Cape Shoveller		
[2]*Anas sparsa*	African Black Duck		
[2]*Anas undulata*	Yellowbilled Duck		
[2]*Anhinga rufa*	Darter		
[2]*Anthoscopus minutus*	Cape Penduline Tit		
[2]*Anthropoides paradiseus*	Blue Crane	**VU**	**NT**
[2]*Anthus cinnamomeus*	Grassveld Pipit		
[2]*Anthus vaalensis*	Buffy Pipit		
[2]*Apus affinis*	Little Swift		
[2]*Apus apus*	Eurasian Swift		
[2]*Apus barbatus*	African Black Swift		
[2]*Apus bradfieldi*	Bradfield's Swift		
[2]*Apus caffer*	Whiterumped Swift		
[2]*Apus horus*	Horus Swift		
[1]*Aquila rapax*	Tawny Eagle	**VU**	**EN**
[1]*Aquila verreauxii*	Black Eagle		**VU**
[2]*Ardea cinerea*	Grey Heron		
[2]*Ardea goliath*	Goliath Heron		
[2]*Ardea melanocephala*	Blackheaded Heron		
[2]*Ardea purpurea*	Purple Heron		
[2]*Ardeola ralloides*	Squacco Heron		
[1]*Ardeotis kori*	Kori Bustard	**NT**	**NT**
[2]*Batis pririt*	Pririt Batis		
[2]*Bostrychia hagedash*	Hadeda Ibis		
[2]*Bradornis infuscatus*	Chat Flycatcher		
[2]*Bradornis mariquensis*	Marico Flycatcher		
[1]*Bubo africanus*	Spotted Eagle Owl		
[1]*Bubo lacteus*	Giant Eagle Owl		
[2]*Bubulcus ibis*	Cattle Egret		
[2]*Burhinus capensis*	Spotted Dikkop		
[1]*Buteo rufofuscus*	Jackal Buzzard		
[1]*Buteo vulpinus*	Steppe Buzzard		
[2]*Butorides striatus*	Green-backed Heron		
[2]*Calandrella cinerea*	Redcapped Lark		
[2]*Calendulauda africanoides*	Fawncoloured Lark		
[2]*Calendulauda bradfieldi*	Bradfield's Lark		
[2]*Calidris alba*	Sanderling		

LIST OF BIRDS (continued)

Birds protected according to NCNCA are indicated with their respective Schedule no. in superscript

Scientific name	Common name	IUCN status	SA Red Data Book
[2]*Calidris ferruginea*	Curlew Sandpiper		
[2]*Calidris minuta*	Little Stint		
[2]*Campethera abingoni*	Goldentailed Woodpecker		
[1]*Caprimulgus europaeus*	Eurasian Nightjar		
[1]*Caprimulgus rufigena*	Rufouscheeked Nightjar		
[1]*Caprimulgus tristigma*	Freckled Nightjar		
[2]*Centropus burchellii*	Burchell's Coucal		
[2]*Cercomela familiaris*	Familiar Chat		
[2]*Cercomela sinuata*	Sicklewinged Chat		
[2]*Cercotrichas coryphoeus*	Karoo Robin		
[2]*Cercotrichas paena*	Kalahari Robin		
[2]*Ceryle rudis*	Pied Kingfisher		
[2]*Charadrius asiaticus*	Caspian Plover		
[2]*Charadrius hiaticula*	Common Ringed Plover		
[1]*Charadrius pallidus*	Chestnutbanded Plover	**NT**	**NT**
[2]*Charadrius pecuarius*	Kittlitz's Plover		
[2]*Charadrius tricollaris*	Threebanded Plover		
[2]*Chersomanes albofasciata*	Spikeheeled Lark		
[2]*Chlidonias hybridus*	Whiskered Tern		
[2]*Chlidonias leucopterus*	Whitewinged Tern		
[2]*Chrysococcyx caprius*	Diederik Cuckoo		
[2]*Ciconia abdimii*	Abdim's Stork		**NT**
[2]*Ciconia ciconia*	White Stork		
[1]*Ciconia nigra*	Black Stork		**VU**
[2]*Cinnyris fusca*	Dusky Sunbird		
[1]*Circaetus pectoralis*	Blackbreasted Snake Eagle		
[1]*Circus maurus*	Black Harrier	**EN**	**EN**
[1]*Circus pygargus*	Montagu's Harrier		
[1]*Circus ranivorus*	African Marsh Harrier		**EN**
[2]*Cisticola aridulus*	Desert Cisticola		
[2]*Cisticola fulvicapillus*	Neddicky		
[2]*Cisticola juncidis*	Fantailed Cisticola		
[2]*Cisticola subruficapillus*	Greybacked Cisticola		
[2]*Cisticola tinniens*	Levaillant's Cisticola		
[2]*Clamator glandarius*	Great Spotted Cuckoo		
[2]*Clamator jacobinus*	Jacobin Cuckoo		
[3]*Colius colius*	White-backed Mousebird		
[2]*Columba guinea*	Rock Pigeon		
[2]*Columba livia*	Feral Pigeon		
[2]*Coracias caudata*	Lilacbreasted Roller		
[2]*Coracias garrulus*	Eurasian Roller		**NT**
[2]*Coracias naevia*	Purple Roller		
[3]*Corvus albus*	Pied Crow		
[3]*Corvus capensis*	Black Crow		

