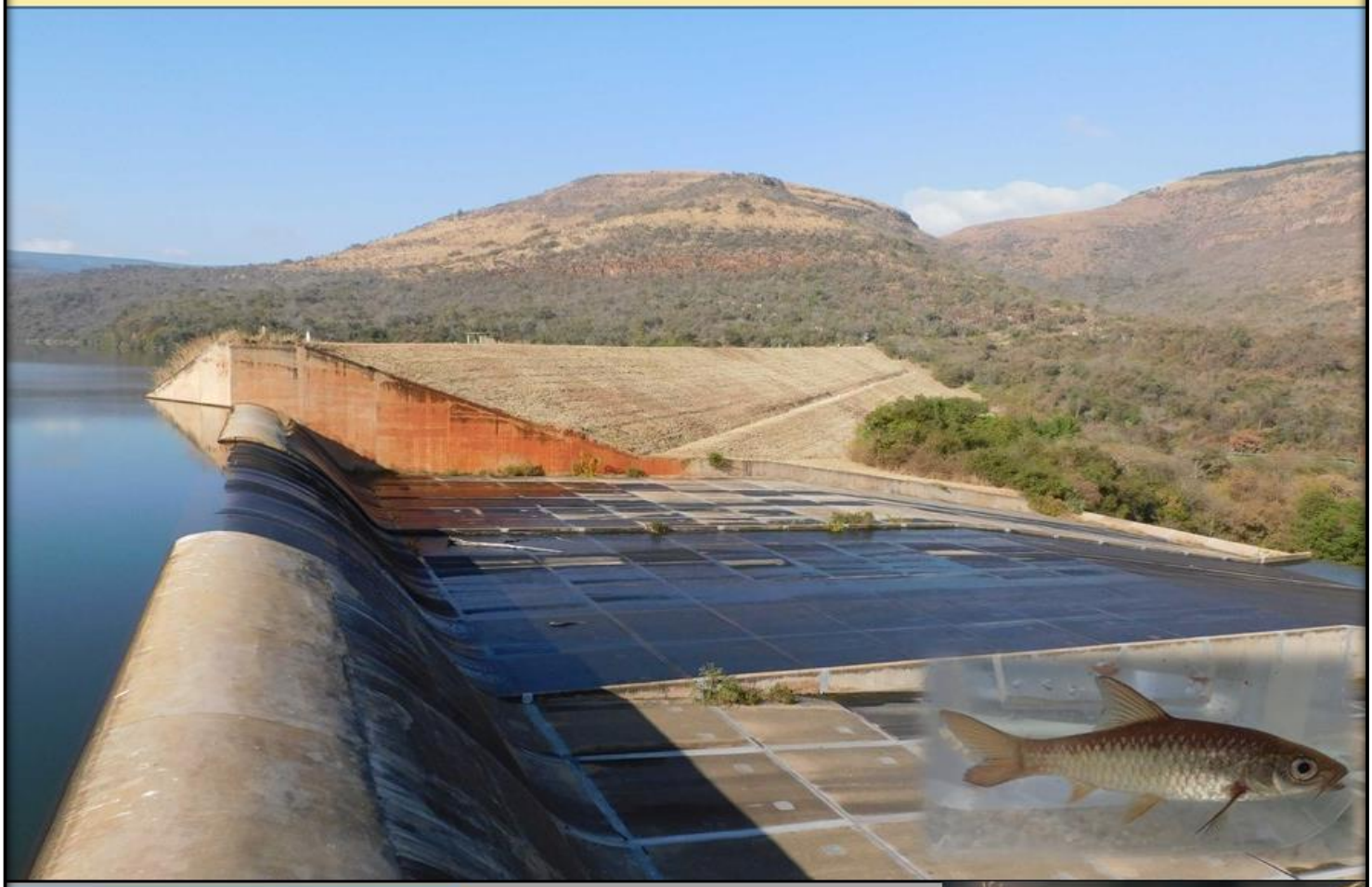
SAPPI NGODWANA: DAM REMEDIATION

An ecological assessment regarding the Environmental and Water Use Authorisation



DR ANDREW DEACON

August 2020

SAPPI NGODWANA: DAM REMEDIATION

An ecological assessment regarding the Environmental and Water Use Authorisation for remedial work required on the SAPPI Ngodwana Dam (Mpumalanga).

SPECIALIST STUDY: ECOLOGICAL ASSESSMENT.

August 2020

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Registered with the South African Council for Natural Scientific Professions

(Registration number: 116951)

Executive Summary

Ecoleges Environmental Consultants were appointed to undertake an Environmental Impact Assessment on the farm Ngodwana 638 and 1030 Portion 0 in the Ngodwana area (Mpumalanga) and this specialist ecological study forms part of the EIA process for the proposed project.

Terms of Reference

The proposal for the Ecological Specialist Study was to undertake an ecological assessment that will form part of the Environmental Impact Assessment for remedial work required on the SAPPI Ngodwana Dam. The Environmental Evaluation concerns the riverine aspects of the delineated footprint (Regulated Zone) and the positioning of site camps in the terrestrial zone.

Project Description

Ngodwana Dam is a 41 m high zoned earthfill Category III Dam. The dam is located on a tributary of the Elands River, Mpumalanga Province, directly upstream from the N4 highway and the Ngodwana Paper Mill, 40 km from Mbombela. The dam facility is regarded as a water reservoir facility which has a primary function of the storage of water for SAPPI's Ngodwana factory, requiring no additional land-use approvals.

The dam remediation is to ensure the continued safe operation of this Category III dam and the stability of the main and right flank embankments and its foundations (Ecoleges, 2020).

The scope of construction works to be included in the rehabilitation and to be authorised is:

1. Stabilizing berm on the downstream face of the main embankment to RL 941.3 m, including approximately 30 000 m^3 of earthworks, a new internal drainage system (sand and gravel filters, rock toe and drain pipes with inspection concrete manholes) and gabion retaining walls.

2. Subsoil pipe drains above the berm of 133 m length with inspection concrete manholes.

3. Raising of the right flank embankment to prevent overtopping and failure during large floods and to improve the stability of the embankment (earthworks to be confirmed).

The material for the haul road upgrading and right flank (± 29,000m^3) will be hauled from the stockpiles at the SAPPI dumpsite area to the South-West of SAPPI and the rock toe material (22,500m^3) will come from commercial sources to the East of Ngodwana. The balance of material (7,500m^3) for this section will also come from SAPPI stockpiles at the dumpsite area.

During the field study in the project area, a total of four units comprising untransformed vegetation/habitat and five units comprising transformed vegetation/habitat were identified. These nine units are listed below.

Vegetation units and land cover type:

Untransformed vegetation/habitat

1. Legogote Sour Bushveld
2. Ngodwana River
3. Ngodwana Catchment Valley Bottom Wetland
4. Ngodwana Catchment Valley Seeps

Transformed vegetation/habitat

5. Old Mining
6. Power Line Servitude
7. Ngodwana Dam Wall
8. Habitat impacted by Dam Wall Construction early 1980s
9. Roads and pipelines

Vegetation communities

The vegetation communities of the Ngodwana Dam study area are classified as the Legogote Sour Bushveld**,** which has a conservation status of "Vulnerable" (NSBA)**.** This vegetation type consists of open woodland of the hilly areas and valleys of the project area. A total of 48 indigenous plant species were recorded during fieldwork; as well as 8 exotic species, some declared alien invaders.

Conservation-important plant species listed for the quarter-degree grid 2530DA in the Mpumalanga Tourism & Parks Agency's (MTPA) threatened species database and the Environmental Screening Tool, listed 17 threatened species for the study- and surrounding area. None were encountered during the survey. Four riparian indicator plant species were observed in the riparian zone along the Ngodwana River during the survey.

Aquatic habitat assessment.

During the July 2020 survey, the IHAS and HQI scores at Site 1 were classified as "Fair" to "Good" due to the fast flowing riffles and associated habitats. Site 2 habitat consisted mostly of pools and marginal habitats with little rocky riffles and slower flows, resulting in the aquatic habitat availability consisting of "Fair" scores).

Aquatic invertebrate assessment

The better habitat quality at Site 1 also reflects in the macro-invertebrate scores, where the ASPT score at Site 1 is 6.9 ("Good" very close to "Excellent"), while the ASPT score at Site 2 is 5.0 (borderline between "Fair" and "Good"). Although Site 1 had a lower number of Families, these were mostly more sensitive taxa.

Fish Response Assessment Index (FRAI)

Four out of nine fish species were sampled in the Ngodwana River during the current survey. One of these was *Enteromius argenteus,* a Species of Special Concern. The relative FRAI score at this reach in the Ngodwana River was placed within the limits of an ecological state category Class D (54.9%), which means this reach is "Largely modified".

The "Flow Modification" metric carries the most weight due to the impact of the Ngodwana Dam wall, followed by "Velocity-depth" and "Cover" metrics caused by lack of surface flows certain times of the year, also due to the presence of the dam. Stagnant pools during no-flow situations and poor water quality in the Elands River explain the Physico-chemical metric, while both the dam wall and poor water quality obstacles impact on fish migration. The Rainbow trout in the upper Ngodwana River flags the "Impact of Introduced".

Frog surveys

According to the 2004 Frog Atlas, the Ngodwana Dam project area is situated in the Sour Grassland Assemblage. The associated frog distribution maps, confirms 18 frog species are expected to be present in the study area. Of these frog species it is anticipated that 17 species may reside in the project area, accommodated by potential habitat in the area.

Using distribution maps and habitat quality, two endemic species are expected to occur in the Ngodwana Dam project area:

- Raucous toad *(Sclerophrys capensis)*
- Gray's stream frog (*Strongylopus grayii*)

No threatened frog species are expected to occur in the area.

Reptiles

According to the distribution of reptiles in South Africa, 49 species have distribution ranges extending into the region. Of the 38 of these species that are expected to occur in the area, 37 species has adequate habitat available.

During surveys in July 2020, four of the expected reptile species were encountered in the Ngodwana Dam project area. Due to the fact that reptiles aestivates during the dry and cold winter months, the time of the year plays an important role regarding surveying reptiles. Therefore, the cold and dry winter weather during the survey explains their low numbers observed:

- Common dwarf gecko *(Lygodactylus capensis capensis)*
- Variable skink (*Trachylepis varia)*
- Rainbow rock skink (*Trachylepis margaritifer*)
- Striped skink (*Trachylepis striata*)

According to the South African Reptile Atlas, there are 10 endemic reptile species that have distribution ranges overlapping the study area, nine of these have the potential to occur here:

- Spotted dwarf gecko (*Lygodactylus ocellatus ocellatus*)
- Transvaal gecko (*Pachydactylus affinis*)
- Jacobsen's Thread Snake (*Leptotyphlops jacobseni*)
- Swazi rock snake (*Inyoka swazicus*)
- Western Natal green snake (*Philothamnus natalensis occidentalis*)
- Montane dwarf burrowing skink (*Scelotes mirus*)
- Large-scaled grass lizard *(Chamaesaura macrolepis)*
- Wilhelm's flat lizard (*Platysaurus intermedius wilhelmi*)
- Distant's ground agama (*Agama aculeata distanti*)

There are two threatened reptile species expected to occur in the area:

- Wilhelm's flat lizard (*Platysaurus intermedius wilhelmi*) - Conservation status for South Africa – Least concern; Conservation status for Mpumalanga – Near-threatened; Endemic – Mpumalanga.
- Large-scaled grass lizard *(Chamaesaura macrolepis)* - IUCN 2015: Near-threatened; SARCA 2015: Near-threatened.

There is also one South African Threatened or Protected Species (TOPS) expected to be present in the region:

- Southern African python (*Python natalensis*).

Birds

During the July 2020 survey, a variety of biotopes and sites were surveyed for bird species, including both transformed and untransformed habitats. A total of 283 bird species were observed in this region during the Bird Atlas project. If bird distribution and local habitat are evaluated, it is clear that all the species of birds that are likely to utilise the different biotopes of the study area, can be present in the Ngodwana Dam and surrounding area. The July 2020 surveys produced a total of 44 bird species across all transects in the Ngodwana Dam project area.

Through comparisons with expected bird lists, a total of 23 bird species expected to be found in the area are listed as “Species of Special Concern”. If bird distribution and local habitat are evaluated, all the Species of Special Concern birds are likely to utilise the different biotopes of

the study area.

Currently thirteen endemic bird species are expected to occur in the area:

- Southern Bald Ibis *(Geronticus calvus)*
- Forest Buzzard (*Buteo trizonatus*)
- Blue korhaan *(Eupodotis caerulescens)*
- Knysna Turaco (*Tauraco corythaix*)
- Ground Woodpecker (*Geocolaptes olivaceus*)
- Eastern Long-billed Lark (*Certhilauda semitorquata*)
- Cape Rock Thrush (*Monticola rupestris*)
- Sentinel Rock Thrush (*Monticola explorator*)
- Buff-streaked Chat (*Oenanthe bifasciata*)
- Chorister Robin-Chat (*Cossypha dichroa*)
- Yellow-breasted Pipit (*Anthus chloris*)
- Pied Starling *(Lamprotornis bicolor)*
- Greater Double-collared Sunbird (*Cinnyris afer*)

The following 15 threatened bird species have distribution ranges that correspond with the study area (IUCN, 2014; NEMBA, 2014; Red Data Book, 2015):

- African Crowned Eagle *(Stephanoaetus coronatus)* - IUCN 2015 Status: Near-threatened. SA Red Data (Taylor 2015): Vulnerable. NEMBA (TOPS 2007): Vulnerable species. Mpumalanga: Vulnerable.
- African Grass-owl *(Tyto capensis)* - SA Red Data (Taylor 2015): Vulnerable.
- Black-bellied Bustard (*Lissotis melanogaster*) - SA Red Data (Barnes 2000): Near-threatened.
- Black-winged Pratincole *(Glareola nordmanni)* - IUCN 2017 NT: Near-threatened; SA Red Data (Taylor 2015): Near-threatened. Conservation status for Mpumalanga – Near-threatened.
- Blue korhaan *(Eupodotis caerulescens)* – IUCN (2018) Near-threatened.
- Cape Vulture *(Gyps coprotheres)* - IUCN 2015: EN Endangered; SA Red Data (Taylor 2015): Endangered. NEMBA TOPS (2015): Endangered species.
- Denham's Bustard *(Neotis denhami)* - IUCN 2017 NT: Near-threatened. NEMBA TOPS (2015): Vulnerable species; SA Red Data (Taylor 2015): Vulnerable.
- European Roller (*Coracias garrulus*) - SA Red Data (Taylor 2015): Near-threatened; IUCN 2018 Least concern.
- Gurney's Sugarbird (*Promerops gurneyi*) - IUCN (2018): Near-threatened.
- Lanner Falcon *(Falco biarmicus)* - SA Red Data (Taylor 2015): Vulnerable. IUCN 2017 Status: Least concern.
- Secretary bird (*Sagittarius serpentarius*) - IUCN 2017 VU Vulnerable; SA Red Data (Taylor 2015): Vulnerable. NEMBA (TOPS 2007): Vulnerable species.
- Southern Bald Ibis *(Geronticus calvus)* – IUCN 2017 VU: Vulnerable; SA Red Data (Taylor 2015): Vulnerable; NEMBA TOPS (2015): Vulnerable species; SA endemic.
- White-bellied korhaan (*Eupodotis caffra*) – SA Red Data (Taylor 2015): Vulnerable.
- Yellow-breasted Pipit (*Anthus chloris*) - IUCN 2017 Vulnerable. SA Red Data (Taylor 2015): Vulnerable.

Mammals

Of all the mammal species that have distribution ranges in the region, 109 coincide with the Ngodwana Dam project area. If local habitat are evaluated, it is clear that a total of all 109 species of mammals are likely to utilise the different biotopes of the study area. The larger species will be accommodated in the adjacent game reserve.

During the July 2020 survey, signs and/or sightings of 7 mammal species were recorded or reported by the staff in the area:

- Chacma baboon (*Papio ursinus*)

- Vervet monkey (*Cercopithecus aethiops*)
- Leopard (*Panthera pardus*)
- Black-backed jackal (*Canis mesomelas*)
- Bushpig *(Potamochoerus larvatus)*
- Nyala *(Tragelaphus angasii)*
- Greater Canerat *(Thryonomys swinderianus)*

After analysing the fauna distribution data and habitat availability, 17 frog species, 37 reptile species, 283 bird species and 109 mammal species are expected to occur in the project area, a total of 446 animal species. The presence of these different faunal groups is however dependent on availability of potential habitat types in each distinct biotope.

It is expected that 45 faunal Species of Special Concern that have a Medium to Optimal probability of occurring in the region, will frequent the Ngodwana Dam project area, periodically as nomads, or permanent as inhabitants. In the event that any threatened or near-threatened animal species are recorded within the study area in future, appropriate conservation measures should be developed in consultation with the relevant conservation authorities

Screening Report

The National Web based Environmental Screening Tool is a geographically based web-enabled application which allows a proponent intending to submit an application for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended to screen their proposed site for any environmental sensitivity. Following is an abstract from the Screening Tool application:

Sensitivity features of the project area.

Theme	Sensitivity	Feature
Agriculture Theme	Very High	Land capability; 12. High-Very high
Animal species theme	Medium	Mammalia - *Cercopithecus albogularis schwarzi* Mammalia - *Ourebia ourebi ourebi* Insecta - *Lepidochrysops irvingi* Insecta - *Serradinga clarki amissivallis* Insecta - *Lepidochrysops swanepoeli* Insecta - *Orachrysops violescens*
Aquatic biodiversity	Very High	Aquatic CBAs Strategic water source area Freshwater ecosystem priority area quinary catchments
Archaeological and Cultural Heritage Theme	High	Within 500 m of an important river
Plant Species Theme	Medium	Sensitive species 330
Terrestrial Biodiversity Theme	Very High	Vulnerable ecosystem Critical Biodiversity Area 1 Focus Areas for land-based protected areas expansion Freshwater ecosystem priority area quinary catchments Strategic Water Source Area

Sensitivity mapping

Sensitivity assessments identify those sections of the study area that have high conservation value or that may be sensitive to disturbance. The overall ecological value and sensitivity of the different vegetation and land cover types of the project area, are rated as follow:

Vegetation units and land cover type:

Untransformed vegetation/habitat

1. Legogote Sour Bushveld - **Very high**
2. Ngodwana River - **Very high**
3. Ngodwana Catchment Valley Bottom Wetland - **Very high**
4. Ngodwana Catchment Valley Seeps - **Very high**

Transformed vegetation/habitat

5. Old Mining - **Negligible**
6. Power Line Servitude - **Negligible**
7. Ngodwana Dam Wall - **Negligible**
8. Habitat impacted by Dam Wall Construction early 1980s - **Low**
9. Roads and pipelines - **Negligible**

The use of CBA maps in Environmental Impact Assessments

A CBA map of the study area was compiled by using the Biodiversity Geographic Information System (BGIS) maps. The key results of the Biodiversity Geographic Information System (BGIS) maps and LUDS Report are summarised below:

National terrestrial information: Ngodwana 638 and 1030 (Mpumalanga).

- Savanna Biome (Lowveld): SVI 9 Legogote Sour Bushveld - Threatened ecosystem status: Vulnerable
- Terrestrial CBA: Irreplaceable

Aquatic Critical Biodiversity Areas

- Water Management Area (WMA): Inkomati WMA - Freshwater Ecosystem Priority Areas (FEPA) WMA;
- Ecological Support Areas: Important subcatchments and ESA: FEPA subcatchments; Fish support area
- Freshwater Critical Biodiversity Areas **(**CBA): FEPA river

Buffer zones

Buffer zones have been used in land-use planning to protect natural resources and limit the impact of one land-use on another. Buffer zones will serve as a mitigating measure for impacts created by the construction and operational phases of the proposed Ngodwana Dam project.

Final aquatic impact buffer requirements (including practical management considerations) for both sites and all the segments are:

Wetland system	Construction Phase	Operational Phase	Final aquatic impact buffer requirement
Ngodwana River	18 m	19 m	19 m
Ngodwana catchment valley bottom wetland	21 m	22 m	19 m
Ngodwana catchment seep wetland	24 m	24 m	24 m

Assessment of impacts and proposed mitigation

The potential impacts of the project on biodiversity of the study area are assessed under five broad impacts. The following list provides a summary of the impact assessment, indicating the changes from pre-mitigation to post mitigation.

Main Impact 1: The clearing of vegetation or covering of habitat in the project footprint area for construction purposes.

Many different areas will be cleared and covered during the proposed project construction period. By adhering to the main mitigation aspects, a "Medium" significance can be mitigated to a "Low" significance:

- Care must be taken not to impact on areas outside the demarcated route and unnecessary clearing of areas should also be avoided.
- Removing large trees should be avoided as far as possible.
- Whenever tall trees are removed on haul roads, these trees must be replaced in order to mimic the natural habitat impacted on.
- During site clearing, large trees should be left intact as they can become incorporated as shade and garden features in the site establishment areas.
- Refrain from fragmenting the riparian corridor by respecting the buffer zones.
- No indigenous plants of Special Concern must be impacted on.
- Indigenous vegetation should be planted during rehabilitation.
- Corridors and buffers must be respected and the riparian zone must not be disturbed at all.

Main Impact 2: Altering bed, banks or course of a watercourse.

The Ngodwana Dam project area surrounds a network of riverine wetland areas which could be impacted adversely by the proposed project activities. By adhering to the main mitigation aspects, a "Medium" significance can be mitigated to a "Low" significance:

- All riverine wetlands should be treated with care throughout the construction phase.
- Respect buffer zones.
- No covering of material or dumping of any rubble will be allowed into the wetland system.
- Water flow in drainage lines and wetland systems must not be obstructed.
- Construction activities inside the riparian buffer zone must proceed with special care.

Main Impact 3: Erosion and siltation.

Due to the proximity of the Ngodwana River and associated network of riverine wetland areas, erosion and siltation originating from construction activities could be impacted adversely by the proposed project activities. By adhering to the main mitigation aspects, a "Medium" significance can be mitigated to a "Low" significance:

- Best Practice measures should be implemented during construction and rehabilitation.
  Mitigation and management measures are to be specified in order to ensure that areas susceptible to potential erosion are protected both during the construction and operational phase of the development.
- Stringent mitigation measures must be imposed during construction to minimize runoff and stop possible silt run-off.
- The contamination of water leaving the site could be controlled by the use of silt-fencing, rows of hessian bags, mulch, brushwood and deflection berms.
- All areas susceptible to erosion must be identified and protection measures be implemented.
- In any areas where the risk of erosion is evident, appropriate temporary or permanent works and water energy dispersion structures must be installed.

- Cleared or bare areas prone to erosion should be monitored and rehabilitation should be implemented wherever indications of potential erosion become evident.

Main Impact 4: Noise, movement and dust.

Proposed construction activities over a period of time will result in noise, movement and dust which will impact negatively on local fauna and flora. By adhering to the main mitigation aspects, a “Medium” significance can be mitigated to a “Low” significance:

- The disturbance will be for a relative short period, no major activities other than routine maintenance should be allowed during the Operational Phase.
- All activities will be contained to the dam wall and roads leading tot the construction site.
- Workers should be restricted to the construction site.
- Dust incidences can be treated by either watering, alternative material choices or using dust binders.
- Alternatives include re-vegetation of temporarily exposed surfaces on which infrastructure will not be constructed.

Main Impact 5: Introduction of alien vegetation.

Proposed construction activities and transport of material into the project area have the potential to spread further and impact on indigenous plant communities in the area. By adhering to the main mitigation aspects, a “Medium” significance can be mitigated to a “Low” significance:

- All aggressive alien species should be removed.
- Footprint areas should be kept as small as possible when removing alien plant species.
- Control involves killing the plants present, killing the seedlings which emerge, and establishing and managing an alternative plant cover to limit re-growth and re-invasion.
- Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge.
- Implement an invasive alien plant management plan. The broad objectives of the plan include the following:

    - Ensure alien plants do not become dominant in parts of the site, or the whole site, through the control and management of alien and invasive species presence, dispersal and encroachment.
    - Develop and implement a monitoring and eradication programme for alien and invasive plant species.
    - Promote the natural re-establishment and planting of indigenous species in order to retard erosion and alien plant invasion.

i) General Requirements for EAPs and Specialists including Content of Specialist Reports in terms of Appendix 6 of the EIA Regulations, 2014

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Table 1:	Specialist reports and reports on specialist processes Checklist	STATUS
	Requirements for Specialist Reports Appendix 6 of Amendments to the environmental impact assessment regulations, 2014 (Government Notice No 326, 7th April 2017), promulgated in terms of National Environmental Management Act, 1998 (Act No. 107 of 1998).	Reference to section of specialist report or justification for not meeting requirement
1	A specialist report prepared in terms of these Regulations must contain—	
(a) i	the specialist who prepared the report; and	The title page of this report.
(a) ii	the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section v) Details of the Author; Appendix 2 of this report.
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Section ii) of this report: declaration of interest.
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	1.1 Terms of Reference.
(cA)	an indication of the quality and age of base data used for the specialist report;	Section 1.2 Review - an indication of the quality and age of base data used for the specialist report
(cB)	a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	3.1 Present Ecological State of the study area
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	1.5 Assumptions, Limitations and Knowledge gaps.
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	2. Methodology - Methods and approach
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	5.2 Sensitivity mapping.
(g)	an identification of any areas to be avoided, including buffers;	5. Sensitivity mapping - Critical Biodiversity Areas – 5.4 Corridors for Connectivity - buffers.
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	5.6 Desired management Objective; Figure 45 buffers; Figure 39: CBAs.

Table 1:	Specialist reports and reports on specialist processes Checklist	STATUS
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	1.5 Assumptions, Limitations and Knowledge gaps.
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity (including identified alternatives, on the environment) or activities;	5.7 Assessment of impacts and proposed mitigation.
(k)	any mitigation measures for inclusion in the EMPr	5.8 Conditions for inclusion in the environmental authorisation (Step 2.3 – Table 7).
(l)	any conditions for inclusion in the environmental authorisation	5.8 Conditions for inclusion in the environmental authorisation (Step 2.3 – Table 7).
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation	5.9 Monitoring requirements
(n)	a reasoned opinion -	
.i	as to whether the proposed activity, activities or portions thereof should be authorised;	5.10 Reasoned opinion
(iA)	regarding the acceptability of the proposed activity or activities; and	b. Apply the mitigation hierarchy (Step 2.3.2 – Table 7):
.ii	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	5.10 Reasoned opinion: Summary of mitigation measures
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	5.11 Consultation process
(p)	a summary and copies if any comments that were received during any consultation process, and where applicable all responses thereto; and	n/a
(q)	any other information requested by the competent authority.	n/a

ii) DECLARATION

I, Andrew Richard Deacon, declare that I –

- act as an independent specialist consultant in the field of ecological science;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2006;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report; and
- will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not.

ANDREW RICHARD DEACON

iii) Table of Contents

iv) Abbreviations

#	Number
AQV	Aquatic vegetation
ASPT	Average Score per Taxon
BGIS	Biodiversity Geographic Information System
°C	Degrees Celsius
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Areas
cm	Centimetre
DWA	Department of Water Affairs (post-2010)
DWAF	Department of Water Affairs and Forestry (pre-2010)
DWS	Department of Water and Sanitation (since May 2014))
E	East
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
e.g.	For example
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMF	Environmental Management Frameworks
EMP	Environmental Management Plan
EMPr	Environmental Management Programme
EN	Endangered
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Areas
FRAI	Fish Response Assessment Index
FROC	Frequency of Occurrence
GIS	Geographic Information System
GPS	Global Positioning System
Ha	Hectares
HCR	Habitat Cover Ratings
HQI	Habitat Quality Index
IHAS	Integrated Habitat Assessment System
IUCN	International Union for Conservation of Nature
km	Kilometre
KNP	Kruger National Park
LUDS	Land-Use Decision Support Tool
m	Meter
m^2	Square meter
m^3	Cubic meter
m^3/s	Cubic meter per seconds
mamsl	Metres above mean sea level
MBCP	Mpumalanga Biodiversity Conservation Plan
MBSP	Mpumalanga Biodiversity Sector Plan
mm	Millimetre
MNCA	Mpumalanga Nature Conservation Act
MTPA	Mpumalanga Tourism and Parks Agency
MV	Marginal vegetation
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMBA	National Environmental Management & Biodiversity Act
NP	National Park
NSBA	National Spatial Biodiversity Assessment
ONA	Other Natural Areas
PES	Present Ecological State

PhD	Doctor of Philosophy
POSA	Plants of Southern Africa
Pr. Sci. Nat	Natural Scientific Professionals
Reg. no.	Registration number
RL	Reduced level
S	South
SA	South Africa
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SAPPI	South African Pulp and Paper Industries
SASS5	South African Scoring System version 5
SCC	Species of Conservation Concern
SHI	Site Fish Habitat Integrity Index
SIC	Stones in current
SOOC	Stones out of current
Sqkm	Square kilometre
SSC	Species of Special Concern
TOPS	Threatened or Protected Species
WMA	Water Management Area
WTW	Water Treatment Works

v) Details of the Author

Dr Andrew Deacon (PhD Zoology) worked as a researcher at Scientific Services, South African National Parks (SANParks, 1989 - 2012). He was initially employed as an Aquatic ecologist to coordinate the multidisciplinary KNP Rivers Research Programme, but later was tasked to manage the monitoring and research programmes for small vertebrate ecology in 15 South African National Parks (including Addo-, Kalahari- and Kruger NP).

As a recognised scientist in the fields of Ichthyology and Terrestrial Ecology, he is currently engaged as a specialist consultant regarding ecological studies. He was involved in numerous research programmes and projects, and produced EIA specialist reports (aquatic or terrestrial ecology) for 82 projects. Additionally he also participated in Aquatic ecosystem projects, Environmental Water Requirement Studies and Faunal and ecosystems monitoring projects.

Apart from multiple environmental projects in South Africa, he has worked on assignments in the Democratic Republic of the Congo, Zambia, Mozambique, Zimbabwe, Namibia and Swaziland. He completed: Wetland Introduction and Delineation Course – Centre for Environmental Management: University of the Free State. He is a registered Professional Natural Scientist (Pr. Sci. Nat.) in the fields of Ecological Science (Reg. no. 116951).

1. Introduction

1.1 Terms of Reference

The proposal for the Ecological Specialist Study was to undertake an ecological assessment that will form part of the Environmental Impact Assessment for remedial work required on the SAPPI Ngodwana Dam. The Environmental Evaluation concerns the riverine aspects of the delineated footprint (Regulated Zone) and the positioning of site camps in the terrestrial zone. The Environmental Evaluation of the proposed activities includes the following services/specialist components:

Terrestrial ecology study for the EIA

- This specialist ecological study will form part of the Environmental Impact Assessment process of the proposed construction of the project area.

- Literature review: Applicable documentation will be studied and reviewed, especially the original and supplied specialist studies. Background studies regarding species distribution, habitat preference and species status will be updated.

- A site survey will be conducted to determine the current state of the biodiversity environment on site. The following services/specialist components will be addressed:

  a) Specialist Studies for the Terrestrial Ecology according to the MTPA Minimum Requirements:

  - Vegetation studies
  - Faunal studies
    - Mammals
    - Birds
    - Reptiles
    - Frogs

  b): Specialist Studies for the Aquatic Ecology according to the MTPA Minimum Requirements:

  - Wetlands
  - Wetland fauna (Fish, mammals, birds, reptiles and frogs; invertebrates)
  - wetland delineation

- Evaluate the sensitivity of biota surveyed in both the terrestrial and wetland habitats (aquatic and riparian), on site;

- Highlight floral and faunal species present on site and determine whether any Threatened or Protected Species (ToPs) or Red Data species are present; this should include species identified on-site as well as those potentially occurring;

- Evaluate the sensitivity of the habitat for fauna. Establish and delineate buffer zones and migration corridors in riparian habitats, and also establish passage devices for aquatic species at migration obstacles.

- Ground-truth the desktop level findings regarding the provincial C-Plan and provide an opinion regarding the conservation status and actual conditions in situ;

- Provide a general biodiversity sensitivity map for the project area. This should include any proposed buffer zones and “no-go” zones for development

- Management aspects:

    - Identification and quantification of risks to biodiversity.
    - The development of management criteria for each risk.

- Indicate in the report any opportunities, constraints and fatal flaws to the study and the project, including gaps in available information and make recommendations going forward.

1.2 Review - an indication of the quality and age of base data used for the specialist report;

The following sources of information provided important information for the area as a whole:

Biota:

- Conservation-important biota listed for the quarter-degree grid 2530BC in the Mpumalanga Tourism & Parks Agency's (MTPA) (2020).
- Protected species as listed under the Mpumalanga Nature Conservation Act (MNCA) (No. 10 of 1998), or the National Environmental Management: Biodiversity Act Threatened or Protected Species (NEMBA ToPS) (No. 10 of 2004).

Plants:

- List of all protected tree species, 2019.
- Vegetation map for South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006).
- Riparian delineation and habitat evaluation was done according to the DWAF Guidelines (2005) and DWAF updated manual (2008).
- Plants of South Africa (POSA) data from the South African National Biodiversity Institute (SANBI) (2020).
- SANBI Red List of South Africa 2020.
- Buffer Zone Tools (Macfarlane and Bredin, 2017).

Fish:

- Fish distribution data sourced the South African Institute for Aquatic Biodiversity (SAIAB), the Mpumalanga Tourism and Parks Agency (MTPA) 2020.
- Red Data: IUCN, 2019.
- Aquatic ecosystem classification, Ollis *et al*. (2013).

Frogs:

- Red Data: IUCN, 2019.

- Du Preez, L. & Carruthers, V. 2009

Reptiles:
- Animal Demographic Unit (ADU). 2010.
- Red list: Bates, et al, 2014
- Red Data: IUCN, 2019.

Birds:
- Red Data: IUCN, 2019.
- Harrison, et al. 1997.

Mammals:
- Red list: Child, 2016
- Red Data: IUCN, 2019.

General
- Desktop Present Ecological State, Ecological Importance and Ecological Sensitivity per sub Quaternary reaches in South Africa (DWS 2014); and
- Google Earth coverage, dated September 2020.
- MTPA. 2014. Mpumalanga Biodiversity Sector Plan Handbook. Compiled by Lötter M.C.
- Land-Use Decision Support Tool (LUDS) (2020).
- National Web based Environmental Screening Tool (2019).
- Ecoregion - Water Resource Classification System (DWS, 2005).

1.3 Legislative requirements

Environmental Authorisation (Ecoleges, 2020)

An Environmental Authorisation is required for the construction-related remedial work on the dam as per the following Listed Activities through a Basic Assessment (BA) process:

Listing Notice 1 (GG No. 40772, GN No. 327, 07 April 2017):

Listed Activity 19

The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation**, removal or moving of soil**, sand, shells, shell grit, pebbles or rock **of more than 10 cubic metres from a watercourse**;
but excluding where such infilling, depositing, dredging, excavation, removal or moving—

(a) will occur behind a development setback;
(b) is for maintenance purposes undertaken in accordance with a maintenance management plan;
(c) falls within the ambit of activity 21 in this Notice, in which case that activity applies;
(d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or
(e) where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.

Listed Activity 27

The clearance of an area of 1 hectares or more, but less than 20 hectares **of indigenous vegetation**, except where such clearance of indigenous vegetation is required for—

(i) the undertaking of a linear activity; or

(ii) maintenance purposes undertaken in accordance with a maintenance management plan.

Listing Notice 3 (GG No. 40772, GN No. 324, 07 April 2017):

Listed Activity 4

The development of a road wider than 4 metres with a reserve less than 13,5 metres.

f. Mpumalanga

i. Outside urban areas:

(aa) A protected area identified in terms of NEMPAA, excluding disturbed areas;

(bb) National Protected Area Expansion Strategy Focus areas;

(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;

(dd) Sites or areas identified in terms of an international convention;

(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;

(ff) Core areas in biosphere reserves; or

(**gg) Areas within** 10 kilometres from national parks or world heritage sites or **5 kilometres from any other protected area** identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas, where such areas comprise indigenous vegetation; or

ii. Inside urban areas:

(aa) Areas zoned for use as public open space; or

(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose.

Listed Activity 12

The **clearance of an area of 300 square metres or more of indigenous vegetation** except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.

f. Mpumalanga

i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;

ii. Within critical biodiversity areas identified in bioregional plans; or

iii. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning or proclamation in terms of NEMPAA.

Listed Activity 18

The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.

f. Mpumalanga

i. Outside urban areas:

(aa) A protected area identified in terms of NEMPAA, excluding conservancies;

(bb) National Protected Area Expansion Strategy Focus areas;

(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;

(dd) Sites or areas identified in terms of an international convention;

(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;

(ff) Core areas in biosphere reserves; or

(gg) Areas within 10 kilometres from national parks or world heritage sites or **5 kilometres from any other protected area** identified in terms of NEMPAA or from the core area of a biosphere reserve, where such areas comprise indigenous vegetation; or

ii. Inside urban areas:

(aa) Areas zoned for use as public open space; or

(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose.

Listed Activity 23

The expansion of—

(i) **dams or weirs where the dam or weir is expanded by 10 square metres or more; or**

(ii) infrastructure or structures where the physical footprint is expanded by 10 square metres or more;

where such expansion occurs—

(a) within a watercourse;

(b) in front of a development setback adopted in the prescribed manner; or

(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; excluding the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour.

f. Mpumalanga

i. Outside urban areas:

(aa) A protected area identified in terms of NEMPAA**,** excluding conservancies;

(bb) National Protected Area Expansion Strategy Focus areas;

(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;

(dd) Sites or areas identified in terms of an international convention;

(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;

(ff) Core areas in biosphere reserves;

(**gg) Areas within** 10 kilometres from national parks or world heritage sites or **5 kilometres from any other protected area** identified in terms of NEMPAA or from the core area of a biosphere reserve, where such areas comprise indigenous vegetation; or
ii. Inside urban areas:
(aa) Areas zoned for use as public open space; or
(bb) Areas designated for conservation use in Spatial Development Framework.

1.4 Project Description

Ecoleges Environmental Consultants were appointed to undertake an Environmental Impact Assessment on the farm Ngodwana 638 and 1030 Portion 0 in the Ngodwana area (Mpumalanga) and this specialist ecological study forms part of the EIA process for the proposed project.

Ngodwana Dam is a 41 m high zoned earthfill Category III Dam. The dam is located on a tributary of the Elands River, Mpumalanga Province, directly upstream from the N4 highway and the Ngodwana Paper Mill, 40 km from Mbombela. The dam facility is regarded as a water reservoir facility which has a primary function of the storage of water for SAPPI's Ngodwana factory, requiring no additional land-use approvals.

The layout of the dam is shown in Figure 1.

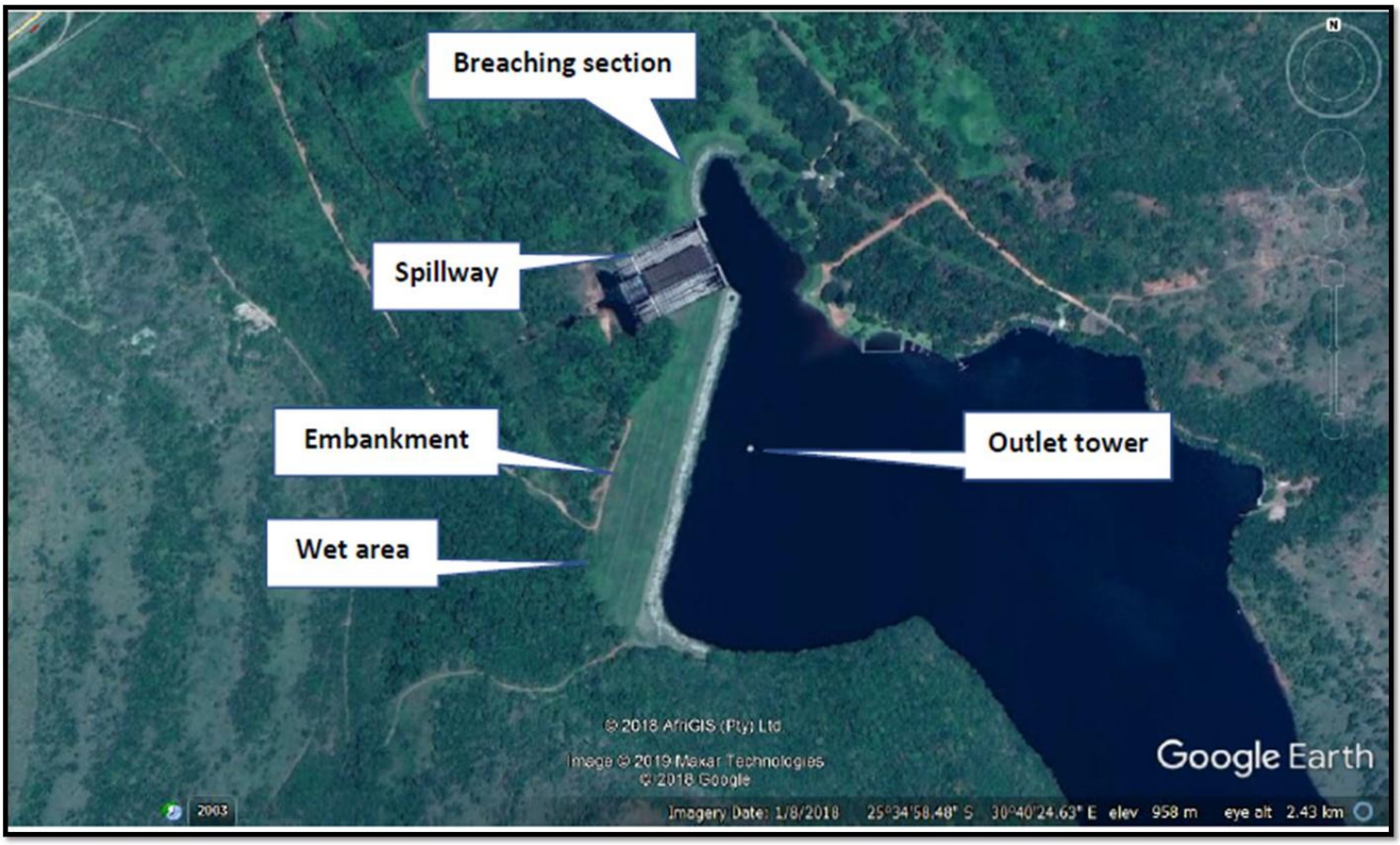

Figure 1: The existing Ngodwana Dam and associated elements (Hagen, 2019).

The Hagen letter 20191203 (2019) by Professional Engineer DJ Hagen, reports the following in his review of the Dam Safety Risk and proposed remedial work associated with Category 3 Ngodwana Dam:

“Since 1987, six dam safety evaluations of the dam have been completed with the last one in September 2016. Annual dam safety reports are also presently conducted with the last one completed in September 2019 by Altus de Beer Consulting Engineer, who is also presently the Approved Professional Person responsible for the dam.

The 2016 dam safety evaluation report recommended further analyses and monitoring of the suspect downstream slope stability of the dam. These investigations were concluded in the 2019 dam safety report. The main conclusion from this report is quoted below for ease of reference:

“The principal safety risk for Ngodwana Dam is the precarious stability conditions of the downstream slope, as was determined as part and parcel of the 2018 dam safety report.”

In this review report it is concluded that a downstream slope failure of the dam is a very likely potential failure mode, but that internal erosion of the poorly protected embankment core, internal erosion of the complex embankment foundation, specifically the embankment left flank, or internal erosion along the outlet conduit are other potential failure modes to be considered.

Observations, analyses, original design shortfalls and instrumentation monitoring have identified likely potential failure modes of Ngodwana Dam. The present probability of failure of this Category III is considered too high. A dam break analysis conducted in 1987 indicated that the dam break flood peak could be as much as 11 000 m^3/s compared to the 1 in 200 year flood of the catchment of the dam of 832 m^3/s. A dam failure will cause significant damage to the N4 and SAPPI Mill immediately downstream of the dam, and also further downstream of the dam.

The dam remediation is to ensure the continued safe operation of this Category III dam and the stability of the main and right flank embankments and its foundations (Ecoleges, 2020).

The scope of construction works to be included in the rehabilitation and to be authorised is:

1. Stabilizing berm (Figure 2) on the downstream face of the main embankment to RL 941.3 m, including approximately 30 000 m^3 of earthworks, a new internal drainage system (sand and gravel filters, rock toe and drain pipes with inspection concrete manholes) and gabion retaining walls.

2. Subsoil pipe drains above the berm of 133 m length with inspection concrete manholes.

3. Raising of the right flank embankment to prevent overtopping and failure during large floods and to improve the stability of the embankment (earthworks to be confirmed).