LIST OF BIRDS (continued)

Birds protected according to NCNCA are indicated with their respective Schedule no. in superscript

Scientific name	Common name	IUCN status	SA Red Data Book
[2]*Cossypha caffra*	Cape Robin		
[2]*Coturnix coturnix*	Common Quail		
[2]*Creatophora cinerea*	Wattled Starling		
[2]*Cuculus clamosus*	Black Cuckoo		
[2]*Cuculus solitarius*	Red-chested Cuckoo		
[2]*Cursorius rufus*	Burchell's Courser		**VU**
[2]*Cursorius temminckii*	Temminck's Courser		
[2]*Cypsiurus parvus*	Palm Swift		
[2]*Delichon urbica*	Common House-Martin		
[2]*Dendrocygna bicolor*	Fulvous Duck		
[2]*Dendrocygna viduata*	White-faced Duck		
[2]*Dendropicos fuscescens*	Cardinal Woodpecker		
[2]*Dicrurus adsimilis*	Forktailed Drongo		
[2]*Egretta alba*	Great Egret		
[2]*Egretta ardesiaca*	Black Heron		
[2]*Egretta garzetta*	Little Egret		
[2]*Egretta intermedia*	Yellow-billed Egret		
[1]*Elanus caeruleus*	Black-shouldered Kite		
[2]*Emberiza capensis*	Cape Bunting		
[2]*Emberiza flaviventris*	Goldenbreasted Bunting		
[2]*Emberiza impetuani*	Larklike Bunting		
[2]*Emberiza tahapisi*	Rock Bunting		
[2]*Eremomela icteropygialis*	Yellowbellied Eremomela		
[2]*Eremopterix verticalis*	Greybacked Finchlark		
[2]*Estrilda astrild*	Common Waxbill		
[2]*Estrilda erythronotos*	Blackcheeked Waxbill		
[3]*Euplectes afer*	Yellow-crowned Bishop		
[3]*Euplectes orix*	Red Bishop		
[2]*Eupodotis afraoides*	Northern Black Korhaan		
[2]*Eupodotis ruficrista*	Red-crested Korhaan		
[1]*Falco biarmicus*	Lanner Falcon		**VU**
[1]*Falco naumanni*	Lesser Kestrel		
[1]*Falco peregrinus*	Peregrine Falcon		
[1]*Falco rupicolis*	Rock Kestrel		
[1]*Falco rupicoloides*	Greater Kestrel		
[2]*Fulica cristata*	Red-knobbed Coot		
[2]*Galerida magnirostris*	Large-billed Lark		
[2]*Gallinago nigripennis*	Ethiopian Snipe		
[2]*Gallinula chloropus*	Common Moorhen		
[1]*Glareola nordmanni*	Blackwinged Pratincole	**NT**	**NT**
[1]*Glaucidium perlatum*	Pearlspotted Owl		
[2]*Granatina granatina*	Violeteared Waxbill		
[1]*Gyps africanus*	White-backed Vulture	**CR**	**CR**
[1]*Gyps coprotheres*	Cape Vulture	**EN**	**EN**
[2]*Halcyon albiventris*	Brown-hooded Kingfisher		

LIST OF BIRDS (continued)

Birds protected according to NCNCA are indicated with their respective Schedule no. in superscript

Scientific name	Common name	IUCN status	SA Red Data Book
[1]*Haliaeetus vocifer*	African Fish Eagle		
[2]*Hieraaetus pennatus*	Booted Eagle		
[2]*Himantopus himantopus*	Blackwinged Stilt		
[2]*Hippolais icterina*	Icterine Warbler		
[2]*Hirundo albigularis*	White-throated Swallow		
[2]*Hirundo cucullata*	Greater Striped Swallow		
[2]*Hirundo dimidiata*	Pearl-breasted Swallow		
[2]*Hirundo fuligula*	Rock Martin		
[2]*Hirundo rustica*	Barn Swallow		
[2]*Hirundo semirufa*	Rufous-chested Swallow		
[2]*Hirundo spilodera*	South African Swallow		
[2]*Indicator indicator*	Greater Honeyguide		
[2]*Indicator minor*	Lesser Honeyguide		
[2]*Ixobrychus minutus*	Common Little Bittern		
[2]*Lagonosticta senegala*	Red-billed Firefinch		
[2]*Lamprotornis nitens*	Red-shouldered Glossy-starling		
[2]*Laniarius atrococcineus*	Crimson-breasted Shrike		
[2]*Lanius collaris*	Common Fiscal		
[2]*Lanius collurio*	Red-backed Shrike		
[2]*Lanius minor*	Lesser Grey Shrike		
[2]*Larus cirrocephalus*	Grey-headed Gull		
[1]*Leptoptilos crumeniferus*	Marabou Stork		**NT**
[2]*Macronyx capensis*	Cape Longclaw		
[2]*Malcorus pectoralis*	Rufous-eared Warbler		
[2]*Megaceryle maxima*	Giant Kingfisher		
[1]*Melierax canorus*	Pale Chanting Goshawk		
[1]*Melierax gabar*	Gabar Goshawk		
[2]*Merops apiaster*	European Bee-eater		
[2]*Merops bullockoides*	White-fronted Bee-eater		
[2]*Merops hirundineus*	Swallowtailed Bee-eater		
[2]*Milvus aegyptius*	Yellowbilled Kite		
[1]*Milvus migrans*	Black Kite		
[2]*Mirafra africana*	Rufous-naped Lark		
[2]*Mirafra fasciolata*	Eastern Clapper Lark		
[2]*Mirafra passerina*	Monotonous Lark		
[2]*Monticola brevipes*	Shorttoed Rockthrush		
[2]*Motacilla aguimp*	African Pied Wagtail		
[2]*Motacilla capensis*	Cape Wagtail		
[2]*Muscicapa striata*	Spotted Flycatcher		
[1]*Mycteria ibis*	Yellow-billed Stork		**EN**
[2]*Myrmecocichla formicivora*	Anteating Chat		
[1]*Neotis ludwigii*	Ludwig's Bustard	**EN**	**EN**
[2]*Netta erythrophthalma*	Southern Pochard		
[2]*Nilaus afer*	Brubru		
[2]*Numenius phaeopus*	Whimbrel		
[2]*Numida meleagris*	Helmeted Guineafowl		
[2]*Nycticorax nycticorax*	Blackcrowned Night Heron		
[2]*Oena capensis*	Namaqua Dove		
[2]*Oenanthe monticola*	Mountain Chat		
[2]*Oenanthe pileata*	Capped Wheatear		

LIST OF BIRDS (continued)

Birds protected according to NCNCA are indicated with their respective Schedule no. in superscript