Proposed remedial works

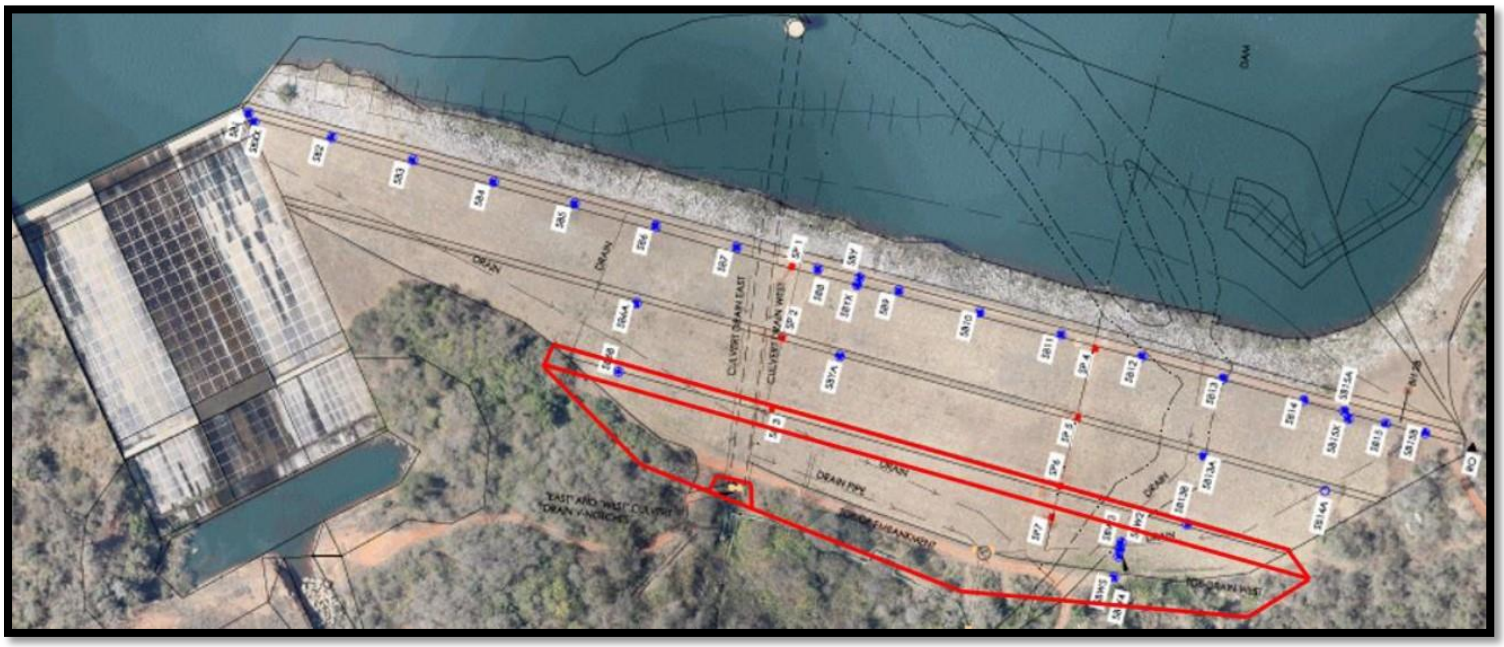

Figure 2: The proposed stabilising berm (red polygon) on downstream face of the Ngodwana Dam wall (Hagen, 2019).

The proposed remedial work to construct a downstream stabilizing berm with an adequate internal drainage filter system and toe drain is supported. The proposed layout of the berm is shown in Figure 2. The extent and size of the berm should be optimized by further slope stability analyses. A new toe drain for the embankment flanks above the berm should also be considered. The berm toe drain should have manholes at regular intervals for maintenance and monitoring.

As part of this review investigation the following other items were identified and could be included in the remedial work scope of works (Hagen, 2019):

- Remedial work to the breaching section downstream face local slip and possible raising of the breaching section as it is no longer considered a necessary emergency spillway.
- Repair of outlet conduit joints where water with muddy material is leaking out.
- Spillway joint sealant replacement.
- Removal of trees along spillway discharge channel training walls and repair of joint.
- Provide safety handrails alongside the spillway retaining walls.
- Reservoir rim stability assessment.

Figure 3: Outlet conduit exit at embankment toe (20 November 2019). Seepage was noted emanating from sides of conduit monitored at v-notch weirs.

Figure 4: Spillway right training wall joint movement likely caused by tree roots (19 November 2019).

Figure 5: Downstream toe on lower left flank (19 November 2019). Note wet conditions which could be attributed to high phreatic surface within embankment.

Figure 6: Downstream face of breaching section (fuseplug embankment) on right flank showing local slip (19 November 2019).

Figure 7: The proposed alterations in the Ngodwana Dam wall project area (Hagen, 2019).

Figure 8: Infrastructure setup involved in the proposed Ngodwana Dam rehabilitation project.

Haul roads for the Ngodwana Dam rehabilitation

Figure 9 supply an aerial view of the layout of the catchment area, proposed haul routes, construction areas, possible stockpile areas, conflicting infrastructure and proposed new infrastructure as described in DMV Nelspruit Incorporated (2020).

Most of the information following is sourced from the document: DMV Nelspruit Incorporated (2020). Preliminary assessment of haul roads for SAPPI, Ngodwana Dam Rehabilitation. Project 20828.

The proposed Ngodwana Dam rehabilitation process will require approximately 41,000m³ of material. It will be upgraded with a raised right flank to the North of the dam spillway and a rock toe berm on the main sections south of the spillway, which includes the left flank of the dam.

The material for the haul road upgrading and right flank (± 29,000m³) will be hauled from the stockpiles at the SAPPI dumpsite area to the South-West of SAPPI (Route 1) and the rock toe material (22,500m³) will come from commercial sources to the East of Ngodwana (Route 2). The balance of material (7,500m³) for this section will also come from SAPPI stockpiles at the dumpsite area and is included in the figures above.

Route 1: This route (indicated in green road arrows on Figure 9) starts at the SAPPI dumpsite stockpile, continue on N4 and to the Kaapsehoop road to the existing fishing club access (#1). A material stockpile area is located approximately 600m along this road (#2) from where material will be hauled to the point of placement on the north flank (#3). An access route to the contractors' site office turns off to the stockpile towards the spillway area (road indicated in yellow on Figure 9). This access route will also serve as a haul road for the ± 7,500m³ material from the SAPPI stockpiles reserved for the main section of the embankment, as well as the ± 10,200m³ material required for the upgrading of haul roads. A link from this road to the Northern spillway retaining wall is required for the clearing of trees along this retaining wall (#4).

Route 2: The material for the rock toe berm (± 22,500m³) will be hauled from commercial sources situated at Alkmaar or Karino via the N4 in 18m³ tipper trucks (normal road haulers). These trucks will use the road which provides access to SAPPI's Water Treatment Works (WTW) (#5). Material will be stockpiled on a stockpile area opposite the WTW (#6). Material will be hauled from the WTW stockpile area to the rock toe berm on the main section of the dam on an existing route. It runs along the SAPPI bulk water supply line to the West of the Ngodwana River (#7) to the embankment of the central section (road indicated in green on Figure 9). A new route (road indicated in blue on Figure 9) up the embankment (#8) up to the point of placement of the rock toe berm on the main section of the dam will be required due to material delivery requirements and restricted space between the toe and the bulk water pipeline. A foot bridge (#9) below the spillway will link the site office area (#10) with the contractor's laydown area (#11).

A pedestrian walkway and pedestrian bridge below the spillway will provide access to the construction site from here. This must be done in a way to conserve the area and to serve as an eco-recreation area after construction.

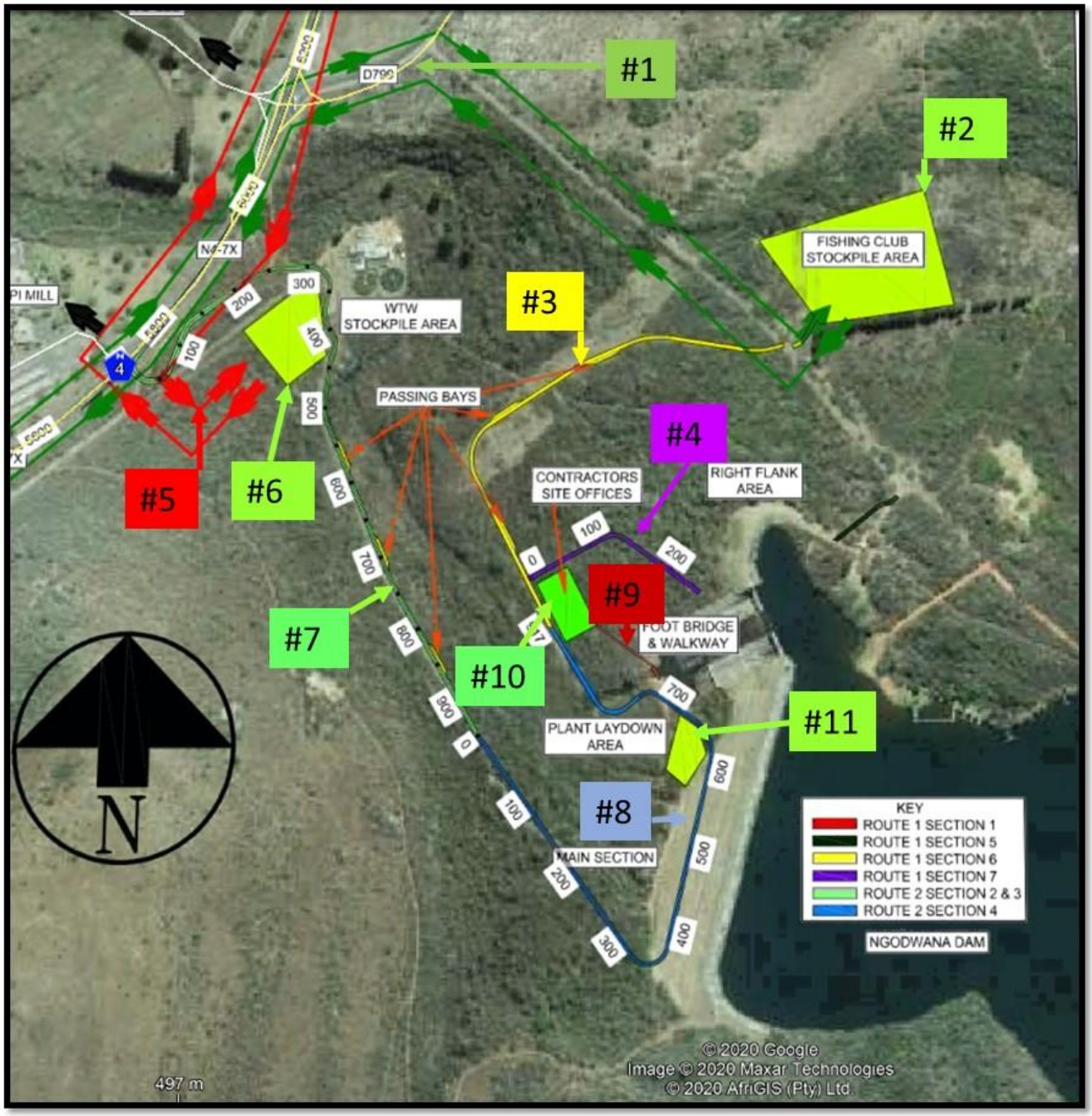

Figure 9: The proposed Ngodwana Dam rehabilitation infrastructure setup, highlighting haul road routes to areas.

This project and the report below, is based on the EIA guidelines provided in the Mpumalanga Biodiversity Sector Plan (MTPA, 2014). The Mpumalanga Tourism and Parks Agency (MTPA), as custodian of the environment in Mpumalanga, is the primary implementing agent of the MBSP for the province.

This report addresses the findings of the field surveys as well as a desktop review of the potentially occurring threatened flora and fauna in the proposed development footprint.

1.5 Assumptions, Limitations and Knowledge gaps

Assumptions, Limitations and Knowledge gaps associated with this study include the following:

- Due to the relatively brief duration of the field surveys (5 days in total) conducted during a single season (winter), the species list provided for the area cannot be regarded as comprehensive. Only species of plants visible and/or flowering at that time were detected. It is possible that plants which flower at other times of the year are under-represented.

- Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list may be located in an area where it was not formerly known to exist.

- The lists of fauna for the site are based on those observed at the site as well as those likely to occur in the area based on their distribution and habitat preferences. Due to the nature and habits of most faunal taxa it is unlikely that all species would have been observed during a site assessment of limited duration. Therefore, site observations are compared with literature studies where necessary.

- Animal species, especially birds, are mostly highly mobile and often migrate seasonally. Any field assessment of relatively short duration is therefore unlikely to record anything more than the most common species that happen to be on site at the time of the survey. Such field surveys are generally a poor reflection of the overall diversity of species that could potentially occur on site.

- Project proponents will always strive to avoid and mitigate potentially negative project related impacts on the environment, with impact avoidance being considered the most successful approach, followed by mitigation. It further assumes that the project proponents will seek to enhance potential positive impacts on the environment.

2. Methodology - Methods and approach

This project, and this report, is based on the guidelines provided in the Mpumalanga Biodiversity Sector Plan Handbook (MTPA, 2014). According to the MBSP, “it is important to note that all decisions regarding land-use applications in Mpumalanga are going to be evaluated by the authorities using the CBA maps and data, so it makes sense to consider these proactively, either prior to, or during, the EIA process.”

The methods used in this report were undertaken in accordance with to the MTPA Minimum Criteria Guideline with special emphasis on Protected Species.

Baseline Data

Baseline data were collected during a single field survey undertaken during the dry season (1-9 July 2020). During the field survey detailed ecological data were collected and the following fields were covered:

2.1 Vegetation

Specialist assessment of terrestrial vegetation for the project

In accordance with the accepted proposal for this study, the botanical specialist study presented in the current report was to assess the footprint of the proposed Ngodwana Dam development. The scope of work will include the Terrestrial- and Riparian Components as per the MTPA Minimum Criteria Guideline with special emphasis on Protected Species, including GPS coordinates for encountered species to facilitate obtaining the necessary permits.

Desktop

Vegetation communities and general land use patterns were identified prior to fieldwork using satellite imagery on Google Earth. Conservation-important plant species listed for the quarter-degree grid 2530BC in the Mpumalanga Tourism & Parks Agency's (MTPA) threatened species database, as well as the Plants of South Africa (POSA) data from the South African National Biodiversity Institute (SANBI), were used to produce a list of the most likely occurring species, which were searched for during fieldwork. Conservation-important plants include those listed as species of conservation concern by the SANBI Red List of South Africa or protected species as listed under the Mpumalanga Nature Conservation Act (MNCA) (No. 10 of 1998), or the National Environmental Management: Biodiversity Act Threatened or Protected Species (NEMBA ToPS) (No. 10 of 2004).

Fieldwork

Vegetation communities identified in the desktop phase were ground-truthed during a field visit on 1-9 July 2020. The project area as well as the surrounding environment was surveyed on foot and dominant plant species were listed according to each of the vegetation communities.

The study area was broadly stratified into major classes on the basis of gradient, aspect, terrain units (e.g. crest, mid-slope and foot slope), rock cover, soils, land-use and vegetation physiognomy.

A total of 9 sites were surveyed and floristic data is summarised in Table 12. Environmental parameters recorded at each stand included the following:

- locality coordinates using a Global Positioning System (GPS) receiver;

- terrain unit (midslope, foot slope, etc.);
- estimated percentage surface rock cover; and
- any visible disturbances (e.g. grazing, fire, old lands).

This floristic classification was used only to guide the identification of the robust 'vegetation units' described in this report, which are based on qualitative and semi-quantitative floristic and habitat data gathered at the sites surveyed during the study.

Parameters such as geology, topography, etc. were also obtained from the relevant topographical-, geological- and soils maps.

For the purposes of this study, the most recent version of the Mpumalanga Biodiversity Conservation Plan (MBCP) map of ecological sensitivity was obtained from the Mpumalanga Tourism and Parks Agency, and the boundaries of the study area were superimposed on this map. The MBCP divides the entire province into the following categories of importance in terms of biodiversity conservation value: 'Irreplaceable', 'Highly Significant', 'Important and Necessary', 'Least Concern' and 'No Natural Habitat Remaining'. No 'Irreplaceable' or 'Important and Necessary' areas occur within the study area.

Riparian delineation

It is important to differentiate between wetlands and riparian habitats. Riparian zones are not wetlands, however, depending on the ecosystem structure, wetlands can be also be classified as riparian zones if they are located in this zone (e.g. valley bottom wetlands). Although these distinct ecosystems will be interactive where they occur in close proximity it is important not to confuse their hydrology and eco-functions.

The valley drainage directly to the west of the project area have been identified as a non-perennial sub-type system with intermittent flows in a channelled valley-bottom drainage structure according to the hierarchical system described by Ollis *et al*. (2013). This drainage was incorporated into the study due to its proximity to the project area and the probability that it might be influenced by the project activities.

Riparian delineations are performed according to *"A practical field procedure for identification and delineation of wetlands and riparian areas"* as amended and published by the Department of Water Affairs and Forestry (2005); (Henceforth referred to as DWAF Guidelines (2005).

Aerial photographs and land surveys were used to determine the different features and riparian areas of the study area. Vegetation diversity and assemblages were determined by completing survey transects along all the different vegetation communities identified in the riparian areas.

Riparian areas are protected by the National Water Act (Act 36 of 1998), which defines a riparian habitat as follows:

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

Riparian areas include plant communities adjacent to and affected by surface and subsurface hydrologic features, such as rivers, streams, lakes, or drainage ways. Due to water availability and rich alluvial soils, riparian areas are usually very productive.

Tree growth rate is high and the vegetation is lush and includes a diverse assemblage of species. The delineation process requires that the following be taken into account:

- Topography associated with the watercourse;
- Vegetation;
- Alluvial soils and deposited material.

A typical riparian area according to the DWAF Guidelines (2005) is illustrated in Figure 10.

In addition to the DWAF Guidelines (2005) and DWAF updated manual (2008), the unpublished notes: *Draft riparian delineation methods prepared for the Department of Water Affairs and Forestry, Version 1* (Mackenzie & Rountree, 2007) were used for classifying riparian zones encountered on the property according to the occurrence of nominated riparian vegetation species.

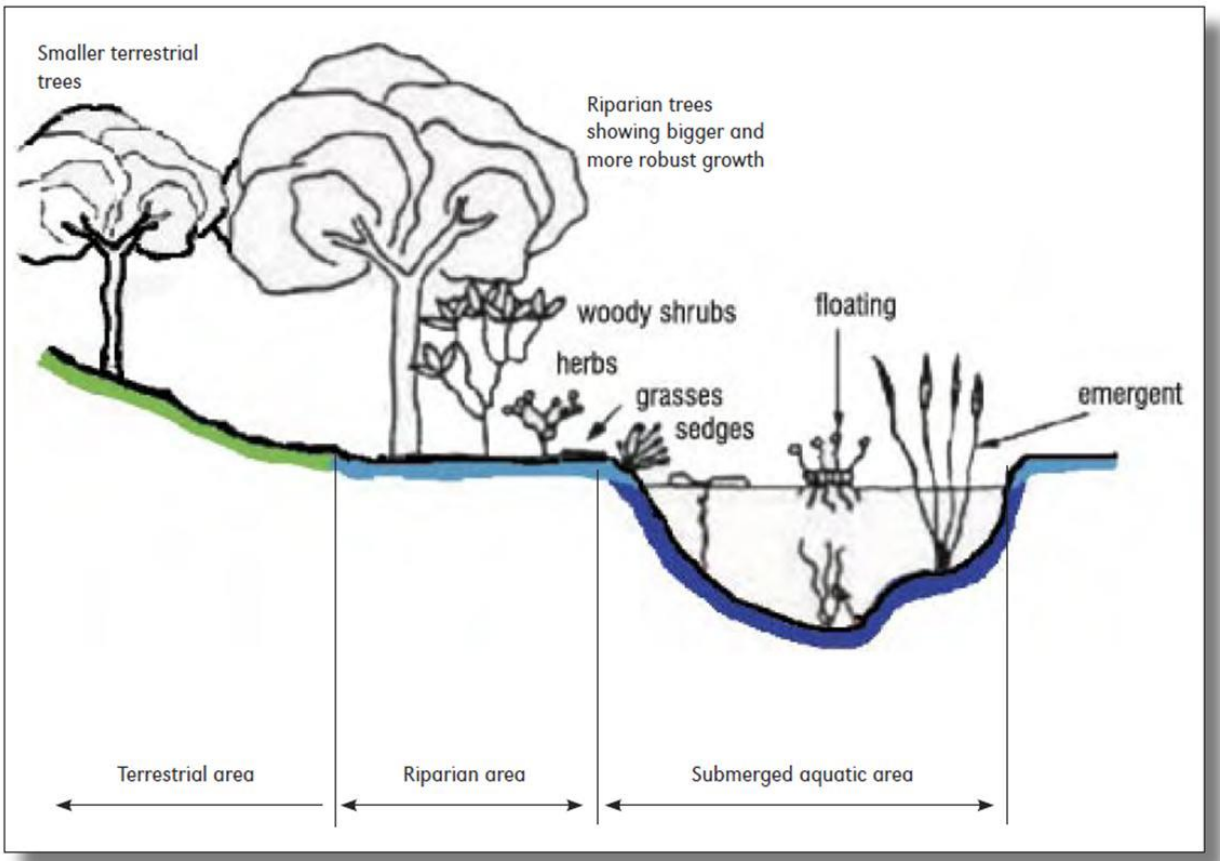

Figure 10: A cross section through a typical riparian area (DWAF Manual, 2008).

Buffers

Aquatic buffer zones are typically designed to act as a barrier between human activities and sensitive water resources thereby protecting them from adverse negative impacts. Buffer zones associated with water resources have been shown to perform a wide range of functions, and on this basis, have been proposed as a standard measure to protect water resources and associated biodiversity (Macfarlane et al, 2015). These functions include:

- Maintaining basic aquatic processes;
- Reducing impacts on water resources from upstream activities and adjoining land uses;
- Providing habitat for aquatic- and semi-aquatic species;
- Providing habitat for terrestrial species; and
- A range of ancillary societal benefits.

Due to their positioning adjacent to water bodies, buffer zones associated with streams and rivers will typically incorporate riparian habitat. Riparian habitat, as defined by the NWA, includes the physical structure and associated vegetation of the areas associated with a watercourse. These areas are commonly characterised by alluvial soils (deposited by the current river system), and are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas (Macfarlane et al, 2015).

However, the riparian zone is not the only vegetation type that lies in the buffer zone as the zone may also incorporate stream banks and terrestrial habitats depending on the width of the aquatic impact buffer zone applied. A diagram indicating how riparian habitat typically relates to aquatic buffer zones defined in this guideline is provided in Figure 11.

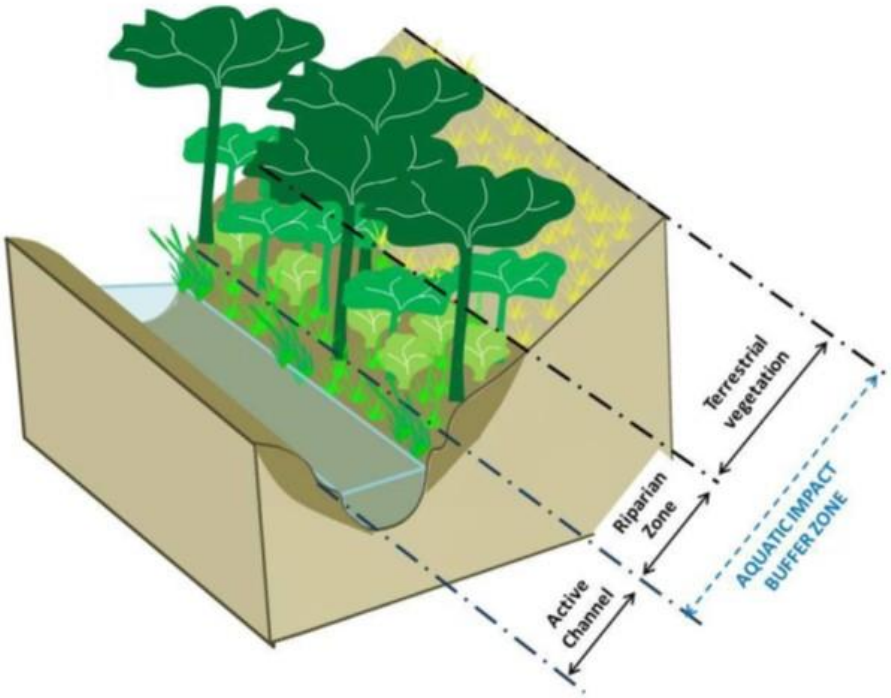

Figure 11: Schematic diagram indicating the boundary of the active channel and riparian habitat, and the areas potentially included in an aquatic impact buffer zone (Macfarlane et al, 2015).

Once an aquatic impact buffer zone has been determined, management measures need to be tailored to ensure buffer zone functions are maintained for effective mitigation of relevant threat/s. Management measures must therefore be tailored to ensure that buffer zone functions are not undermined. Aspects to consider include:

- Aquatic impact buffer zone management requirements;
- Management objectives for the aquatic impact buffer zone; and
- Management actions required to maintain or enhance the aquatic impact buffer zone in line with the management objectives. Activities that should not be permitted in the aquatic impact buffer zone should also be stipulated.

Determining appropriate management and monitoring of buffer zones

A series of Excel based Buffer Zone Tools have been developed to help users determine suitable buffer zone requirements (Macfarlane and Bredin, 2017). These include a rapid desktop tool for determining potential aquatic impact buffer zone requirements together with three site-based tools for determining buffer zone requirements for rivers, wetlands and estuaries. Central to these tools is a buffer model, which is populated automatically from the data capture sheets provided. This is based on best available science and is used to generate buffer zone recommendations as part of the assessment process. The Overview of the step-wise assessment process for buffer zone determination (Macfarlane and Bredin, 2017) is illustrated if Figure 12.

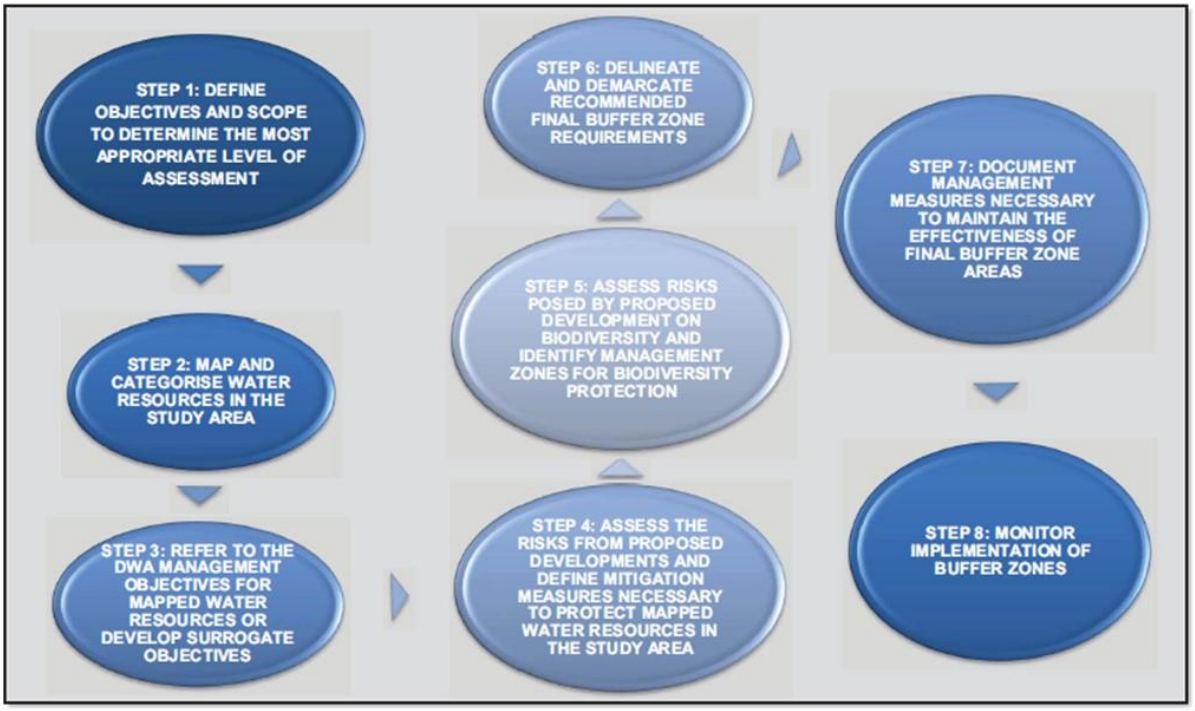

Figure 12: Overview of the step-wise assessment process for buffer zone determination (Macfarlane and Bredin, 2017).

Once a final buffer zone area has been determined, appropriate management measures should be documented to ensure that the water quality enhancement and other buffer zone

functions, including biodiversity protection, are maintained or enhanced. Key aspects addressed include:

- Demarcating buffer zones.
- Defining suitable management measures to maintain buffer functions.
- Reviewing the need to integrate protection requirements with social and development imperatives.
  Monitoring to ensure that buffer zones are implemented and maintained effectively.

2.2 Aquatic Ecosystem Classification

The Aquatic ecosystem in the vicinity of the project area was classified according to a hierarchical system described by Ollis *et al*. (2013). The valley drainage directly to the west of the project area is a non-perennial sub-type system with intermittent flows in a channelled valley-bottom drainage structure. This drainage was incorporated into the study due to its proximity to the project area and the probability that it might be influenced by the project activities.

Biota – Aquatic invertebrates and Fish

Aquatic surveys

Macro-invertebrates and fish are good indicators of river health. By making use of established and accepted survey methods (SASS5 for invertebrates and FRAI-based surveys for fish) and incorporate the habitat aspects, a proper basis for biological diversity can be obtained.

The different components of the proposed development and its impact on the aquatic environment will be assessed for the river in the project area.

Aquatic biota

Macro-invertebrates and fish are good indicators of river health. By making use of established and accepted survey methods (SASS5 for invertebrates and FRAI-based surveys for fish) and incorporate the habitat aspects, a proper basis for biological diversity could be obtained.

The Aquatic specialist assessed the condition of the proposed development and its impact on the aquatic environment. The following recognized bio-parameters and methods were used:

- Aquatic invertebrates (South African Scoring System version 5 — SASS5).
- Fish communities: Fish Response Assessment Index (FRAI). Applicable fish habitat assessments such as the Habitat Cover Ratings (HCR) and Site Fish Habitat Integrity Index (SHI) will be used to assess the habitat potential and condition for fish assemblages.

Aquatic invertebrate assessment

Benthic macro-invertebrate communities of the selected sites were investigated according to the South African Scoring System, version 5 (SASS5) approach. An invertebrate net (30 x

30 cm square with 0.5 mm mesh netting) was used for the collection of the organisms. The available biotopes at each site will be identified on arrival. Each of the biotopes was then sampled separately and by different methods. Sampling of the biotopes was done as follow:

Stones in current (SIC): Movable stones of at least cobble size (3 cm diameter) to approximately 20 cm in diameter, within the fast and slow flowing sections of the river. Kick-sampling is used to collect organisms in this biotope. This is done by placing the net on the bottom of the river, just downstream of the stones to be kicked, in a position where the current will carry the dislodged organisms into the net. The stones are then kicked over and against each other to dislodge the invertebrates (kick-sampling) for ± 2 minutes.

Stones out of current (SOOC): *Where the river is calm, such as behind a sandbank or ridge of stones or in backwaters.* Collection is again done by method of kick-sampling, but in this case the net is swept across the area sampled to catch the dislodged biota. Approximately 1 m^2 is sampled in this way.

Sand: These include sandbanks within the river, small patches of sand in hollows at the side of the river or sand between the stones at the side of the river where flow was slow or no flow was recorded. This biotope is sampled by stirring the substrate, shuffling or scraping of the feet is done for half a minute, whilst the net is continuously swept over the disturbed area.

Gravel: Gravel typically consists of smaller stones (2-3 mm up to 3 cm). Sampling similar to that of sand.

Mud: *It consists of very fine particles, usually as dark-coloured sediment.* Mud usually settles to the bottom in still or slow flowing areas of the river. Sampling similar to that of sand.

Marginal vegetation (MV): *This is the overhanging grasses, bushes, twigs and reeds from the riverbank.* Sampling is done by holding the net perpendicular to the vegetation (half in and half out of the water) and sweeping back and forth in the vegetation (± 2m of vegetation).

Aquatic vegetation (AQV): *Rooted, submerged or floating waterweeds such as Potamogeton, Aponogeton and Nymphaea.* Sampled by pushing the net (under the water) against and amongst the vegetation in an area of approximately one square meter.

The organisms sampled in each biotope were identified and their relative abundance is also noted on the SASS5 datasheet. Habitat assessments, according to the habitats sampled, were performed due to the fact that changes in habitat can be responsible for changes in SASS5 scores. This was done by the application of SASS orientated habitat assessment indices. The indices used are the Integrated Habitat Assessment System (IHAS) score sheet and the Habitat Quality Index (HQI).

The SASS5 method was used to establish the macro-invertebrate integrity and it was attempted to sample all three of the main habitat assemblages: stones, vegetation and sand/mud/gravel. The associated habitats were determined with the Invertebrate Habitat Assessment System (IHAS) and the Habitat Quality Index (HQI).

Although the SASS5 method was used as prescribed by DWS, it must be kept in mind that this method was designed for water quality purposes. Therefore the macro-invertebrate

integrity scores may vary throughout the year as water quality changes, due to flow variation, as should be the case in the pre- and post-construction phases of the monitoring project.

Macro-invertebrates and fish are good indicators of river health. By making use of established and accepted survey methods (SASS5 for invertebrates and FRAI-based surveys for fish) and incorporate the habitat aspects, a proper basis for biological diversity could be obtained.

Fish communities - Fish Response Assessment Index (FRAI)

The biotic assessment method uses a series of fish community attributes related to species composition and ecological structure to evaluate the quality of an aquatic biota. Data on distribution, richness, length frequency and abundance will be collected. The sampling methods will be fish traps, seine nets, mosquito nets and electro-fishing.

Fish segment identification, species tolerance ratings, abundance ratings, frequency of occurrence and health status techniques are applied during this survey to determine the integrity of the fish communities.

On arrival at the site a basic on site visual appraisal is made of the habitats available on that particular day at that particular flow. A site diagram is sketched indicating the different habitats and the various components thereof. Sampling takes place in each of the different habitats. These different habitats are sampled separately using different methods.

a) Electro-shocking

Electro-shocking commences in the downstream component of the habitat. One person uses a backpack electro-shocker for shocking, using a scoop net to catch the stunned fish. The researcher progresses upstream, keeping the fish caught in a bucket until that particular habitat is finished. Each habitat shocked is timed. It is necessary to take care (as far as possible) when shocking so as not to disturb the rest of the habitat still to be worked. As each habitat is completed the fish species caught, are identified, recorded and released back into their respective habitats.

Any fish species that cannot be identified at the time is preserved in 10% formalin (in a sample bottle with label inside) for later identification by experts. The data sheet is completed for that particular habitat – recording every fish, its age class (adult, sub-adult, juvenile) and whether any fish is diseased (e.g. visible ecto-parasites). Each habitat type is recorded (e.g. shoot, riffle or pool etc.), as well as the width, depth, substrate, the extent sampled, the percentage of algae on substrate, whether there was any vegetation, and the turbidity. The flow of that particular habitat is classified into one of five flow classes (no flow, slow flow, medium flow, fast and very fast flow).

The electro shocking device is used to sample certain habitats: shoots, riffles, rapids, shallow- medium depth pools in stream and off stream, runs and back waters.

b) Cast net

A cast net (a weighted circular net that is thrown into the water) is used in pool type or slower flow and deeper habitats. As with method (a) all aspects of the habitat type are

recorded as well as the fish species, numbers, age class and health. The number of throws / efforts per a habitat is also recorded.

2.3 Specialist assessment of terrestrial fauna

A detailed desktop study on all faunal species recorded in the past was completed and includes a description of red data and protected status according to the IUCN red data list and the National Environmental Management Biodiversity Act (TOPS List). All applicable literature was reviewed and extensive background studies regarding species distributions, habitat preferences and species status were updated accordingly (Appendices 10-13). The potential occurrence of threatened species was also evaluated from historical records, available literature, habitat availability and personal experience. The fauna species lists thus represent the majority of species occurring in the study area and provide a solid basis from which the project can continue to develop a comprehensive species list. The following detailed desktop studies and baseline animal assessment were conducted:

- Identification of all animal species expected to be present according to desktop studies of all relevant animal groups, namely birds; herpetofauna (amphibians and reptiles); and mammals. Potential occurrence of fauna in the study area was predicted based on knowledge of known habitat requirements of local fauna species.
- Lists of conservation-important mammals, birds, reptiles and frogs potentially occurring within the proposed agricultural development were prepared using data from the MTPA's threatened species database and applicable literature. The above data was captured mostly at a quarter-degree spatial resolution, but was refined by excluding species unlikely to occur within the study area, due to unsuitable habitat characteristics (e.g. altitude and land-use).
- Identification of all red data, protected and conservation important species per animal group and the compilation of distribution maps and GPS coordinates where recorded.
- Design management and monitoring programs to successfully monitor and manage all red data and protected and/or conservation important species.
- The assessment includes a review of all relevant literature, completion of field surveys, production of specialist reports and development of management recommendations.

Terrestrial vertebrate surveys

Amphibians, reptiles, birds and mammals were surveyed in pre-selected units. Emphasis was placed on fauna with high conservation value and their probability of occurrence in the unit. These include meticulous searches on fixed transects in all the representative biotopes to assess the presence/absence of amphibians, reptiles, birds and mammals species. Where necessary, special methods were implemented to augment the chances of finding species, including traps, nocturnal spotlight searches and identifying tracks and scats. Special emphasis is placed on finding threatened species.

- **Amphibian surveys**

Visual encounter surveys and audio monitoring are appropriate techniques for both inventory and monitoring of amphibian species. Both visual and auditory surveys were conducted along all transects, in plots, along streams and around ponds. Most amphibians are detectable in this manner. To ensure a comprehensive inventory, all possible microhabitats were also searched, namely: soil, water, tree trunks, and beneath rocks, during both the day and at night.

- **Reptile surveys**

The most practical way to monitor reptiles, over large areas, is to sample along transects and systematically search encountered refuge areas. Transects were surveyed in different habitats and all “cover” objects within a specified distance of the line turned over and checked. One particular strength of such transect monitoring is that it can be used to relate reptile abundance to habitat variables, such as vegetation and cover. The main objective of the survey is not to find as many reptiles as possible, but to get a reliable estimate of available habitat and quality of shelter and to compare these with expected reptiles and their required suite of habitat types.

- **Bird surveys**

Transects are probably the most widely used method of estimating the number of bird species in terrestrial habitats. Traditionally, observers will move along a fixed route undertaking surveys and recording the birds they see on either side of the route. For small birds, which are usually relatively numerous, a transect width of 10m on either side of the route (or 20-30m in open habitats) was found to be suitable for this study.

Transects were placed in such a way that all dominant soil and associated habitat types were adequately covered. Birds outside the transect band or those flying over were noted. Surveys always commenced at first light when avian activity was at its peak. Bird calls are equally important in bird surveys and especially important during point counts in rugged terrain and dense bush where visual observations are limited. Point surveys can also be used within wide open areas where birds can be spotted from a distance, for example pans and grassland flats.

- **Mammal surveys**

The same line-transects were surveyed on foot to monitor diurnal mammal species. Each sighting as well as the related vegetation features was recorded to establish habitat preferences. All major habitat types were assessed.

For smaller mammals such as rodents and insectivores, Sherman traps were put out near the transect lines, while pitfall traps for collecting vertebrates were discontinued due to the time consuming effort and low success rates. Visual sightings, as well as all signs of mammal presence (tracks and scats) were used as indicators of presence for some species.

- **Habitat surveys**

Representative habitat transects within the study area were surveyed. Macro- and micro-habitat surveys were executed to assess the quality of habitat and its potential to support various faunal species.

In assessing the habitat profiles in conjunction with the distribution data per species, accurate information on the probability of the species occurring in the relevant biotopes was obtained. Thus a list of expected species for the different biotopes in the survey area was compiled and compared with the fauna observed during monitoring surveys.

The information obtained from the micro-habitat surveys was used to enhance the prediction abilities of the process. To this end, quality and quantity of habitat aspects provide an indication of species abundance, while presence or absence of habitat aspects indicates the probability of species occurrence. Habitat quality classifications could be a useful indication of resource utilisation (especially in adjacent areas).

The quality of baseline data is considered reasonable and appropriate for the purposes of this report.

2.4 Impact Assessment methodology

Mpumalanga Biodiversity Sector Plan (MBSP) and Threatened Ecosystems

It is important to note that all decisions regarding land-use applications in Mpumalanga are going to be evaluated by the authorities using the CBA maps and data (Figure 13 and 14), so it makes sense to consider these proactively, either prior to, or during, the EIA process (MTPA, 2014).

The following are extracts from the MBSP Handbook (MTPA 2014) provided as background to our approach: “Environmental assessment is used to determine the broad ‘environmental fit’, and ecological sustainability of proposed land-use changes. It also establishes the biodiversity context within which a change in land-use is being contemplated and against which its likely impacts (both site-based and cumulative) must be assessed. CBA maps and their associated land-use guidelines provide a proactive and scientific basis for assessing the potential impacts of proposed land-uses and play an important role in providing a biodiversity-sensitive perspective in this process.”

Preliminary systematic biodiversity plans will help ascertain whether any habitat modification will contribute to cumulative impacts and compromise biodiversity targets for specific ecosystems or species, or by contributing to habitat fragmentation and degradation of ecological processes.

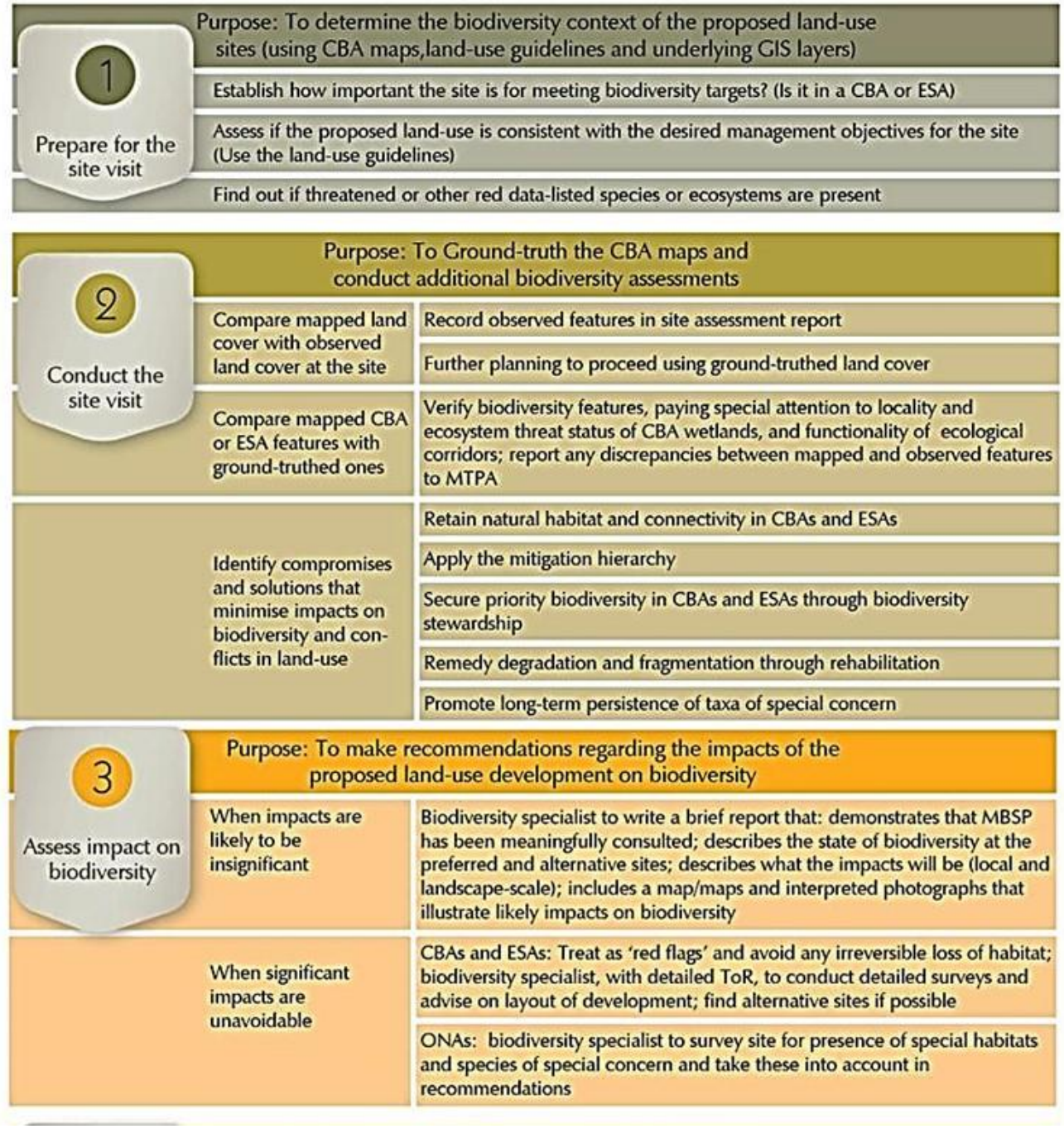

Figure 13: A summary of the first three steps to be followed in using the CBA maps proactively in environmental impact assessment.

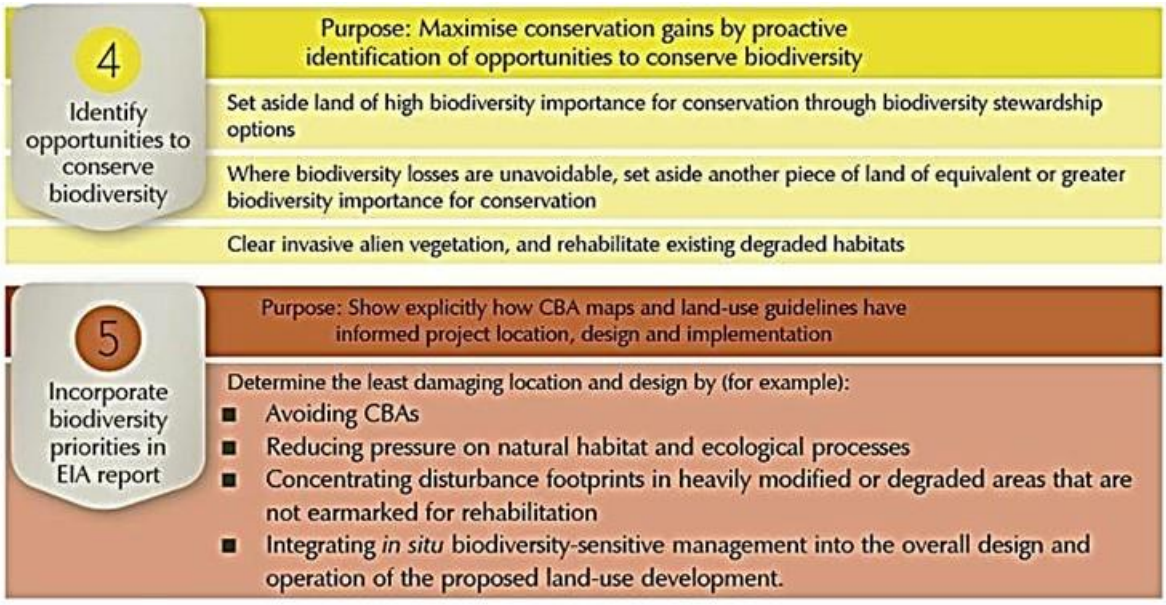

Figure 14: A summary of steps 4 and 5 to be followed in using the CBA maps proactively in environmental impact assessment.