Scientific name	Common name	IUCN status	SA Red Data Book
[2]*Onychognathus nabouroup*	Palewinged Starling		
[2]*Oriolus oriolus*	Eurasian Golden Oriole		
[2]*Ortygospiza atricollis*	Quail Finch		
[2]*Oxyura maccoa*	Maccoa Duck	**VU**	**NT**
[2]*Parisoma layardi*	Layard's Tit-Babbler		
[2]*Parisoma subcaeruleum*	Chestnut-vented Tit-Babbler		
[2]*Parus cinerascens*	Ashy Tit		
[2]*Passer diffusus*	Southern Greyheaded Sparrow		
[3]*Passer domesticus*	House Sparrow		
[3]*Passer melanurus*	Cape Sparrow		
[2]*Passer motitensis*	Great Sparrow		
[2]*Phalacrocorax africanus*	Reed Cormorant		
[2]*Phalacrocorax lucidus*	White-breasted Cormorant		
[2]*Philetairus socius*	Sociable Weaver		
[2]*Philomachus pugnax*	Ruff		
[1]*Phoenicopterus minor*	Lesser Flamingo	**NT**	**NT**
[1]*Phoenicopterus ruber*	Greater Flamingo		**NT**
[2]*Phoeniculus purpureus*	Green Wood-Hoopoe		
[2]*Phragmacia substriata*	Namaqua Warbler		
[2]*Phylloscopus trochilus*	Willow Warbler		
[2]*Platalea alba*	African Spoonbill		
[2]*Plectropterus gambensis*	Spurwinged Goose		
[2]*Plegadis falcinellus*	Glossy Ibis		
[2]*Plocepasser mahali*	Whitebrowed Sparrowweaver		
[3]*Ploceus velatus*	Masked Weaver		
[2]*Podiceps cristatus*	Great Crested Grebe		
[2]*Podiceps nigricollis*	Blacknecked Grebe		
[1]*Polemaetus bellicosus*	Martial Eagle	**EN**	**EN**
[1]*Polihierax semitorquatus*	Pygmy Falcon		
[1]*Polyboroides typus*	Gymnogene		
[2]*Porphyrio madagascariensis*	African Purple Swamphen		
[2]*Porzana pusilla*	Baillon's Crake		
[2]*Prinia flavicans*	Blackchested Prinia		
[2]*Psophocichla litsipsirupa*	Groundscraper Thrush		
[2]*Pternistis adspersus*	Red-billed Francolin		
[2]*Pterocles burchelli*	Burchell's Sandgrouse		
[2]*Pterocles namaqua*	Namaqua Sandgrouse		
[1]*Ptilopsis granti*	Southern White-faced Owl		
[3]*Pycnonotus nigricans*	African Red-eyed Bulbul		
[2]*Pytilia melba*	Melba Finch		
[3]*Quelea quelea*	Red-billed Quelea		
[2]*Rallus caerulescens*	African Rail		
[2]*Recurvirostra avosetta*	Pied Avocet		
[2]*Rhinopomastus cyanomelas*	Scimitarbilled Woodhoopoe		
[2]*Rhinoptilus africanus*	Doublebanded Courser		
[2]*Riparia cincta*	Banded Martin		
[2]*Riparia paludicola*	Brownthroated Martin		
[2]*Riparia riparia*	Sand Martin		
[1]*Rostratula benghalensis*	Greater Painted-snipe		
[1]*Sagittarius serpentarius*	Secretarybird	**EN**	**VU**

LIST OF BIRDS (continued)

Birds protected according to NCNCA are indicated with their respective Schedule no. in superscript