Explanation of the Mitigation hierarchy

Identify the best practicable environmental options by avoiding loss of biodiversity and disturbance to ecosystems, especially in CBAs, by applying the **mitigation hierarchy** and the land-use guidelines. In particular:

- **Maximise connectivity in CBAs and ESAs, the retention of intact natural habitat and avoid fragmentation:** Design project layouts and select locations that minimise loss and fragmentation of remaining natural habitat, and maintain spatial components of ecological processes, especially in ecological corridors, buffers around rivers and wetlands, CBAs and ESAs. Activities that are proposed for CBAs must be consistent with the desired management objectives for these features and should not result in fragmentation.
- **Minimise unavoidable impacts:** Reduce the impact of the project footprint on biodiversity pattern and ecological processes.
- **Take opportunities to conserve biodiversity:** Set aside part of the land at the proposed land-use site, or another site of equivalent or greater biodiversity significance, to be managed for conservation purposes through one of the biodiversity stewardship options.
- **Remedy habitat degradation and fragmentation through rehabilitation**: Aim to reinstate pre-disturbance ecosystem composition, structure and functioning, especially in threatened ecosystems, CBAs and ESAs. Site-specific conservation measures may include contributing areas of natural habitat for the consolidation of corridor networks.
- **Promote long-term persistence of taxa of special concern.**

Impact Rating Methodology

It is the goal of the impact assessment process to determine the significance of potential environmental impacts associated with the proposed development. The significance of an impact is defined as a combination of the consequence of the impact occurring and the

probability that the impact will occur. Each impact was evaluated individually, however the possibility of a cumulative impact was also considered and evaluated accordingly.

The potential impacts or risks associated with the proposed development were assessed based on the following criteria:

- **Applicable phase: Construction, Operational, (Decommissioning)**
- **Nature of impact:** Provides a description of the expected impacts (Negative, neutral or positive)

The criteria used to determine impact consequence are presented in the table below.

Table 2: Criteria used to determine the consequence of the impact

Rating	**Definition of Rating**	**Score**
A. Extent - the area over which the impact will be experienced		
Site	Confined to the site, or part thereof	1
Local	Effect limited to 3 to 5 km of the site	2
Regional	Effect will have an impact on a regional scale.	3
B. Intensity - the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. Duration - the timeframe over which the impact will be experienced and its reversibility		
Short-term	Up to 2 years	1
Medium-term	2 - 15 years	2
Long-term	>15 years	3

The scores are then combined (A+B+C) to determine the Consequence Rating (Table 3).

Table 3: Calculation of the consequence score.

Combined Score (A+B+C)	3-4	5	6	7	8-9
Consequence Rating	Very low	Low	Medium	High	Very high

The probability of the impact occurring needs to be considered in order for the final significance rating to be informed by the specific context.

Table 4: Probability Classification.

Probability - the likelihood of the impact occurring	
Improbable	<40% chance of occurring

Possible	40% - 70% chance of occurring
Probable	>70%- 90% chance of occurring
Definite	>90% chance of occurring

The significance of the impact is attained by cross-referencing probability against consequence, as is listed below.

- **Significance:**
  - Low: Where the impact will have a relatively small effect on the environment and will not have an influence on the decision
  - Medium: Where the impact can have an influence on the environment and the decision and should be mitigated
  - High: Where the impact definitely has an impact on the environment and decision regardless of any possible mitigation

Table 5: Status and Confidence classification.

Status of Impact	
Indication whether the impact is adverse (negative) or beneficial (positive)	+ ve
	- ve
Confidence of Assessment	
The degree of confidence in predictions based on available information, the EAP's judgement and/or specialist knowledge.	Low
	Medium
	High

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **INSIGNIFICANT**: the potential impact is negligible and **will not** have an influence on the decision regarding the proposed activity/development.
- **VERY LOW**: the potential impact is very small and **should not** have any meaningful influence on the decision regarding the proposed activity/development.
- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.
- **MEDIUM**: the potential impact **should** influence the decision regarding the proposed activity/development.
- **HIGH**: the potential impact **will** affect the decision regarding the proposed activity / development.
- **VERY HIGH**: The proposed activity should only be approved under special circumstances.

Significance post mitigation: Describes the significance after mitigation.

Mitigation: Provides recommendations for mitigation measures

Spatial data sets that indicate Critical Biodiversity Areas

To establish how important the site is for meeting biodiversity targets, a number of resources and tools are used as prescribed by the Mpumalanga Biodiversity Sector Plan (MBSP) (Mpumalanga Biodiversity Sector Plan, 2014). Specifically, the Land-Use Decision Support Tool (LUDS) and the MBCP are extensively used to compile the LUDS Report (BGIS, 2016). LUDS was developed to facilitate and support biodiversity planning and land-use decision-making at a national and provincial level. Its primary objective is to serve as a guideline for biodiversity planning but should not replace specialist ecological assessments.

Critical Biodiversity Areas (CBAs) are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. If these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.

Land-Use Decision Support Tool (LUDS)

To establish how important the site is for meeting biodiversity targets, it is necessary to answer the following three simple but fundamentally important questions:

- How important is the site for meeting biodiversity objectives (e.g. is it in a **Critical Biodiversity Areas** (CBA) or Ecological Support Area (ESA)?
- Is the proposed land-use consistent with these objectives or not (to be checked against the land-use guidelines)?
- Does the sensitivity of this area trigger the requirements for assessing and mitigating environmental impacts of developments, or in terms of the listed activities in the EIA regulations?

Habitat sensitivity assessment

Much of the current conservation effort in South Africa is focused on promoting land-use practices that reconcile development opportunities and spatial planning at a landscape scale, with the over-arching goal of maintaining and increasing the resilience of ecosystems. This ‘landscape approach’ to biodiversity conservation involves working within and beyond the boundaries of protected areas to manage biodiversity within a mosaic of land-uses (Lötter et al, MTPA, 2014).

Initially an ecological sensitivity map of the project area was produced by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various relevant reports. This includes delineating the different vegetation and habitat units identified in the field and assigning sensitivity values to the units based on their ecological properties. Additionally, values and potential presence of vegetation and fauna species diversity, as well as species of conservation concern, were evaluated.

A three-step methodology was used to identify ecosystems:

• Step 1: Identify clusters of very high Irreplaceability planning units from the systematic biodiversity plan

• Step 2: Delineate ecosystems using ecological, topographical and/or geological features

• Step 3: Assess the threat value (high to low) for each ecosystem based on data Included In the systematic biodiversity planning process, to categorise as critically endangered, endangered or vulnerable respectively.

Five, broad-scale botanical biodiversity 'sensitivity' categories were identified and were developed for practical mapping purposes (Table 6). They are intended as a summary of the perceived botanical biodiversity value and sensitivity, of mapped broad-scale vegetation and land-cover type units. Based on the assessment, the sensitivity of the project footprint can be divided into five categories of sensitivity: Very high, High, Moderate, Low and Negligible.

The purpose of producing a habitat sensitivity map is to provide information on the location of potentially sensitive biodiversity features in the study area, including areas of natural vegetation, habitat types supporting important biodiversity features or high diversity, areas supporting important ecological processes and habitat suitable for any species of conservation concern.

An explanation of the different sensitivity classes is given in Table 6. Areas containing untransformed natural vegetation of conservation concern, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to potentially have low sensitivity.

Table 6: Explanation of sensitivity ratings.

Sensitivity	**Factors contributing to sensitivity**	**Example of qualifying features**
VERY HIGH	Indigenous natural areas that are highly positive for any of the following: • Presence of threatened species (Critically Endangered, Endangered, Vulnerable) and/or habitat critical for the survival of populations of threatened species. • High conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk). • Protected habitats (areas protected according to national/provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEMBA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act) And may also be positive for the following: • High intrinsic biodiversity value (high species richness and/or turnover, unique ecosystems) • High value, ecological goods & services (e.g. water supply, erosion control, soil formation, • carbon storage, pollination, refugia, food production, raw materials, genetic resources,	• CBA areas. • Remaining areas of vegetation type listed in Draft Ecosystem List of NEMBA as Critically Endangered, Endangered or Vulnerable. • Protected forest patches. • Confirmed presence of populations of threatened species.

	cultural value) • Low ability to respond to disturbance (low resilience, dominant species very old).	
HIGH	Indigenous natural areas that are positive for any of the following: • High intrinsic biodiversity value (moderate/high species richness and/or turnover). Presence of habitat highly suitable for threatened species (Critically Endangered, Endangered, Vulnerable species). • Moderate ability to respond to disturbance (moderate resilience, dominant species of intermediate age). • Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). • Moderate to high value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value). And may also be positive for the following: Protected habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEMBA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act).	• Habitat where a threatened species could potentially occur (habitat is suitable, but no confirmed records). • Confirmed habitat for species of lower threat status (near threatened, rare). • Habitat containing individuals of extreme age. • Habitat with low ability to recover from disturbance. • Habitat with exceptionally high diversity (richness or turnover). • Habitat with unique species composition and narrow distribution. • Ecosystem providing high value ecosystem goods and services.
MEDIUM-HIGH	Indigenous natural areas that are positive for one or two of the factors listed above, but not a combination of factors.	• Corridor areas. • Habitat with high diversity (richness or turnover). • Habitat where a species of lower threat status (e.g. (near threatened, rare) could potentially occur (habitat is suitable, but no confirmed records).
MEDIUM	Other indigenous natural areas in which factors listed above are of no particular concern. May also include natural buffers around ecologically sensitive areas and natural links or corridors in which natural habitat is still ecologically functional.	
MEDIUM-LOW	Degraded, secondary or disturbed indigenous natural vegetation.	

LOW	No natural habitat remaining.	

A Biodiversity Sector Plan can be used to guide conservation action (such as identifying priority sites for expansion of protected areas), or to feed spatial biodiversity priorities into planning and decision-making in a wide range of cross-sectoral planning processes and instruments such as provincial and municipal integrated development plans and spatial development frameworks, land-use management schemes, environmental management frameworks and environmental management plans (Lötter et al, MTPA, 2014).

Different categories of CBA have specific management objectives (Table 7), according to their biodiversity priority. In broad terms, the biodiversity priority areas need to be maintained in a healthy and functioning condition, whilst those that are less important for biodiversity can be used for a variety of other land-use types (Lötter et al, MTPA, 2014).

Table 7: The use of CBA maps in Environmental Impact Assessment and the reference to relevant sections present in the report.

Land-use planning and Decision-making	**Reference**
Step 1: Prepare for the site visit: Purpose: To determine the biodiversity context of the proposed land-use sites (using CBA maps, land-use guidelines and underlying GIS layers)	5.3 The use of CBA maps in Environmental Impact Assessments
Step 1.1 Establish how important the site is for meeting biodiversity targets? (Is it in a CBA or ESA?)	Critical Biodiversity Areas (under 5.3)
○ Step 1.1.1 Proposed land use	1. Project Description
○ Step 1.1.2 Environmental Impact Assessments (EIA) and Freshwater Ecosystem Priority Areas (FEPA)	Freshwater Ecosystem Priority Areas (FEPAs) (under 5.3)
○ Step 1.1.3 Description of the biophysical environment	3.2 Physiography of the study area
○ Step 1.1.4 Present Ecological State of the Ngodwana Dam project area	5.1 Present Ecological State of the study area
○ Step 1.1.5 Critical Biodiversity Areas	Critical Biodiversity Areas (under 5.3)
• Step 1.2 Assess if the proposed land-use is consistent with the desired management objectives for the site (Use the land-use guidelines)	5.5 Land-use guidelines 5.6 Desired management Objective
○ Step 1.2.1 Critical Biodiversity Area in the Ngodwana Dam project area	Critical Biodiversity Areas (under 5.3)
• Step 1.3 Find out if threatened or other red data-listed species or ecosystems are present ○ Vegetation ○ Fish ○ Frogs ○ Reptiles ○ Birds ○ Mammals	4.3 Biodiversity assessments
Step 2: Conduct the site visit: Purpose: To Ground-truth the CBA maps and conduct additional biodiversity	4.2 Ecological survey transects

assessments in the study area	in the Ngodwana Dam project area.
Step 2.1 Compare mapped land cover with observed land cover at the site	4.1 Vegetation and land cover types identified for the ecological surveys.
○ Step 2.1.1 Record observed features in site assessment report ▪ Ecological surveys - methods ▪ Aquatic habitat assessments ▪ Vegetation ▪ Aquatic biota ▪ Aquatic invertebrate assessment ▪ Fish communities ▪ Terrestrial fauna studies ▪ Amphibian surveys ▪ Reptile surveys ▪ Bird surveys ▪ Mammal surveys	2. Methodology - Methods and approach 4.1 Vegetation units and land cover types within the study area 4.3 Biodiversity assessments
○ Step 2.1.2 Results of Ecological Surveys	4. Results
Vegetation	4.1 Vegetation and land cover types identified for the ecological surveys
▪ Observed vegetation	4.3.1 Vegetation communities
▪ Riparian delineation	5.4 Buffers and Corridors for Connectivity
○ Fauna surveys	4.3.3 Terrestrial ecology
▪ Aquatic habitats and fauna	4.3.2 Riverine Ecology
▪ Aquatic habitat assessment	4.3.2 Riverine Ecology
▪ Aquatic invertebrate assessment	4.3.2 Riverine Ecology
▪ Fish Response Assessment Index	4.3.2 Riverine Ecology
▪ Terrestrial fauna	4.3.3 Terrestrial ecology
○ Frogs	4.3.3.2 Frogs
○ Reptiles	4.3.3.3 Reptiles
○ Birds	4.3.3.4 Birds
○ Mammals	4.3.3.5 Mammals

○ Step 2.1.3 Further planning to proceed using ground-truthed land cover	4.1 Vegetation units and land cover types within the study area
Step 2.2 Compare mapped CBA or ESA features with ground-truthed ones	4.1 Vegetation units and land cover types within the study area
Step 2.3 Identify compromises and solutions that minimise impacts on biodiversity and conflicts in land-use	5.5 Land-use guidelines 5.4 Buffers and Corridors for Connectivity
○ Step 2.3.1 Retain natural habitat and connectivity in CBAs and ESAs	Retain natural habitat and connectivity in CBAs and ESAs (under 5.8)
○ Step 2.3.2 Apply the mitigation hierarchy	Apply the mitigation hierarchy (under 5.8)
○ Step 2.3.3 Secure priority biodiversity in CBAs and ESAs through biodiversity stewardship	Secure priority biodiversity in CBAs and ESAs through biodiversity stewardship (under 5.8)
○ Step 2.3.4 Remedy degradation and fragmentation through rehabilitation	Remedy degradation and fragmentation through rehabilitation (under 5.8)
○ Step 2.3.5 Promote long-term persistence of taxa of special concern	Promote long-term persistence of taxa of special concern (under 5.8)
Step 3: Assess impact on biodiversity: Purpose: To make recommendations regarding the impacts of the proposed land-use development on biodiversity	5.7 Assessment of impacts and proposed mitigation
Step 3.1 When impacts are likely to be insignificant	5.10 Reasoned opinion
○ Step 3.2 When significant impacts are unavoidable	5.10 Reasoned opinion
○ Step 3.2.1 CBAs and ESAs	5.10 Reasoned opinion
○ Step 3.2.2 ONAs	5.10 Reasoned opinion

Step 4: Identify opportunities to conserve biodiversity: Purpose: Maximise conservation gains by proactive identification of opportunities to conserve biodiversity	Apply the mitigation hierarchy (under 5.8)
○ Step 4.1 Set aside land of high biodiversity importance for conservation through biodiversity stewardship options	Secure priority biodiversity in CBAs and ESAs through biodiversity stewardship (under 5.8)
○ Step 4.2 Where biodiversity losses are unavoidable, set aside another piece of land of equivalent or greater biodiversity importance for conservation	Secure priority biodiversity in CBAs and ESAs through biodiversity stewardship (under 5.8)
○ Step 4.3 Clear invasive alien vegetation and rehabilitate existing degraded habitats	5.10 Reasoned opinion
Step 5: Incorporate biodiversity priorities in EIA report: Purpose: Show explicitly how CBA maps and land-use guidelines have informed project location, design and implementation	5.3 The use of CBA maps in Environmental Impact Assessments
○ Step 5.1 Determine the least damaging location and design	Critical Biodiversity Areas (under 5.3)
○ Step 5.1.1 Avoiding CBAs	Critical Biodiversity Areas (under 5.3)
○ Step 5.1.2 Reducing pressure on natural habitat and ecological processes.	5.7 Assessment of impacts and proposed mitigation
○ Step 5.1.3 Concentrating disturbance footprints in heavily modified or degraded areas that are not earmarked for rehabilitation	5.7 Assessment of impacts and proposed mitigation
○ Step 5.1.4 Integrating *in situ* biodiversity-sensitive management into the overall design and operation of the proposed land-use development	5.7 Assessment of impacts and proposed mitigation

3. Description of the study area

3.1 Present Ecological State of the study area

Ngodwana Dam is next to Ngodwane and is located in Mpumalanga, South Africa. The Sappi Ngodwana Dam was constructed on the Farm Ngodwana 1030 JT., Ngodwana. Ngodwana Dam is a 41 m high zoned earth fill Category III Dam and has a length of 7.69 kilometres. The dam islocated on a tributary of the Elands River, Mpumalanga Province, directly upstream from the N4 highway and the Ngodwana Paper Mill, 40 km from Mbombela.

Figure 15: Location of the Ngodwana Project area.

The planned project activities will take place in the area below the Ngodwana Dam and the river which forms part of the assessment is the Ngodwana River (X21H-01060). The study area is between the dam outlet and the N4 highway, close to the confluence of the Ngodwana River and the Elands River. The Ngodwana Dam is a man-made Ngodwana lake with a 10 m^3 χ 10^6 m^3 water storage facility that was constructed in the early 1980s on the lower Ngodwana River, a tributary of the Elands River. The SAPPI Paper Mill uses water stored in the Ngodwana Dam (owned and managed by Sappi).

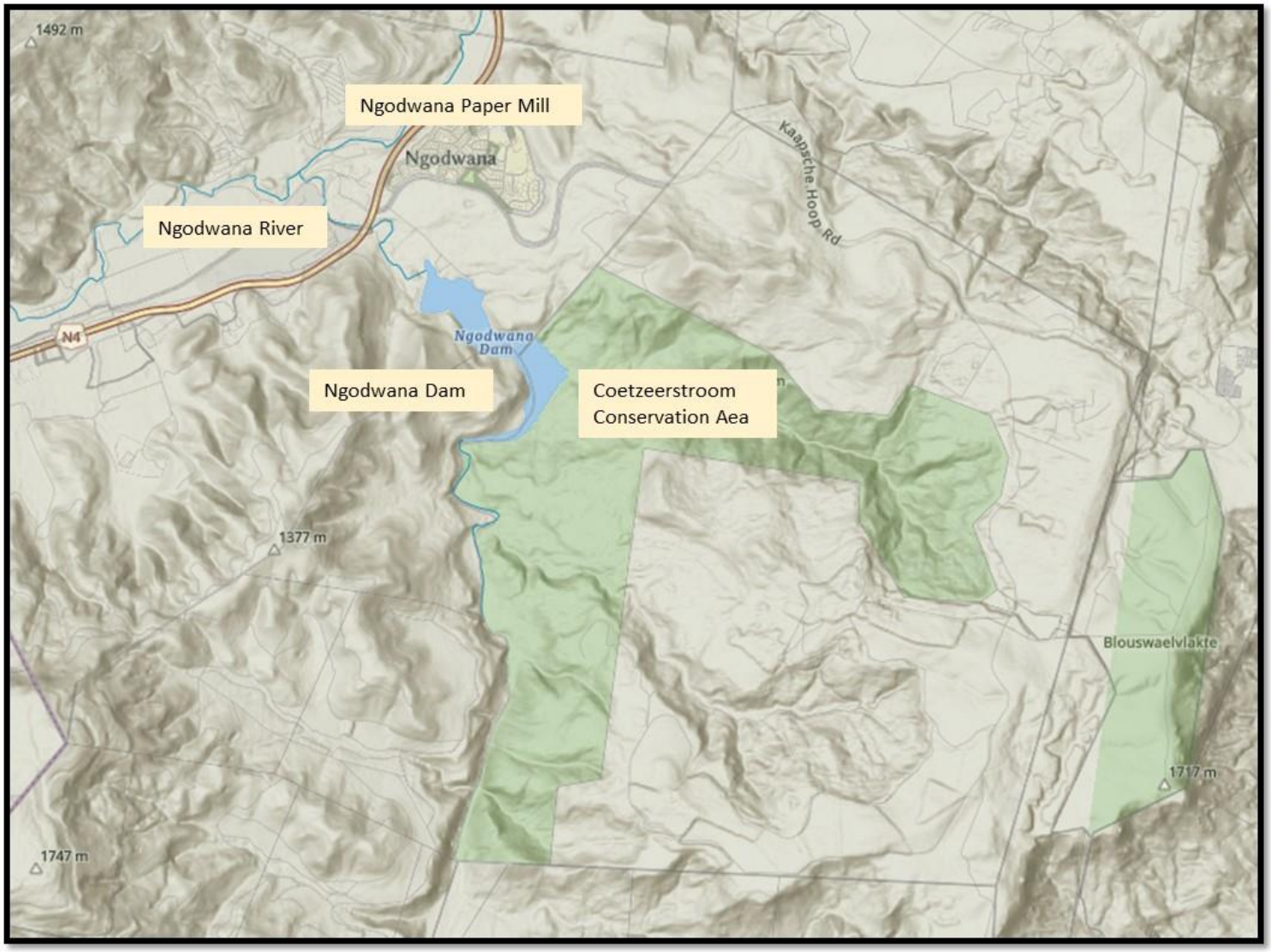

Figure 16: The Ngodwana Dam, illustrating the nearby town, SAPPI Mill and hilly topography.


Project Area
Elands River
Ngodwana Dam
Ngodwana River
X21H-01060
SAPPI Paper Mill

Figure 17: The map which indicates the SAPPI Paper Mill and affected reach of the Ngodwana River in which the project are proposed take place (Yellow rectangle).

3.2 Physiography of the study area

The most recent vegetation map for South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006), maps the vegetation of the study area as Legogote Sour Bushveld (SVI 9) in the Lowveld Bioregion**.**

Distribution

Mpumalanga and Limpopo Provinces: Lower eastern slopes and hills of the north-eastern escarpment from Mariepskop in the north through White River to the Nelspruit area extending westwards up the valleys of the Crocodile, Elands and Houtbosloop Rivers and terminating in the south in the Barberton area. Altitude 600–1 000 m and higher in places.

Vegetation & Landscape Features: Gently to moderate. Sloping upper pediment slopes with dense woodland including many medium to large shrubs often dominated by *Parinari curatellifolia* and *Bauhinia galpinii* with *Hyperthelia dissoluta* and *Panicum maximum* in the undergrowth. Short thicket dominated by *Vachellia ataxacantha* occurs on less rocky sites. Exposed granite outcrops have low vegetation cover.

Geology & Soils: Most of the area is underlain by gneiss and migmatite of the Nelspruit Suite, but the southern part occurs on the potassium-poor rocks of the Kaap Valley Tonalite (both Swazian Erathem). The westernmost parts of the distribution are found in Pretoria Group shale and quartzite (Vaalian). Archaean granite plains with granite inselbergs and large granite boulders also occur. Soils are of Mispah, Glenrosa and Hutton forms, shallow to deep, sandy or gravelly and well drained. Diabase intrusions are common, giving rise to Hutton soils.

Climate: Summer rainfall with dry winters. MAP from about 700 mm on the footslopes of the escarpment in the east to about 1 150 mm where it borders on grassland at higher altitude to the west. Frost infrequent to occasional at higher altitudes. Mean monthly maximum and minimum temperatures for Nelspruit 35.7°C and 1.6°C for October and July, respectively. Corresponding values for Barberton 36.0°C and 0.8°C for October and June, respectively. Both weather stations lie at the eastern edge of the unit at lower altitude.

Conservation: Vulnerable (BGIS). Target 19%. About 2% statutorily conserved mainly in the Bosbokrand and Barberton Nature Reserves; at least a further 2% is conserved in private reserves including the Mbesan and Kaapsehoop Reserves and Mondi Cycad Reserve. It has been greatly transformed (50%), mainly by plantations and also by cultivated areas and urban development. Scattered alien plants include *Lantana camara, Psidium guajava* and *Solarium mauritianum.* Erosion is very low to moderate.

Remark: At places on the footslopes this vegetation becomes very dense and is transitional to forest in kloofs on the eastern slopes of the escarpment.

Table 8: SVI 9 Legogote Sour Bushveld – status.

Name of vegetation type	Legogote Sour Bushveld
Code as used in the Book - contains space	SVl9
Conservation Target (percent of area) from NSBA	19%
Protected (percent of area) from NSBA	1.6% (+2.3%)
Remaining (percent of area) from NSBA	50.4%
Description of conservation status from NSBA	Vulnerable
Description of the Protection Status from NSBA	Poorly protected
Area (sqkm) of the full extent of the Vegetation Type	3538.14 (354 000 ha)

Name of the Biome	Savanna Biome
Name of Group (only differs from Bioregion in Fynbos)	Lowveld Bioregion
Name of Bioregion (only differs from Group in Fynbos)	Lowveld Bioregion

Catchment and Wetland Setting

The Ngodwana Dam is situated in the Crocodile River Sub-Water Management Area which form part of the Inkomati drainage system. The planned project activities will take place in the area below the Ngodwana Dam and the river which forms part of the assessment is the Ngodwana River (X21H-01060). The project site is located in quaternary catchment X21H and the site slopes towards the Elands River to the south (Figure 18).

Figure 18: The study area is between the dam outlet and the N4 highway, close to the confluence of the Ngodwana River and the Elands River.

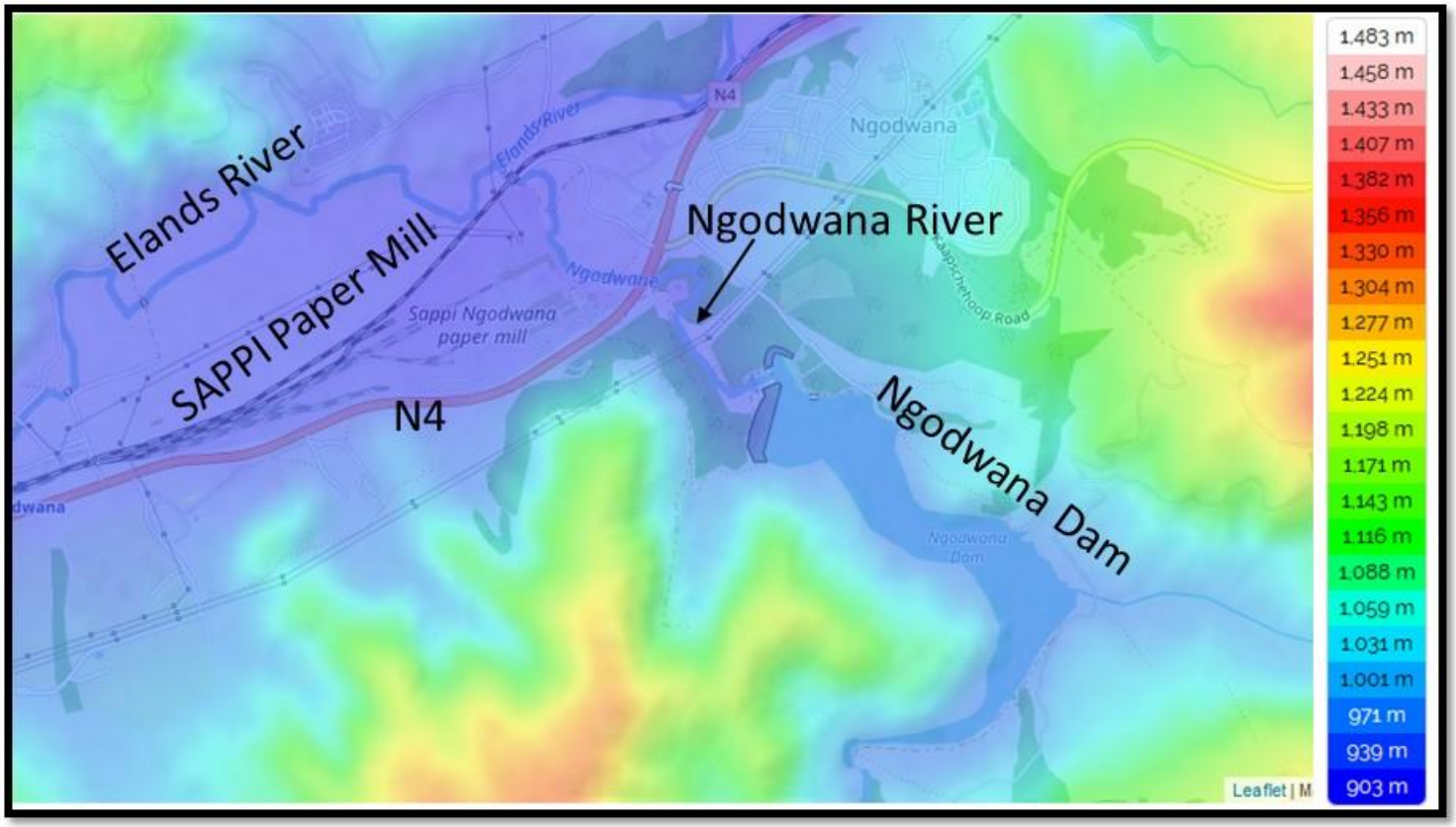

Figure 19: Altitude across the project area varies from *c*. 971 to 1224 mamsl and comprises rolling hills to the west and east of the dam, draining down the slope to the Elands River north of the area.

The Ngodwana Dam is a man-made Ngodwana lake with a 10 m^3 χ 10^6 m^3 water storage facility that was constructed in the early 1980s on the lower Ngodwana River, a tributary of the Elands River. The SAPPI Paper Mill uses water stored in the Ngodwana Dam (owned and managed by Sappi).

Ecoregion and River Characteristics

Ecoregions are groups of rivers within South Africa, which share similar physiography, climate, geology, soils and potential natural vegetation. For the purposes of this study, the ecoregional classification presented by Department of Water Affairs and Forestry in 1999 (DWAF, 1999), which divides the country's rivers into ecoregions, was used. The project site is located in quaternary catchment X21E with the development taken place within the catchment of the Elands River draining the Northern Escarpment Mountains (10.02) Ecoregion.

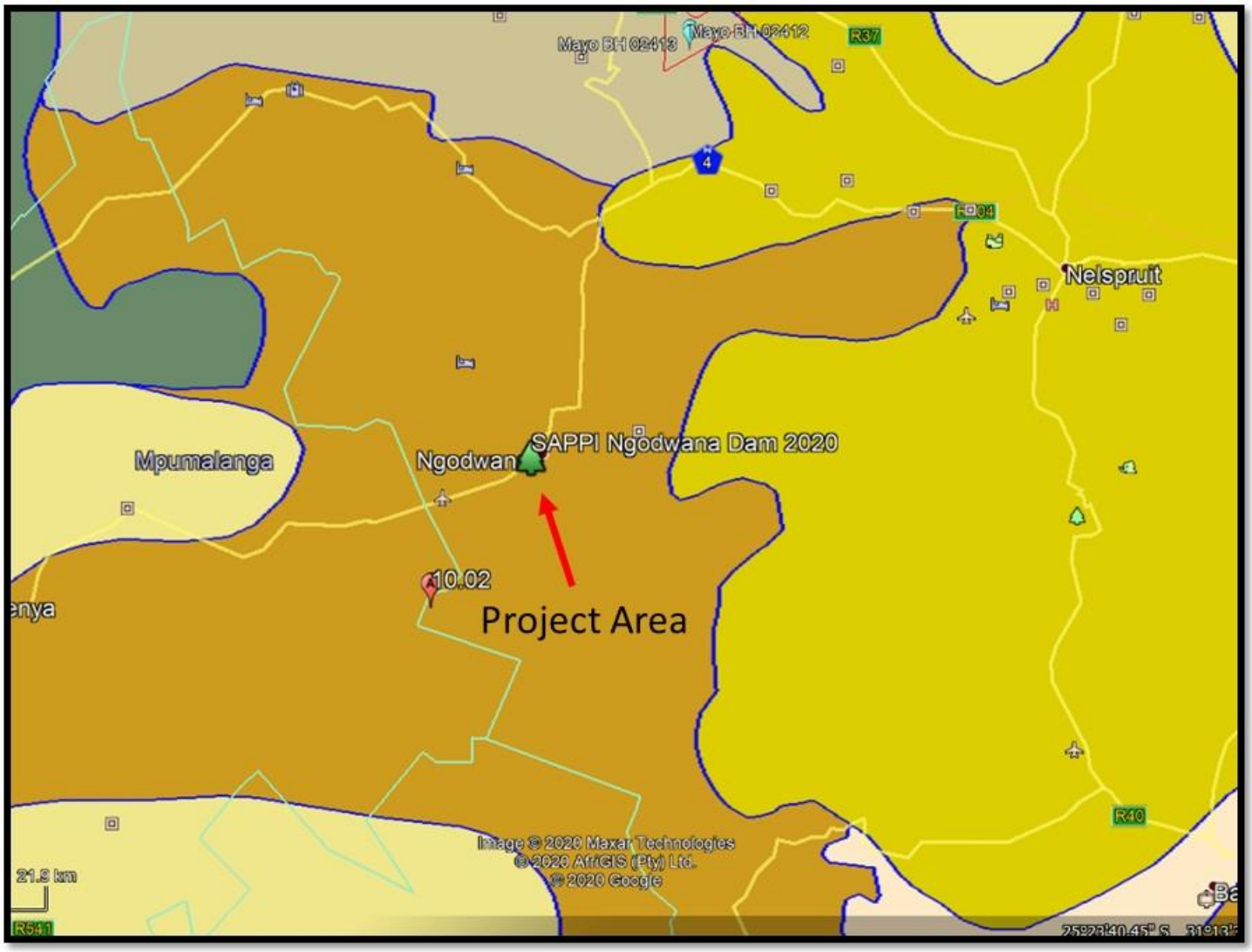

Figure 20: The Project Area is situated in the Northern Escarpment Mountains (10.02) Ecoregion according to the Water Resource Classification System (DWS, 2005).

10.02 Northern Escarpment Mountains Ecoregion

Primary boundary determinants:

The topography of this high lying region is highly definitive and consists of closed hills and mountains with a moderate to high relief. Towards the east, a well-defined escarpment is present along the majority of the length of the region. Northeastern Mountain Grassland is the dominant vegetation type in the region with areas of Sour Lowveld Bushveld towards the east. Patches of Afromontane Forest occur regularly as an interrupted, thin band towards the eastern boundary.

Drainage density is high and coefficient of variation of precipitation is very low. Rivers such as the Blyde, Sabie and Letaba have their sources here. Perennial tributaries of rivers such as the Crocodile, Komati and Olifants occur commonly in the region.

- Mean annual precipitation: High in most areas.
- Coefficient of variation of annual precipitation: Varies from low to very low.
- Drainage density: Low
- Stream frequency: Mostly medium to high
- Slopes <5%: <20%.
- Median annual simulated runoff: Generally high to very high
- Mean annual temperature: Cool to moderate.

Table 9: Characteristics of the Northern Escarpment Mountains Ecoregion (**Project Area attributes In Bold**).

Main Attributes	**Description**
Terrain Morphology: Broad division	Plains; Moderate Relief; **Closed Hills; Mountains; Moderate and High Relief**
Vegetation types	**North Eastern Mountain Grassland;** Sour Lowveld Bushveld; Mixed Bushveld (limited) Patches of Afromontane Forest
Altitude (m a.m.s.l)	500-900 (limited) 900-2300
MAP (mm)	500 to 1000
Rainfall seasonality	Early to mid summer
Mean annual temp. (°C)	10 to 22
Median annual simulated runoff (mm) for quaternary catchment	40 to >250

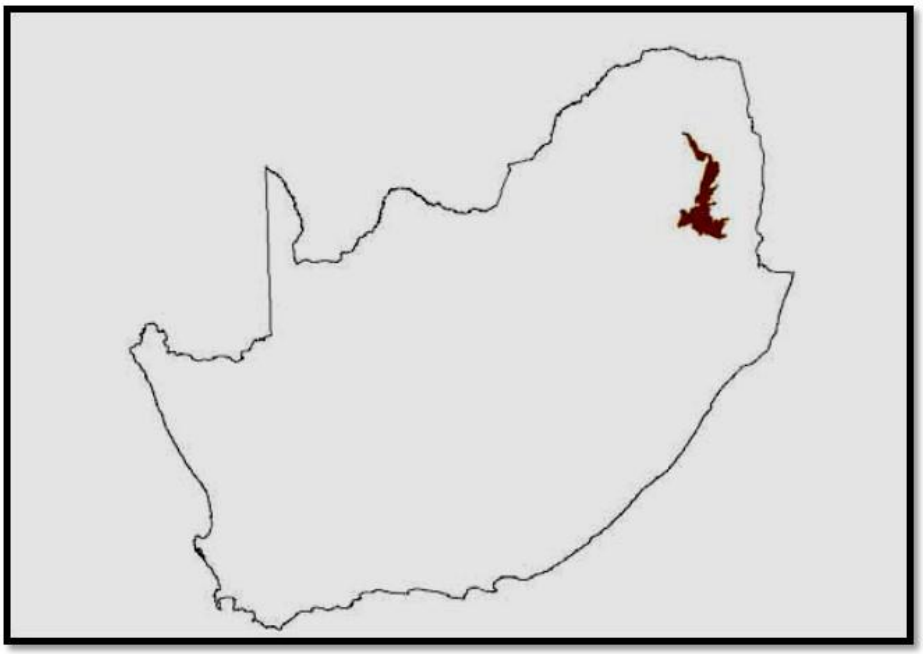

Figure 21: The Northern Escarpment Mountains Ecoregion (10.02) according to the Preliminary Level I River Ecoregional classification System for South Africa.

4. Results

4.1 Vegetation units and land cover types within the study area

The most recent vegetation map for South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2007), places the entire study area within the Legogote Sour Bushveld (SVI 9).

Vegetation/habitat types are mapped on the basis of available information (aerial photography, soil types, geology) and will consist of structurally distinct vegetation units (wetland, grasslands, woodland) as well as transformed areas. Vegetation/habitat units will be graded according to biodiversity value and conservation status.

Figure 22 illustrates the land cover surrounding the Ngodwana Dam project area. Apart from the extensive area covered by the dam basin and dammed water surface, most of the area consists of Legogote Sour Bushveld. Wetlands created by the Ngodwana River and associated seepage wetlands below the dam, can be devided into three different wetland types (see below).

Rekative large patches of land are covered by areas transformed byold mining, servitudes and the dam wall. Tracks and unpaved roads criss-cross the area.

The following broad-scale vegetation units are simply practical units that combine various plant communities which share structural and functional characteristics and might have common management requirements (Figure 22).

A total of four units comprising untransformed vegetation/habitat and five units comprising transformed vegetation/habitat were identified. These nine units are listed below, and each unit is later described in more detail.

Vegetation units and land cover type:

Untransformed vegetation/habitat

1. Legogote Sour Bushveld
2. Ngodwana River
3. Ngodwana Catchment Valley Bottom Wetland
4. Ngodwana Catchment Valley Seeps

Transformed vegetation/habitat

5. Old Mining
6. Power Line Servitude
7. Ngodwana Dam Wall
8. Habitat impacted by Dam Wall Construction early 1980s
9. Roads and pipelines

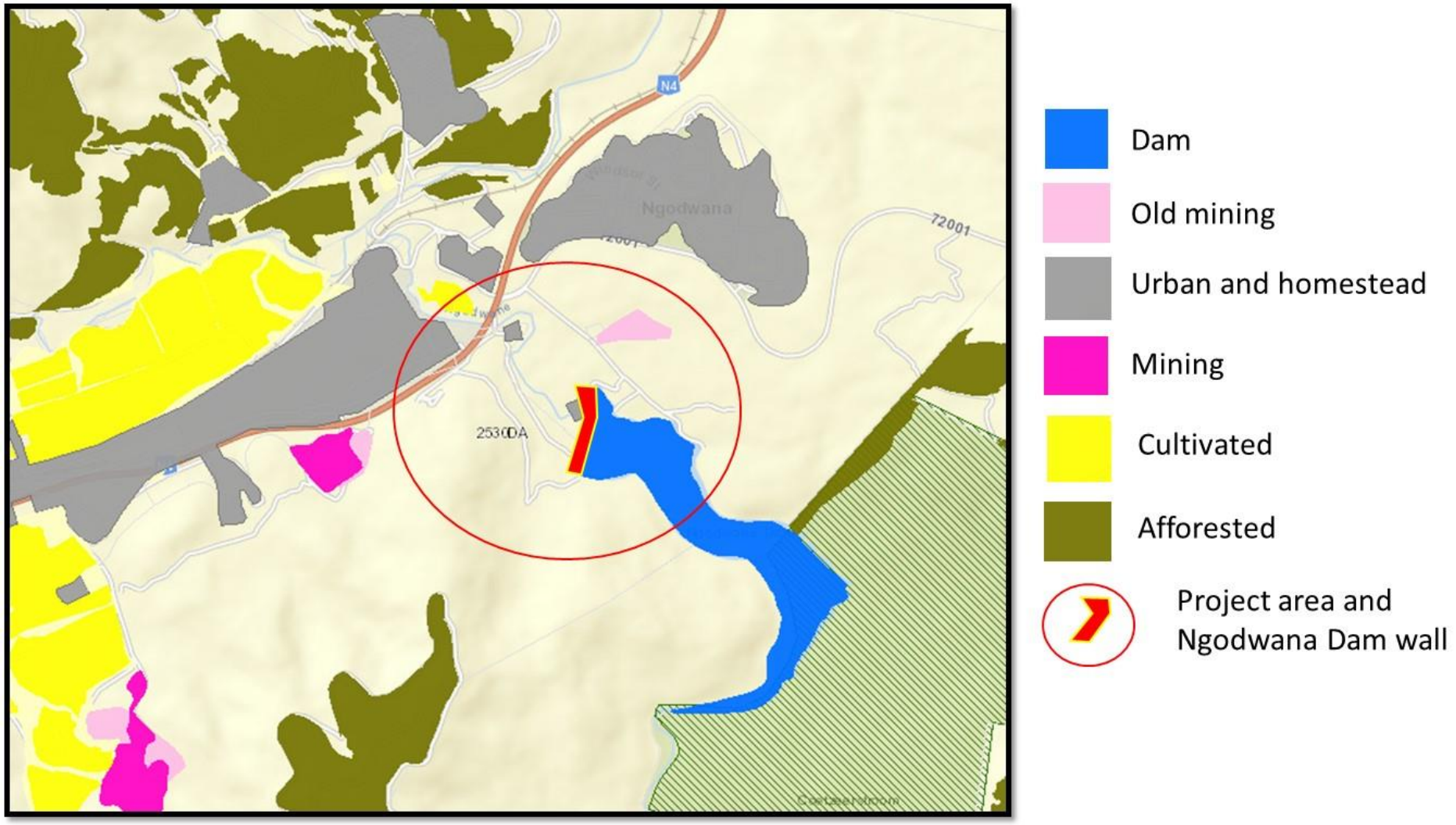

Figure 22: The land cover for the Ngodwana Dam project area obtained from the Mpumalanga LUDS maps (BGIS).

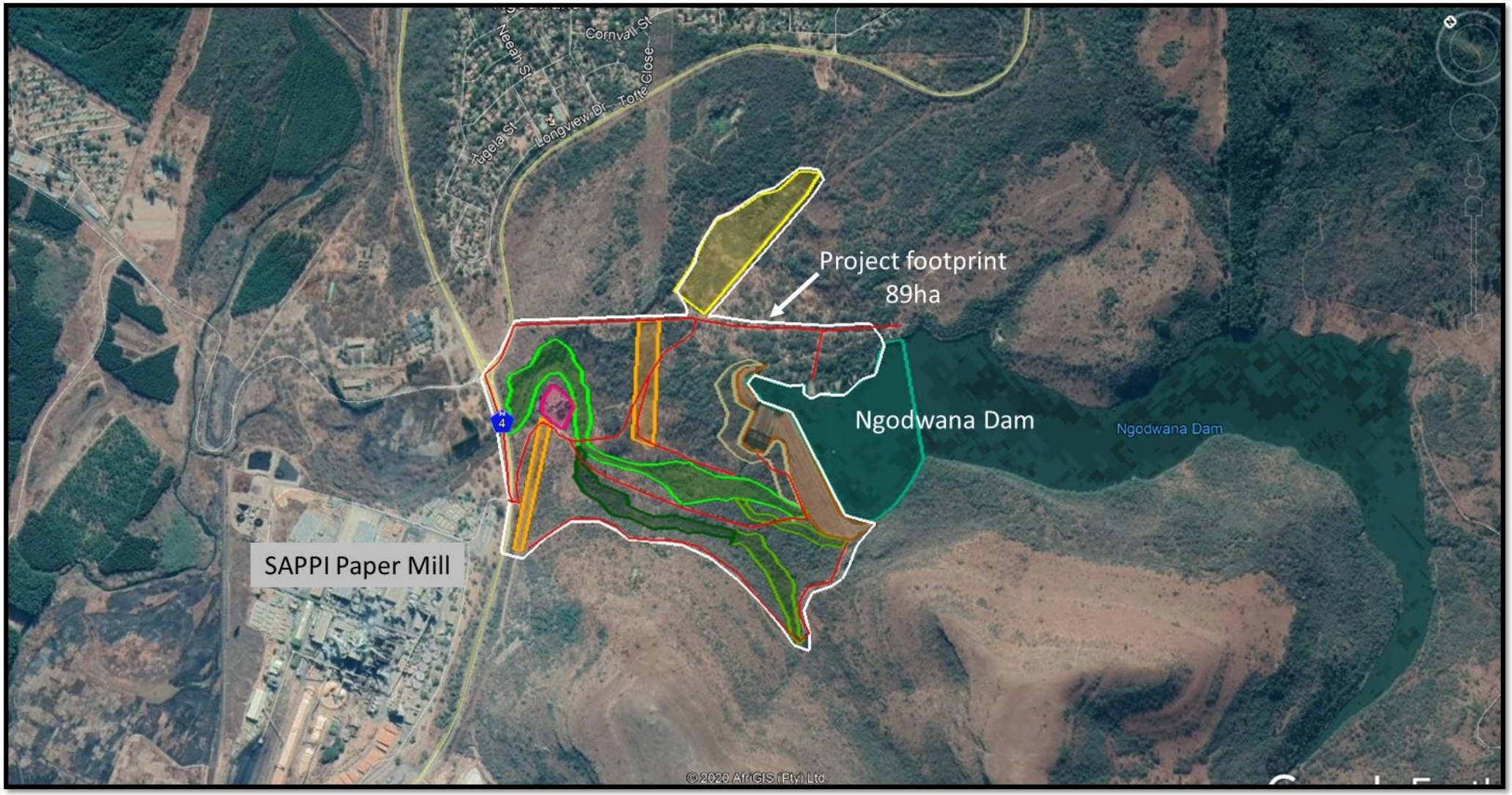

Figure 23: The Ngodwana project area footprint evaluated in this report.

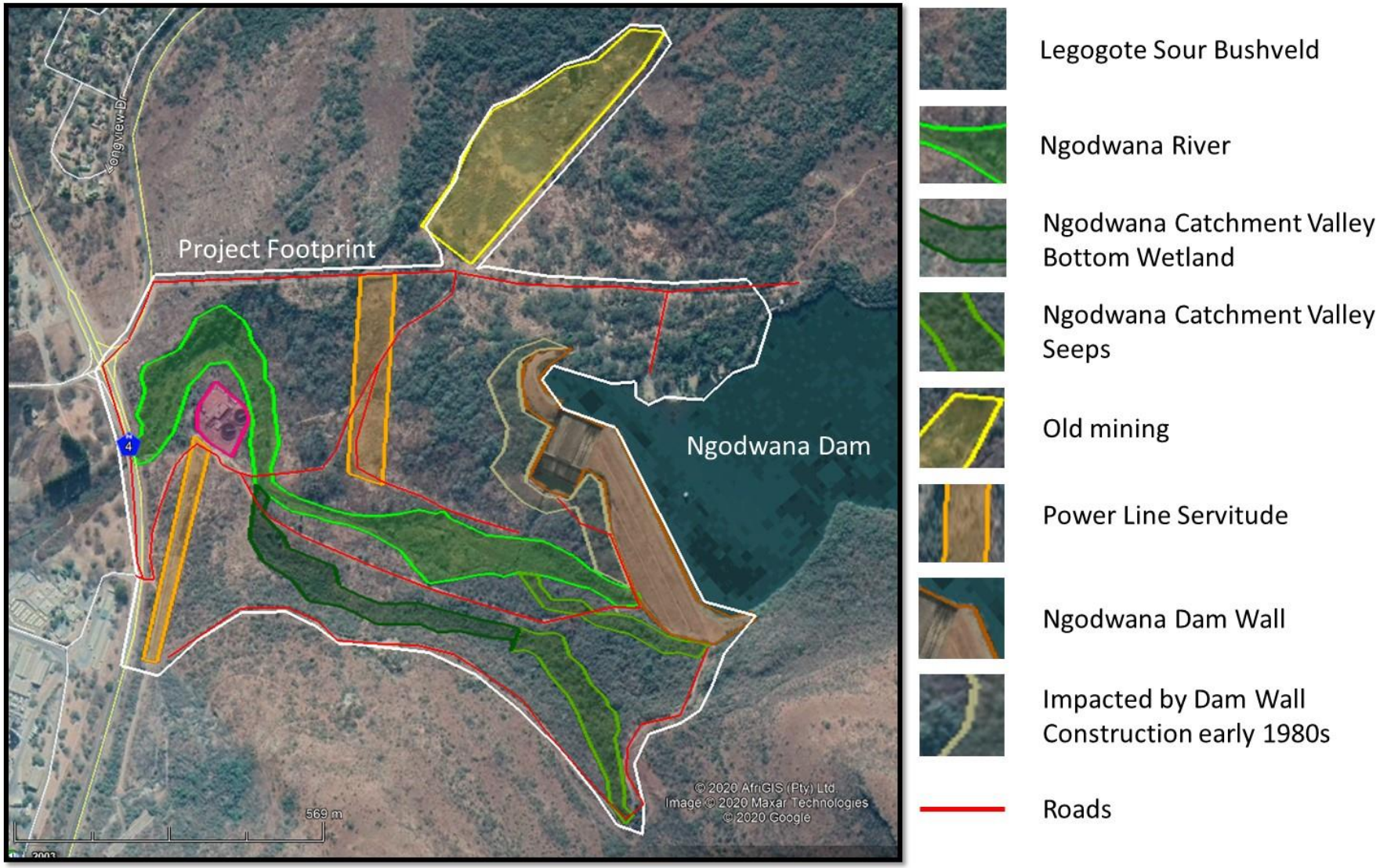

Figure 24: The broad-scale ground cover or vegetation units of the Ngodwana project area.

The following table (Table 10) is a summary the vegetation units and land cover types within the study area. It is important to have a thorough understanding of the vegetation types and the structure of these components, and with the physiography of the area it provides the template for potential faunal habitat.

Table 10: The vegetation units and land cover types of the Ngodwana Dam project area.

Vegetation unit and land cover type	**Description**	**Position in the study area**	**Hectares area cover**
Project footprint area = 89 ha			
Untransformed vegetation/habitat (Total = 70.5 ha)*			
1. Legogote Sour Bushveld	This vegetation type consists of open woodland of the hilly areas and valleys of the project area.	This vegetation type covers the major part of the area not transformed by infrastructure or previous developments.	57.7 ha
2. Ngodwana River	The Ngondwana River falls within the upper foothills geomorphological zone, dominated by alluvial cobble-bed, rapids, riffles, runs, glides, and pools. Trees, shrubs, herbaceous plants, and grasses dominate the marginal zone, with commercial forestry and grassland with scattered trees and shrubs in the surrounding landscape	The Ngodwana River is a tributary of the Elands River and the portion in the project area flows between the dam and the Elands River.	7.7 ha
3. Ngodwana Catchment Valley Bottom Wetland	One of the seeps becomes the Valley Bottom Wetland further down and the near-perennial flow are surrounded by a dense riparian zone.	The valley bottom wetland which joins the Ngodwana River just before the Water Works.	2.4 ha
4. Ngodwana Catchment Valley Seeps	Two wetland seeps originating on the slope of the mountain and drain down into the area below.	One seep becomes a valley bottom wetland which joins the Ngodwana River just before the Water Works, while the other shorter seepage joins the original drainage line of the Ngodwana River below the dam.	2.7 ha
Transformed vegetation/habitat (Total = 18.8 ha)*			
5. Old Mining	An area generally impacted by previous sand mining activities.	Lies towards the east of the project area.	6.7 ha
6. Power Line Servitude	An area kept open as the servitude by regular vegetation clearing. A pipeline shares the servitude in this stretch between the R4 and the power lines.	Entering the project area from the east up to the Ngodwana River and then continues from the WTW parallel with the N4.	3.7 ha

7. Ngodwana Dam Wall	The Ngodwana Dam is a man-made Ngodwana lake with a 10 m^3 χ 10^6 m^3 water storage facility that was constructed in the early 1980s on the lower Ngodwana River, a tributary of the Elands River. The spillway created a short section of channelled flow whenever the spillway overflows before its confluence with the original Ngodwana River channel.	The Ngodwana Dam was constructed on the lower Ngodwana River, a tributary of the Elands River.	5.8 ha
8. Habitat impacted by Dam Wall Construction early 1980s	These areas were totally denuded during the construction of the dam wall in the early 1980s. The regrowth of vegetation in the area consists of a mix of indigenous and alien vegetation.	The area directly below the Ngodwana Dam Wall.	2.6 ha
9. Roads and pipelines	There are a number of roads in the project area, most of them are unpaved. There are also pipeline servitudes for taking water from the dam area to the SAPPI Plant.		

*Area sizes are approximate figures.

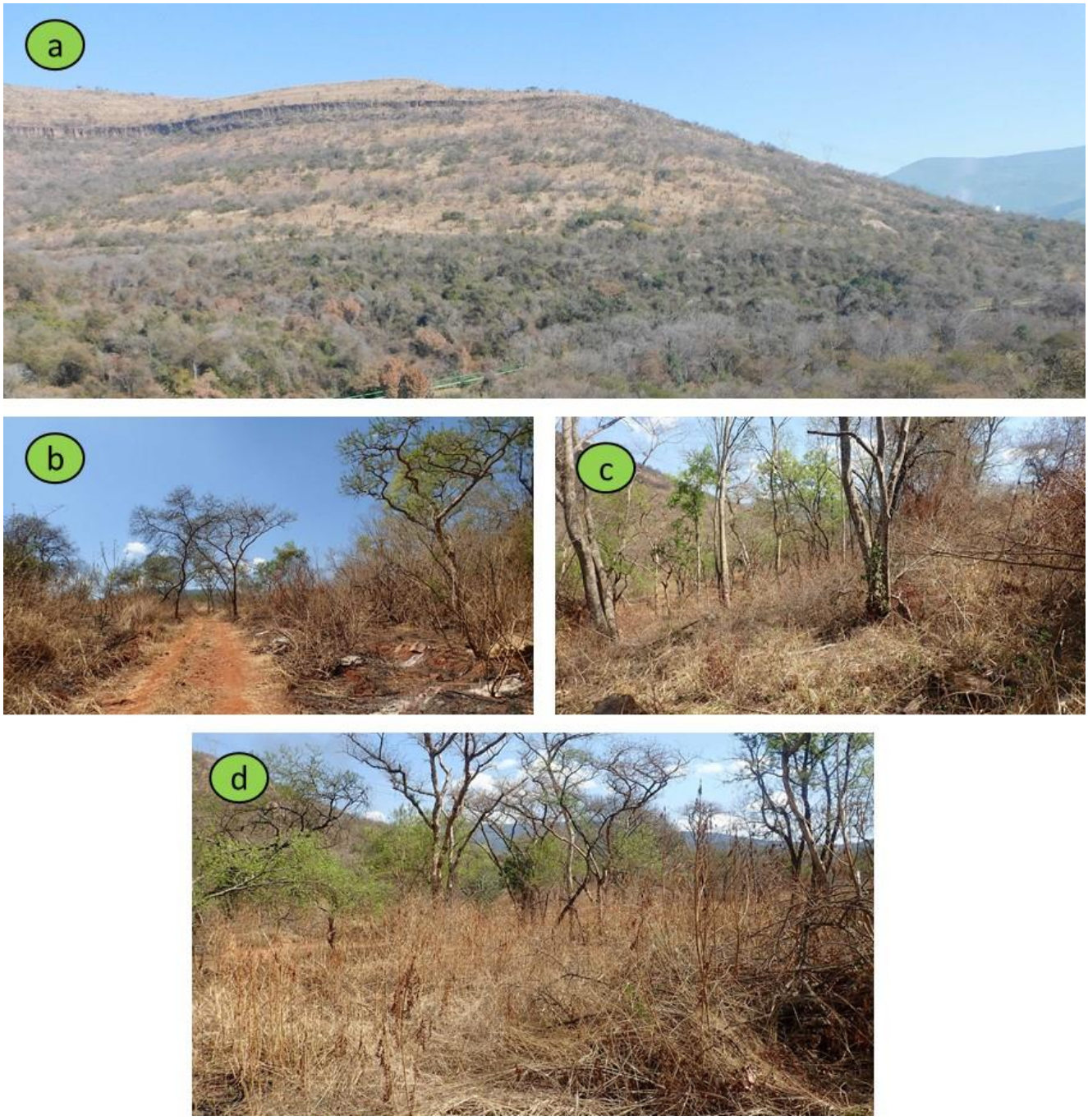

Figure 25 a-d: Examples of Legogote Sour Bushveld in and around the study area.

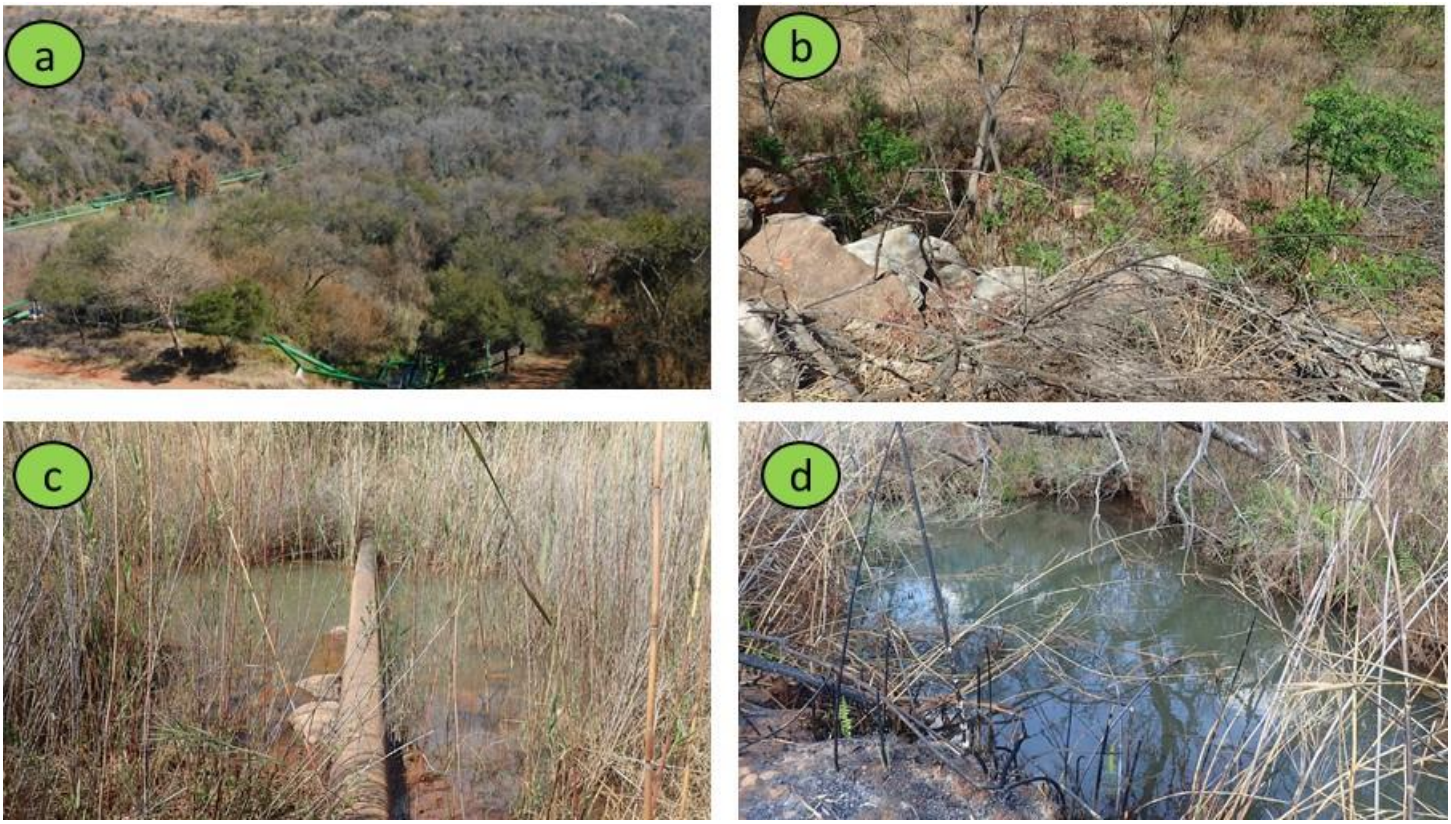

Figure 26 a: The Ngodwana River valley.

Figure 26 b-d: Examples of Ngodwana River drainage in the study area.

Figure 27 a: The dense riparian woodland along one of the Ngodwana Catchment Valley Seeps.

Figure 27 b: Reed growth in the Ngodwana Catchment Valley Bottom Wetland.

Figure 28 a-d: The old mining area to the east of the project area.

Figure 29 a: The Power Line Servitude.

Figure 30 a-c: The Ngodwana Dam Wall and spillway.

Figure 31 a-c: The construction of the Ngodwana Dam Wall in the early 1980s, showing the extensive areas below the wall impacted by clearing and construction.

Figure 32 a-c: Most of the roads in the project area are unpaved. .

4.2 Ecological survey transects in the Ngodwana Dam project area.

A major component of this study is the characterisation of habitat types and associated fauna (obtained from regional distribution records) of the available landscape/environment. This information is used as a basis for predicting the potential impacts of the proposed project, and other human-induced activities, on the composition of threatened fauna in the study area. Representative survey sites were selected in all prominent vegetation types of the study area. Extensive transects (400-3000m) were then surveyed for potential habitat and all associated fauna. GPS readings provide fixed locations of these transects for future monitoring (Table 11; Figure 33).

Table 11: A description of the transects or point counts conducted for habitat, micro-habitat, influences and impacts, birds, mammal signs and herpetofauna (July 2020). Some transects are shared (e.g. left side/right side - e.g. wetland left, grassland right).

Habitat	Coordinates		Length (m)	Total (m)
	Start	End		
Untransformed vegetation/habitat				
1. Legogote Sour Bushveld				
Transect 8	25°34'54.38"S 30°40'20.03"E	25°35'2.42"S 30°40'19.56"E	257	
Transect 9	25°34'52.10"S 30°40'9.20"E	25°34'43.29"S 30°40'5.34"E	280	
Transect 11	25°34'39.07"S 30°40'4.56"E	25°34'40.95"S 25°34'40.95"S	326	
Transect 12	25°34'46.48"S 30°40'13.37"E	25°34'50.49"S 30°40'16.54"E	446	
Transect 13	25°34'37.87"S 30°40'22.24"E	25°34'51.58"S 30°40'31.10"E	619	
			Total	1928
2. Ngodwana River				
Transect 6	25°35'0.65"S 30°40'16.20"E	25°34'52.10"S 30°40'9.20"E	342	
Transect 8	25°34'54.38"S 30°40'20.03"E	25°35'2.42"S 30°40'19.56"E	257	
Transect 10	25°34'40.95"S 30°40'6.11"E	25°34'36.95"S 30°40'1.73"E	422	
			Total	764
3. Ngodwana Catchment Valley Bottom Wetland				
Transect 6	25°35'0.65"S 30°40'16.20"E	25°34'52.10"S 30°40'9.20"E	342	
Transect 9	25°34'52.10"S 30°40'9.20"E	25°34'43.29"S 30°40'5.34"E	280	
			Total	622
4. Ngodwana Catchment Valley Seeps				
Transect 7	25°35'7.14"S 30°40'21.24"E	25°34'59.11"S 30°40'15.18"E	307	
			Total	307
Transformed footprint				
5. Old Mining				
Transect 1	25°34'34.17"S 30°40'34.18"E	25°34'37.66"S 30°40'44.07"E	461	

			Total	461
6. Power Line Servitude				
Transect 2	25°34'39.30"S 30°40'19.72"E	25°34'45.38"S 30°40'12.41"E	248	
Transect 3	25°34'37.74"S 30°40'4.55"E	25°34'41.23"S 30°39'59.62"E	176	
			Total	424
7. Ngodwana Dam Wall				
Transect 4	25°34'55.46"S 30°40'21.31"E	25°35'7.08"S 25°35'7.08"S	385	
Transect 5	25°34'47.93"S 30°40'27.32"E	25°34'51.79"S 30°40'19.38"E	338	
			Total	723
8. Habitat impacted by Dam Wall Construction early 1980s				
Transect 4	25°34'55.46"S 30°40'21.31"E	25°35'7.08"S 25°35'7.08"S	385	
Transect 5	25°34'47.93"S 30°40'27.32"E	25°34'51.79"S 30°40'19.38"E	338	
			Total	723
			Grand total	

GPS coordinates, acquired in the field (Table 11), were added to Google Earth to illustrate and demarcate the study area and survey transects. Nine transects were completed to assess resident biota and their associated habitats. Specific habitat features were identified to provide an indication of available habitat for different animals favouring a specific biotope (specifically medium-sized fauna across all vertebrate groups).

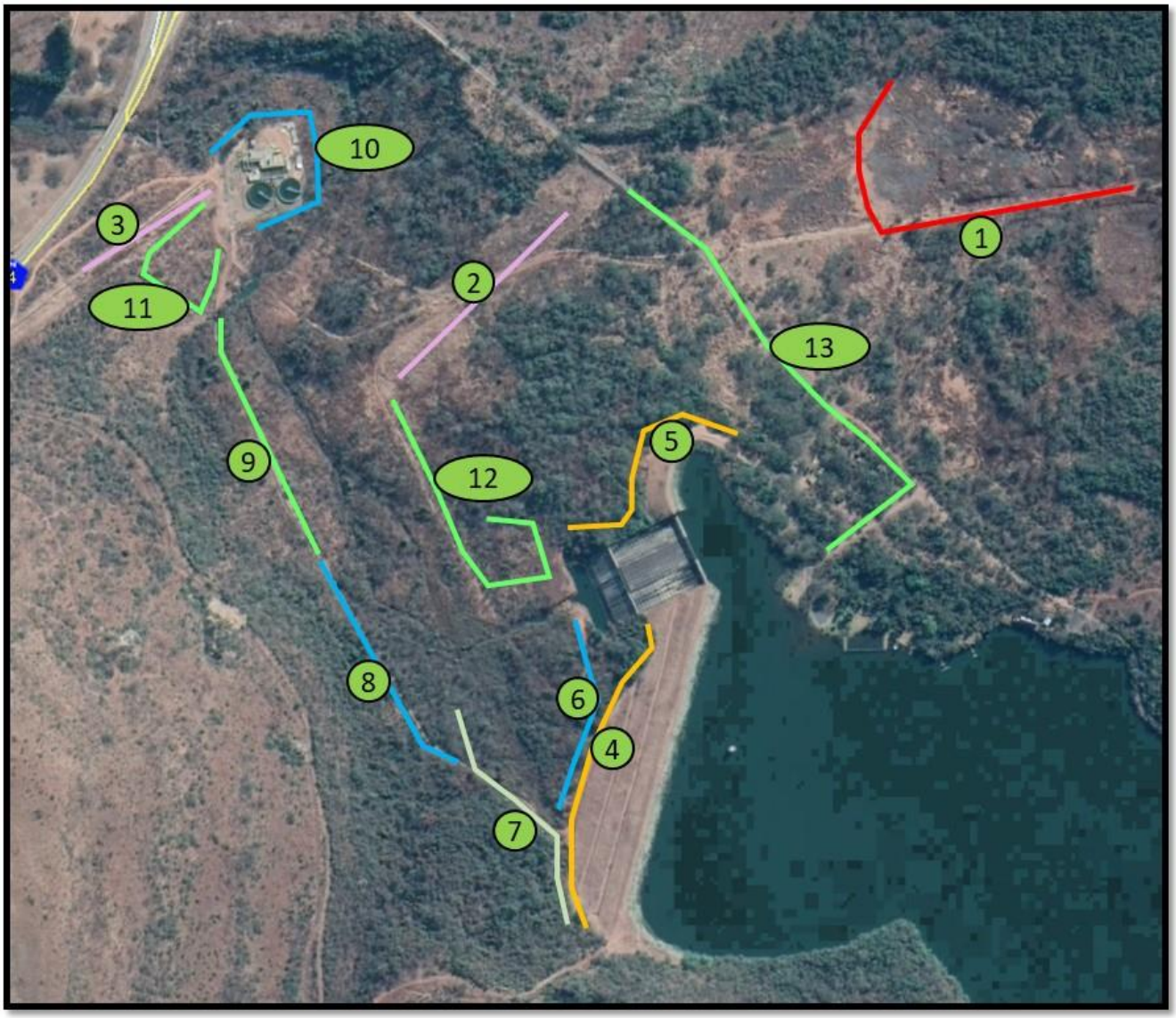

Figure 33: A map compiled by using a Google Earth image, indicating the Ngodwana Dam Project Area in which the proposed project activities will take place and which also indicates the survey transects which corresponds with the list in Table 11.

4.3 Biodiversity assessments

The fieldwork component of this study was conducted during July 2020. The survey methods described herein make use of a habitat surrogate technique, where habitat type and availability is used as a baseline assessment, with species' presence used to verify habitat integrity. The specialist report includes detailed species lists obtained from an extensive background review and the field monitoring results, with emphasis on the following:

- Probability of occurrence of species with high conservation value and assessment of the availability of their habitat on the property, as well as potential risks or threats to these species.
- Detailed overview on the current biodiversity status of the area in terms of terrestrial and wetland biota.
- Status of habitat, habitat preference and probability of occurrence.

During the biodiversity assessments (July 2020) of the Ngodwana Dam Project Area landscape, different vegetation and land cover units were identified. By definition, ecosystem status reflects the ecosystem's ability to function naturally, at a landscape scale and in the long-term. Vegetation types provide a good representation of terrestrial biodiversity because most animals, birds, insects and other organisms are associated with specific vegetation types (Table 10).

In order to establish a baseline of faunal occurrence, an assessment was made of the ecosystem template. The ecosystem template is a function of the geomorphology (abiotic) and the vegetation (biotic) structure of the area. By using species occurrence data from the current survey (2020) and expected occurrence records of known species distributions and preferred habitat type, the baseline integrity of the study is established.

Ecosystem status reflects the ecosystem's ability to function naturally, at a landscape scale and in the long-term. The single biggest cause of biodiversity loss in South Africa is the loss and degradation of natural habitat. Vegetation types provide a good representation of terrestrial biodiversity, as they often reflect specific habitat types and associated animals, birds, insects and other organisms. The vegetation/land cover types were thus classified on the basis of structural and functional characteristics with the following objectives in mind:

- To assess the status of vegetation/land cover types impacted by development: due to either historical and/or present farming practices, residential occupation and/or mining practices;
- To assess the status of faunal assemblages in the study area, with emphasis on Species of Special Concern.

The next step is to establish the likelihood of Species of Special Concern, occurring in the vicinity (include degree of confidence). For this report, the category "Species of Special Concern" is considered to include all threatened taxa listed by South African Red Data lists (Species of Conservation Concern) (Appendix 3), Threatened or Protected Species (NEMBA) and all South African endemic taxa.

Conservation-important plant species listed for the quarter-degree grid 2530DA in the Mpumalanga Tourism & Parks Agency's (MTPA) threatened species database were used to produce a list of the most likely occurring species, which were searched for during fieldwork.

Due to their limited distribution and range in South Africa, endemic species are also included as species of special interest. Traditionally, an endemic species will have a global distribution restricted to >90% of the atlas region.

Species of special concern are those that have particular ecological, economic or cultural importance and include: those that are rare, endemic or threatened; species with unusual distributions; and medicinal and other indigenous species that are exploited commercially or for traditional use. A 'Species of Special Concern' is any species or subspecies of biota, native to the province that has entered a long-term state of decline in abundance or is vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance. These are species that are threatened, or, if not, their population number is a special concern of the following ecological foundations:

- Occur in small, isolated populations or in fragmented habitat, and are threatened by further isolation and population reduction;

- Show marked population declines. Population estimates are unavailable for the vast majority of taxa. Species that show a marked population decline, yet are still abundant, do not meet the Special Concern definition, whereas a marked population decline in uncommon or rare species is an inclusion criterion;
- Depend on a habitat that has shown substantial historical or recent declines in size. This criterion infers the population viability of a species based on trends in the habitat types upon which it specialises;
- Occur only in or adjacent to an area where habitat is being converted to land uses incompatible with the animal's survival;
- Have few records, or which historically occurred here but for which there are no recent records; and
- Occur largely on public lands, but where current management practices are inconsistent with the species persistence.

Threatened faunal species represent a decline in biological diversity because of their numbers decrease and their genetic variability is severely diminished. Rare species, as well as those of special concern carry challenges different to most other large and common species; characteristics of these species are:

- extremely small or localised range
- requiring a large territory
- having low reproductive success
- needing specialised breeding areas
- needing specialised feeding areas
- habitat specificity
- life-histories not captured completely in the area (migrants)

4.3.1 Vegetation communities

Four untransformed vegetation communities were identified within the study area (Table 10) on the basis of distinctive vegetation structure (grassland, wetland, thicket, etc), floristic composition (dominant and diagnostic species) and position in the landscape (mid-slopes, terrace, crest, etc). Due to the small sizes of the wetlands, they were clumped as riverine wetlands. The detail of the untransformed communities and the species found in different habitat types are tabled in Table 12.

Plant surveys

A total of 48 indigenous plant species were recorded during fieldwork (Table 12); as well as 8 exotic species, some declared alien invaders.

Table 12: Vegetation assemblages and relevant plant species in the identified vegetation types in the project footprint (shading represents present; blue font = true riparian).

Plant species	Legogote Sour Bushveld	Riverine wetlands
Trees		
African olive (*Olea europaea africana*)		
African wattle (*Peltophorum africanum*)		
Bladdernut (*Diospyros whyteana*)		
Bluebush (*Diospyros lycioides*)		
Blue guarri (*Euclea crispa*)		

Broom cluster fig (*Ficus sur*)		
Buffalo-thorn (*Ziziphus mucronata*)		
Bushman's grape (*Rhoicissus tridentata*)		
Common hook thorn (*Senegalia caffra*)		
Cork-bush (*Mundulea sericea*)		
Crow-berry (*Searsia pentheri*)		
Dogwood (*Rhamnus prinoides*)		
False-horsewood (*Hippobromus pauciflorus*)		
Fever tree (*Vachellia xanthophloea*)		
Flute willow (*Salix mucronata*)		
Jacket plum (*Pappea capensis*)		
Kaht (*Catha edulis*)		
Koko tree (*Maytenus undata*)		
Paperbark thorn (*Vachellia sieberana*)		
Red crowberry (*Searsia chirindensis*)		
Red-leaved fig (*Ficus ingens*)		
River bushwillow (*Combretum erythrophyllum*)		
River climbing thorn (*Senegalia schweinfurthii*)		
Robust thorn (*Vachellia robusta*)		
Sourplum (*Ximenia caffra*)		
Stamvrug (*Englerophytum magalismontanum*)		
Sweet thorn (*Vachellia karroo*)		
Thorny rope (*Dalbergia armata*)		
Tree fuscia (*Halleria lucida*)		
Velvet bushwillow (*Combretum molle*)		
Water berry (*Syzygium cordatum*)		
Weeping lavender tree (*Heteropyxis natalensis*)		
White stinkwood (*Celtis africana*)		
Wild pear (*Dombeya rotundifolia*)		
Forbs		
Fever tea (*Lippia javanica*)		
Mother-in-law's tongue (*Sansevieria hyacinthoides*)		
Traveller's joy (*Clematis brachiata*)		
Grass		
Blue thatching grass (*Hyparrhenia tamba*)		
Broad-leaved bristle grass (*Setaria megaphylla*)		
Bushveld signal grass (*Urochloa mossambicensis*)		
Common crowfoot (*Dactyloctenium aegyptium*)		
False bristle grass (*Pennisetum sphaecelatum*)		
Guinea grass (*Panicum maximum*)		
Natal red top (*Melenis repens*)		
Rooigras (*Themeda triandra*)		

Species of Conservation Concern: Plants

Conservation-important plant species listed for the quarter-degree grid 2530DA in the Mpumalanga Tourism & Parks Agency's (MTPA) threatened species database (obtained from Mr. Mervyn Lötter) were used to produce a list of the most likely occurring species, which were searched for during fieldwork. The extensive list of species (fauna and flora) for the 2530DA grid have been narrowed down to the areas listed below.

2530DA NGODWANA

Sclerochiton triacanthus (Conservation status for South Africa – Vulnerable; Conservation status for Mpumalanga – Vulnerable; Endemic – South Africa)

ROODEWAL 470 JT and COETZEESTROOM 479 JT

Streptocarpus denticulatus (Conservation status for South Africa – Vulnerable; Conservation status for Mpumalanga – Vulnerable; Endemic – South Africa)

COETZEESTROOM 479 JT

Encephalartos humilis (Conservation status for South Africa – Vulnerable; Conservation status for Mpumalanga – Vulnerable; Endemic – South Africa)

Ledebouria galpinii (Conservation status for South Africa – Endangered; Conservation status for Mpumalanga – Endangered; Endemic – South Africa)

Syncolostemon incanus (Conservation status for South Africa – Endangered; Conservation status for Mpumalanga – Endangered; Endemic – South Africa)

COETZEESTROOM 479 JT and BERLIN 446 JT

Eucomis montana (Conservation status for South Africa – Vulnerable; Conservation status for Mpumalanga – Vulnerable; Endemic – South Africa)

BERLIN 446 JT

Arhyrolobium muddii (Conservation status for South Africa – Endangered; Conservation status for Mpumalanga – Endangered; Endemic – South Africa)

Curtisia dentata (Conservation status for South Africa – Near-threatened; Conservation status for Mpumalanga – Near-threatened)

Encephalartos humilis (Conservation status for South Africa – Vulnerable; Conservation status for Mpumalanga – Vulnerable; Endemic – South Africa)

Eucomis autumnalis (Conservation status for South Africa – Declining; Conservation status for Mpumalanga – Declining)

Ocotea kenyensis (Conservation status for South Africa – Vulnerable; Conservation status for Mpumalanga – Vulnerable)

Additionally, information which was obtained from the Screening Tool exercise, lists the environmental sensitivity of the proposed footprint and also recorded certain Species of Conservation Concern species for the Animal and Plant species themes expected in the footprint. These assemblages will also be evaluated as part of the expected SCC lists.

Table 13: Sensitive and threatened species expected to occur in the project region according to the Environmental Screening Tool results (compare with Figure 38).

Theme	Sensitivity	Feature
Plant Species Theme	Medium	*Ocotea bullata* *Ocotea kenyensis* *Prunus africana* *Streptocarpus cyaneus subsp. longi-tommii* *Syncolostemon incanus* *Miraglossum davyi*

		Aspidonepsis shebae *Argyrolobium muddii* *Sclerochiton triacanthus*
	High	*Streptocarpus denticulatus*

4.3.2 Riverine Ecology

4.3.2.1 Riparian zone

The extent of the riparian habitat. Ngodwana Dam drainage lines and associated riparian zone

During the survey of the Ngodwana Dam project area and surrounding environment, the riverine environment was surveyed by doing two transects through the drainage line. Figure 35 consists of a map which was compiled by using a Google Earth image which indicates the survey transects through the Ngodwana River drainage line and associated riparian zone.

The riverine environment of the Ngodwana River can be classified as follow, using the Classification System for Wetlands and other aquatic Ecosystems in South Africa (Ollis et al, 2013) as reference: “River—a linear landform with clearly discernable bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit” (Figure 34). Riverine vegetation is important for bank stabilization, where root structures minimise erosion of banks under moderate to high flows.

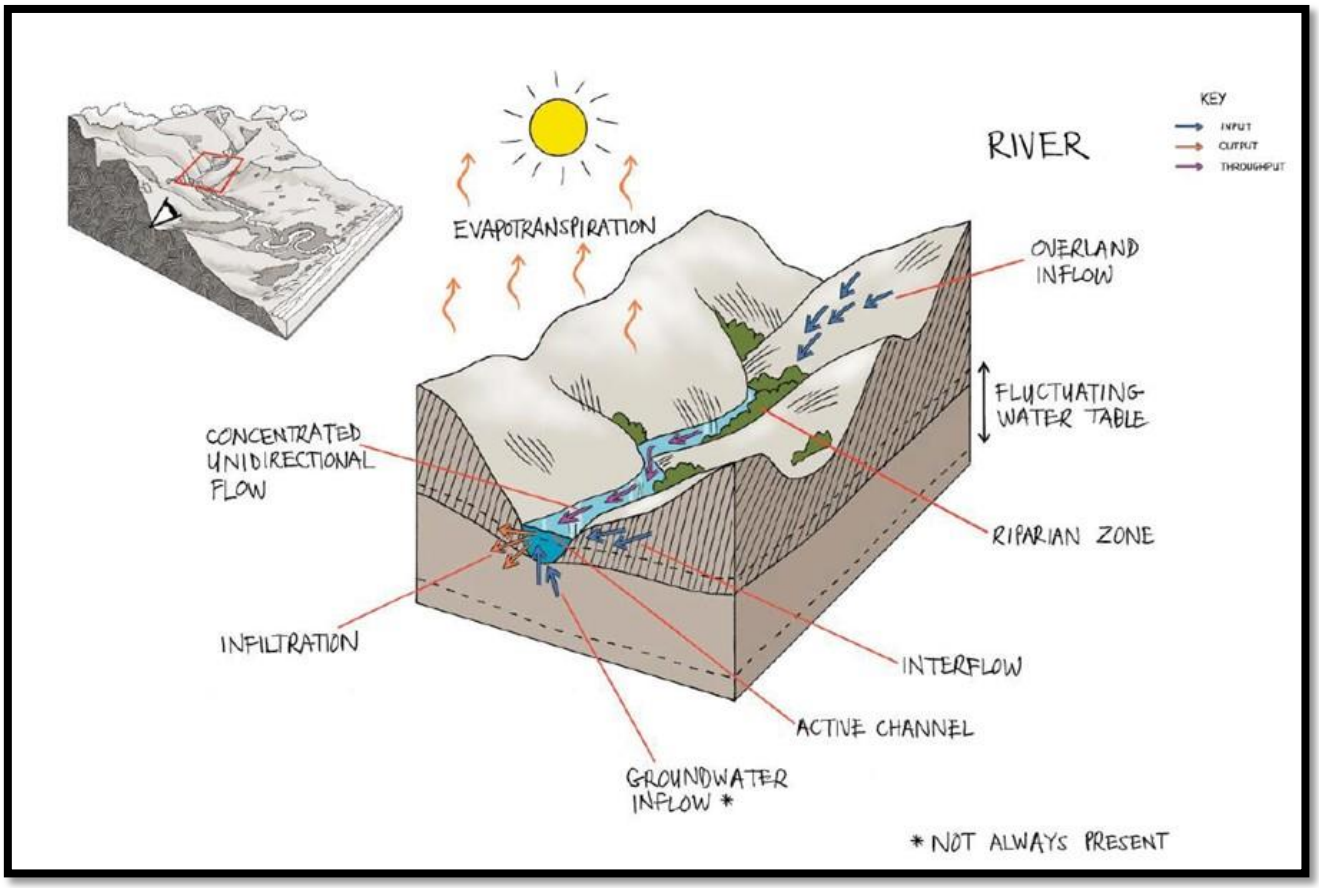

Figure 34: A diagram of a typical River (Ollis et al, 2013).

During the survey of the Ngodwana Dam project, the Ngodwana River environment was surveyed by doing 2 riparian transects in order to establish the extent of the riparian zone, the Present Ecological State of the areas, as well as identifying issues relating to possible impacts (current and future) in the study area.

Figure 35 consists of a map which was compiled by using a Google Earth image and it indicates the survey transects in the river and also supplies an indication of the human impact in the area surrounding these drainage lines. The coordinates of the transects are summarised in Table 14.

Table 14: The coordinates of the transects surveyed in the project area (see Figure 35).

Project site	**Coordinates Start**
Survey site 1	25°34'32.33"S 30°39'45.18"E
Survey site 2	25°34'55.75"S 30°40'15.58"E
Transect 1	25°34'32.64"S 30°39'44.31"E to 25°34'31.19"S 30°39'46.11"E
Transect 2	25°35'10.35"S 30°40'7.37"E to 25°34'49.49"S 30°40'18.36"E

The transects which were surveyed as part of the riparian delineation, were also assessed for the presence of all local flora which could potentially be influenced by the project activities. The two survey sites were surveyed for freshwater biota at the river points.

A transect runs from the outer edge of one riparian zone (right bank), through the drainage line to the outer edge of the other riparian zone (left bank). The results of the vegetation

surveys are depicted in Figures 36 and 37 and the results for the vegetation survey for the areas are summarised in Table 15.

Transect 1 is a simple transect (71m) through the Ngodwana River north of the N4 highway where it was also accessible to do aquatic biota studies (Figure 36). This site is impacted by developments up to the edge of the riparian zone (Figure 36). The riparian zone consisted of a narrow band of riparian trees, and the riverbed is overgrown with Thatching reed (*Phragmites mauritianus*). The flow of the river here is medium to fast over cobble riffles and rocky rapids with good overhanging vegetation.

Transect 2 was done over the extensive of the dam wall (314m) to include a seepage area on the eastern side, run through wetland areas created by seepage from the dam environment, over the Nngodwana River below the dam spillway, and through a narrow floodplain to end against the macro-channel bank of the system (Figure 37).

At Transect 2 the Nngodwana River riparian zone proper consists of larger riparian trees on the channel banks, which extends into the wide seepage area of the dam. The river bed in this reach is scoured due to turbulent high flows over the dam spillway, forming pools surrounded by reeds. Here are less stones in current habitats than at Transect 1.

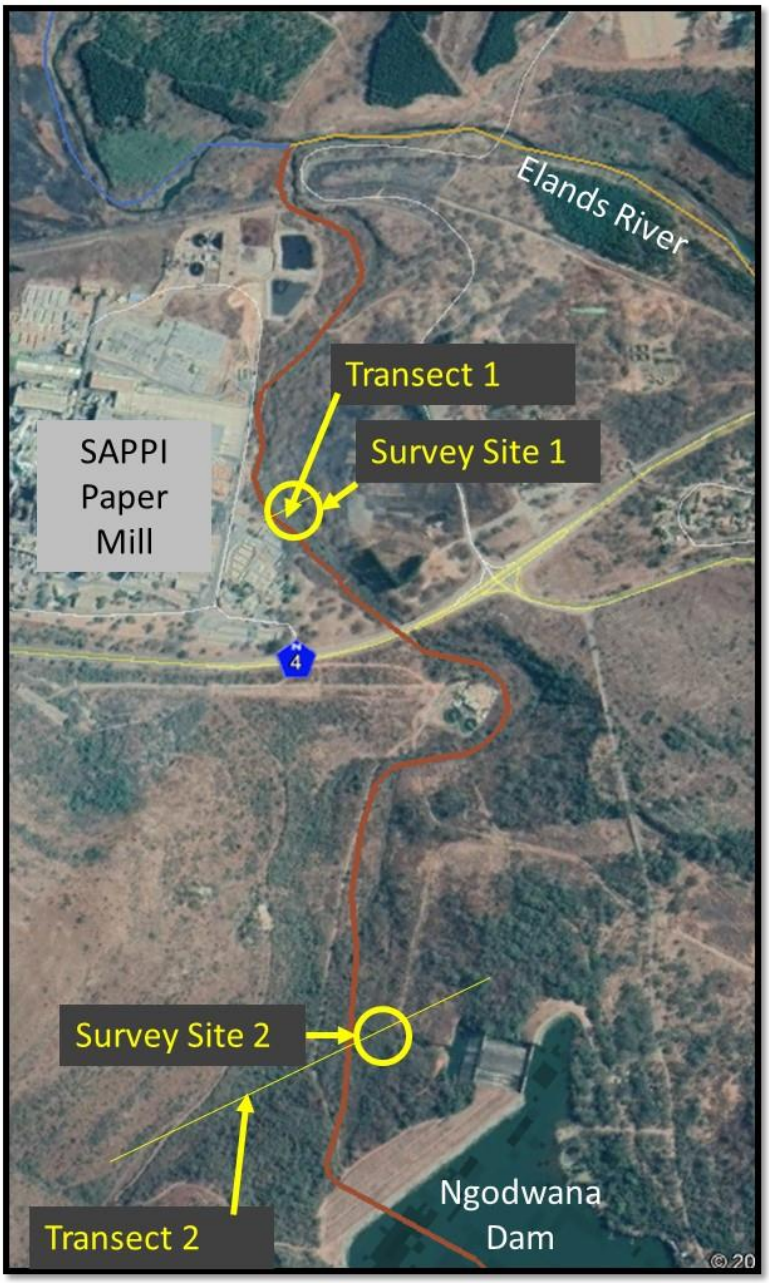

Figure 35: This Google Earth photo illustrates the placement of the riparian survey sites and transects in riparian zone of the project area.