Scientific name	Common name	IUCN status	SA Red Data Book
[2]*Sarkidiornis melanotos*	Comb Duck		
[2]*Saxicola torquata*	African Stonechat		
[2]*Scleroptila levaillantoides*	Orange River Francolin		
[2]*Scopus umbretta*	Hamerkop		
[2]*Serinus albogularis*	Whitethroated Canary		
[2]*Serinus atrogularis*	Blackthroated Canary		
[2]*Serinus flaviventris*	Yellow Canary		
[2]*Sigelus silens*	Fiscal Flycatcher		
[2]*Spizocorys conirostris*	Pinkbilled Lark		
[2]*Sporopipes squamifrons*	Scalyfeathered Finch		
[2]*Spreo bicolor*	Pied Starling		
[2]*Stenostira scita*	Fairy Flycatcher		
[2]*Streptopelia capicola*	Cape Turtle Dove		
[2]*Streptopelia semitorquata*	Redeyed Dove		
[2]*Streptopelia senegalensis*	Laughing Dove		
[2]*Struthio camelus*	Ostrich		
[2]*Sylvia borin*	Garden Warbler		
[2]*Sylvietta rufescens*	Longbilled Crombec		
[2]*Tachybaptus ruficollis*	Dabchick		
[2]*Tachymarptis melba*	Alpine Swift		
[2]*Tadorna cana*	South African Shelduck		
[2]*Tchagra australis*	Threestreaked Tchagra		
[2]*Telophorus zeylonus*	Bokmakierie		
[2]*Terpsiphone viridis*	African Paradise-Flycatcher		
[2]*Thalassornis leuconotus*	White-backed Duck		
[2]*Threskiornis aethiopicus*	Sacred Ibis		
[2]*Tockus leucomelas*	Southern Yellowbilled Hornbill		
[2]*Tockus nasutus*	Grey Hornbill		
[1]*Torgos tracheliotus*	Lappet-faced Vulture	**EN**	**EN**
[2]*Trachyphonus vaillantii*	Crested Barbet		
[2]*Tricholaema leucomelas*	Acacia Pied Barbet		
[2]*Tringa glareola*	Wood Sandpiper		
[2]*Tringa nebularia*	Greenshank		
[2]*Tringa stagnatilis*	Marsh Sandpiper		
[2]*Turdus smithi*	Karoo Thrush		
[2]*Turnix sylvatica*	Kurrichane Buttonquail		
[1]*Tyto alba*	Barn Owl		
[2]*Upupa africana*	African Hoopoe		
[2]*Uraeginthus angolensis*	Blue Waxbill		
[3]*Urocolius indicus*	Red-faced Mousebird		
[2]*Vanellus armatus*	Blacksmith Plover		
[2]*Vanellus coronatus*	Crowned Plover		
[2]*Vidua chalybeata*	Steelblue Widowfinch		
[2]*Vidua macroura*	Pintailed Whydah		
[2]*Vidua regia*	Shafttailed Whydah		
[2]*Zosterops pallidus*	Pale White-eye		

APPENDIX 3

A photographic guide for species of conservation concern that occur on site

Lessertia annularis

All *Lessertia* spp. are protected in terms of Schedule 1 of NCNCA

Vachellia erioloba

This species is protected under the NFA

Olea europaea subsp. *africana*

Protected under Schedule 2 of the NCNCA

Gymnosporia buxifolia

All *Gymnosporia* spp. are protected under Schedule 2 of the NCNCA

Spiny shrub or small tree. Leaves in tufts, obovate, toothed above. Highly variable

Many white flowers with an unpleasant smell in axillary cymes.

Aloe claviflora

All Asphodelaceae spp. are protected under Schedule 2 of the NCNCA

Aloe grandidentata

All Asphodelaceae spp. are protected under Schedule 2 of the NCNCA

Trachyandra bulbinifolia

All Asphodelaceae spp. are protected under Schedule 2 of the NCNCA

Ornithogalum flexuosum

All Ornithogalum spp. are protected under Schedule 2 of the NCNCA

Moraea pallida

All Iridaceae spp. are protected under Schedule 2 of the NCNCA

Oxalis lawsonii

All *Oxalis* spp. are protected under Schedule 2 of the NCNCA

Jamesbrittenia tysonii

All *Jamesbrittenia* spp. are protected under Schedule 2 of the NCNCA

Nemesia fruticans

All *Jamesbrittenia* spp. are protected under Schedule 2 of the NCNCA