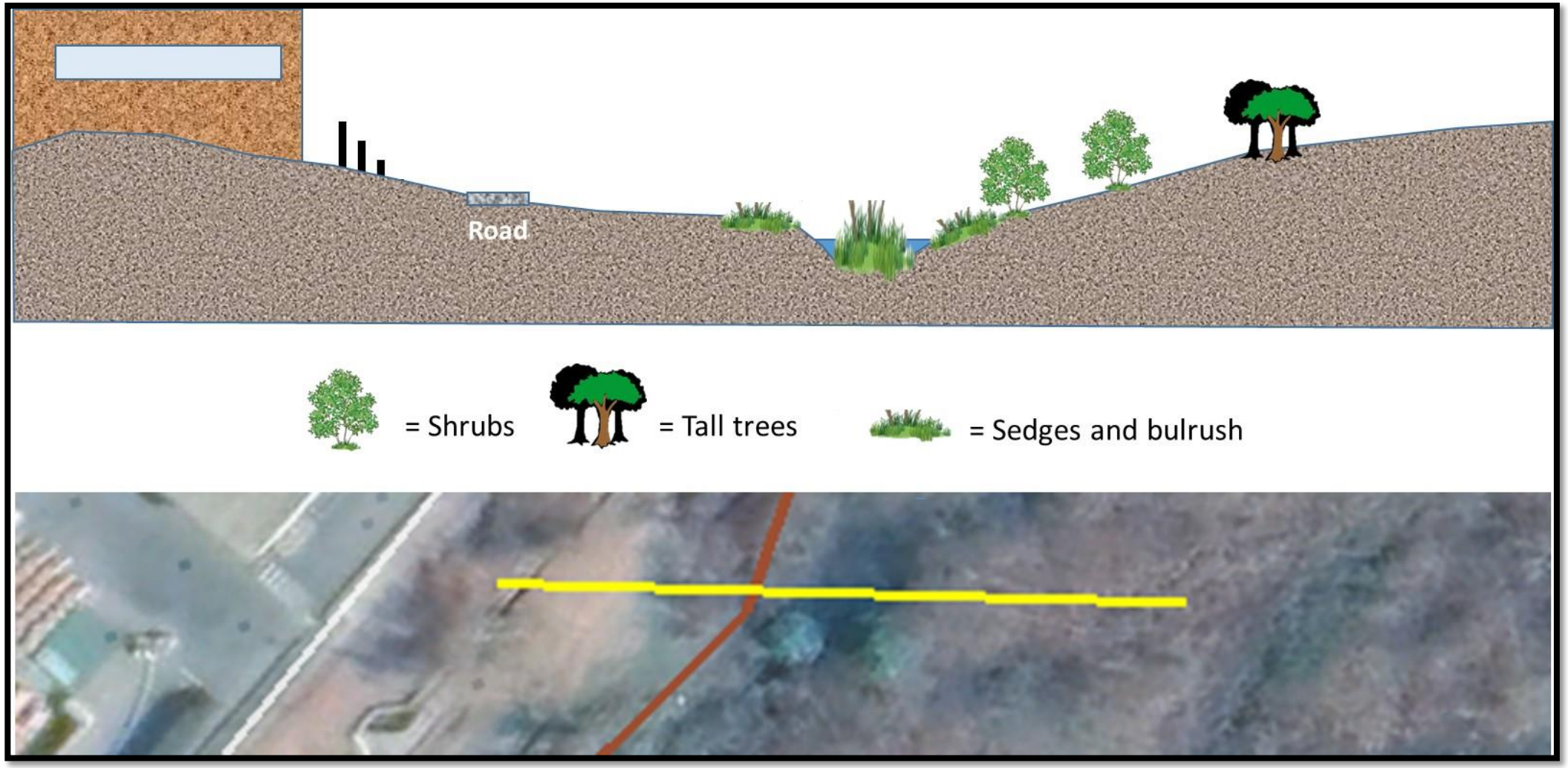

Figure 36: Transect 1 crossing the Ngodwana River bed and riparian zones.

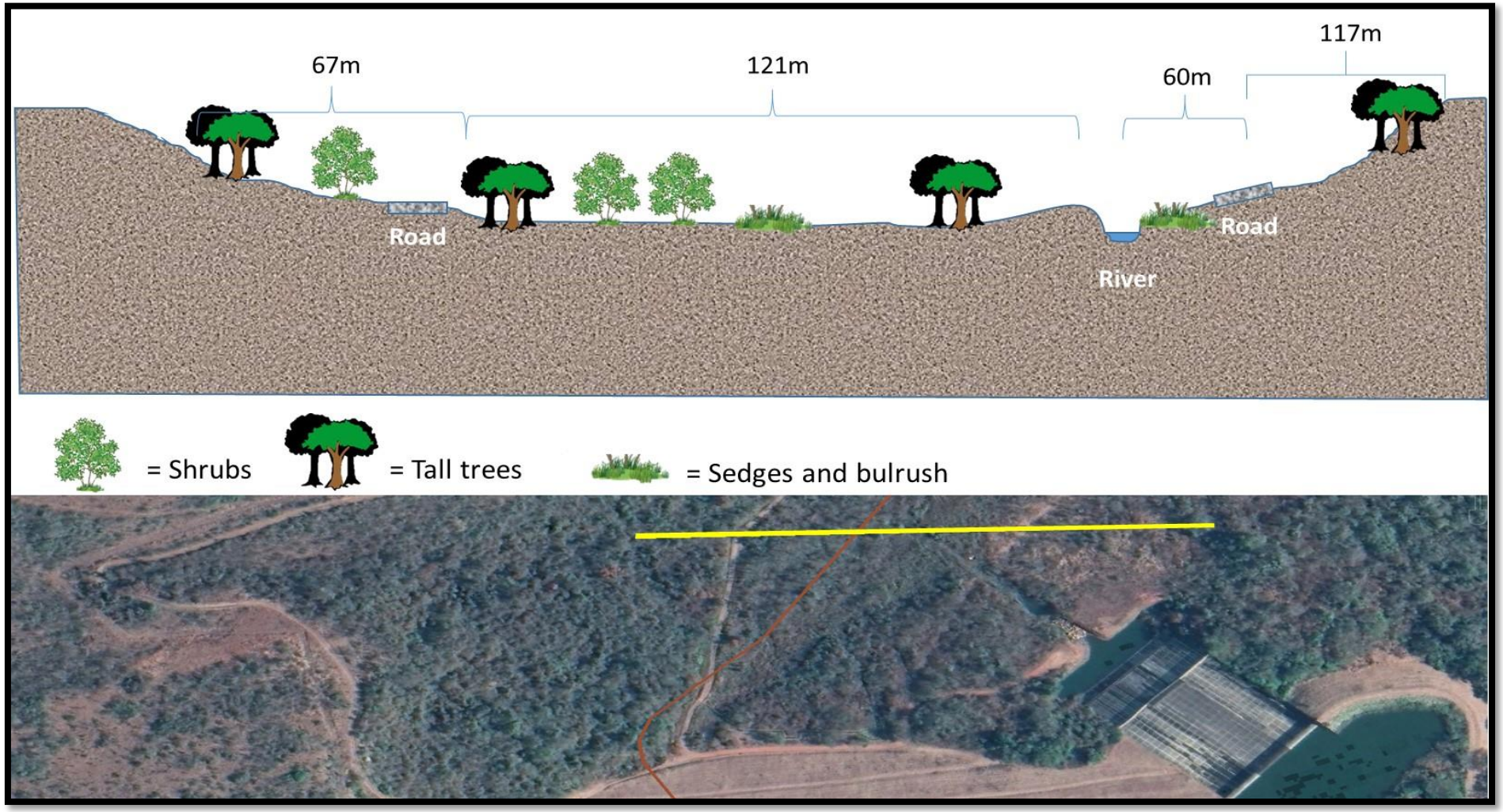

Figure 37: Transect 2 crossing the Ngodwana River bed and riparian zones.

Although Transect 2 is an extensive transect (314m), the Nngodwana River riparian zone proper consists of narrow bands of proper riparian (total = 50m). The results for the vegetation survey for the areas are summarised in Table 15.

Table 15: The vegetation observed along the two transects (Transects 1 and 2) in the Ngodwana River project area (Figure 35).

Transect 1	**Transect 2**
Marginal	
Paperbark thorn (*Vachellia sieberana*)	Weeping lavender tree (*Heteropyxis natalensis*)
Common hook thorn (*Senegalia caffra*)	Sweet thorn (*Vachellia karroo*)
River climbing thorn (*Senegalia schweinfurthii*)	Paperbark thorn (*Vachellia sieberana*)
Buffalo-thorn (*Ziziphus mucronata*)	Robust thorn (*Vachellia robusta*)
River bushwillow (*Combretum erythrophyllum*)	River bushwillow (*Combretum erythrophyllum*)
Robust thorn (*Vachellia robusta*)	Red crowberry (*Searsia chirindensis*)
Water berry (*Syzygium cordatum*)	Broom cluster fig (*Ficus sur*)
*Bugweed (*Solanum mauritianum*)	Buffalo-thorn (*Ziziphus mucronata*)
*Christmas berry (*Lantana camara*)	Bushman's grape (*Rhoicissus tridentata*)
*Yellow bells (*Tecoma stans*)	Fever tree (*Vachellia xanthophloea*)
*Japanese liguster (*Ligustrum lucidum*)	Flute willow (*Salix mucronata*)
	River climbing thorn (*Senegalia schweinfurthii*)
	Water berry (*Syzygium cordatum*)
	Common hook thorn (*Senegalia caffra*)
	*Christmas berry (*Lantana camara*)
	*Yellow bells (*Tecoma stans*)
	*Syringa (*Melia azedarach*)
	*Bugweed (*Solanum mauritianum*)
	*Japanese liguster (*Ligustrum lucidum*)
Instream	
Thatching reed (*Phragmites mauritianus*)	Thatching reed (*Phragmites mauritianus*)
Sedges	Sedges
	Ferns

*Alien plants

The drainage lines were delineated and the delineation are available as a shapefile in Appendix 6. At each of these survey sites, a transect was surveyed: from the edge of the riparian area (left or right bank), and through the streambed to the other side. The results of the surveys are depicted in Figures 36 and 37 in the previous section. The true riparian tree species noted in the project area, are listed in Table 16.

Table 16: Riparian indicator plant species observed in the riparian zone along the Ngodwana River during the survey.

FAMILY	*TAXON*	HABITAT
RHAMNACEAE	Buffalo thorn *(Ziziphus mucronata)*	In a wide variety of habitats, in open woodland, often in alluvial soils along rivers, and frequently on termite mounts; it is said to indicate the presence of underground water.
COMBRETACEAE	River bushwillow (*Combretum erythrophyllum*)	Along river banks where it can form thick stands, with trunks reclining in and overhanging the water.
MYRTACEAE	Water berry (*Syzygium cordatum*)	Along stream banks, in riverine thicket and forest, always near water or along watercourses, and in KZN, forming stands of almost pure swamp forest.
SALICACEAE	Flute willow (*Salix mucronata*)	Stream and river banks, in a wide range of habitats.

Aquatic ecology

Surveys of Aquatic Invertebrates and Fish

Aquatic surveys and bio-monitoring are essential components of an EIA and aim to measure present biological conditions and trends in the aquatic ecosystem. It also attempts to relate the observed variation to changes in available habitat, as dictated by physical system drivers of the system such as water quality, geomorphology, and hydrology (Kleynhans & Louw, 2008).

Aquatic Invertebrates and Fish

During a field study in 2016 by the team of the Mpumalanga Tourism and Parks Agency (MTPA). Undertook a river monitoring exercise in the Elands River and made use of three sites which is important to refer to in this report (Roux et al, 2016):

- the Elands River at the Ngodwana River confluence (X2ELAN-ROODE - downstream of the dam),
- a site in the Ngodwana River upstream of the dam (X2NGOD-NOOIT)
- as well as at a tributary in the Ngodwana River upstream of the dam (X2HOUT-UITZI)

The reason for using these sites, is due to the fact that the X2HOUT-UITZI and X2NGOD-NOOIT sites are upstream of the Ngodwana Dam and can serve somehow as a reference point for less disturbed habitat and water quality, while the X2ELAN-ROODE Site is below the dam in the Elands River below the SAPPI Paper Mill.

The two sites evaluated for the current project are situated between the two upstream sites and the Elands River sites; both the current project sites are below the dam outflow and upstream of the Elands River.

The X2HOUT-UITZI and X2NGOD-NOOIT sites falls within the upper foothills geomorphological zone, dominated by alluvial bedrock, cobble-bed, riffles, runs, glides, and pools. Reeds, shrubs, and herbaceous plants with grasses dominate large portions of the immediate riparian zone. Commercial pine trees (right bank facing downstream) are located

within the riparian zone. The Ngodwana Pulp and Paper Mill, the Ngodwana villages, commercial forestry, and citrus orchids are the main upstream land-uses.

The Uitzight site (X2HOUT-UITZI) is located on the Houtboschloop, a tributary of the Ngodwana River, merging with the Ngodwana River a few kilometres upstream from Ngodwana Dam. The site falls within the upper foothills geomorphological zone, dominated by alluvial cobble-bed, rapids, riffles, runs, glides, and pools. Trees, shrubs, and herbaceous plants dominate the marginal zone, with grassland and scattered trees and shrubs the surrounding landscape.

It was mentioned in the 2016 report that the Ngodwana River was stagnant during the survey period, indicating that the stream became intermittent below the dam wall.

Aquatic habitat assessment

Aquatic surveys and bio-monitoring are essential components of ecological risk assessment and aim to measure present biological conditions and trends in the aquatic ecosystem. It attempts to relate the observed variation to changes in available habitat, as dictated by physical system drivers of the system such as water quality, geomorphology, and hydrology (Kleynhans & Louw, 2008).

During the monitoring survey in July 2020 the following parameters were measured - IHAS (Integrated Habitat Assessment System) and HQI (Habitat Quality Index) with the results summarized in Table 17. Site 1 near the Elands River confluence consisted of dense reed beds, good overhang and riffles, while Site 2 below the dam wall consisted of scoured pools and good overhang.

Table 17: The habitat parameters as measured at the stream sites of the Ngodwana River between the dam and the confluent reach.

SITE	IHAS%	CATEGORY	HQI%	CATEGORY
SITE 1	68	Fair	80	Good
SITE 2	60	Fair	62	Fair

During the July 2020 survey, the IHAS and HQI scores at Site 1 were classified as “Fair” to “Good” due to the fast flowing riffles and associated habitats. Site 2 habitat consisted mostly of pools and marginal habitats with little rocky riffles and slower flows, resulting in the aquatic habitat availability consisting of “Fair” scores (Table 17).

Aquatic invertebrate assessment

The X2HOUT-UITZI Site upstream of the Ngodwana Dam and X2ELAN-ROODE Site below the dam in the Elands River below the SAPPI Paper Mill will be used as two reference sites (not natural reference).

During a field study in 2016, the X2NGOD-NOOIT site in the Ngodwana River upstream of the dam had an ASPT of 6.7, and although the Ecological Category was not stated, it probably would have been at least a B/C category. During the same period the Elands River at the Ngodwana River confluence (downstream of the dam), had an ASPT of 6.0 with an Ecological Category of a C (Roux et al, 2016).

Based on MIRAI of the Uitzight Site (X2HOUT-UITZI), stream conditions were categorised as a category B/C (slightly to moderately modified), with taxa associated with fast to moderate flows still dominant. Some of the sensitive taxa are present at lower abundances, which is considered natural since flow conditions provided a habitat template with more depositional zones and less deep-fast flowing riffles-rapids.

The macro-invertebrates were sampled according to the SASS5 method at the two sites, and Table 18 lists the macro-invertebrates sampled at the site and reflects the SASS5 scores for the July 2020 survey.

Table 18: SASS5 scores of the different habitat types at Site 1 (a complete table of this summarized version can be viewed in Appendix 4).

TAXON	Stones	Vegetation	GSM	Total
Oligochaeta 1			A	A
Potamonautidae 3	1			1
Atyidae (Shrimp) 8		B		B
Baetidae 1 spp 4	B	B	1	B
Heptageniidae 10	A			A
Leptophlebiidae 13	A			A
Aeshnidae 8	1	1		A
Hydropsychidae 1= 4	A			A
Philopotamidae 10		A		A
Gyrinidae 5		A	A	B
Psephenidae 10	A			A
SASS Score	52	35	10	76
No of families	7	5	3	11
ASPT	7.4	7.0	3.3	6.9

Estimated abundance: 1=1; A=2-10; B=11-100; C=101-1000; D=>1000

Table 19: SASS5 scores of the different habitat types at Site 2 (a complete table of this summarized version can be viewed in Appendix 4).

TAXON	Stones	Vegetation	GSM	Total
Oligochaeta 1			B	B
Atyidae (Shrimp) 8		B		B
Baetidae 1 spp 4	B	A		B
Coenagrionidae 4		A		A
Aeshnidae 8	1			1
Gomphidae 6			A	A
Gerridae 5	A	A		B
Nepidae 3		1		1
Veliidae 5		1		1
Hydropsychidae 1= 4	A			A
Dytiscidae 5		A		A
Gyrinidae 5		A	A	B
Psephenidae 10	1			1
Chironomidae 2		A	B	B
Simuliidae 5	A	A		B
SASS Score	36	46	14	75
No of families	6	10	4	15

ASPT	6.0	4.6	3.5	5.0

Estimated abundance: 1=1; A=2-10; B=11-100; C=101-1000; D=>1000

Table 20: A summary of the IHAS, HQI and SASS scores at the Ngodwana River in the project area.

SURVEY SITE	Habitat scores		SASS5 Scores		
	IHAS %	HQI %	SASS score	Number of families	ASPT
Site 1	68	80	76	11	6.9
Site 2	60	62	75	15	5.0

Judging from Table 20, the habitat scores are “Fair” to “Good” at Site 1 (Table 21), while at Site 2, all habitat scores are “Fair”. The lack of running water habitats, such as riffles and rapids, reflected in the macro-invertebrate scores at Site 2, resulting in the “Fair” SASS scores (Table 21), while the favourable stones-in-current habitats at Site 1, resulted in HQI score of 80% (“Good”).

The better habitat quality at Site 1 also reflects in the macro-invertebrate scores, where the ASPT score at Site 1 is 6.9 (“Good” very close to “Excellent”), while the ASPT score at Site 2 is 5.0 (borderline between “Fair” and “Good”). Although Site 1 had a lower number of Families, these were mostly more sensitive taxa.

Table 21: Categories used to classify Habitat, SASS and ASPT values:

HABITAT	SASS4	ASPT	CONDITION
>100	>140	>7	Excellent
80-100	100-140	5-7	Good
60-80	60-100	3-5	Fair
40-60	30-60	2-3	Poor
<40	<30	<2	Very poor

Fish Response Assessment Index (FRAI)

During a field study in 2016 the Elands River at the Ngodwana River confluence (downstream of the dam), and the Ngodwana River upstream of the dam was surveyed for fish (Roux et al, 2016). During the survey, five indigenous species of fish of an expected nine species were collected as well as a single female rainbow trout (*Oncorhynchus mykiss*) filled with eggs. This exotic alien and invasive species is a predatory species which will have a negative impact on the indigenous fish species present.

The purpose of the Fish Response Assessment Index (FRAI) is to provide a habitat-based cause-and-effect interpretation underpinning the deviation of the fish assemblage from the reference condition.

The application of the FRAI is based on the following:

- The FRAI is an assessment index based on the environmental intolerances and preferences of the reference fish assemblage and the response of the constituent species of the assemblage to particular groups of environmental determinants or rivers.
- These intolerance and preference attributes are categorized into metric groups with constituent metrics that relate to the environmental requirements and preferences of individual species.
- Assessment of the response of the species metrics to changing environmental conditions occur either through direct measurement (surveys) or are inferred from changing environmental conditions (habitat). Evaluation of the derived response of species metrics to habitat changes are based on knowledge of species ecological requirements. Usually the FRAI is based on a combination of fish sample data and fish habitat data.
- Changes in environmental conditions are related to fish stress and form the basis of ecological response interpretation.

Table 22 explains the 8 steps followed in the calculation of the FRAI.

Table 22: Main steps and procedures in the calculation of the FRAI

STEP	PROCEDURE
River section earmarked for assessment	As for study requirements and design
Determine reference fish assemblage: species and frequency of occurrence	Use historical data & expert knowledge Model: Use eco-regional and other environmental information Use expert fish reference frequency of occurrence database if available
Determine present state for drivers	Hydrology Physico-chemical Geomorphology or Index of habitat integrity
Select representative sampling sites	Field survey in combination with other survey activities
Determine fish habitat condition at site	Assess fish habitat potential Assess fish habitat condition
Representative fish sampling at site or in river section	Sample all velocity depth classes per site if feasible Sample at least three stream sections per site
Collate and analyse fish sampling data per site	Transform fish sampling data to frequency of occurrence ratings
Execute FRAI model	Rate the FRAI metrics in each metric group Enter species reference frequency of occurrence data Enter species observed frequency of occurrence data Determine weights for the metric groups Obtain FRAI value and category Present both modelled FRAI and adjusted FRAI.

Determine reference fish assemblage: species and frequency of occurrence

The X2HOUT-UITZI and X2NGOD-NOOIT sites upstream of the Ngodwana Dam and X2ELAN-ROODE Site below the dam in the Elands River below the SAPPI Paper Mill, will be viewed as reference sites (<u>not</u> natural reference).

<u>Frequency of Occurrence (FROC)</u>

The fish reference Frequency of Occurrence (FROC) database (Kleynhans, Louw, & Moolman, 2007), which provides consistent reference frequency of occurrence for more than 700 fish sites in South Africa, was used to establish the baseline data for this report. The FROC was developed to be used in the following programmes:

- the FRAI
- procedures that requires a reference fish assemblage (e.g. extrapolation from known sites to unknown sites)

Fish are considered to be one of the important indicators of river health and their responses to modified environmental conditions are measured in terms of the Fish Response Assessment Index (FRAI) (Kleynhans 1999; Kleynhans *et al*. 2005). This index is based on a combination of fish species habitat preferences as well as intolerance to habitat changes, and the present frequency of occurrence of species compared to the reference frequency of occurrence (Kleynhans, Louw, & Moolman, 2007).

The list of species is based on species that are expected to be present or to have been present under close to reference habitat conditions. Species that are derived to have been present under relatively recent reference habitat conditions are also identified. The resulting species reference list is a combination of both of the above approaches.

The rating of the FROC refers to the reference fish frequency of occurrence (FROC) in a particular ecologically defined reach of a river. Ratings are scored from 1 to 5.

Rating of the reference fish FROC refers to the reference fish frequency of occurrence in a particular ecologically defined reach of a river. This means that FROC ratings are derived based on conditions at the particular site as well as the available habitat in the reach for species expected under reference conditions.

Basic habitat conditions that were considered in terms of the FROC of species are based on intolerance and preference rating as contained in the FRAI (Kleynhans *et al.* 2005). The presence and abundance of habitat features such as velocity-depth classes, cover types (including substrate) and the characteristics of the natural flow regime (especially the degree of perenniality) in a river reach under reference conditions formed the basis for the expert judgment of the FROC (Kleynhans, Louw, & Moolman, 2007).

There is no FROC Data available for the Ngodwana River (project reach). On the other hand, fish data from the for reports of Roux et al (2016) are available and will be used as an indication of the species with the potential to migrate up the river and inhabit the viable habitats in the Ngodwana River. Fortunately the PESEIS data (DWS 2014) is also available and the combination of data sets will be adequate to run the FRAI.

Table 23: Expected Reference and Habitat derived from the PESEIS data and survey results of Le Roux et al (2016), of fish in the Ngodwana area (two sites upstream of dam, one at Elands confluence). Observed species (HIGHLIGHTED) (Skelton, 2016).

Scientific Names (Expected species)	Common Name	Species abbreviation	Present PESEIS	Roux et al 2016	Observed 2020
Anguilla mossambica	Longfin eel	AMOS	No	No	No

Scientific Names (Expected species)	Common Name	Species abbreviation	Present PESEIS	Roux et al 2016	Observed 2020
Enteromius anoplus	Chubbyhead barb	BANO	Yes	Yes	No
Enteromius argenteus (*crocodilensis*)	Rosefin barb	BARG	Yes	Yes	Yes
Enteromius polylepis	Smallscale yellowfish	BPOL	Yes	Yes	No
Amphilius uranoscopus	Mountain catfish	AURA	Yes	Yes	No
Chiloglanis bifurcus	Incomati suckermouth	CBIF	Yes	Yes	No
Chiloglanis pretoriae	Limpopo Rock catlet	CPRE	Yes	Yes	Yes
Pseudocrenilabrus philander	Southern mouthbrooder	PPHI	Yes	Yes	Yes
Tilapia sparrmanii	Banded tilapia	TSPA	Yes	Yes	Yes
Alien/Introduced					
Oncorhynchus mykiss	Rainbow trout	OMYK	No	Yes	No

The list of species is based on species that are expected to be present under close to reference habitat conditions. This would include information from historical sites within a particular river reach.

Determine present state for drivers

The purpose is to provide information on the fish response and associated habitat condition and *vice versa* (i.e. fish responses that are possible, given certain habitat conditions). This assessment considers the whole river section to be studied. If information on the drivers is available, these should be used.

In the project area, the Ngodwana River flows are largely impacted by the presence of the Ngodwana Dam. Scouring flows when the spillway overflows and no-flows during drought periods are the main drivers that will impact on habitat, thus influencing the presence of fish species. The poor water quality of the Elands River downstream of the SAPPI Ngodwana Paper Mill renders the Ngodwana River a refuge for sensitive species, which will disappear when the river cease to flow. The Elands River with its poor water quality can also become a migration barrier for fish migrating from downstream areas.

Sampling site selection

During the July 2020 survey, two river sites for aquatic biota was sampled in the Ngodwana River below the dam wall. Site 1 is a site in the Ngodwana River north of the N4 highway where it was also accessible to do aquatic biota studies (Figure 35). The flow of the river here is medium to fast over cobble riffles and rocky rapids with good overhanging vegetation.

Site 2 was selected below the dam spillway, where the river bed is scoured due to turbulent high flows over the dam spillway, forming pools surrounded by reeds. Here are less stones in current habitats than at Site 1.

Fish habitat assessment at site

Habitat potential assessment

Habitat assessment refers to an evaluation of fish habitat potential (i.e. the potential that the habitat provides suitable conditions for a fish species to live there) at a site in terms of the diversity of velocity-depth classes present and the presence of various cover types at each of these velocity-depth classes. This provides a framework within which the presence, absence and frequency of occurrence of species can be interpreted. Habitat assessment includes a general consideration of impacts that may influence the condition or integrity of fish habitat at a site (Kleynhans, Louw, & Moolman, 2007).

The two aquatic sampling sites has different habitat types which resulted in different species assemblages. Site 1 is dominated by rifle-rapid habitats over cobble and rocks with an abundance of over hanging reeds and root wads. Site 2 is a reach with pools, slower flows and overhanging vegetation, including trees in the marginal areas.

Table 24: Fish velocity-depth classes and cover present in the project sites (project area) during the July 2020 survey.

FISH VELOCITY-DEPTH CLASSES AND COVER PRESENT AT SITE (Abundance: 0=absent; 1=rare; 2=sparse; 3=moderate; 4=abundant; 5=very abundant)			
SLOW DEEP: 1	SLOW SHALLOW: 2	FAST DEEP: 1	FAST SHALLOW: 3
Overhanging vegetation: 4	Overhanging vegetation: 4	Overhanging vegetation: 4	Overhanging vegetation: 4
Undercut banks & root wads: 3	Undercut banks & root wads: 2	Undercut banks & root wads: 4	Undercut banks & root wads: 1
Substrate: 1	Substrate: 1	Substrate: 4	Substrate: 4
Aquatic macrophytes: 0	Aquatic macrophytes: 0	Aquatic macrophytes: 0	Aquatic macrophytes: 0
Water Column: 4	Water Column: 2	Water Column: 2	Water Column: 1
Remarks: Only slow deep habitats in pools.	Remarks: Some slow shallow habitats on the edges of the pool.	Remarks: Good stones in current habitats at Site 1	Remarks: Good riffle habitats at Site 1

Habitat Condition

The purpose is to provide an indication of the deviation of the habitat from the reference condition. In contrast to the assessment of driver conditions or the Index of Habitat Integrity (IHI) in a river section (Table 25), fish habitat condition assessment is done for the site and modifications that have a direct influence on fish habitat at the site are considered.

Table 25: Habitat Cover Ratings (HRC) and Site Fish Habitat Integrity Index (SHI) of the two fish monitoring sites during the March 2020 survey.

HCR's:	Slow - Deep	Slow - Shallow	Fast - Deep	Fast - Shallow	Classification: Pools/Backwaters: Slow-<0.3m/s Shallow-<**0.5**m Riffles/Runs/Rapids: Slow-<0.3m/s Shallow-<**0.3**m Rating: **0**=Absent; **1**=Rare (<5%); **2**=Sparse (5-25%) **3**=Moderate (25-75%); **4**=Extensive (>75)
Overhanging vegetation	4	3	4	4	
Bank undercut root wads	3.	1	2	1	
Substrate	1	1	4	4	
Macrophyte	0	0	0	0	

SHI:	Score	Comments	RATINGS
Water abstraction:	0	None	0 :None
Flow modification:	5	In-stream Dams	1: Small
Bed modification:	3	Scouring	2:Moderate
Channel modification:	2	In-stream Dams and scouring	3:Large
Inundation:	4	In-stream Dams	4:Serious
Exotic macrophytes:	1	Scattered	5:Critical
Solid waste disposal:	1	Rubbish	
Indigenous vegetation removal:	1	Local wood collecting and construction disturbance	
Exotic vegetation encroachment	2	Riparian	
Bank erosion:	1	Scouring	

According to Table 25, the habitat integrity of the Ngodwana River is mostly impacted by the presence of the Ngodwana Dam and some local people activities.

Fish sampling

Sampling effort and results are reported per velocity-depth class sampled.

- **Slow-deep:** A large seine net can be used. A cast net, (diameter = 1.85 m, mesh size = 2.5 cm) can be used in pools. In this case, only the cast net was used and the capture results are recorded as number of fish caught during each effort.

- **Slow-shallow:** A small seine net (5 m long, 1.5 m deep, mesh size = 1 mm) can be used to sample fish. An electrical shocking apparatus should preferably be used. Capture results are recorded as the number of fish caught per time unit (minutes) with an electro-shocker. Both the electrical shocking apparatus and cast net were used in this case.

The following habitats were not sampled as there were none present:

- **Fast-deep:** An electrical shocking apparatus, one operator and two dip net handlers are used in such habitat types. Capture results are recorded as number of fish caught per time unit (minutes).

- **Fast-shallow:** Capture results are recorded as number of fish caught per time unit (minutes) with an electrical shocker.

Due to the terrain and flows in the river only electro-shocking and cast netting methods were applied.

Table 26: Habitats sampled and the sampling effort made per survey site.

HABITATS SAMPLED AND EFFORT

SAMPLING EFFORT	SLOW DEEP	SLOW SHALLOW	FAST DEEP	FAST SHALLOW
Electro shocker (minutes)	20 minutes	20 minutes	20 minutes	20 minutes
Small seine (mesh size, length, depth, efforts)				
Large seine (mesh size, length, depth, efforts)				
Cast net (dimensions, efforts)	10 casts	10 casts	10 casts	10 casts
Gill nets (mesh size, length, time)				

Table 27: Fish sampled during the survey.

SPECIES SAMPLED	SLOW DEEP	SLOW SHALLOW	FAST DEEP	FAST SHALLOW
Rosefin barb *(Enteromius argenteus)*			1	
Limpopo Rock catlet *(Chiloglanis pretoriae)*				3
Southern mouth-brooder (*Pseudocrenilabrus philander*)		3		
Banded tilapia (*Tilapia sparrmanii*)	1			

Collate and analyse fish sampling data per site

All the information collected during the survey is then collated in the tables of the FRAI model and analyzed throughout the database spreadsheets. The FRAI model calculates the ranks, weights and ratings to eventually provide an Ecological Class for the three sites.

EXECUTE THE FRAI MODEL

The FRAI model makes use of the fish intolerance and preference database that was compiled in 2001 (Kleynhans 2003). This information was built into the FRAI. The approach followed included the ranking, weighting and rating of metric groups. A large component of the FRAI is based on an automated calculation of ranks, weights and ratings. Table 28 indicates the weights of the different metric groups for fish at C sites.

Table 28: The weight allocated to the different metric groups in the model.

METRIC GROUP	WEIGHT (%)
VELOCITY-DEPTH	97,14
COVER	71,43
FLOW MODIFICATION	100,00
PHYSICO-CHEMICAL	51,43
MIGRATION	57,14
IMPACT OF INTRODUCED	45,71

According to Table 28, the "Flow Modification" metric carries the most weight due to the impact of the Ngodwana Dam wall, followed by "Velocity-depth" and "Cover" metrics caused by lack of surface flows certain times of the year due to the presence of the dam. Stagnant pools during no-flow situations and poor water quality in the Elands River explain the Physico-chemical metric, while both the dam wall and poor water quality obstacles impact on fish migration. The Rainbow trout in the upper Ngodwana River flags the "Impact of Introduced".

Table 29: The FRAI results at the study sites during the current surveys with the expected and observed fish species and the resultant ecological class.

AUTOMATED	
FRAI (%)	**54.9**
EC: FRAI	**D**

ABBREVIATIONS: REFERENCE SPECIES (INTRODUCED SPECIES EXCLUDED)	SCIENTIFIC NAMES: REFERENCE SPECIES (INTRODUCED SPECIES EXCLUDED)	REFERENCE FREQUENCY OF OCCURRENCE	EC:OBSERVED & HABITAT DERIVED FREQUENCY OF OCCURRENCE
AMOS	ANGUILLA MOSSAMBICA PETERS 1852	1,00	0,00
BANO	BARBUS ANOPLUS WEBER, 1897	3,00	2,00
BARG	BARBUS ARGENTEUS GÜNTHER, 1868	4,00	3,00
BPOL	LABEOBARBUS POLYLEPIS BOULENGER, 1907	4,00	2,00
AURA	AMPHILIUS URANOSCOPUS (PFEFFER, 1889)	2,00	0,00

CBIF	CHILOGLANIS BIFURCUS JUBB & LE ROUX, 1969	3,00	1,00
CPRE	CHILOGLANIS PRETORIAE VAN DER HORST, 1931	4,00	3,00
PPHI	PSEUDOCRENILABRUS PHILANDER (WEBER, 1897)	4,00	3,00
TSPA	TILAPIA SPARRMANII SMITH, 1840	4,00	3,00

The relative FRAI score at this reach in the Ngodwana River was placed within the limits of an ecological state category Class D (54.9%), which means this reach is “Largely modified” according to Table 30 and according to Appendix 5, a Category D represent a “Large change” (42.01 – 57.4).

Table 30: Ratings for the fish integrity classes.

	FRAI ASSESSMENT CLASSES	
Class rating	Description of generally expected conditions for integrity classes	Relative FRAI score (% of expected)
A	Unmodified, or approximate natural conditions closely.	90 to 100
B	Largely natural with few modifications. A change in community characteristics may have taken place but species richness and presence of intolerant species indicate little modification.	80 to 89
C	Moderately modified. A lower than expected species richness and presence of most intolerant species. Some impairment of health may be evident at lower limits of this class.	60 to 79
D	c. A clearly lower than expected species richness and absence or much lowered presence of intolerant and moderate intolerant species. Impairment of health may become more evident at the lower limit of this class.	40 to 59
E	Seriously modified. A strikingly lower than expected species richness and general absence of intolerant and moderately intolerant species. Impairment of health may become very evident.	20 to 39
F	Critically modified. An extremely lowered species richness and an absence of intolerant and moderately intolerant species. Only tolerant species may be present with a loss of species at the lower limit of the class. Impairment of health generally very evident.	0 to 19

Species of Concern: Fish

The Critically Endangered, *Barbus anoplus* - Escarpment form (Conservation status for

South Africa – Critically Endangered; Conservation status for Mpumalanga – Endangered; Endemic – South Africa) has been recorded on the farms Coetzeestroom 479 JT, Doornkloof 478 JT and 480JT.

The Critically Endangered, Incomati suckermouth *(Chiloglanis bifurcus)* (Conservation status for South Africa – Critically Endangered; Conservation status for Mpumalanga – Critically Endangered; Endemic – Mpumalanga), has been recorded on the farms Coetzeestroom 479 JT, Roodewal 470 JT and Doornkloof 478 JT.

Barbus argenteus – a Species of Special Concern, has been recorded on the farms Coetzeestroom 479 JT and Grootgeluk 477 JT, and during the current survey in the Ngodwana River near the Elands River confluence.

Amphilius natalensis – Mpumalanga form (Conservation status for South Africa – Data Deficient, Vulnerable?; Conservation status for Mpumalanga – Vulnerable), has been recorded on the farm Doornkloof 478 JT.

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4.3.3 Terrestrial ecology

4.3.3.1 Invertebrates

Although no in-depth surveys were done for invertebrates, all insects observed were photographed, but not identified to species level yet. During the transect surveys, it was kept in mind that two sensitive butterfly species might be present in the area. The invertebrate Species of Special Concern were listed for the footprint and will also be evaluated as part of the expected SSC lists.

Species of Concern: Invertebrates

Table 31: Sensitive and threatened species expected to occur in the project region according to the Environmental Screening Tool results (compare with Figure 38).

Theme	Sensitivity	Feature
Animal species theme	Medium	Insecta - *Chrysoritis phosphor borealis* Insecta - *Lepidochrysops irvingi* Invertebrate - *Thoracistus jambila*

4.3.3.2 Frogs

Frog fauna is a product of the diversity of the region's topography, climate and associated habitat types. Although frogs have adapted to almost every type of environment, many species are highly specialised to suit conditions in a particular locality. This can leave a species vulnerable when a habitat is degraded or irreversibly changed (Du Preez & Carruthers, 2009). Recent work has shown that amphibian species are declining worldwide as a result of global habitat loss. Their small areas of occupancy make them more susceptible to extinction due to habitat loss and degradation compared to other vertebrates. Suitable environmental conditions, especially breeding sites, are critically important, and species are often very specific to those habitat types. Therefore habitat conservation should be a priority for amphibian preservation.

The amphibian populations in the Mpumalanga Province are faced with several environmental threats. Major threats include habitat destruction and invasion by alien vegetation resulting in a fragmentation of populations. Agriculture has already resulted in the

rapid destruction and fragmentation of habitat types responsible for supporting populations of many species discussed here. Overgrazing and severe fires in the grassland catchment areas have resulted in extensive silting of streams and wetlands, thereby also threatening the breeding habitat of these frogs. For many reasons, frogs are important and useful indicators of environmental health. Factors that make frogs particularly sensitive to environmental deterioration include (Du Preez & Carruthers, 2009):

- Absorbent skin surface – absorbs water and any solvents it may contain
- Food contaminants – tadpoles are susceptible to ingesting pollutants
- Fragmented distribution – habitat losses may isolate surviving populations
- Sequestered tissue contaminants – disrupting hormone interference
- Temperature – extreme environmental temperature fluxes affect their biology
- Amphibious lifestyle – frogs are exposed to aquatic as well as terrestrial environment and are thus affected by changes to both
- Trophic level – important prey items to wide array of predators

In addition, water pollution is another major concern, which may arise from different contamination sources of, including:

- Chemical contamination
- Agricultural pesticides and herbicides
- Acid precipitation (atmospheric pollution)
- Heavy metals
- Eutrophication (fertiliser run-off)
- Endocrine-disrupting contaminants

Other factors include out-of-season fires caused by humans, road mortalities, diseases and climate change.

Amphibians are localised in their movement and habitat choices. Although most frogs can live away from water, they need water to lay their eggs and for the larval stage. An absence of standing water will therefore denote an absence of frog species in the area. After good rains when standing water is replenished, frogs believed absent may emerge to feed and breed. The rest of the year they will seek shelter in damp places in order to escape the dry or cold climate.

Their permeable skin gives them the advantage of being amphibious, but it is also this permeable skin that makes them very susceptible to air- and water pollution. Frog surveys therefore, give a good indication of water quality and overall environmental condition. The frog diversity in areas less affected by mining activities might appear moderately healthy, although the effects of air pollution or disease on these assemblages are unknown.

Wetlands are interlinking systems, as such upstream or wetland-adjacent impacts can adversely affect the ecosystems downstream. Numerous water quality-related problems may exist in a farming area, and these will have further negative impacts on the wetland systems in the area if not contained. In compiling the expected frog lists, detailed frog distribution records (from the old Transvaal compiled by Jacobsen 1989) were used, along with interpolated distribution maps, and data from the frog atlas project (Minter et al 2004). Additional information from the latest comprehensive work of Du Preez and Carruthers (2009) was also consulted.

Frog surveys

According to the 2004 Frog Atlas (Minter, *et al* 2004), the Ngodwana Dam project area is situated in the Sour Grassland Assemblage. This assemblage has a relatively high species richness (21-30 species per grid cell), decreasing westwards, but is moderate in endemic species (7-10 species) (Minter *et al*, 2004). The associated frog distribution maps, confirms 18 frog species are expected to be present in the study area. Of these frog species that are expected to occur within the study area, we anticipate 17 species may reside in the project area, accommodated by potential habitat in the area.

During surveys in July 2020, two of the expected species were encountered in the Ngodwana Dam project area, and they are listed below:

- African split-skin toad (*Schismaderma carens)*
- Delelande's river frog (*Amietia delalandii*)

Species of Special Concern: Frogs

Species of special concern comprises threatened, endemic and rare species. According to the South African Frog Atlas map (Minter, *et al.* 2004) the study area potentially contains 7-10 endemic species. Using distribution maps and habitat quality, three endemic species have the potential to occur in the Ngodwana Dam project area. Currently no threatened frog species is expected to occur in the area.

According to the South African Frog Atlas map (Minter, *et al.* 2004) the study area potentially contains 4-6 endemic species (Appendix 10). Using distribution maps and habitat quality, two endemic species are expected to occur in the Ngodwana Dam project area:

- Raucous toad *(Sclerophrys capensis)*
- Gray's stream frog (*Strongylopus grayii*)

No threatened frog species are expected to occur in the area.

Viability and estimated population size: Frogs

Comparing the habitat requirements of the endemic species (which are considered Species of Special Concern) with habitat availability in the Ngodwana Dam project area, Table 32 illustrates the potential of the area to include suitable habitat.

Table 32: Probability of occurrence based on habitat availability for frog species of concern in the study area.

Frog species	**Habitat requirements**	**The potential of the area to supply habitat.**
Raucous toad (*Amietophrynus rangeri*) - common	Rivers, large ponds and stream-side pools along **slow-flowing streams** in grassland; **shallow water near banks, or among reed beds**. Aquatic vegetation.	**Medium**
Gray's stream frog (*Strongylopus grayii*)	It inhabits all biomes of South Africa, excluding the arid areas, such as forest, fynbos heath land, thicket, savanna and **grassland, as well as modified habitats. It breeds in almost any well vegetated shallow body of water, such as pools, dams, ponds, ditches, and brackish pools** along the coast within the spray zone, and shallow seeps. It can also tolerate polluted waters. It lays its eggs out of the	**Good**

	water in moist situations, and the tadpoles enter the water to complete their development. Breeds in almost any shallow body of water which is well provided with vegetation.	

* Viability and estimated population size scores: Poor 1; Low 2; Medium 3; Good 4; Optimal 5

According to Table 32, the endemic species of concern have “Medium to Good” habitat available in the Ngodwana Dam environment. The probable presence of the frogs in the project area can be summarised as follows:

Medium to Good probability:

- Raucous toad – Habitat quality Medium, species probably present.
- Gray's stream frog – Habitat quality Good, species probably present.

4.3.3.3 Reptiles

Current knowledge of reptiles within the study area is derived from the Reptile Atlas Project (Bates, et al. 2014). In compiling the expected reptile lists, the detailed distribution records by Jacobsen (1989) of the herpetofauna of the old Transvaal were used together with the distribution maps. The Animal Demographic Unit’s reptile atlas project data (ADU, 2010), collated in the Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland, was also referenced (Bates, et al. 2014).

We conclude that the following factors played a role in lower numbers of reptile species being recorded across all project sites:

- Subterranean lifestyle of many species
- Nocturnal lifestyle of many species
- Secretive and retiring lifestyle of many species
- Small size of most of the species
- Well-camouflaged species

Surveys in primary habitats

The savanna is the most extensive ecoregion in the subregion, occuring over much of the northern parts of southern Africa. Savanna has a well-developed, grassy layer and a medium density of scattered trees. Rains occur during summer, and fire is an important regulator of the balance between densities of grass- and woody vegetation. Reptile species richness and endemism is extremely high, but this is partially a result of the large extent of the ecoregion. Few savanna reptiles are classified as threatened, and many have extensive ranges (Alexander & Marais, 2007).

According to the distribution of reptiles in South Africa, 49 species have distribution ranges extending into the region. Of the 38 of these species that are expected to occur in the area (Jacobsen, 1989; Animal Demographic Unit, 2010), 37 species has adequate habitat available (Appendix 11).

During surveys in July 2020, four of the expected reptile species were encountered in the Ngodwana Dam project area. Due to the fact that reptiles aestivates during the dry and cold winter months, the time of the year plays an important role regarding surveying reptiles. Therefore, the cold and dry winter weather during the survey explains their low numbers observed:

- Common dwarf gecko *(Lygodactylus capensis capensis)*

- Variable skink (*Trachylepis varia)*
- Rainbow rock skink (*Trachylepis margaritifer*)
- Striped skink (*Trachylepis striata*)

Species of Special Concern: Reptiles

Species of special concern comprises threatened, endemic and rare species.

Threatened reptile species are rated by standards established by the International Union for Conservation of Nature (IUCN) 2019*,* National Environmental Management: Biodiversity Act (NEMBA) of 2004, and the SA Red List (Bates, et al. 2014). There are more endemic reptiles in southern Africa than any other vertebrates, and new species are being discovered regularly in this country.

Due to their limited distribution and range in South Africa, endemic species are included as species of special interest below. An endemic species has a global distribution restricted to >90% of the atlas region. According to the South African Reptile Atlas (ADU, 2010), there are 10 endemic reptile species that have distribution ranges overlapping the study area (SA endemic - Including Lesotho & Swaziland), nine of these have the potential to occur here:

- Spotted dwarf gecko (*Lygodactylus ocellatus ocellatus*)
- Transvaal gecko (*Pachydactylus affinis*)
- Jacobsen's Thread Snake (*Leptotyphlops jacobseni*)
- Swazi rock snake (*Inyoka swazicus*)
- Western Natal green snake (*Philothamnus natalensis occidentalis*)
- Montane dwarf burrowing skink (*Scelotes mirus*)
- Large-scaled grass lizard *(Chamaesaura macrolepis)*
- Wilhelm's flat lizard (*Platysaurus intermedius wilhelmi*)
- Distant's ground agama (*Agama aculeata distanti*)

A sub-section of the 2530DA quarter-degree grid square was demarcated and used to present a more realistic component of the species of special concern (SSC) assemblage in the project area vicinity (MTPA threatened species database). No SSC were listed.

There are two threatened reptile species expected to occur in the area:

- Wilhelm's flat lizard (*Platysaurus intermedius wilhelmi*) - Conservation status for South Africa – Least concern; Conservation status for Mpumalanga – Near-threatened; Endemic – Mpumalanga.
- Large-scaled grass lizard *(Chamaesaura macrolepis)* - IUCN 2015: Near-threatened; SARCA 2015: Near-threatened.

There is also one South African Threatened or Protected Species (TOPS) expected to be present in the region:

- Southern African python (*Python natalensis*).

Viability and estimated population size: Reptiles

Comparing the habitat requirements of the endemic species (which are considered Species of Conservation Concern) with habitat availability in the Ngodwana Dam project area, Table 33 illustrates the potential of area to include suitable habitat.

Table 33: Probability of occurrence based on habitat availability for reptile species of concern in the study area.

Reptile species	**Habitat requirements**	**The potential of the area to supply habitat.**
Spotted dwarf gecko *(Lygodactylus ocellatus ocellatus)*	Rocky hillsides. Exclusive rupicolous; among rocks and stones on exposed hillsides.	**Good**
Transvaal gecko (*Pachydactylus affinis*)	Rocky outcrops and dead termite nest in Highveld grassland. Nocturnal; Largely rupicolous: Seek refuge during day and move about slowly in crevices and under stones on rocky outcrops and hillsides; moribund termitaria, piles of rubble or other suitable refuges. Eggs deposited in any suitable spot under bark, under stones and in rock cracks.	**Good**
Jacobsen's Thread Snake (*Leptotyphlops jacobseni*)	Grassland and moist Savanna at an altitude of between 1300 and 1700m. Found under stones and in deserted termite mounds.	**Medium**
Swazi rock snake (*Inyoka swazicus*)	Rock outcrops in Savanna. Nocturnal, sheltering in rock cracks.	**Good**
Western Natal green snake (*Philothamnus natalensis occidentalis*)	Varied: Wet montane, miombo woodland and dry forest. In shrubs or trees close to water. Home near water bodies where it hunts for frogs, frequenting marshes, ponds, rivers, reedbeds, pans, vleis and streams.	**Good**
Montane dwarf burrowing skink (*Scelotes mirus*)	Rocky montane grassland. Live in grass among rocks on upper mountain slopes and summits.	**Good**
Large-scaled grass lizard *(Chamaesaura macrolepis)*	Montane grassland. Rocky hillsides covered with grass; flat rocks and grass tussocks.	**Good**
Wilhelm's flat lizard (*Platysaurus intermedius wilhelmi*)	Lowveld; mesic highveld grassland. Commonly occurs on granite outcrops and inselbergs where it uses open, exposed rock with associated boulders. Narrow rock crevices are important for refuge. Vegetation surrounding rock outcrops is frequently quite dense and juveniles may escape predators by running into it.	**Good**
Distant's ground agama (*Agama aculeata distanti*)	Semi-desert and Savanna: Open highveld (Grassland) and sandy thornbush (woodland) country with suitable rodent and other small animal burrows for shelter. Utilize rodent and	**Good**

	other small animal burrows for shelter; burrows in termitaria; under stones and debris, partly buries in soil.	
Southern African python (*Python natalensis*)	Open savanna regions, particularly rocky areas and **riverine scrub**. Moist, rocky, well-wooded valleys, reed-beds or even bush country, seldom venture far from permanent water. Eggs are laid in hollow tree trunks, ant-bear holes, caves or old termite hills. Fond of water in which they may lie and hunt. Dive into deep pools, remain submerged for long periods.	**Good**

* Viability and estimated population size scores: Poor 1; Low 2; Medium 3; Good 4; Optimal 5

According to Table 33, all species of concern have habitat available in the study area, therefore, should these biotopes be managed properly, the survival of these species will be secured. However, it is anticipated that these species have small population sizes in this area.

4.3.3.4 Birds

Birds are important species in many ecosystems, fortunately they are also relatively easy to observe and count. Bird count data has been shown to accurately detect environmental change. A decline in species richness and diversity, as determined by routine monitoring, may serve as an early warning of environmental degradation. The presence or absence of bird species with specific habitat requirements can be indicative of the state of the environment.

The Bird Atlas (Harrison et al. 1997, Volumes 1 & 2) formed the basis of the distribution data used in this report, as it is currently the most updated printed information sources on South African birds available. Roberts Birds of southern Africa (Hockey, et al. 2005) was also consulted for habitat- and bird data. Of the bird species expected to be found in the study area, certain birds were resident and thus remain in the area throughout the year. Nomadic species periodically move to other areas further away from the study area for feeding- or breeding purposes. Of the expected migratory bird species, some North African visitors will only appear during the warmer seasons where they will feed and likely breed. The Palaearctic migrants spend our winters in Eurasia and are summer visitors to the warm south during the cold winters up north, however very few breed in southern Africa.

Surveys in primary habitats

During the July 2020 survey, a variety of biotopes and sites were surveyed for bird species, including both transformed and untransformed habitats. A total of 283 bird species were observed in this region during the Bird Atlas project (Harrison *et al.* 1997) (Appendix 12).

If bird distribution and local habitat are evaluated, it is clear that all the species of birds that are likely to utilise the different biotopes of the study area, can be present in the Ngodwana Dam and surrounding area.

The July 2020 surveys produced a total of 44 bird species across all transects in the Ngodwana Dam project area (See Appendix 12 for detail):

1. Western Cattle egret (*Bubulcus ibis*)

2. Hadeda Ibis (*Bostrychia hagedash*)
3. Egyptian goose (*Alopochen aegyptiaca*)
4. African fish eagle (*Haliaeetus vocifer*)
5. Natal spurfowl (*Francolinus natalensis*)
6. Three-banded plover (*Charadrius tricollaris*)
7. Blacksmith plover (*Vanellus armatus*)
8. Ring-necked Dove (*Streptopelia capicola*)
9. Purple-crested Turaco (*Tauraco porphyreolophus*)
10. Brown-hooded Kingfisher (*Halcyon albiventris*)
11. Black-collared Barbet (*Lybius torquatus*)
12. Greater Honeyguide (*Indicator indicator*)
13. Golden-tailed Woodpecker (*Campethera abingoni*)
14. Black-headed Oriole (*Oriolus larvatus*)
15. Dark-capped Bulbul (*Pycnonotus tricolor)*
16. Sombre Greenbul *(Andropadus importunus)*
17. Groundscraper thrush *(Psophocichla litsitsirupa*)
18. African Stonechat *(Saxicola torquata)*
19. White-browed robin-chat *(Cossypha heuglini)*
20. Red-capped robin-chat (*Cossypha natalensis*)
21. Bar-throated Apalis *(Apalis thoracica)*
22. Green-backed Camaroptera *(Camaroptera brachyura)*
23. Tawny-flanked prinia (*Prinia subflava*)
24. Southern Black Flycatcher (*Melaenornis pammelaina*)
25. African pied wagtail (*Motacilla aguimp*)
26. Cape wagtail *(Motacilla capensis)*
27. Common Fiscal *(Lanius collaris)*
28. Black-backed puffback (*Dryoscopus cubla*)
29. Black-crowned Tchagra (*Tchagra senegala*)
30. Southern Boubou *(Laniarius ferrugineus)*
31. Red-winged Starling *(Onychognathus morio)*
32. Southern double-collared sunbird (*Cinnyris chalybeus*)
33. White-bellied Sunbird *(Cinnyris talatala*)
34. Cape white-eye *(Zosterops capensis)*
35. House Sparrow *(Passer domesticus)*
36. Spectacled Weaver (*Ploceus ocularis*)
37. Southern Masked weaver (*Ploceus velatus*)
38. Thick-billed weaver *(Amblyospiza albifrons)*
39. White-winged Widowbird *(Euplectes albonotatus)*
40. African Firefinch (*Lagonosticta rubricata*)
41. Common Waxbill (*Estrilda astrild*)
42. Blue Waxbill (*Uraeginthus angolensis*)
43. Swee Waxbill *(Estrilda melanotis)*
44. Yellow-fronted Canary *(Crithagra mozambicus*)

Species of Special Concern: Birds

Species of special concern comprises threatened, endemic and rare species.

In this document, the category “Species of Special Concern” is considered to include all threatened taxa listed by South African Red Data lists, and all South African endemic taxa. Through comparisons with expected bird lists, a total of 23 bird species expected to be found in the area are listed as “Species of Special Concern”. If bird distribution and local habitat are evaluated, all the Species of Special Concern birds are likely to utilise the different biotopes of the study area.

Currently thirteen endemic bird species are expected to occur in the area:

- Southern Bald Ibis *(Geronticus calvus)*
- Forest Buzzard (*Buteo trizonatus*)
- Blue korhaan *(Eupodotis caerulescens)*
- Knysna Turaco (*Tauraco corythaix*)
- Ground Woodpecker (*Geocolaptes olivaceus*)
- Eastern Long-billed Lark (*Certhilauda semitorquata*)
- Cape Rock Thrush (*Monticola rupestris*)
- Sentinel Rock Thrush (*Monticola explorator*)
- Buff-streaked Chat (*Oenanthe bifasciata*)
- Chorister Robin-Chat (*Cossypha dichroa*)
- Yellow-breasted Pipit (*Anthus chloris*)
- Pied Starling *(Lamprotornis bicolor)*
- Greater Double-collared Sunbird (*Cinnyris afer*)

A sub-section of the 2530DA quarter-degree grid square was demarcated and used to present a more realistic component of the species of special concern (SSC) assemblage in the project area vicinity (MTPA threatened species database).

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African Crowned Eagle (*Stephanoaetus coronatus*) (Conservation status for South Africa – Vulnerable; Conservation status for Mpumalanga – Vulnerable. Africa)

In this document, the category “Species of Special Concern” is considered to include all threatened taxa listed by South African Red Data lists, and all South African endemic taxa. Through comparisons with expected bird lists, a total of 15 bird species expected to be found in the area are listed as “Species of Special Concern”. If bird distribution and local habitat are evaluated, all the Species of Special Concern birds are likely to utilise the different biotopes of the study area.

The following 15 threatened bird species have distribution ranges that correspond with the study area (IUCN, 2014; NEMBA, 2014; Red Data Book, 2015):

- African Crowned Eagle *(Stephanoaetus coronatus)* - IUCN 2015 Status: Near-threatened. SA Red Data (Taylor 2015): Vulnerable. NEMBA (TOPS 2007): Vulnerable species. Mpumalanga: Vulnerable.
- African Grass-owl *(Tyto capensis)* - SA Red Data (Taylor 2015): Vulnerable.
- Black-bellied Bustard (*Lissotis melanogaster*) - SA Red Data (Barnes 2000): Near-threatened.
- Black-winged Pratincole *(Glareola nordmanni)* - IUCN 2017 NT: Near-threatened; SA Red Data (Taylor 2015): Near-threatened. Conservation status for Mpumalanga – Near-threatened.
- Blue korhaan *(Eupodotis caerulescens)* – IUCN (2018) Near-threatened.
- Cape Vulture *(Gyps coprotheres)* - IUCN 2015: EN Endangered; SA Red Data (Taylor 2015): Endangered. NEMBA TOPS (2015): Endangered species.
- Denham's Bustard *(Neotis denhami)* - IUCN 2017 NT: Near-threatened. NEMBA TOPS (2015): Vulnerable species; SA Red Data (Taylor 2015): Vulnerable.
- European Roller (*Coracias garrulus*) - SA Red Data (Taylor 2015): Near-threatened; IUCN 2018 Least concern.
- Gurney's Sugarbird (*Promerops gurneyi*) - IUCN (2018): Near-threatened.
- Lanner Falcon *(Falco biarmicus)* - SA Red Data (Taylor 2015): Vulnerable. IUCN 2017 Status: Least concern.

- Secretary bird (*Sagittarius serpentarius*) - IUCN 2017 VU Vulnerable; SA Red Data (Taylor 2015): Vulnerable. NEMBA (TOPS 2007): Vulnerable species.
- Southern Bald Ibis *(Geronticus calvus)* – IUCN 2017 VU: Vulnerable; SA Red Data (Taylor 2015): Vulnerable; NEMBA TOPS (2015): Vulnerable species; SA endemic.
- White-bellied korhaan (*Eupodotis caffra*) – SA Red Data (Taylor 2015): Vulnerable.
- Yellow-breasted Pipit (*Anthus chloris*) - IUCN 2017 Vulnerable. SA Red Data (Taylor 2015): Vulnerable.

Viability and estimated population size: Birds

Comparing the habitat requirements of Species of Concern with habitat availability in the biotopes, the following units have habitat assemblages that correspond with the optimal requirements of these birds, which will have a direct influence on their viability and estimated population size. The reporting rates c provide an indication of the population sizes of these birds in the area:

Table 34: Probability of occurrence based on habitat availability for bird species of concern in the study area.

Bird species	**Habitat requirements**	**The potential of the area to supply habitat.**
Endemic species (if not listed with Threatened Species)		
Forest Buzzard (*Buteo trizonatus*)	Edge of indigenous and exotic forest, especially pine plantations; not in high mountains.	**Medium**
Knysna Turaco (*Tauraco corythaix*)	Evergreen and riverine forest, dense thickets.	**Good**
Ground Woodpecker (*Geocolaptes olivaceus*)	Steep boulder strewn slopes of buttes, or cave sandstone regions – Alpine grasslands. Avoid dense vegetation. Mountains, rocky hillsides, dongas.	**Low**
Eastern Long-billed Lark (*Certhilauda semitorquata*)	Upland grassland and mixed shrubland and grassland, usually on rocky ridges.	**Good**
Cape Rock Thrush (*Monticola rupestris*)	Rocky, mountainous habitats in relatively high-rainfall areas; gorges, incised river valleys, foothills & lowlands adjacent to mountains. Cliffs, rocky gorges, boulder strewn hillsides and scree slopes, usually with scattered low trees, bushes and succulents, such as Euphorbia and Aloe species.	**Good**
Sentinel Rock Thrush (*Monticola explorator*)	Rocky uplands in grassland biome. High rolling grasslands, rocky slopes, burnt areas, felled plantations.	**Good**
Buff-streaked Chat (*Oenanthe bifasciata*)	Sour grasslands – rocky habitat on mountains, hills, ridges and escarpments (1500-1700m). Avoids woodlands, including aliens.	**Good**
Chorister Robin-Chat (*Cossypha dichroa*)	Evergreen forest, especially in mist belt.	**Medium**

Pied Starling *(Lamprotornis bicolor)*	Open Karoo and grassland habitats. Open fields. Not found in wooded areas. Areas of broken ground.	**Medium**
Greater Double-collared Sunbird (*Cinnyris afer*)	Moist habitats with trees or tall scrub; not into forests – edge or top of canopy. Coastal, montane and riverine scrub, *Protea* savannah. Mountainous or hilly country. Afromontane and Valley Bushveld.	**Optimal**
Threatened species		
African Crowned Eagle *(Stephanoaetus coronatus)*	Dense indigenous forest, including riverine gallery forest; may range far from forest to hunt.	**Good**
African Grass-owl *(Tyto capensis)*	Rank grass and marshes are the preferred habitat. Usually in open habitat at fairly high altitudes.	**Medium**
Black-bellied Bustard (*Lissotis melanogaster*)	Bushveld, savannah, grassland, vleis, cultivated lands.	**Medium**
Blue korhaan *(Eupodotis caerulescens)*	Open. Fairly short grassland biomes and a mixture of grassland and Karoo dwarf shrubland (in ecotone). Cropfields and planted pastures. Open grassveld, karoo scrub, cultivated lands.	**Poor**
Cape Vulture *(Gyps coprotheres)*	Both open country (grasslands) and woodland. Reliant on tall cliffs for breeding and roosting. Wanders widely.	**Optimal**
Denham's Bustard *(Neotis denhami)*	Breeding: High rainfall sour grassveld, fairly high altitudes. Also cultivated pastures. Non-breeding: Lower-lying regions, grassland and woodland, savannah, karoo scrub	**Medium**
European Roller (*Coracias garrulus*)	Woodlands, bushveld and grasslands. Open woodland.	**Medium**
Gurney's Sugarbird (*Promerops gurneyi*)	Montane scrub with *Protea* and *Aloe* (mostly Mountain Sourveld); also gardens and Protea nurseries; may move into suburban gardens in winter.	**Good**
Lanner Falcon *(Falco biarmicus)*	Open habitats. Cliff-nester, also in old nests in trees.	**Good**
Secretary bird (*Sagittarius serpentarius*)	Open country: Savanna, open woodland, grassland and dwarf shrubland.	**Medium**
Southern Bald Ibis *(Geronticus calvus)*	High rainfall, sour and alpine grasslands – absence of trees, short dense grass sward. Montane grassland of Eastern Transvaal escarpment. Cliffs for breeding.	**Good**
White-bellied korhaan (*Eupodotis caffra*)	Open grassland and lightly wooded savannah; prefer taller grass.	**Medium**

Yellow-breasted Pipit (*Anthus chloris*)	Submontane undulating grasslands (Drakensberg). Lush meadowlike conditions. Pasture and fallow lands. Flat to gently rolling lush montane grassland when breeding; lowland grassland to bushveld in winter.	**Medium**

* Viability and estimated population size scores: Poor 1; Low 2; Medium 3; Good 4; Optimal 5

4.3.3.5 Mammals

During the July 2020 survey, a variety of biotopes and sites were surveyed for mammal species, including both transformed and untransformed lands. Of all the mammal species that have distribution ranges in the region, 109 coincide with the Ngodwana Dam project area (Friedman & Daly, 2004).

If local habitat are evaluated, it is clear that a total of all 109 species of mammals are likely to utilise the different biotopes of the study area. The larger species will be accommodated in the adjacent game reserve.

During the July 2020 survey, signs and/or sightings of 7 mammal species were recorded (See Appendix 13 for detail) or reported by the staff in the area:

- Chacma baboon (*Papio ursinus*)
- Vervet monkey (*Cercopithecus aethiops*)
- Leopard (*Panthera pardus*)
- Black-backed jackal (*Canis mesomelas*)
- Bushpig *(Potamochoerus larvatus)*
- Nyala *(Tragelaphus angasii)*
- Greater Canerat *(Thryonomys swinderianus)*

Species of Special Concern: Mammals

Species of special concern comprises threatened, endemic and rare species.

Of the 109 expected mammal species in the study area, not all of them will remain resident as many are nomadic and will visit the area when conditions are favourable. The larger more mobile species will not be resident, but many of the smaller species will settle in the area and use the habitats available.

A sub-section of the 2530DA quarter-degree grid square was demarcated and used to present a more realistic component of the species of special concern (SSC) assemblage in the project area vicinity (MTPA threatened species database).

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- Oribi (*Ourebia ourebi ourebi)* (Conservation status for South Africa – Endangered; Conservation status for Mpumalanga – Endangered)

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- Honey badger (*Mellivora capensis)* (Conservation status for South Africa – Near-threatened; Conservation status for Mpumalanga – Near-threatened).
- Cohen's horseshoe bat (*Rhinolophus cohenae*) (Conservation status for South Africa – Vulnerable; Conservation status for Mpumalanga – Vulnerable. South African Endemic).

Additionally, information which was obtained from the Screening Tool exercise, lists the environmental sensitivity of the proposed footprint and also recorded certain Species of Special Concern species for the Animal and Plant species themes expected in the footprint. These assemblages will also be evaluated as part of the expected SSC lists.

Sensitive and threatened species expected to occur in the project region according to the Environmental Screening Tool results (compare with Figure 38).

- Samango monkey (*Cercopithecus albogularis schwarzi)*

- Oribi (*Ourebia ourebi ourebi)*

Fifteen (15) mammal species which have distribution ranges overlapping with the project area and suitable habitat available, are listed as Species of Special Concern, most of which are considered threatened:

1. Dark-footed forest shrew (*Myosorex cafer*) - SA Red Data (2016): Vulnerable. IUCN 2016: Least concern.
2. Swamp musk shrew (*Crocidura mariquensis):* SA Red Data (2016): Near-threatened. IUCN 2016: Least concern. TOPS: None.
3. Rough-haired golden mole *(Chrysospalax villosus):* IUCN (2014): Vulnerable; SA Red Data (Child 2016): Vulnerable. NEMBA TOPS (2007): Critically endangered. Endemic.
4. Samango monkey (*Cercopithecus mitis schwarzi*) - IUCN (2014) Vulnerable; SA Red Data (Child 2016): Vulnerable; NEMBA (TOPS 2015): Vulnerable species.
5. Brown hyaena *(Parahyaena brunnea*) - IUCN 2015: Near threatened; SA Red Data (Child 2016): Near threatened; NEMBA (TOPS 2007): Protected species.
6. Leopard (*Panthera pardus*) - IUCN (2016): Vulnerable. SA Red Data (Child 2016) Vulnerable. NEMBA (TOPS 2015): Protected species.
7. Cape clawless otter (*Aonyx capensis*): IUCN (2016): NT Near-threatened; SA Red Data (Child 2016): Near-threatened; NEMBA (TOPS 2007): Protected species**.**
8. Spotted-necked otter (*Hydrictis maculicollis*): IUCN (2016): NT Near-threatened; SA Red Data (Child 2016): Vulnerable; NEMBA (TOPS 2007): Protected species.
9. African striped weasel (*Poecilogale albinucha*) - SA Red Data 2016: Near threatened.
10. Honey badger (*Mellivora capensis*) - NEMBA (TOPS) 2007: Protected species. IUCN (2014) Least concern. SA Red Data (Child 2016): Least concern.
11. Oribi (*Ourebia ourebi*) - IUCN (2015): LC Least concern. SA Red Data (Child 2016): Endangered. TOPS NEMA: Endangered species.
12. Temminck's ground Pangolin (*Smutsia temminckii*) - IUCN (2016) Vulnerable. SA Red Data (Child 2016): Vulnerable. NEMBA (TOPS 2015): Vulnerable species.
13. Laminate Vlei Rat *(Otomys laminatus):* SA Red Data (Child 2016): Near threatened. Endemic.
14. Water Rat *(Dasymys incomtus):* SA Red Data (Child 2016): Near threatened; IUCN (2016): Least concern.
15. White-tailed mouse (*Mystromys albicaudatus*) - IUCN (2008): EN Endangered; SA Red Data (Child 2016): Vulnerable. NEMBA (TOPS 2007): None.

Probability of occurrence: Species of Concern

According to the preceding section on faunal assemblages, habitat for Species of Concern is available at different scales of suitability per habitat. In the following section species are grouped by the probability of utilising and/or colonising these habitats. This approach evaluates the integrity of the biotope as a refuge to fauna and their food items.

Table 35: Probability of occurrence based on habitat availability for mammal species of concern in the study area.

Mammal species	**Habitat requirements**	**The potential of the area to supply habitat.**
Threatened species		
Dark-footed forest shrew (*Myosorex cafer*) -	Montane grasslands; wet sponges in mistbelt. Dense scrub and grass in damp areas fringing mountain streams. Moist densely vegetated habitat, mountainous country. Nest on bank of stream in heavy overhead cover of grass and undergrowth. Runways of vlei rats.	Medium
Swamp musk shrew (*Crocidura mariquensis)*	Moist habitats, thick grass along riverbanks, in reedbeds and in swamp. Tangled masses of semi-aquatic grasses along fringes of water. Litter piles deposited by receding floods. Runways of vlei rats. Nests deep in clumps of tussock grasses on slightly raised patches of ground on fringes of swamp.	Good
Rough-haired golden mole *(Chrysospalax villosus)*	Sandy soils in grasslands, meadows and along edges of marshes in savanna and grassland biomes of South Africa. Grassland, dry ground on the fringes of marshes or damp vleis. Excavate burrows; loose piles of soil. Recorded from gardens and parklands, also found in dense stands of kikuyu grass (*Pennisetum clandestinum*) adjoining natural grasslands.	Poor
Samango monkey (*Cercopithecus mitis schwarzi*)	Open forest.	Poor
Brown hyaena *(Parahyaena brunnea*)	Semi-desert, open scrub and open woodland savanna. Nocturnal, holes in ground.	Good
Leopard (*Panthera pardus*	Widespread. Broken country or forests. Nocturnal & solitary.	Optimal
Serval *(Leptailurus serval*)	Proximity to water essential requirement, coupled with availability of adequate cover; tall grass, underbrush or reed beds - during day. Wet grassland, vleis and reed beds.	Good
Cape clawless otter (*Aonyx capensis*)	Predominantly aquatic; freshwater an essential requirement: Rivers, lakes, swamps and dams. Widespread. Tributaries of rivers into small streams - habitat with food. Litters born in holes in banks of rivers. Estuarine and sea water.	Good
Spotted-necked otter (*Hydrictis maculicollis*)	Aquatic, confined to larger rivers, lakes, swamps and dams with extensive areas of open water. Stay close to water edge. Lie up in holes of river banks, in rock crevices or in dense reed.	Medium

African striped weasel (*Poecilogale albinucha*)	Savannah: Moist grassland. Litters born in burrows.	Medium
Honey badger (*Mellivora capensis*)	Widespread. Not in desert. Use crevices in rocky areas, will also dig refuges. Rocky koppies, scrub sandveld, open grassland, open woodland, riverine woodland and floodplain grassland.	Good
Oribi (*Ourebia ourebi*)	Open habitat. Open grassland, flood plain; sparse scattering of trees and bushes.	Medium
Temminck's ground Pangolin (*Smutsia temminckii*)	Temminck's ground Pangolin (*Smutsia temminckii*)	Good
Laminate Vlei Rat *(Otomys laminatus)*	Tied to moist habitats - grasslands in submontane and coastal areas.	Low
Water Rat *(Dasymys incomtus)*	Wet habitat: Streams, rivers, reed beds, swamps and is partially aquatic. Long grass close to water, semi-aquatic grasses, in swampy areas along rivers and streams, or in in grassy or bracken covered areas close to water. Between reeds and among rotting vegetation. Fringes of marshes and backwaters. Nest: Constructed in a depression on the sloping ground bordering the swampy edge of the river.	Good
White-tailed mouse (*Mystromys albicaudatus*)	Highveld and montane grassland. Nocturnal – lives in burrows or cracks in the ground. Sandy soil with good cover.	Medium

* Viability and estimated population size scores: Poor 1; Low 2; Medium 3; Good 4; Optimal 5

4.3.3.6 Summary of all vertebrate fauna

After analysing the fauna distribution data and habitat availability, 17 frog species, 37 reptile species, 283 bird species and 109 mammal species are expected to occur in the project area, a total of 446 animal species. The presence of these different faunal groups is however dependent on availability of potential habitat types in each distinct biotope.

Proposed developments that will involve a change of land use may cause loss of natural habitat or alteration of such habitat. Habitat destruction and habitat change are the greatest threats to fauna in South Africa. In terms of some of the principles of the National Environmental Management Act (Act 107 of 1998) (NEMA, 1998), sustainable development requires the consideration of disturbance and loss of biodiversity, which should be avoided or, if that is not possible, should be minimised and mitigated.

It is expected that 45 faunal Species of Special Concern that have a Medium to Optimal probability of occurring in the region, will frequent the Ngodwana Dam project area, periodically as nomads, or permanent as inhabitants. In the event that any threatened or near-threatened animal species are recorded within the study area in future, appropriate conservation measures should be developed in consultation with the relevant conservation authorities.

5. Impact Assessment

5.1 Present Ecological State of the Project Area

Screening Report

The National Web based Environmental Screening Tool is a geographically based web-enabled application which allows a proponent intending to submit an application for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended to screen their proposed site for any environmental sensitivity.

The Screening Tool also provides site specific EIA process and review information, for example, the Screening Tool may identify if an industrial development zone, minimum information requirement, Environmental Management Framework or bio-regional plan applies to a specific area.

Finally, the Screening Tool allows for the generating of a Screening Report referred to in Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended whereby a Screening Report is required to accompany any application for Environmental Authorisation and as such the tool has been developed in a manner that is user friendly and no specific software or specialised GIS skills are required to operate this system.

A screening report was done for an environmental authorization or for a part two amendment of an environmental authorisation as required by the 2014 EIA regulations, evaluating the proposed development footprint for environmental sensitivity. Following is an abstract from the original Screening Tool application:

Cadastral details of the proposed site

Table 36: Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	NGODWANA	638	0	25°35'46.02S	30°39'14.14E	Erven
2		1030	0	25°34'37.59S	30°38'17.91E	Farm

Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area	No nearby wind or solar developments found.
Environmental Management Frameworks relevant to the application	No intersections with EMF areas found.

Environmental screening results and assessment outcomes

The following sections contain a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development footprint as well as the most environmental sensitive features on the footprint based on the footprint sensitivity screening results for the application classification that was selected.

Table 37: A summary of any development incentives, restrictions, exclusions or prohibitions.

Services	Water services / Storage / Dams| Storage - Dams
Relevant development incentives, restrictions, exclusions or prohibitions	No intersection with any development zones found.

Proposed Development Area Environmental Sensitivity

The following summary of the development footprint environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Table 38: The development footprint environmental sensitivities (Figure 38).

Theme	**Very High sensitivity**	**High sensitivity**	**Medium sensitivity**	**Low sensitivity**
Agriculture Theme	**X**			
Animal species			**X**	
Aquatic Biodiversity Theme	**X**			
Archaeological and Cultural Heritage Theme		**X**		
Civil Aviation Theme		**X**		
Plant Species Theme			**X**	
Defence Theme				**X**
Terrestrial Biodiversity Theme	**X**			

The maps in Figure 38 represents the results of the screening for environmental sensitivity of the proposed footprint for the relative agriculture theme sensitivity associated with the project classification.

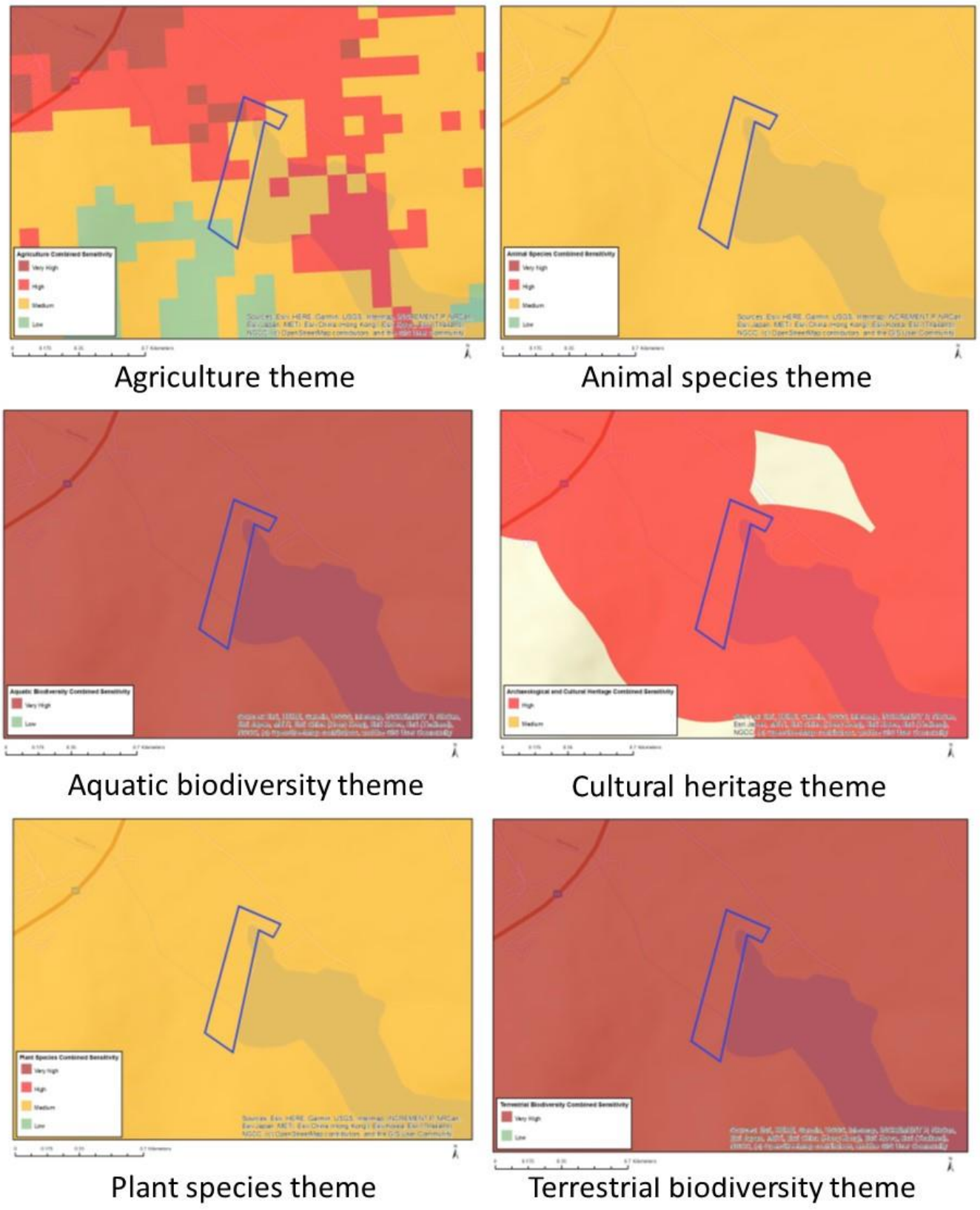


Figure 38: Maps of relative theme sensitivity for important for selected themes (Table 39).

Table 39: Sensitivity features of the project area.

Theme	Sensitivity	Feature
Agriculture Theme	Very High	Land capability; 12. High-Very high
Animal species theme	Medium	Mammalia - *Cercopithecus albogularis schwarzi* Mammalia - *Ourebia ourebi ourebi* Insecta - *Lepidochrysops irvingi* Insecta - *Serradinga clarki amissivallis* Insecta - *Lepidochrysops swanepoeli* Insecta - *Orachrysops violescens*
Aquatic biodiversity	Very High	Aquatic CBAs Strategic water source area Freshwater ecosystem priority area quinary catchments
Archaeological and Cultural Heritage Theme	High	Within 500 m of an important river
Plant Species Theme	Medium	Sensitive species 330
Terrestrial Biodiversity Theme	Very High	Vulnerable ecosystem Critical Biodiversity Area 1 Focus Areas for land-based protected areas expansion Freshwater ecosystem priority area quinary catchments Strategic Water Source Area

5.2 Sensitivity mapping

Sensitivity assessments identify those sections of the study area that have high conservation value or that may be sensitive to disturbance. Sensitivities could be determined based on:

- Areas containing untransformed natural vegetation and associated faunal habitat;
- irreplaceability of the vegetation type and associated faunal habitat;
- ecological importance of vegetation and faunal habitat;
- high diversity or complexity of faunal habitat;
- observations of the abundance and diversity of floral and faunal species present at the time of the assessment;
- occurrence of Species of Conservation Concern (SCC);
- systems vital to sustaining ecological functions;
- presence or absence of CBAs and ESAs;
- degree of disturbance encountered as a result of historical activities.

In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to have a low sensitivity.

An ecological sensitivity map of the project area was produced by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various relevant reports. This includes delineating the different vegetation and habitat units identified in the field and assigning sensitivity values to the units based on their ecological properties. Additionally, values and potential presence of vegetation and fauna species diversity, as well as species of conservation concern, were evaluated.

Five, broad-scale botanical biodiversity ‘sensitivity’ categories were identified and were developed for practical mapping purposes. They are intended as a summary of the perceived botanical biodiversity value and sensitivity, of mapped broad-scale vegetation and land-cover type units. Based on the assessment, the sensitivity of the project footprint can

be divided into five categories of sensitivity: Very high, High, Moderate, Low and Negligible. These categories are listed as biodiversity sensitivity categories in Table 40.

Table 40: Important parameters relating to faunal diversity and landscape sensitivity listed in the different vegetation and land cover types in order to establish the biodiversity sensitivity and value of the project area. SSC fauna with Medium to Optimal habitat available will be taken in account.

Vegetation/ Land cover type unit	**Status and sensitivity of vegetation type**	**CBA Category**	**Biota:** Species of special concern (**SSC**)	**Biodiversity value and sensitivity**	**Overall ecological value and sensitivity**
1. Legogote Sour Bushveld	Legogote Sour Bushveld - Vulnerable	CBA Critical Biodiversity Area - Irreplaceable	**SSC:** 8 reptiles; 22 bird; 10 mammals	Very high	**Very high**
2. Ngodwana River	Legogote Sour Bushveld - Vulnerable	CBA FEPA River	**SSC:** 3 fish; 2 frogs; 2 reptiles; 1 bird; 4 mammals	Very high	**Very high**
3. Ngodwana Catchment Valley Bottom Wetland	Legogote Sour Bushveld - Vulnerable	ESA Fish support area	**SSC:** 1 frog; 2 reptiles; 1 bird; 5 mammals	Very high	**Very high**
4. Ngodwana Catchment Valley Seeps	Legogote Sour Bushveld - Vulnerable	CBA FEPA Catchment	**SSC:** 1 frog; 1 bird; 3 mammals	Very high	**Very high**
5. Old Mining	Legogote Sour Bushveld - Vulnerable	Heavily modified	**SSC:** 0	Negligible	**Negligible**
6. Power Line Servitude	Legogote Sour Bushveld - Vulnerable	Heavily modified	**SSC:** 0	Negligible	**Negligible**
7. Ngodwana Dam Wall	Legogote Sour Bushveld - Vulnerable	Heavily modified	**SSC:** 0	Negligible	**Negligible**
8. Habitat impacted by Dam Wall Construction early 1980s	Legogote Sour Bushveld - Vulnerable	Moderately modified	**SSC:** 1 frog; 1 bird; 3 mammals	Low	**Low**
9. Roads and pipelines	Legogote Sour Bushveld - Vulnerable	Heavily modified	**SSC:** 0	Negligible	**Negligible**

5.3 The use of CBA maps in Environmental Impact Assessments

Ideally, all land-users and people who make decisions about land and the use of natural resources should be aware of spatial biodiversity priorities, and should know how to take these into consideration in their planning and decision-making processes. This is so that

they can proactively identify the ecological opportunities and constraints within a landscape and use these to locate different land-uses appropriately (Cadman *et al.*, 2010).

Systematic biodiversity planning provides a powerful set of tools (maps and land-use guidelines) that facilitate this in a wide range of sectors, at both the policy-making and operational decision-making levels. The Mpumalanga Biodiversity Sector Plan represents the biodiversity sector's input to a wide range of planning and decision-making processes, frameworks and assessments in multiple land-use sectors (MBSP Handbook, Lötter *et al.* 2014).

It is important to note that all decisions regarding land-use applications in Mpumalanga are going to be evaluated by the authorities using the CBA maps and data, so it makes sense to consider these proactively, either prior to, or during, the EIA process (MBSP Handbook, 2014).

Mpumalanga Biodiversity Sector Plan (MBSP) and Threatened Ecosystems

The Mpumalanga Biodiversity Sector Plan (MBSP) (Mpumalanga Tourism & Parks Agency, Mbombela (Nelspruit). provides maps of Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) for the entire province, which is referred to as the CBA Map in the MBSP.

Critical Biodiversity Area (CBA) maps and their associated land-use guidelines are used to determine the biodiversity context of a proposed land-use site, ahead of making the first site visit. Although the CBA maps supply crucial guidelines for the assessment, additional background information is required to develop a broader understanding of the study area. A number of resources and tools are therefore used to establish how important the proposed development site is for meeting biodiversity targets. Specifically, the Land-Use Decision Support Tool (LUDS) and the Mpumalanga Biodiversity Sector Plan (MBSP) are extensively used to compile reports (BGIS, 2015). LUDS was developed to facilitate and support biodiversity planning and land-use decision-making at a national and provincial level.

The conservation status of the Legogote Sour Bushveld is "Vulnerable" with a target of 19%. It has been greatly transformed (50%), mainly by plantations and also by cultivated areas and urban development (Mucina & Rutherford 2006).

The Ngodwana Dam Project Area falls within the planning domain of the Mpumalanga Biodiversity Sector Plan, developed by the Mpumalanga Tourism and Parks Agency (MTPA). The potential impact of the development on Critical Biodiversity Areas should be considered in detail as these areas have been identified through systematic conservation planning exercises and represent biodiversity priority areas which should be maintained in a natural to near natural state in order to safeguard biodiversity patterns and ecological processes.

This report made use of the Mpumalanga Biodiversity Sector Plan (MBSP), which was founded on an extensive biodiversity database compiled over the years by the Province's conservation biologists. These detailed records, together with the latest mapping and remote sensing data on vegetation, land use and water resources, have been combined and subjected to sophisticated analyses. For the finer components of a conservation plan, the MBSP maps were consulted and the detail added to the sensitivity assessment of the study area.

The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to meet national biodiversity objectives. Critical Biodiversity Areas (CBAs) are areas of the landscape that need to be maintained in a natural or near-

natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. If these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.

Its primary objective is to serve as a guide for biodiversity planning but should not replace specialist ecological assessments. To maintain an area in a 'natural' state, a variety of biodiversity-compatible land uses and resource uses should be followed.

The MBSP maps the distribution of the province's known biodiversity into seven categories. These are ranked according to ecological and biodiversity importance and their contribution to meeting the quantitative targets set for each biodiversity feature. The categories are:

- Protected areas - already protected and managed for conservation;
- Irreplaceable areas - no other options available to meet targets—protection crucial;
- Highly significant areas - protection needed, very limited choice for meeting targets;
- Important and necessary areas - protection needed, greater choice in meeting targets;
- Ecological corridors – mixed natural and transformed areas, identified for long term connectivity and biological movement;
- Areas of Least Concern – natural areas with most choices, including for development; and
- Areas with No Natural Habitat Remaining – transformed areas that make no contribution to meeting targets.

It must first be establish how important the site is for meeting biodiversity targets. To do this, it is necessary to answer the following three simple but fundamentally important questions:

- How important is the site for meeting biodiversity objectives (e.g. is it in a CBA or Ecological Support Area (ESA)?
- Is the proposed land-use consistent with these objectives or not (to be checked against the land-use guidelines)?
- Does the sensitivity of this area trigger the MTPA requirements for assessing and mitigating environmental impacts of developments, or in terms of the listed activities in the EIA regulations?

The key results of the Biodiversity Geographic Information System (BGIS) maps and LUDS Report are summarised in Table 41.

Table 41: The key results of the LUDS Report, as extracted for the SAPPI Ngodwana project area, are obtained from the national datasets available on the BGIS website.

National Data Set	Aspect	Present
National terrestrial information: Ngodwana 638 and 1030 (Mpumalanga).		
South African District	Ehlanzeni	Mpumalanga
South African municipal boundaries	Mbombela	MP322
Quarter-degree grid square		2530DA
Terrestrial CBAs		
Bioregion	National vegetation map	Status

Savanna Biome (Lowveld)	SVI 9 Legogote Sour Bushveld	Threatened ecosystem status: Vulnerable
Critical Biodiversity Area	Irreplaceable	
Aquatic Critical Biodiversity Areas		
Water Management Area (WMA)	Inkomati WMA	FEPA WMA
Sub Water Management Area	Crocodile Catchment	
Ecoregion 1	Northern escarpment mountains	
Ecoregion 2	10.02	
Ecological Support Areas	Strategic water source areas	Top 50% of strategic water resource area
Freshwater CBAs and ESAs	ESA: Important sub-catchment	FEPA sub-catchment
	CBA: Rivers	FEPA rivers
	Fish support area	*Chiloglanis bifurcus* (EN)
NFEPA river FEPAs – sub-quaternary catchments	FEPA sub-quaternary catchment	
River Unit (NFEPA)	Ngodwana	10_P_U
Quaternary catchment	X21H	X21H-01060
PES (1999)	Class C	Moderately modified

Critical Biodiversity Areas

Overlaying the BGIS Critical Biodiversity Areas map onto the Ngodwana Project Area, resulted in the compilation of Figures 39 to 41 and Table 41. According to these maps and Luds Report (Table 41) the project area falls into the following sensitive areas:

- Terrestrial:
  - Critical Biodiversity Area: Irreplaceable
  - Vulnerable Ecosystem status: Legogote Sour Bushveld
- Freshwater
  - Critical Biodiversity Area:
    - Rivers
    - FEPA river
    - Fish support area
  - Ecological Support Area:
    - Important subcatchments
    - FEPA subcatchments

With these overarching sensitive landscape properties, it is paramount to approach the construction and operation phases of the entire project with caution. The footprint of the entire project area is classified as Irreplaceable Critical Biodiversity Area, and 64% of it is associated with open to closed bushveld, typical to the Legogote Sour Bushveld vegetation unit. Other untransformed land cover type are:

- Ngodwana River
- Ngodwana Catchment Valley Bottom Wetland
- Ngodwana Catchment Valley Seeps

These wetlands forms part of Inkomati Water Management Area, and thus they are part of a Strategic water source area. They are also freshwater ESAs (important FEPA sub-catchment) and CBAs (Fish support area). The Ngodwana River is a FEPA river and thus a Critical Biodiversity Area in a FEPA sub-quaternary catchment.

Ecological Support Areas: Those areas that play a significant role in supporting ecological functioning of Critical Biodiversity Areas and/or delivering ecosystem services, as determined in a systematic biodiversity plan. A *Critical Biodiversity Area map* is a map of Critical Biodiversity Areas and Ecological Support Areas based on a systematic biodiversity plan. Critical Biodiversity Areas and Ecological Support Areas are areas that require safeguarding to ensure the continued existence of biodiversity, ecological processes and ecosystem services. A Critical Biodiversity Area map, often developed at provincial level, provides the basis for a biodiversity sector plan.

A CBA map of the study area was compiled by using the Biodiversity Geographic Information System (BGIS) maps as illustrated in Figure 39. Every attempt should be made during all phases of the project development not to have an impact on these areas. While determining the area and distribution of a core habitat is important, it is equally important that appropriate management measures be defined to ensure the core habitat continues to function effectively.

The goal is to maximise connectivity in CBAs and ESAs, the retention of intact natural habitat and avoid fragmentation: Design project layouts and select locations that minimise loss and fragmentation of remaining natural habitat and maintain spatial components of ecological processes, especially in ecological corridors, buffers around wetlands, CBAs and ESAs. Activities that are proposed for CBAs must be consistent with the desired management objectives for these features and should not result in fragmentation.

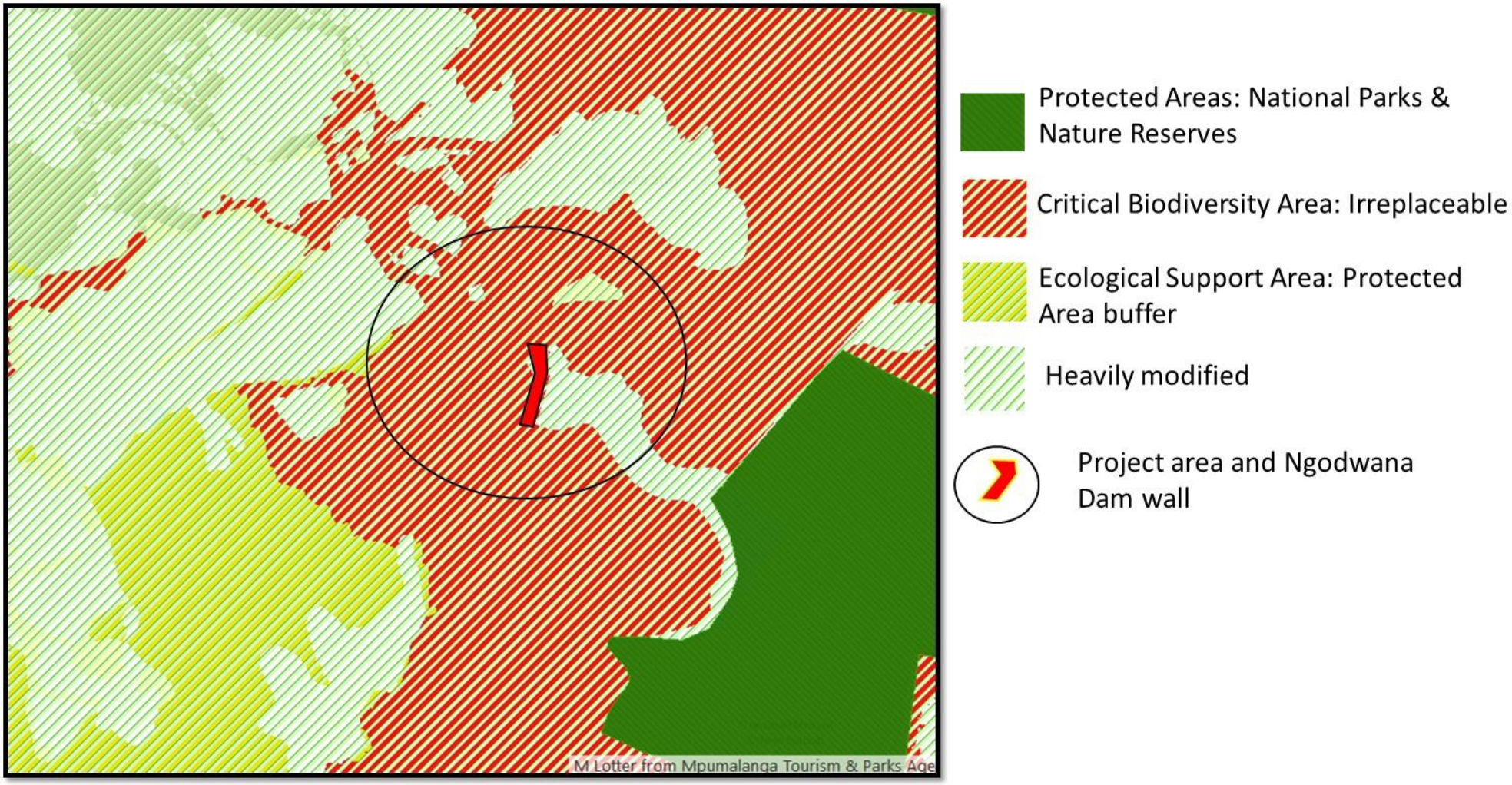


Figure 39: A map obtained by the 2014 Mpumalanga Biodiversity Sector Plan to indicate the Terrestrial CBAs related to the project locations (black circle). Dark green = Protected Area National Parks & Nature Reserves (Mpumalanga Biodiversity Sector Plan, 2014).

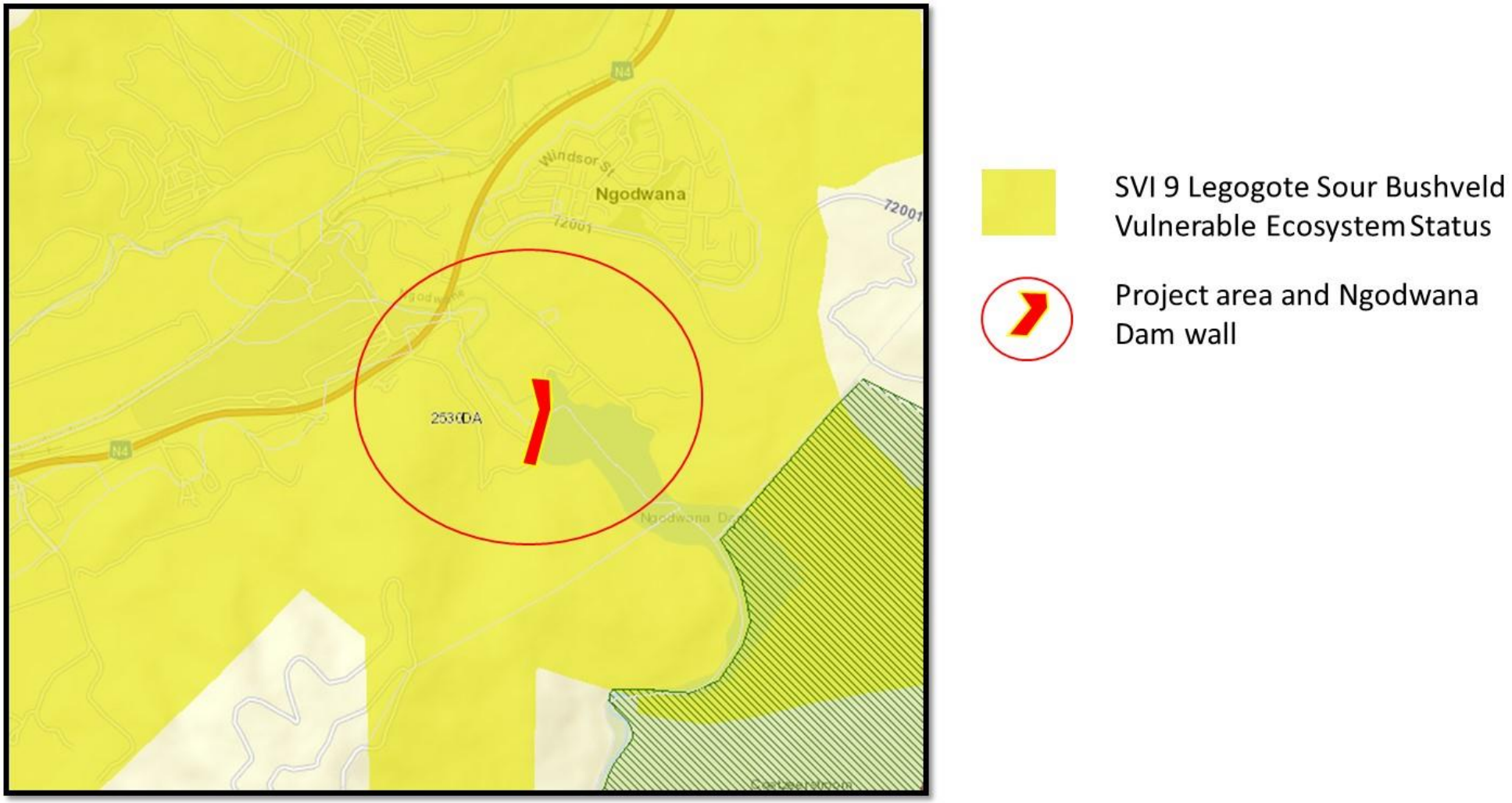


Figure 40: A map obtained by the 2014 Mpumalanga Biodiversity Sector Plan to indicate the vegetation type covering the project location, (red circle) (Mpumalanga Biodiversity Sector Plan, 2014).

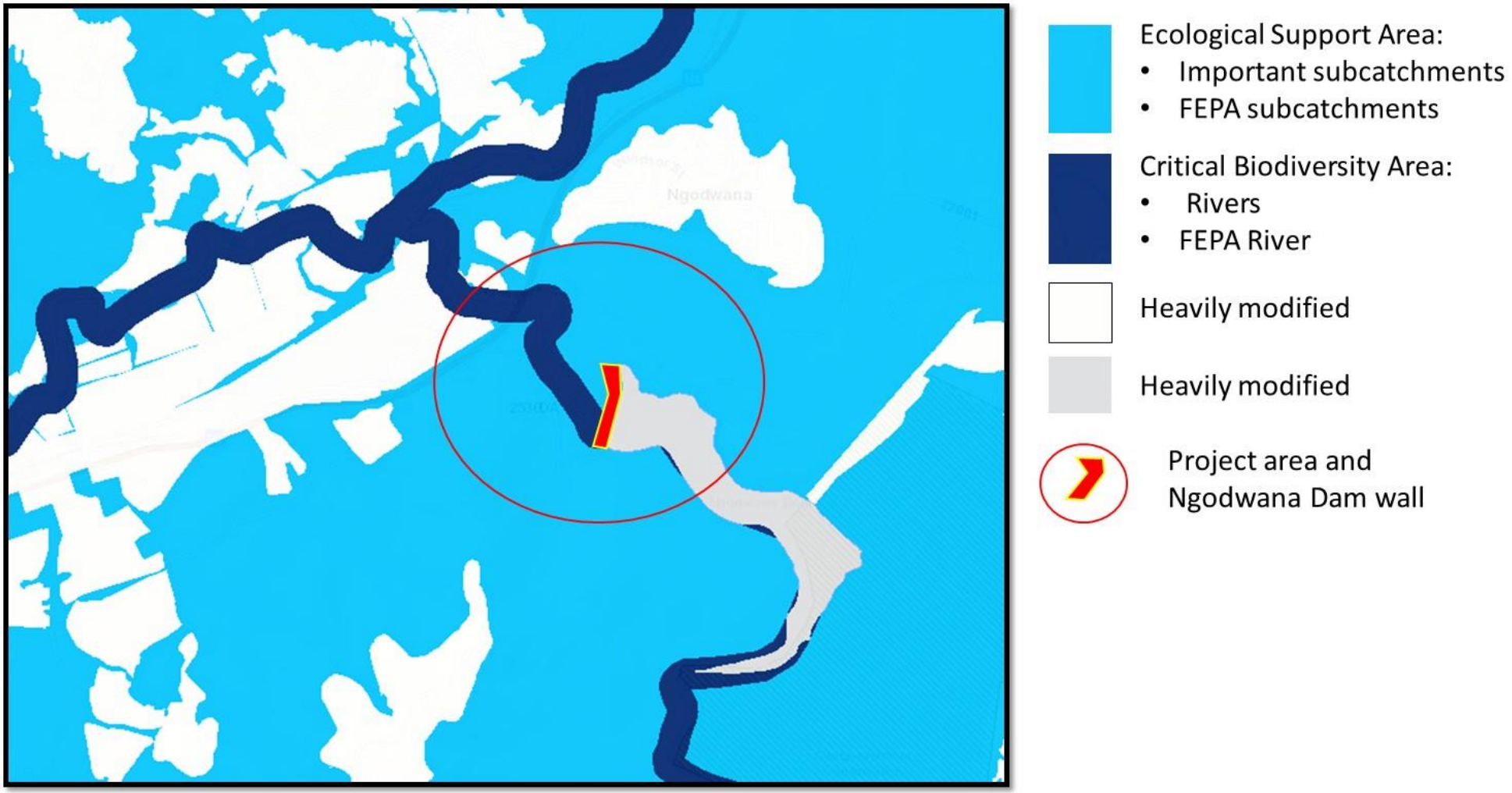


Figure 41: A map obtained by the 2014 Mpumalanga Biodiversity Sector Plan to indicate the Freshwater CBAs and ESAs in the project area, (red circle) (Mpumalanga Biodiversity Sector Plan, 2014). Light blue = Ecological Support Areas; Dark blue = Critical Biodiversity Areas (Mpumalanga Biodiversity Sector Plan, 2014).

Freshwater Ecosystem Priority Areas (FEPAs) were identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries FEPA maps show various different categories, each with different management implications. The categories include river FEPAs and associated sub-quaternary catchments, wetland FEPAs, wetland clusters, Fish Support Areas and associated sub-quaternary catchments, fish sanctuaries, phase 2 FEPAs and associated sub-quaternary catchments, and Upstream Management Areas. NFEPA map products provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. These strategic spatial priorities are known as Freshwater Ecosystem Priority Areas, or FEPAs.

The Ngodwana River is a river FEPA (Figure 42 and Table 41), which means it is a river reach that is required for meeting biodiversity targets for river ecosystems and threatened fish species. The Desired Management Objectives of a river in the Critical Biodiversity Area category, are to maintain the river in a natural state with no loss of ecosystems, functionality or species; no flexibility in land-use options.

Since the river is also situated in an Ecological Support Area, the Desired Management Objectives are to minimise habitat and species loss through judicious planning and maintain basic ecosystem functionality and ecological condition within the surrounding landscape (sub-catchment).

5.4 Corridors for Connectivity

The guidelines for land-use practices or activities that impact on water quantity in freshwater CBAs includes: Generic buffers should be established around streams within these catchments. These buffers can be refined based on a site visit and applying the DWS's wetland delineation tool.

Due to their positioning adjacent to water bodies, buffer zones associated with streams and rivers will typically incorporate riparian habitat. Riparian habitat, as defined by the NWA, includes the physical structure and associated vegetation of the areas associated with a watercourse (Macfarlane et al, 2015). However, the riparian zone is not the only vegetation type that lies in the buffer zone as the zone may also incorporate stream banks and terrestrial habitats depending on the width of the aquatic impact buffer zone applied. Therefore the riparian zone must be delineated before the buffer zone is established.

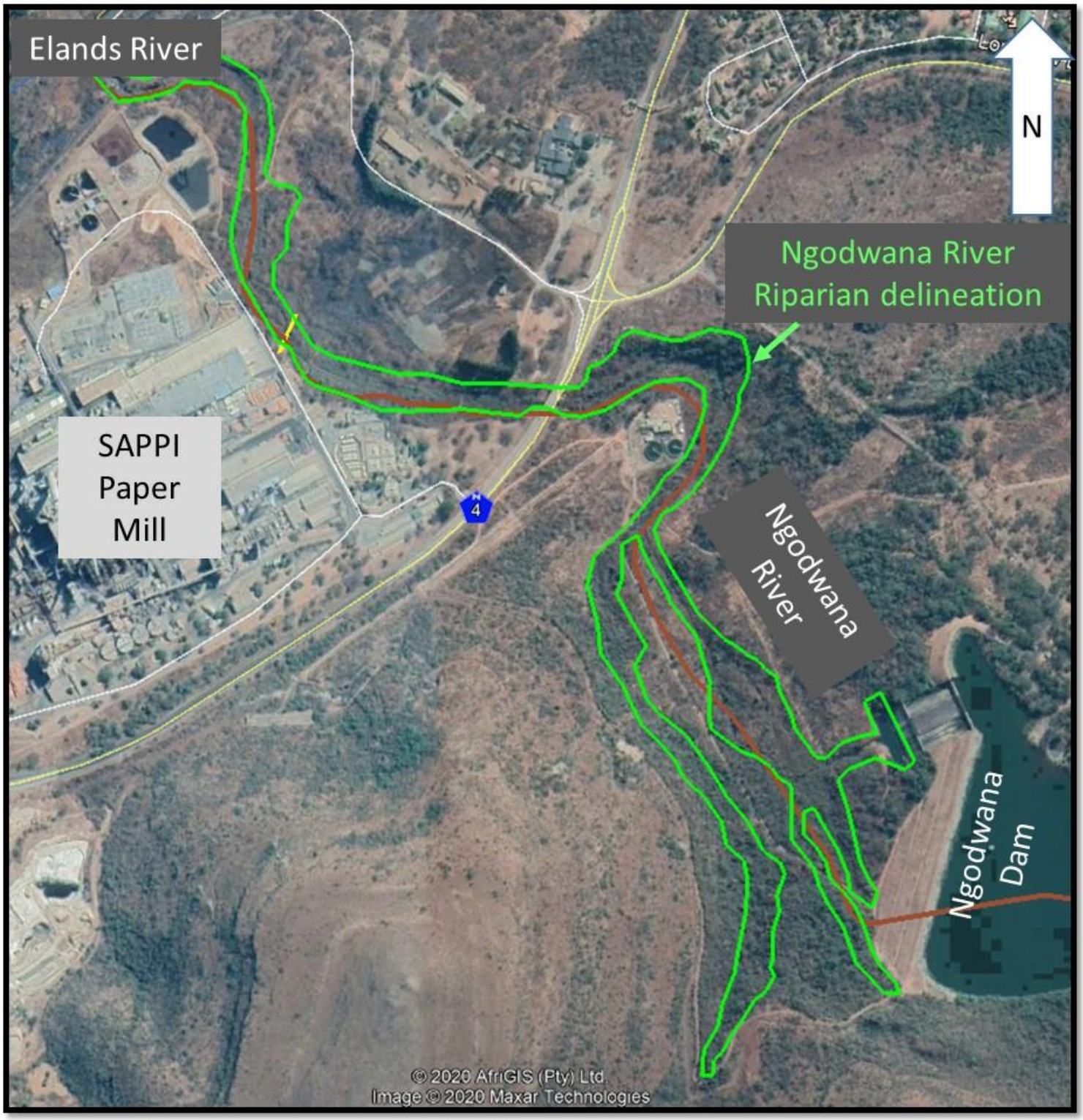
Riparian delineation

During the process of riparian delineation, two transects were surveyed, one transect per site. A transect runs from the outer edge of one riparian zone (left bank), through the drainage line to the outer edge of the other riparian zone (right bank). The results of the surveys are depicted in Figures 36 and 37 in the previous section.

Riparian delineation and habitat evaluation was done according to the DWAF Guidelines (2005) and DWAF updated manual (2008) (see Methods Section 2.1 Vegetation). Figure 45 depicts the Ngodwana River with the riparian zone delineated. The delineation shapefiles are available as Appendices 6-9.

The entire area below the Ngodwana dam wall (314m) consists of wetlands, both natural and created by the dam environment. Although areas are supported by seeping water from

the groundwater, some important natural wetland systems are present in the area below the dam wall. These areas are depicted in Figures 42 and 43 and described in more detail



further down in this section.

Figure 42: The delineated riparian zone (green lines) of the Ngodwana River catchment in the project area.

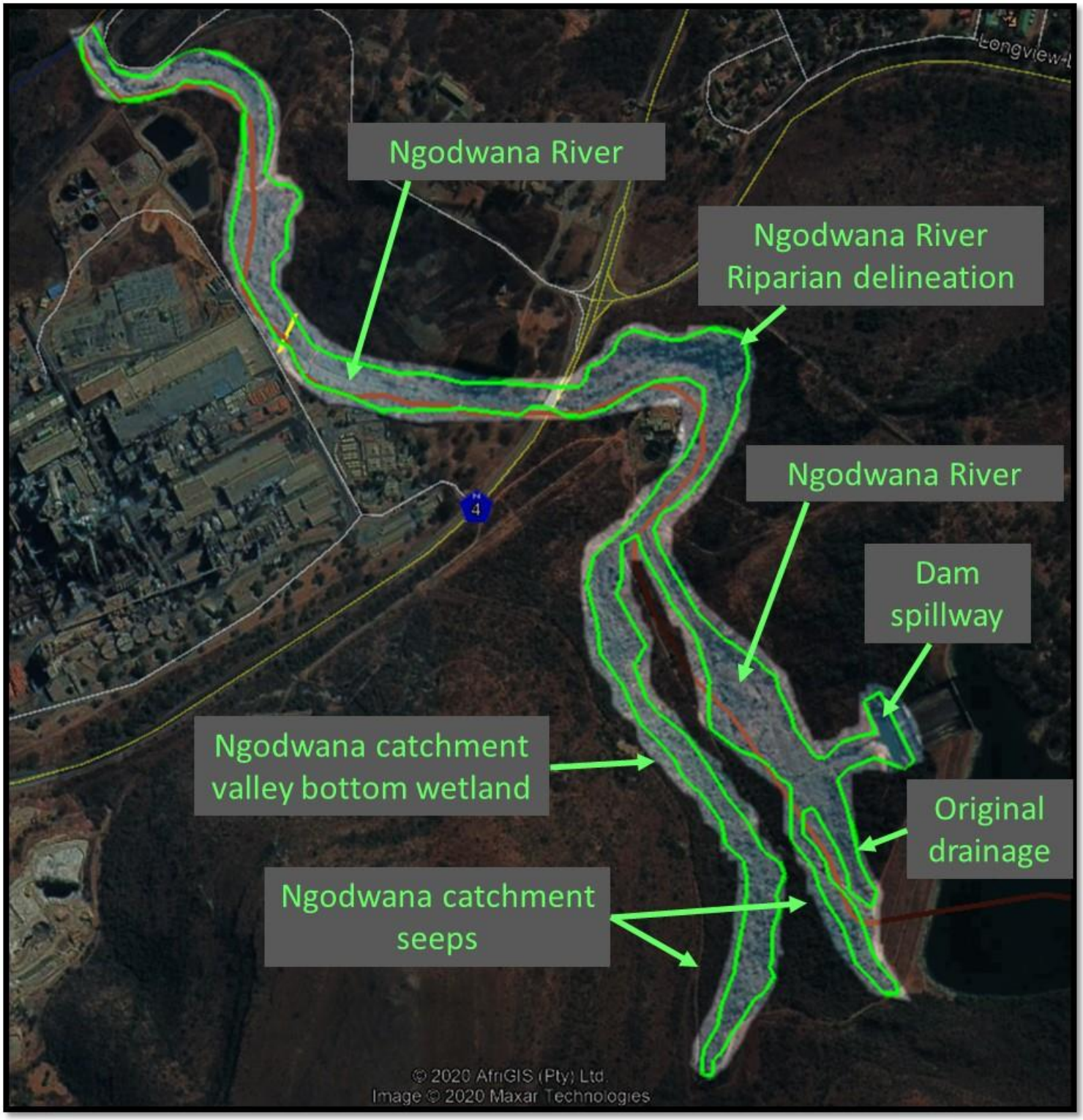


Figure 43: The entire area below the Ngodwana dam wall (314m) consists of wetlands, both natural and created by the dam environment. These areas are illustrated here and described in more detail below.

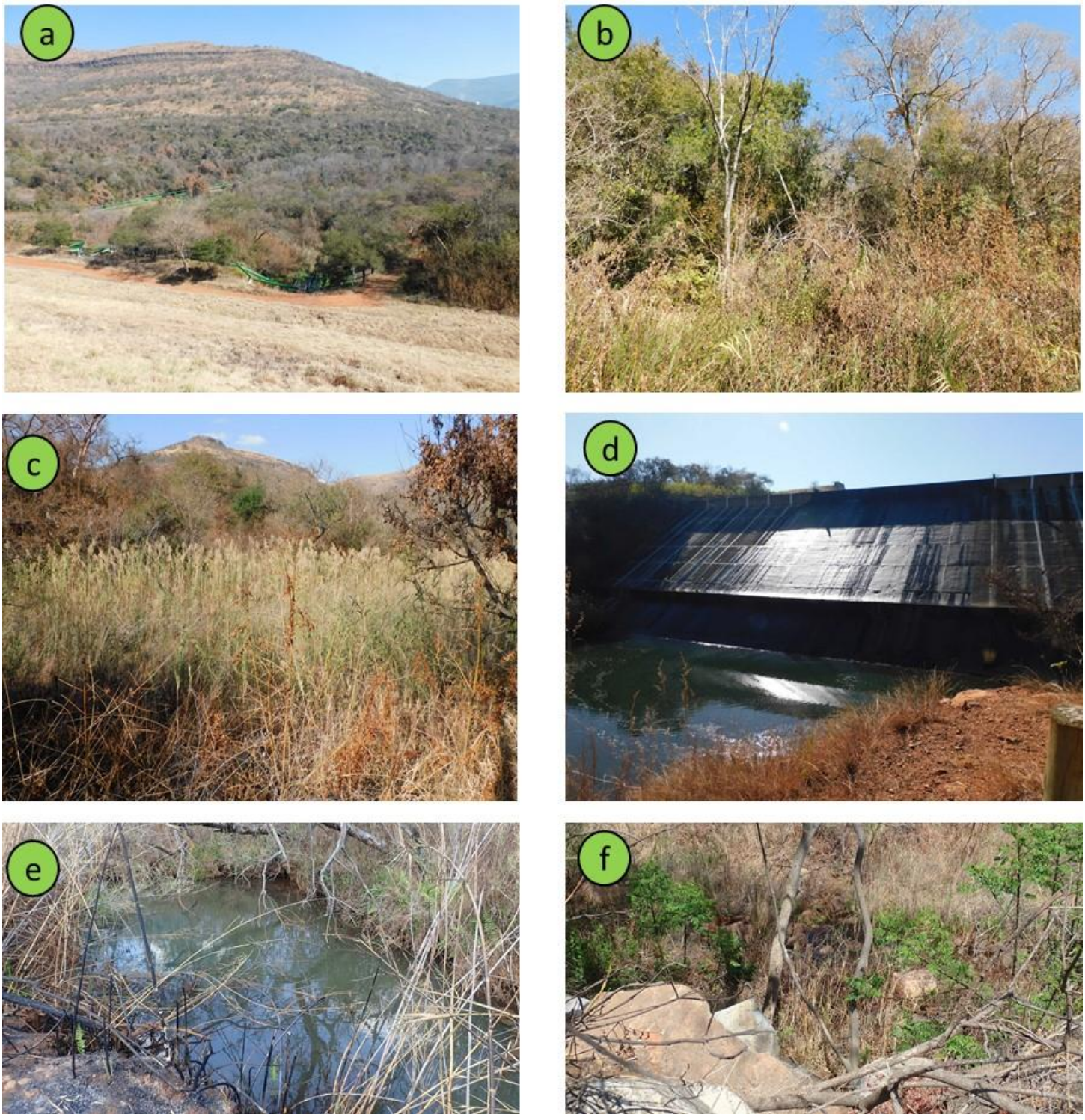


Figure 44: The entire area below the Ngodwana dam wall.

44a. A view of the area below the dam wall.
44b. The lush wetland vegetation in the seepage wetlands.
44c. The overgrown river bed of the Ngodwana River.
44d. The spillway over the dam wall.
44e. The river reach below the spillway.
44f. The Ngodwana River lower down towards the N4.

In the Classification System, the source zone at the upper end of a river would typically be classified as one of the wetland types (e.g. a seep, an unchannelled valley bottom wetland, depression or wetland flat) and not as part of a river. Figure 42 shows two wetland seeps originating on the slope of the mountain and drain down into the area below (Figure 43), one becomes a valley bottom wetland which joins the Ngodwana River just before the Water Works, while the other shorter seepage joins the original drainage line of the Ngodwana River below the dam.

The spillway created a short section of channelled flow whenever the spillway overflows before its confluence with the original Ngodwana River channel. The riparian zone in most of the places is between 20 and 50 meters wide and patches of reed, sedges and hydrophilic grasses are scattered in the river bed.

Buffer zones

Landscape connectivity may be achieved through several main types of habitat configurations that function as linkages for species, communities or ecological processes. Linkages are used as pathways by animals undertaking a range of movements, including daily or regular movements, seasonal and migratory movements, dispersal movements, and range expansion. Linkages also contribute to other ecological functions in the landscape and, in particular, have an important role to play in providing habitat for plants and animals in human-dominated environments (Bennett, 2003).

Buffer zones have been used in land-use planning to protect natural resources and limit the impact of one land-use on another. Buffer zones will serve as a mitigating measure for impacts created by the construction and operational phases of the proposed Ngodwana Dam project, and the implemetation will be recapitulated in the mitigation section (5.7 Assessment of impacts and proposed mitigation).

Buffer zones associated with water resources have been shown to perform a wide range of functions, and on this basis, have been proposed as a standard measure to protect water resources and associated biodiversity. These functions include:

- Maintaining basic aquatic processes;
- Reducing impacts on water resources from upstream activities and adjoining land uses;
- Providing habitat for aquatic and semi-aquatic species;
- Providing habitat for terrestrial species; and
- A range of ancillary societal benefits.

Determining the required buffer width is largely an exercise of assessing the situation and linking it to an acceptable level of risk. Determining appropriate management measures for aquatic impact buffer zones is largely dependent on the threats associated with the proposed activity adjacent to the water resource. These threats include:

- Increases in sedimentation and turbidity;
- Increased nutrient inputs;
- Increased inputs of toxic organic and heavy metal contaminants; and
- pathogen inputs.

Any potential risks must be managed and mitigated to ensure that no deterioration to the water resource takes place. Standard management measures should be implemented to ensure that any on-going activities do not result in a decline in water resource quality. Buffer

zones will serve as a mitigating measure for impacts created by the construction and operational phases of the proposed project.

A buffer zone is therefore proposed for the Ngodwana Dam project. Should it be instated, some of the existing structures are already inside the buffer zone, and other planned activities will be incorporated into this zone due to the existing structures. It might appear if the purpose of the buffer zone will be risked here. To address this, the implementation of a buffer zone will be used to emphasize the importance of the riparian zone and the ecology in the project area. The area included in the buffer zone, as well as the core areas in the riverine zone, should have explicit and very strict biodiversity conservation management measures and the operating teams should be well aware of this.

Final aquatic impact buffer requirements (including practical management considerations) for all the identified systems were refined based on a site visit and applying the DWS's wetland delineation tool, listed in Table 42.

Table 42: Final aquatic impact buffer requirements for the untransformed riverine wetlands of the Ngodwana Project Area (Figure 43).

Buffer Segment	Wetland system	Construction Phase	Operational Phase	Final aquatic impact buffer requirement
1	Ngodwana River	18 m	19 m	19 m
2	Ngodwana catchment valley bottom wetland	21 m	22 m	19 m
3	Ngodwana catchment seep wetland	24 m	24 m	24 m

Once a final buffer zone area has been determined, appropriate management measures need to be documented to ensure that the water quality enhancement and other buffer zone functions, including biodiversity protection, are maintained or enhanced. These measures should ideally be integrated in the environmental management plan (EMP) for the proposed development, as it includes a requirement to assign clear responsibilities for buffer zone management at both the construction and operation phases. Although management measures will be specific to each site, some guidance is provided to ensure that management measures cater adequately for key buffer zone functions.

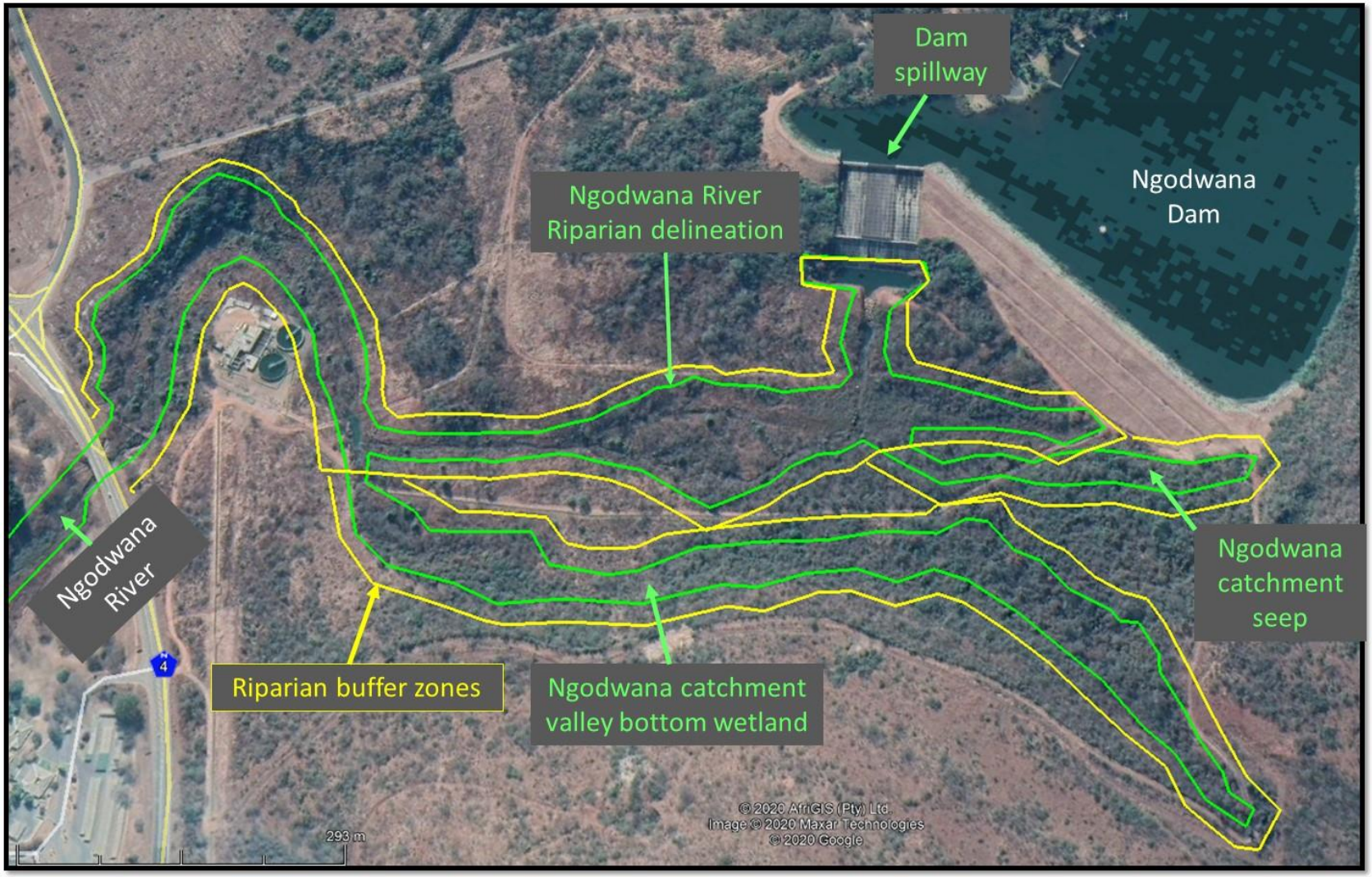


Figure 45: Delineation of the water course components (Ngodwana project area): Boundary of the riparian zone (green line), and final aquatic impact buffer (yellow line).

5.5 Land-use guidelines

The following section outlines land-use activity descriptions and it includes a summary of the circumstances under which any of these land-use activities can be regarded as biodiversity compatible and outlines additional biodiversity-related management practices and controls.

Maintaining biodiversity patterns and ecological processes, and the ecosystem services derived from these, requires integrated management over large areas of land. Although a system of well-managed, strategically located protected areas is the most secure long-term strategy for conserving biodiversity, it is generally acknowledged that protected areas alone will never be adequate to conserve a representative sample of biodiversity and maintain ecosystem functioning – it is both impractical and undesirable to secure all biodiversity priority sites through formal protection, protected areas can be expensive to establish and manage and carry high opportunity costs. It is also difficult to conserve ecological processes in isolated protected areas alone.

There remains a need to safeguard biodiversity beyond the boundaries of protected areas to maintain the integrity of ecosystems across broader landscapes, and for all who live and work in these landscapes to play a part in managing them sustainably. This is the essence of the 'landscape approach' to conservation, in which protected areas are embedded in a matrix of land-uses that strives for biodiversity compatibility, and in which biodiversity management objectives are integrated into the plans, decisions and practices of a wide range of land users. These land-use guidelines are designed to help achieve this.

Different categories of CBA have specific management objectives, according to their biodiversity priority (Table 43). In broad terms, the biodiversity priority areas need to be maintained in a healthy and functioning condition, whilst those that are less important for biodiversity can be used for a variety of other land-use types (Lötter et al, 2014).

Table 43: The different categories on the CBA maps have specific management objectives, according to their biodiversity priority (MBSP Handbook 2014).

Map Category	**Definition**	**Desired management objectives**
Critical Biodiversity Areas (CBAs)	Areas that are required to meet biodiversity targets, for species, ecosystems or ecological processes.	Must be kept in a natural state, with no further loss of habitat. Only low-impact, biodiversity-sensitive land-uses are appropriate.
Ecological Support Areas (ESAs)	Areas that are not essential from meeting biodiversity targets, but that play an important role in supporting the functioning of protected areas or CBAs and for delivering ecosystem services.	Maintain in a functional, near-natural state, but some habitat loss is acceptable. A greater range of land-uses over wider areas is appropriate, subject to an authorisation process that ensures the underlying biodiversity objectives are not compromised.
Other Natural Areas (ONAs)	Areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions. Although they have not been prioritised for biodiversity, they are still an important part of the natural ecosystem.	An overall management objective should be to minimise habitat and species loss and ensure ecosystem functionality through strategic landscape planning. These areas offer the greatest flexibility in terms of management objectives and permissible land-uses, but some authorisation may still be required for high-impact land-uses.
Heavily or Moderately Modified Areas	Areas that have been modified by human activity to the extent that they are no longer natural, and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructural functions, even if they are never prioritised for conservation action.	Such areas offer the most flexibility regarding potential land-uses, but these should be managed in a biodiversity-sensitive manner, aiming to maximise ecological functionality and authorisation is still required for high-impact land-uses. Moderately modified areas (old lands) should be stabilised and restored where possible, especially for soil carbon and water-related functionality.

5.6 Desired management Objective

The following section outlines land-use activity descriptions and it includes a summary of the circumstances under which any of these land-use activities can be regarded as biodiversity compatible and outlines additional biodiversity-related management practices and controls.

Tables 44 to 46 summarises the final permissible land-uses that are proposed for the identified land forms on the Ngodwana Dam project area and the demarcated map illustrated in in Figures 39 to 41. These areas are listed and rated as follow:

Included in **Critical Biodiversity Areas (CBAs) - CBA Irreplaceable**:

- Land type 1: Legogote Sour Bushveld (in Legogote Sour Bushveld vegetation type - Threatened ecosystem status: Vulnerable)

Subcategory: **CBA: Irreplaceable** - Areas that are 80-100% irreplaceable for meeting biodiversity conservation targets; or Critical Linkages; or Critically Endangered Ecosystems. Objective: Maintain in a natural state with no loss of ecosystems, functionality or species; no flexibility in land-use options.

Table 44: The categories in terms of management objectives and permissible land-uses for the Ngodwana Dam Type 1. Subcategory: CBA: Irreplaceable.

Permissible land-uses that are unlikely to compromise the biodiversity objective.	Land-uses that may compromise the biodiversity objective and that are only permissible under certain conditions.	Land-uses that will compromise the biodiversity objective and are not permissible.
Conservation / Stewardship	Livestock & Game Ranching	Arable Lands
	Open Space	Agricultural Infrastructure
	Low Impact Tourism	Forestry
	Water Works, Sewerage Works, Catchment Transfers	Municipal Commonage
		Eco-estates
		Roads & Rail
		High Impact Tourism
		Rural Residential
		Residential
		Urban Influence
		Low Impact & General Industry
		High Impact Industry
		Quarrying / Opencast Mining
		Prospecting / Underground Mining
		Transport Services
		Linear Structures: Pipelines, Canals, Power lines
		Other Utilities

Land type 2. Valley drainage line - riverine: **ESA: Fish Support Areas**

Management Objective: Maintain in a natural state with limited loss of ecosystems or functionality, but without lowering its Present Ecological State. Where there is a FSA for a fish species, more stringent authorisation requirements will be required.

A river FEPA is the river reach that is required for meeting biodiversity targets for river ecosystems and threatened fish species. In managing the condition of a river FEPA, it is important to manage not only the river itself, but also the network of streams and wetlands as well as land-based activities in the sub-catchment that supports the river FEPA.

A proportion of tributaries and wetlands need to remain healthy and functional in order for the river FEPA to be kept in a good ecological condition. This category is similar to FEPAs, except that Fish Support Areas may not always be required to meet proportional targets.

Table 45: The categories in terms of management objectives and permissible land-uses for the Ngodwana Dam Land Type 2. Subcategory: Fish Support Areas.

Permissible land-uses that are unlikely to compromise the biodiversity objective.	Land-uses that may compromise the biodiversity objective and that are only permissible under certain conditions.	Land-uses that will compromise the biodiversity objective and are not permissible.
Livestock & Game Ranching	Arable Lands	Forestry
Conservation / Stewardship	Agricultural Infrastructure	Residential
Open Space	Municipal Commonage	Urban Influence
Low Impact Tourism	High Impact Tourism	Low Impact & General Industry
	Rural Residential	High Impact Industry
	Eco-estates	Quarrying / Opencast Mining
	Prospecting / Underground Mining	
	Transport Services	
	Roads & Rail	
	Water Works, Sewerage Works, Catchment Transfers	
	Linear Structures: Pipelines, Canals, Power lines	
	Other Utilities	

Land type 3 and 4. Ngodwana Catchment Valley Bottom Wetland and Valley Seeps: **Strategic Water Source Areas**

ESA - Strategic Water Source Areas: Strategic Water Source areas produce more than 50% of Mpumalanga's runoff in only 10% of the land surface area. Any land uses that place the continued delivery of an adequate volume of good quality water at risk should be avoided or, at least, mitigated.

Table 46: Land-use guideline summary table for Strategic Water Source Areas.

Permissible land-uses that are unlikely to compromise the biodiversity objective.	Land-uses that may compromise the biodiversity objective and that are only permissible under certain	Land-uses that will compromise the biodiversity objective and are not permissible.

	conditions.	
Livestock & Game Ranching	Arable Lands	Residential
Conservation / Stewardship	Agricultural Infrastructure	Urban Influence
Open Space	Forestry	Low Impact & General Industry
Low Impact Tourism	Municipal Commonage	High Impact Industry
Eco-estates	High Impact Tourism	Quarrying / Opencast Mining
	Rural Residential	
	Prospecting / Underground Mining	
	Transport Services	
	Roads & Rail	
	Water Works, Sewerage Works, Catchment Transfers	
	Linear Structures: Pipelines, Canals, Power lines	
	Other Utilities	

Land type 5 to 9. Heavily and Moderately modified areas.

Heavily and Moderately modified areas:

Land type 5. Old Mining
Land type 6. Power Line Servitude
Land type 7. Ngodwana Dam Wall
Land type 8. Habitat impacted by Dam Wall Construction early 1980s
Land type 9. Roads and pipelines

These areas have been modified by human activity to the extent that they are no longer natural, and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructural functions, even if they are never prioritised for conservation action

Such areas offer the most flexibility regarding potential land-uses, but these should be managed in a biodiversity-sensitive manner, aiming to maximise ecological functionality and authorisation is still required for high-impact land-uses. Moderately modified areas (old lands) should be stabilised and restored where possible, especially for soil carbon and water-related functionality.

5.7 Assessment of impacts and proposed mitigation

The potential impacts of the project on the biodiversity of the study area are assessed under the following broad categories, namely:

Construction

- **Activity 1.** Stabilizing the berm and toe drain
  - **Aspect 1.1:** Vegetation clearing
  - **Aspect 1.2:** Disturbance - Altering the bed, banks, course of a watercourse
  - **Aspect 1.3:** Disturbance - Noise and movement
  - **Aspect 1.4:** Impacting the small stream on the western slope
- **Activity 2.** Raising of the right flank embankment
  - **Aspect 2.1:** Vegetation clearing
  - **Aspect 2.2:** Topping soil on the embankment
- **Activity 3.** Establish stockpile areas
  - **Aspect 3.1:** Vegetation clearing
- **Activity 4.** Haul route **–** both sides of the river
  - **Aspect 3.1:** Vegetation clearing
  - **Aspect 3.2:** Fragmentation or riparian corridor
  - **Aspect 3.3:** Impacting stream flow of the small stream on the western slope
  - **Aspect 3.4:** Erosion and siltation
- **Activity 5.** Site establishment area and footbridge
  - **Aspect 4.1:** Vegetation clearing
  - **Aspect 4.2:** Erosion and siltation
- **Activity 6.** Alien invading vegetation
  - **Aspect 5.1:** Introduction of alien vegetation

Operational

- **Activity 6:** Haul route **–** both sides of the river
  - **Aspect 6.1:** Dust
- **Activity 7:** Alien invading vegetation
  - **Aspect 7.1:** Spreading of alien vegetation

Construction

Activity 1. Stabilizing the berm and toe drain

Dam wall berm and toe drain

The dam remediation is to ensure the continued safe operation of this 41 m high zoned earth-fill Category III dam and the stability of the main and right flank embankments and its foundations (Ecoleges, 2020).

The scope of construction works to be included in the rehabilitation and to be authorised is:

1. Stabilizing berm (Figure 46) on the downstream face of the main embankment to RL 941.3 m, including approximately 30 000 m^3 of earthworks, a new internal drainage system (sand & gravel filters, rock toe and drain pipes with inspection concrete manholes) and gabion retaining walls.

2. Subsoil pipe drains above the berm of 133 m length with inspection concrete manholes.

Figure 46: Dam wall berm and toe drain to be stabilised.

Figure 47:

47a. A panoramic view of the area below the dam wall (July 2020).
47b. An aerial photo of the Gondwana Dam being constructed during the early 1980s. Note the denuded area from riverine area all the way to the spillway.

47c. The area below the dam wall (July 2020). Note how the denuded area illustrated in Figure 38b recovered. The vegetation that established in the denuded area is about 60% indigenous and 40% alien invaders.
47d. and 47e: Two photos taken from the Gondwana Dam wall: Photo 47d) during the period when the wall was constructed (early 1980s) and photo 47e) July 2020 during the current survey period.

Activity 2. Raising of the right flank embankment

Right flank embankment

3. Raising of the right flank embankment to prevent overtopping and failure during large floods and to improve the stability of the embankment (earthworks to be confirmed).

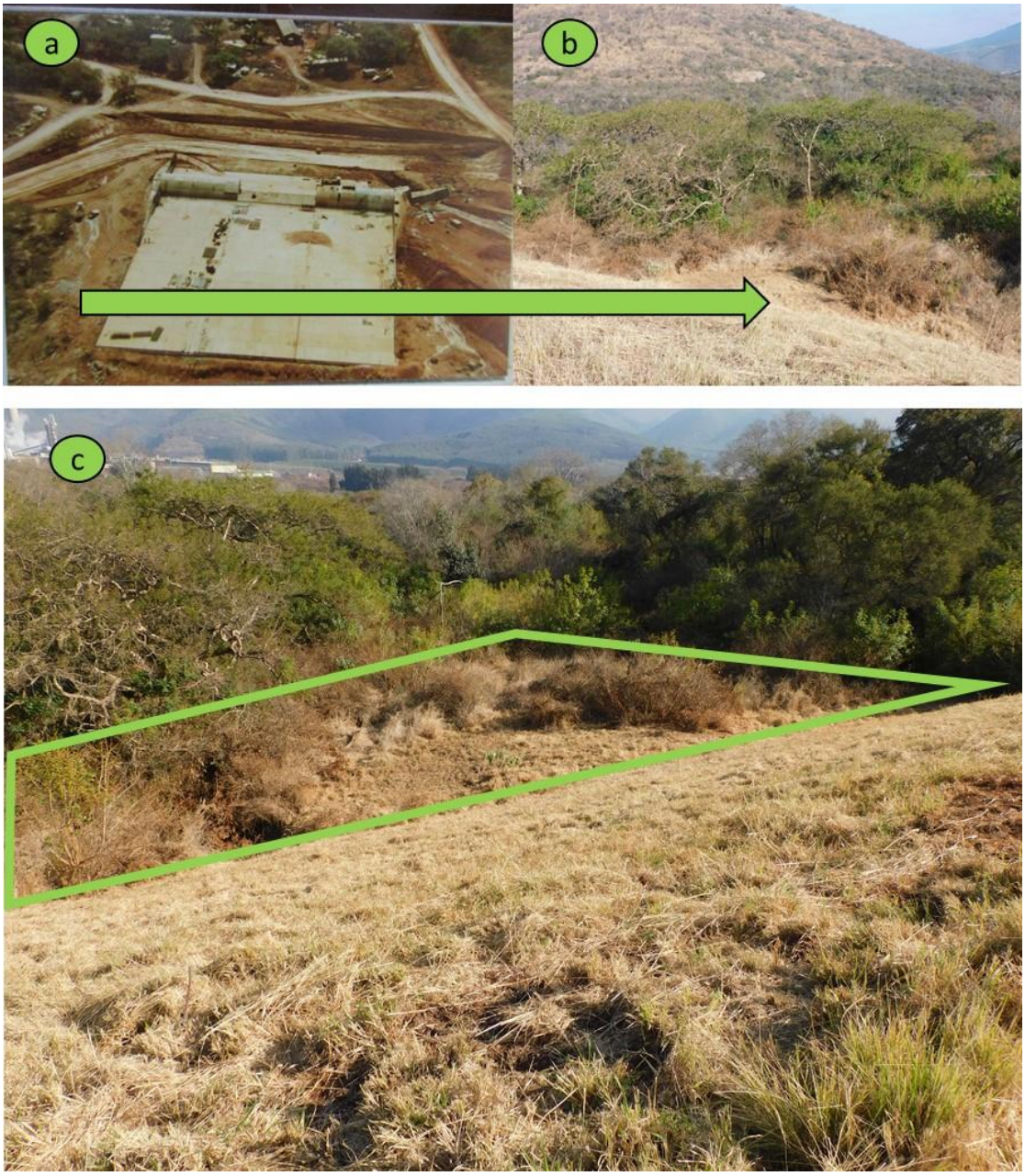


Figure 48:

48a. and 48b. Two photos taken from the Gondwana Dam right flank embankment: Photo 39a) during the period when the wall was constructed (early 1980s) and photo 48e) July 2020 during the current survey period. Note the denuded area on the right flank embankment during construction (48a) and the regrowth in (48b).
48c. The area below the toe of the dam (green rectangle) is regularly cleared of vegetation as part of maintenance.

Activity 3. Establish stockpile areas

There are two stockpile areas planned for the project: The Fishing Club Temporary Stockpile and the WTW Temporary Stockpile.

Figure 49:

49a. The WTW Temporary Stockpile near the N4 (Figures 8 and 9).
49b and 49c. The low woodland area which is earmarked for the stockpile area.

Figure 50:

50a-50d. The Fishing Club Temporary Stockpile is planned on an area with no ecological value – old mining/dumping area (Figures 8 and 9).

Figure 51: This figure shows the locations of the two temporary stockpile areas.

Activity 4. Haul route **–** both sides of the river

#1 Haul route to the north flank

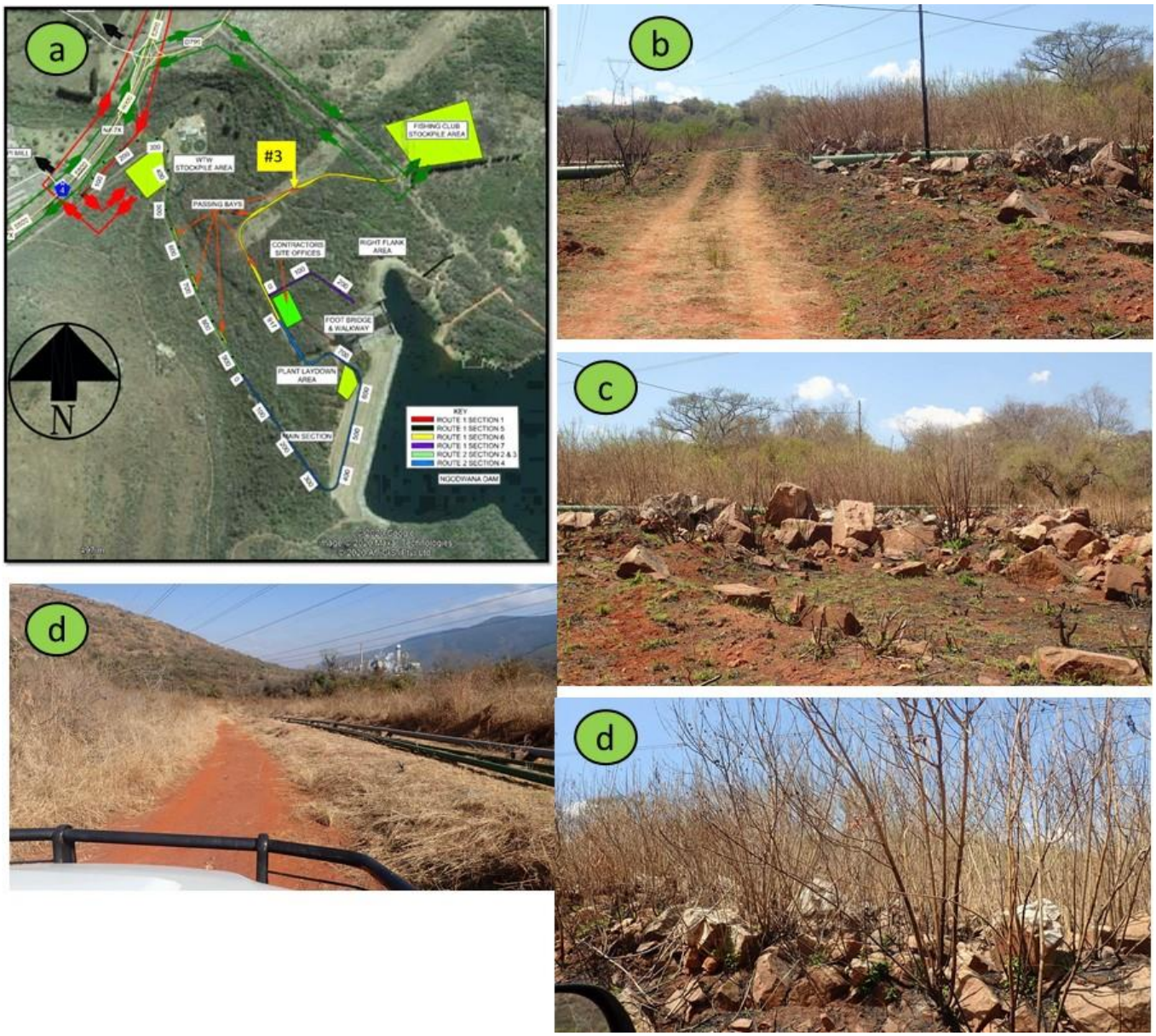
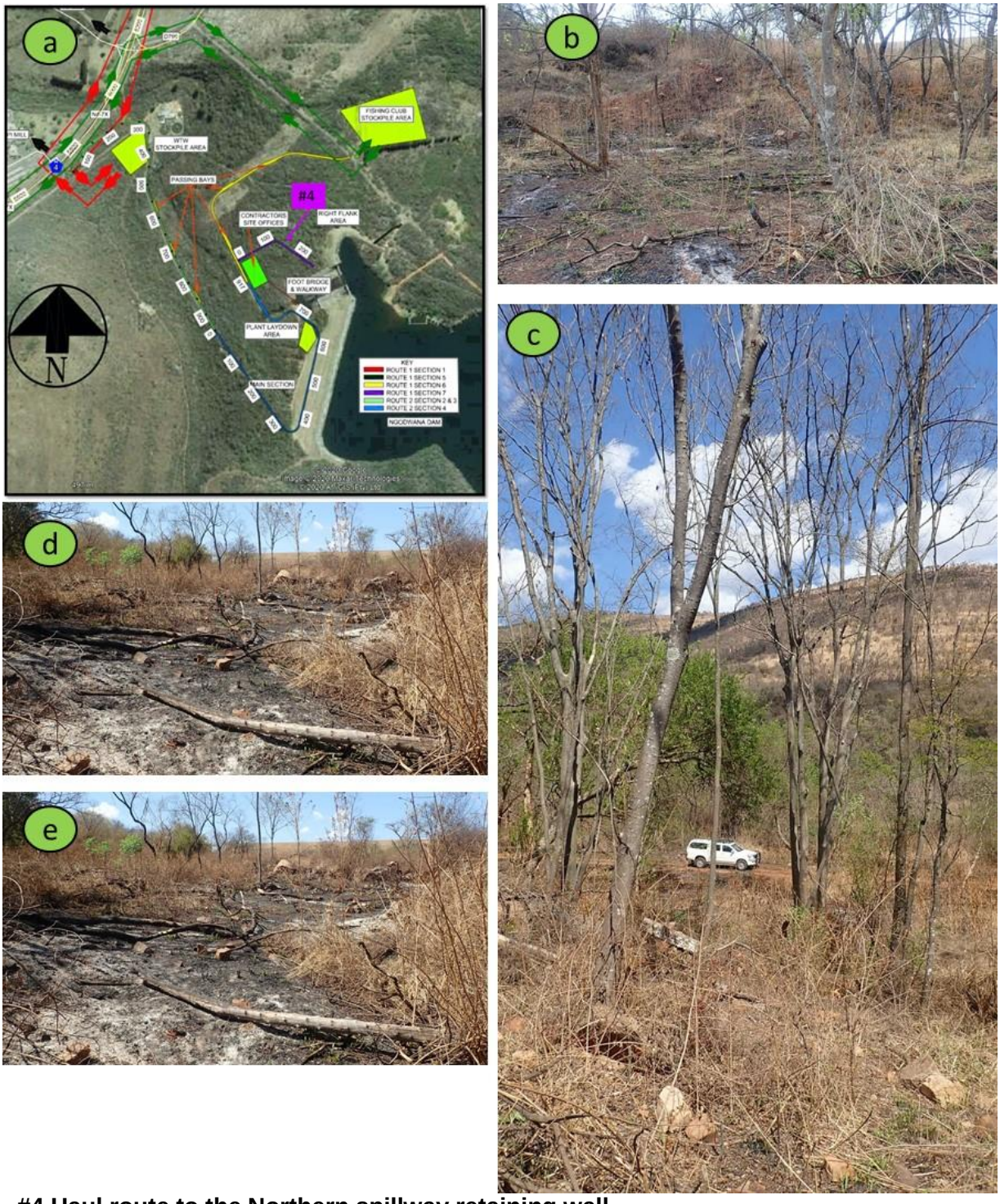


Figure 52:

52a. The proposed Ngodwana Dam haul road route (#3) to the north flank (Figures 8 and 9).

52b to 52d. Photos of the established dirt road which will be upgraded.



#4 Haul route to the Northern spillway retaining wall.

Figure 53:

53a. The proposed #4 Haul route to the Northern spillway retaining wall (Figures 8 and 9).

53b to 53e. Photos of the area identified as the best route – signs of previous activities indicate historical human interference, however a small number of trees will have to be removed for the route clearing.

#5 Haul route past the SAPPI's Water Treatment Works (WTW).

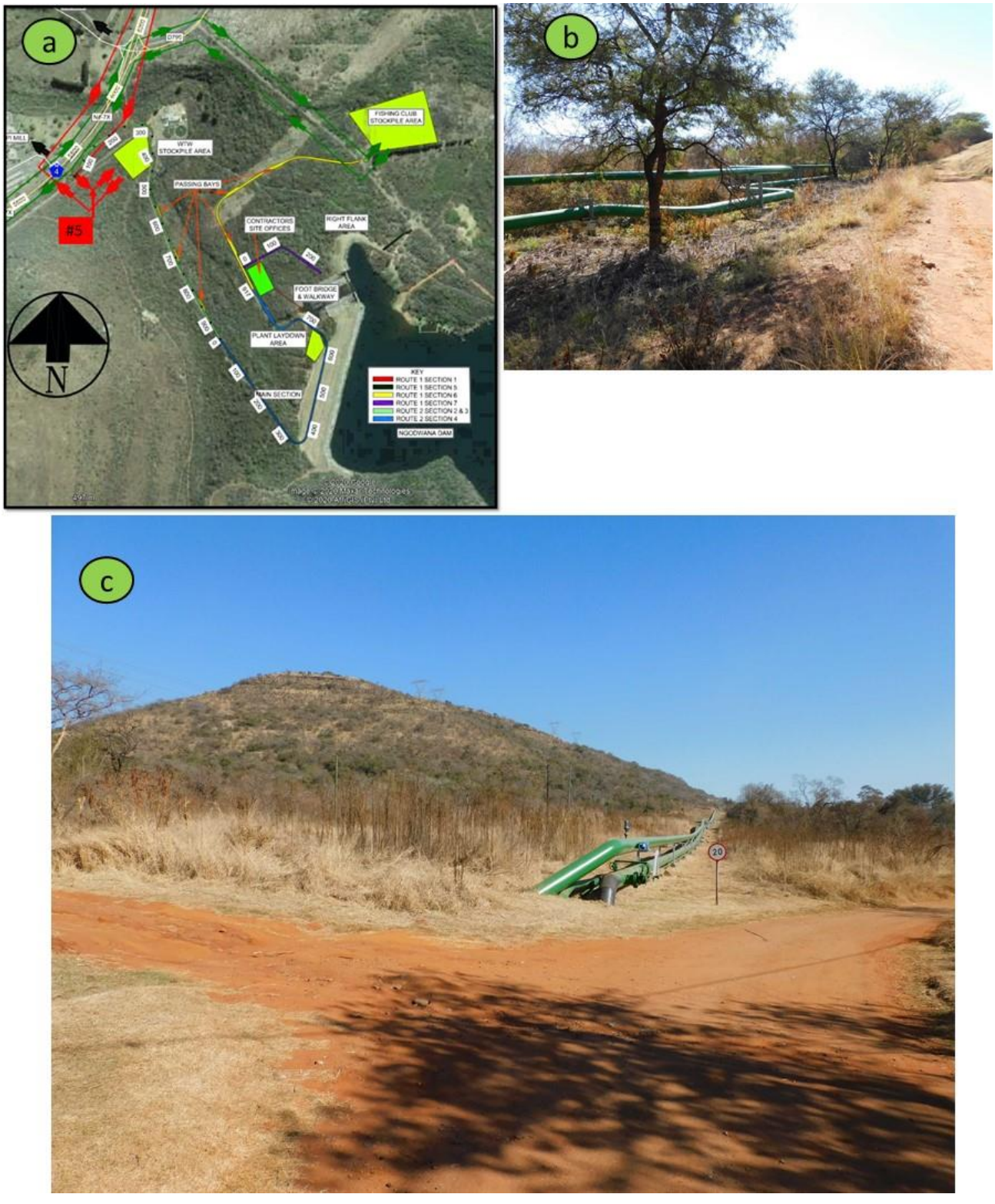


Figure 54:

54a. The proposed #5 Haul route past the SAPPI's Water Treatment Works (WTW) (Figures 8 and 9).

54b and 54c. Photos of the existing road past the SAPPI's Water Treatment Works (Figures 8 and 9).

54b to 54e. Photos of the area identified as the best route – signs of previous activities indicate historical human interference, however a small number of trees will have to be removed for the route clearing.

#7 Haul route west of the Ngodwana River.

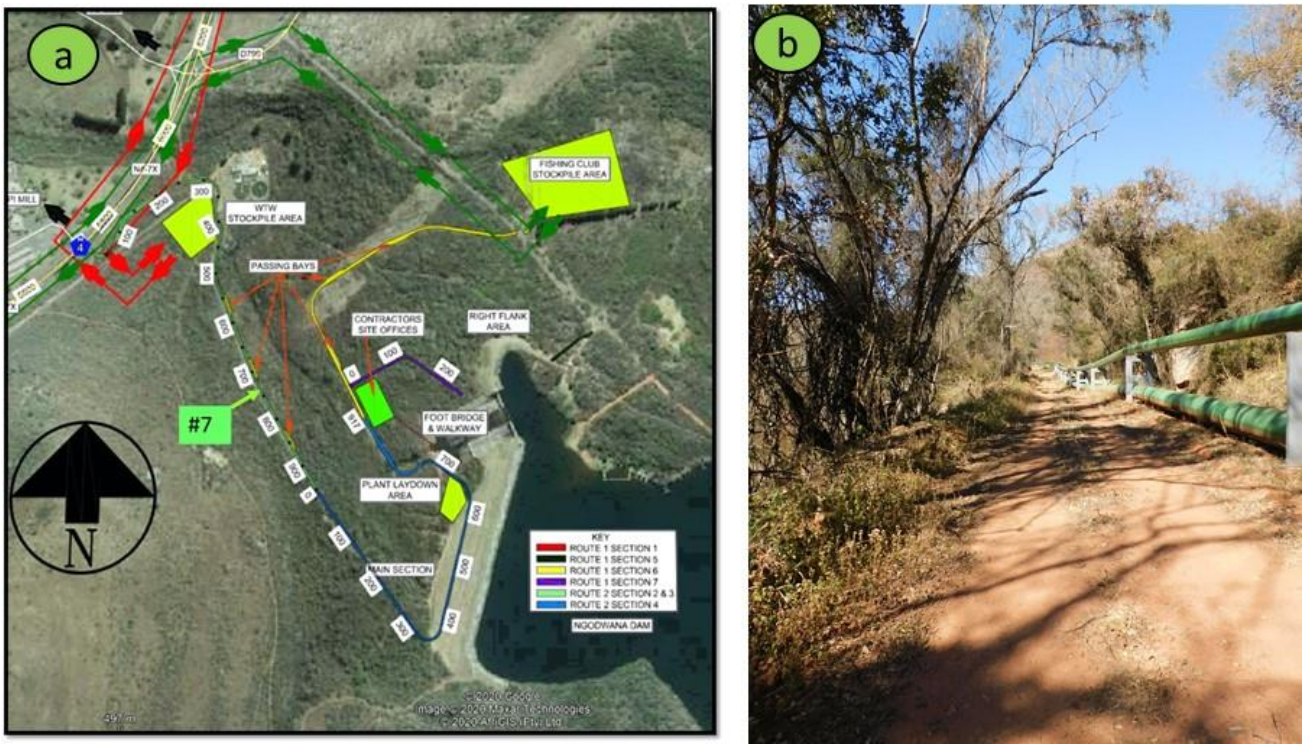


Figure 55:

55a. The proposed new #7 Haul route west of the Ngodwana River (Figures 8 and 9).

55b. Existing road and water pipeline.

#8 New haul route up the embankment of the dam.

Figure 56:

56a. The proposed new #5 Haul route up the embankment of the dam (Figures 8 and 9).

56b. Existing road at the toe of the dam.

56c. and 56d. Existing road going northwards towards the WTW.

56e. Large white stinkwood trees in areas west of the existing road

Haul road #8 will link up with haul road #3 and haul road #7. Figure 58 illustrates the areas where the proposed haul routes intersects with the riparian buffer zones. Four areas of intersections have been identified: Points 7.1 and 7.2 on the #7 haul road, and Points 8.1 and 8.2 on the proposed #7 haul road.

- **Point 7.1:** Here the existing #7 haul road crosses the Ngodwana catchment valley bottom wetland over an existing bridge structure.
- **Point 7.2:** Here the existing #7 haul road runs for a few meters through the Ngodwana River buffer zone.
- **Point 8.1:** Here the existing portion of #8 haul road crosses the Ngodwana catchment seep, and most of the water pass under the road, but there is an area where it seeps over the road.
- **Point 8.2:** Here the proposed portion of #8 haul will road cross the Ngodwana spillway drainage (Figure 57) by means of a low-level bridge that will not impede the flows of the spillway overflow.

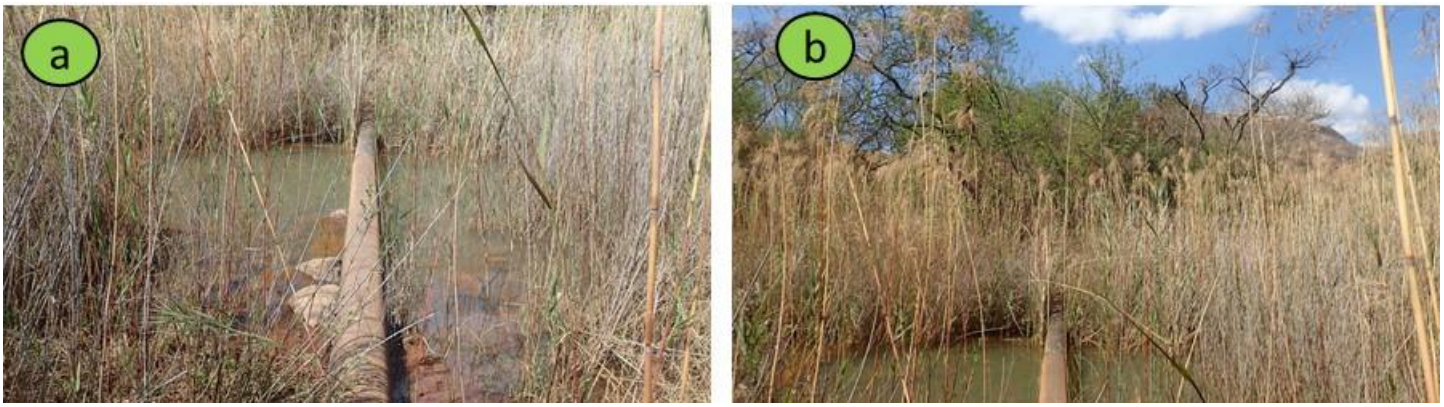


Figure 57: The area where the haul road will cross the Ngodwana spillway drainage by means of a low-level bridge.

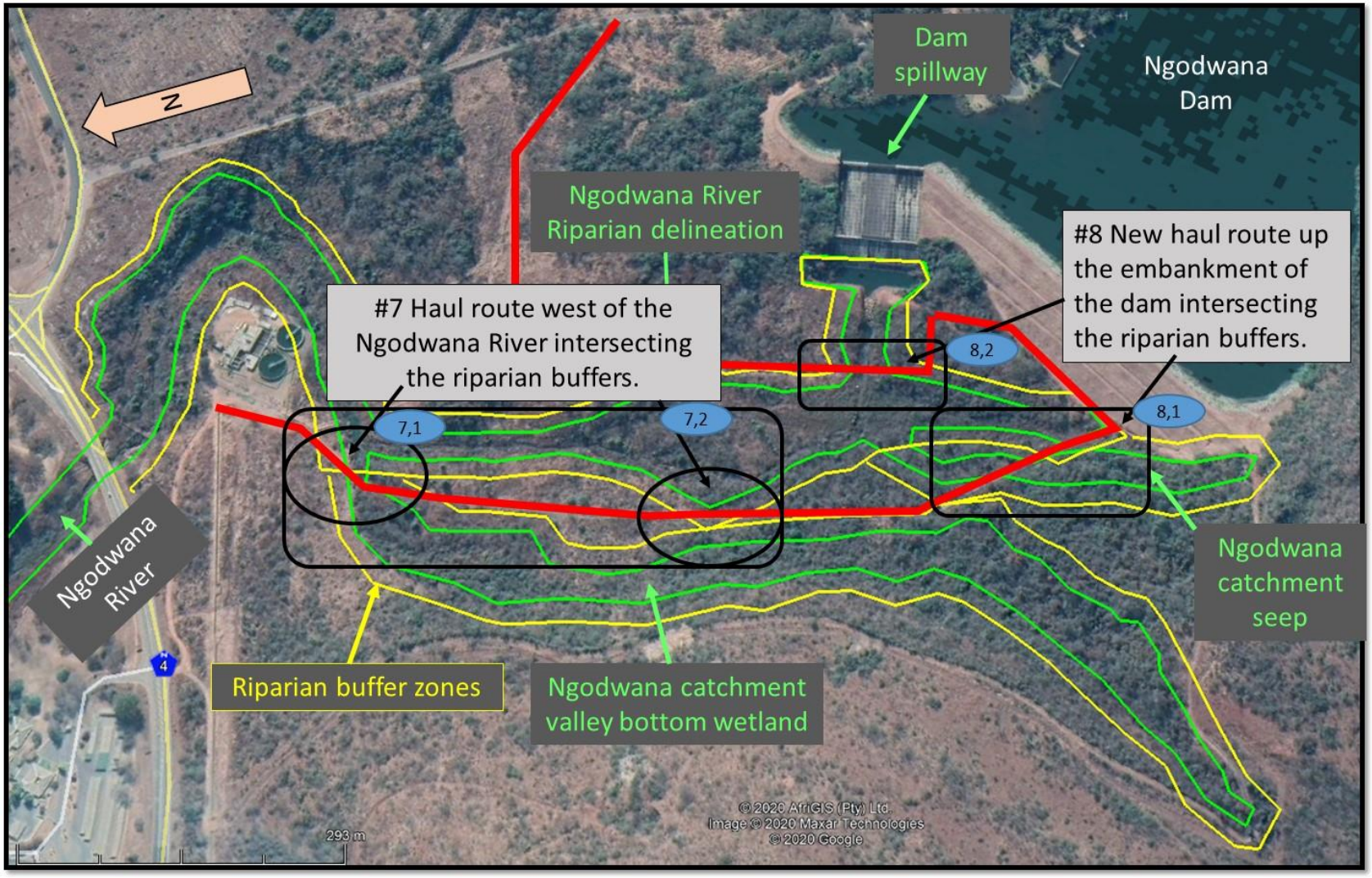


Figure 58: This figure illustrates the areas of the proposed haul routes intersecting with the riparian buffer zones.

Activity 5. Site establishment area and footbridge

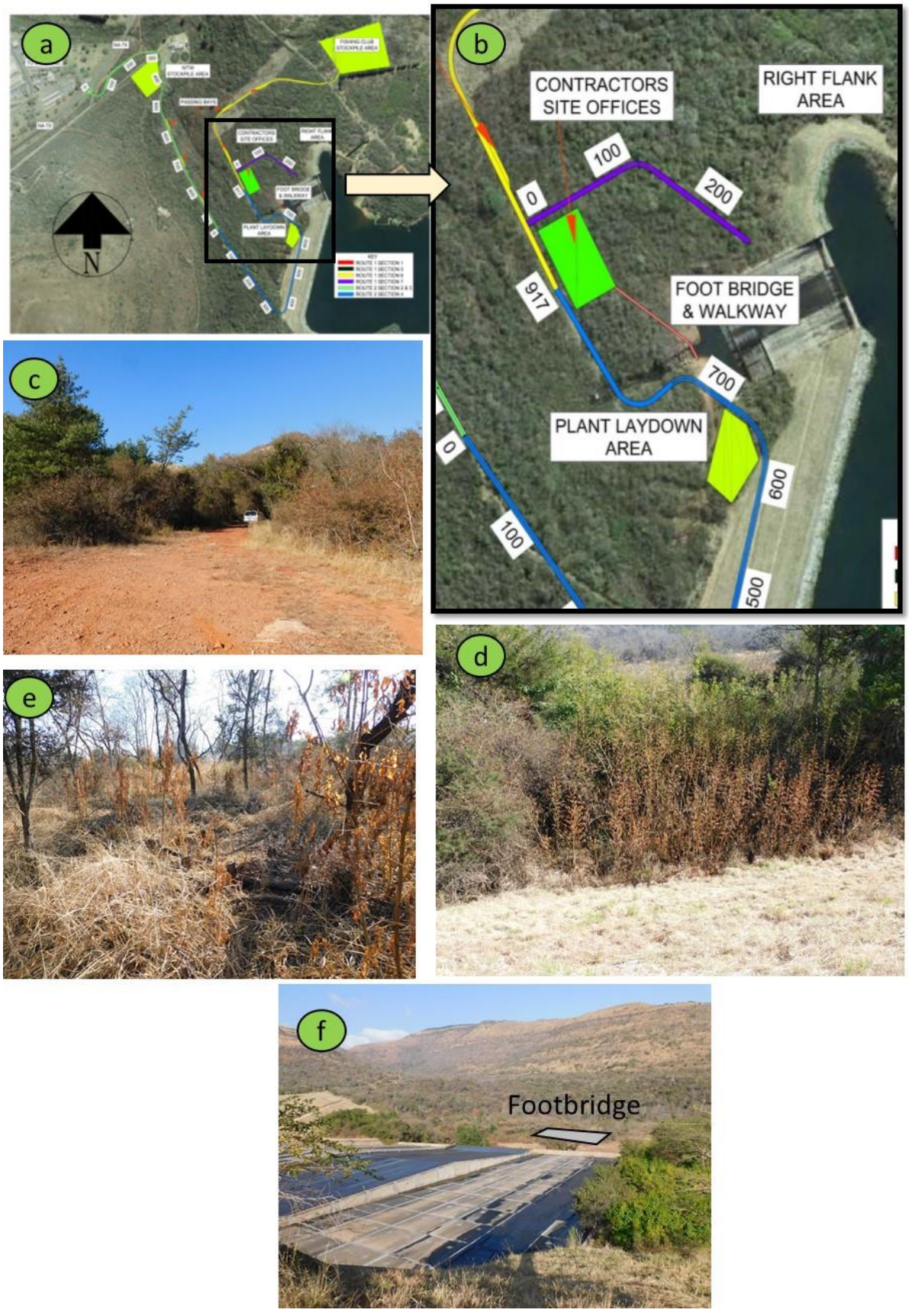


Figure 59:

59a. The proposed Ngodwana Dam rehabilitation infrastructure setup, highlighting haul road routes to areas (Figure 8 and 9).

59b. Plan of the proposed site establishment area and footbridge location.

59c. Existing road towards the footbridge location.

59d. A view of the current vegetation of the proposed contractor's laydown area, illustrating the mix of indigenous and alien vegetation on the site.

59e. A view of the current vegetation of the proposed contractor's site offices, illustrating the open woodland on the site.

59f. The proposed footbridge location as viewed from the top of the dam wall.

A foot bridge below the spillway will link the site office area with the contractor's laydown area. A pedestrian walkway and pedestrian bridge below the spillway will provide access to the construction site from here. This must be done in a way to conserve the area and to serve as an eco-recreation area after construction.

Alien invading vegetation

The spread of alien invasive species is an ongoing problem as alien plants in the surrounding landscape act as a long term source of seeds and future spread. Numerous alien invasive species were recorded in varying densities at the various sites, which reduces the ecological integrity of the riparian zone and its PES class. The high abundance of alien plant species within the site impacts adjacent plant communities and promote the invasion of alien species into the intact vegetation.

The disturbance to the vegetation and soils, during the clearing and preparation phase, could increase the risk of alien plant invasion, especially where soils are exposed. Loss of habitat adjacent to roads and pipelines may result in an increase in alien invasive plant species. Roads and traffic may facilitate the invasion of weeds and exotic plants as seeds attached to undercarriages in mud and dirt may bring seeds from a large potential catchment and move them across the landscape rapidly.

Inappropriate maintenance activities during the operational phase would also promote the invasion or dominance of alien plant species at the site. Alien species are already present in the area and will colonise any area of disturbance should they not be actively controlled.

60: The alien invader, yellow bells (*Tecoma stans*) is abundant in many places in the project area.

The impact assessment of all the perceived impacts are provided below, describing each broad impact, determines the significance of the impact and lists summarised mitigation and monitoring measures for each impact.

Phase: Construction

Activity 1. Stabilizing the berm and toe drain.

Aspect 1.1 Vegetation clearing.

Impact 1: Loss of riparian habitat and potential habitat for local biota, including corridors and buffers.

Applicable Phase: Clearing phase

Applicable activity: Vegetation clearing.

Nature of impact: This impact refers to the loss of transformed and untransformed habitat assemblages.

The clearance of vegetation will result in the direct loss of vegetation and indirect loss of habitat that will decrease the viability of biota by reducing the size of populations that can be supported on the project site.

Mitigation of Impact 1:

The area to be cleared as proposed for constructing the stabilizing berm and toe drain, was cleared completely during the dam construction in the early 1980s. The vegetation that returned after construction contained a large component of alien species (Table 15; Transect 2). This second round of clearing should be followed up by an alien plant control programme during rehabilitation of the construction footprint and replanting indigenous plants.

Table 47: Loss of habitat: Criteria used to determine the consequence of the impact.

ISSUE:	Vegetation clearing: Loss of habitat
Project Phase	Clearing
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Short term (1)
Consequence	Very low (4)
Probability	Possible
Degree to which impact cannot be reversed	Medium
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	Medium
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Medium
Preferred Alternative	None

Impact 2: Damage to riparian large trees or shrubs.

Applicable Phase: Clearing phase

Applicable activity: Vegetation clearing.

Nature of impact: Influencing large indigenous trees.

Mitigation of Impact 2:

Removing large trees should be avoided as far as possible and unnecessary clearing of areas should also be avoided. Trees, such as indigenous Paperbark thorn (*Vachellia sieberana*) and Sweet thorn (*Vachellia karroo*) that grows vigorously, should be planted during rehabilitation and thus replace trees that have been removed.

Table 48: Loss of large trees and shrubs: Criteria used to determine the consequence of the impact.

ISSUE:	Vegetation clearing: *Loss of large trees and shrubs*
Project Phase	Clearing
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Short term (1)
Consequence	Very low (4)
Probability	Possible
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	Medium
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Low
Preferred Alternative	None

Impact 3: Fragmenting the riparian corridor by removing riparian bushes or river bank vegetation and thus compromise the function of riparian connectivity.

Applicable Phase: Clearing phase

Applicable activity: Vegetation clearing.

Nature of impact: This impact refers to impact on the riparian zone.

Mitigation of Impact 3:

The Ngodwana River has been intercepted by the dam wall, thus fragmenting the riverine environment permanently. Other than covering an area of the original streambed (now not flowing, some seepage), no further fragmentation is foreseen due to the proposed construction activities.

Table 49: Fragmenting the riparian corridor: Criteria used to determine the consequence of the impact.

ISSUE:	Vegetation clearing: Fragmenting the riparian corridor
Project Phase	Clearing
Nature	Negative

Extent	Site (1)
Intensity	Low (1)
Duration	Short term (1)
Consequence	Very low (3)
Probability	Improbable
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Low
Preferred Alternative	None

Aspect 1.2: Disturbance - Altering the bed, banks, course of a watercourse.

Impact 4: The covering of indigenous riverine vegetation will be associated with the construction of the berm and toe drain.

Applicable Phase: Construction phase

Applicable activity: Covering of indigenous riverine vegetation.

Nature of impact: This impact refers to the loss of vegetation under construction material.

Mitigation of Impact 4:

The area that will be covered by during construction of the stabilizing the berm and toe drain by material, currently consists of an area that has previously been cleared and now consists of some local indigenous plants and a large component of alien invading species. No indigenous plants of Special Concern are present in the area to be impacted and the covering of the vegetation will be permanent (Figure 46).

Table 50: The covering of indigenous riverine vegetation: Criteria used to determine the consequence of the impact.

ISSUE:	Altering the river bed
Project Phase	Construction
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Short term (1)
Consequence	Very low (4)
Probability	Possible
Degree to which impact cannot be reversed	High
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Medium (-ve)
Degree of Mitigation	Low
Preferred Alternative	None

Impact 5: Covering the marginal vegetation on the embankment will lead to loss of potential habitat and biodiversity.

Applicable Phase: Construction phase

Applicable activity: Covering of marginal vegetation.

Nature of impact: This impact refers to the loss of marginal vegetation under construction material.

Mitigation of Impact 5:

The area that will be covered by stabilizing the berm and toe drain, consists of an area previously been cleared and now consists of low woodland and wetted areas created by seeping from the dam wall. No habitat of Special Concern are foreseen to be impacted.

Table 51: Covering the marginal vegetation: Criteria used to determine the consequence of the impact.

ISSUE:	Altering the river bed
Project Phase	Construction
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Short term (1)
Consequence	Very low (4)
Probability	Possible
Degree to which impact cannot be reversed	High
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Medium (-ve)
Degree of Mitigation	Low
Preferred Alternative	None

Impact 6: Erosion of cleared areas will lead to siltation of the downstream aquatic habitat.

Applicable Phase: Construction phase

Applicable activity: Erosion of cleared areas.

Nature of impact: This impact refers to the erosion and siltation of soil.

Mitigation of Impact 6:

Best Practice procedures should be implemented during construction and when the area is rehabilitated. Stringent mitigation measures must be imposed during construction to minimize runoff and stop possible silt run-off. The contamination of water leaving the site could be controlled by the use of silt-fencing, rows of hessian bags, mulch, brushwood and deflection berms (the choice depending on the situation).These mitigation measures are essential in all exposed areas.

Table 52: Erosion of cleared areas: Criteria used to determine the consequence of the impact.

ISSUE:	Vegetation clearing: Altering the river bed
Project Phase	Construction
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Short term (1)
Consequence	Very low (4)
Probability	Possible
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Medium
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Medium
Preferred Alternative	None

Aspect 1.3: Disturbance - Noise and movement

Impact 7: Vehicle and human movement and sounds will disturb riparian fauna in the vicinity of the construction activities.

Applicable Phase: Construction phase

Applicable activity: Audio-visual disturbance.

Nature of impact: This impact refers to the disturbance of local fauna.

Mitigation of Impact 7:

The disturbance will be for a relative short period and the activities will be contained to the dam wall and roads leading tot the construction site. Workers should be forbidden to move around off the construction site.

Table 53: Vehicle and human movement: Criteria used to determine the consequence of the impact.

ISSUE:	Disturbance - Noise and movement
Project Phase	Construction
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Medium term (2)
Consequence	Low (5)
Probability	Possible
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)

Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Low
Preferred Alternative	None

Aspect 1.4: Impacting the Ngodwana catchment seep on the western slope.

Impact 8: Impacting the flow and water quality of this near-pristine mountain stream due to construction activities.

Applicable Phase: Construction phase

Applicable activity: Construction disturbance.

Nature of impact: Physical damage to the ecology of the catchment seep.

Mitigation of Impact 8:

This small wetland should be treated with care throughout the construction phase. Wherever possible, no covering of material or dumping of any rubble should be allowed into the wetland system. Personnel should refrain from accessing the forested wetland. The buffer must be respected and the water flow towards the Ngodwana River must not be obstructed.

Table 54: Construction disturbance: Criteria used to determine the consequence of the impact.

ISSUE:	Disturbance – Impact on sensitive seep.
Project Phase	Construction
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Medium term (2)
Consequence	Low (5)
Probability	Possible
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	High
Confidence level	High
Significance Pre- Mitigation	High (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Low
Preferred Alternative	The wetland could be fenced off.

Activity 2. Raising of the right flank embankment

Aspect 2.1: Vegetation clearing

Impact 9: Loss of riparian habitat and potential habitat for local biota, including corridors and buffers.

Applicable Phase: Clearing phase

Applicable activity: Vegetation clearing.

Nature of impact: This impact refers to the loss of transformed and untransformed habitat assemblages.

Mitigation of Impact 9:

The area to be cleared for constructing in order to raise the right flank embankment, was cleared completely during the dam construction in the early 1980s. The vegetation that returned after construction contained a large component of alien species. This second round of clearing should be followed up by an alien plant control programme during rehabilitation of the construction footprint and replanting indigenous plants.

Table 55: Loss of habitat: Criteria used to determine the consequence of the impact.

ISSUE:	Vegetation clearing: Loss of habitat
Project Phase	Clearing
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Medium term (2)
Consequence	Low (5)
Probability	Possible
Degree to which impact cannot be reversed	Medium
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	Medium
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Medium
Preferred Alternative	None

Aspect 2.2: Topping soil on the embankment

Impact 10: Erosion of dumped soil will lead to siltation of the downstream aquatic habitat.

Applicable Phase: Construction phase

Applicable activity: Erosion and siltation.

Nature of impact: Topping soil being eroded and silt ends up in the river.

Mitigation of Impact 10:

The area to be cleared for constructing in order to raise the right flank embankment, was cleared completely during the dam construction in the early 1980s. The vegetation that returned after construction contained a large component of alien species. This second round of clearing should be followed up by an alien plant control programme during rehabilitation of the construction footprint and replanting indigenous plants.

Table 56: Erosion and siltation: Criteria used to determine the consequence of the impact.

ISSUE:	Covering the embankment.
Project Phase	Construction

Nature	Negative
Extent	Site (1)
Intensity	Low (1)
Duration	Medium term (2)
Consequence	Very Low (4)
Probability	Possible
Degree to which impact cannot be reversed	Medium
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	Medium
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Medium
Preferred Alternative	None

Activity 3. Haul route – both sides of the river

Aspect 3.1: Vegetation clearing.

Impact 11: Removal of indigenous riparian vegetation, considering coves of White Stinkwood along the western haul route.

Applicable Phase: Construction phase

Applicable activity: Removal of vegetation and large trees.

Nature of impact: Loss of a cove of large White Stinkwood trees along the route.

Mitigation of Impact 11:

About 90% of the planned haul routes will be on existing tracks or unpaved roads. Care must be taken not to impact on areas outside the demarcated route. Construction activities inside the riparian buffer zone must proceed with special care (Figure 49). Whenever tall white stinkwood trees are removed on the #8 new haul road, these trees must be replaced in order to mimic the natural habitat impacted on.

Table 57: Removal of vegetation and large trees: Criteria used to determine the consequence of the impact.

ISSUE:	Clearing vegetation.
Project Phase	Construction
Nature	Negative
Extent	Local (2)
Intensity	High (2)
Duration	Medium term (2)
Consequence	Medium (6)
Probability	Possible
Degree to which impact cannot be reversed	Medium
Degree to which Impact may cause irreplaceable loss of resources	Medium
Confidence level	Medium
Significance Pre- Mitigation	High (-ve)
Significance Post Mitigation	Medium (-ve)

Degree of Mitigation	Medium
Preferred Alternative	None

Aspect 3.2: Fragmentation or riparian corridor

Impact 12: Impacting on indigenous riparian vegetation, fragmenting the riparian corridor.

Applicable Phase: Construction phase

Applicable activity: Impacting on riparian corridor.

Nature of impact: Riparian corridor fragmentation will influence faunal migration routes.

Mitigation of Impact 12:
Corridors and buffers must be respected and the riparian zone must not be disturbed at all.

Table 58: Fragmenting the riparian corridor: Criteria used to determine the consequence of the impact.

ISSUE:	Clearing vegetation.
Project Phase	Construction
Nature	Negative
Extent	Local (2)
Intensity	High (2)
Duration	Medium term (2)
Consequence	Medium (6)
Probability	Possible
Degree to which impact cannot be reversed	Medium
Degree to which Impact may cause irreplaceable loss of resources	Medium
Confidence level	Medium
Significance Pre- Mitigation	High (-ve)
Significance Post Mitigation	Medium (-ve)
Degree of Mitigation	Medium
Preferred Alternative	None

Aspect 3.3: Impacting stream flow of the Ngodwana catchment seep on the western slope.

Impact 13: Impacting the flow and water quality of this near-pristine mountain stream due to construction activities.

Applicable Phase: Construction phase

Applicable activity: Impacting on wetland seep.

Nature of impact: Physical and structural damage to the seep zone.

Mitigation of Impact 13:

Flow down the Ngodwana catchment seep must be allowed to flow unhindered to its confluence with the Ngodwana River.

Table 59: Impacting on wetland seep: Criteria used to determine the consequence of the impact.

ISSUE:	Altering the seep habitat
Project Phase	Construction
Nature	Negative
Extent	Local (2)
Intensity	High (2)
Duration	Medium term (2)
Consequence	Medium (6)
Probability	Possible
Degree to which impact cannot be reversed	High
Degree to which Impact may cause irreplaceable loss of resources	Medium
Confidence level	Medium
Significance Pre- Mitigation	High (-ve)
Significance Post Mitigation	Medium (-ve)
Degree of Mitigation	Medium
Preferred Alternative	None

Aspect 3.4: Erosion and siltation.

Impact 14: Disturbing the soil during the construction of roads, clearing areas and create bare patches, channelling storm water and road run-off, etc. will cause erosion and siltation of the river.

Applicable Phase: Construction phase

Applicable activity: Erosion and siltation.

Nature of impact: Roads being eroded and silt ends up in the river.

Mitigation of Impact 14:

If appropriate mitigation is carried out, including strict adherence to anti-erosion actions given in the EMP, this impact could be reduced to low significance. All areas susceptible to erosion must be identified and protection measures be implemented. In any areas where the risk of erosion is evident, appropriate temporary or permanent works and water energy dispersion structures must be installed. Cleared or bare areas prone to erosion should be monitored and rehabilitation should be implemented wherever indications of potential erosion become evident. Mitigation and management measures are to be specified in order to ensure that areas susceptible to potential erosion are protected both during the construction and operational phase of the development.

Table 60: Erosion and siltation: Criteria used to determine the consequence of the impact.

ISSUE:	Erosion and siltation

Project Phase	Construction
Nature	Negative
Extent	Local (2)
Intensity	Low (1)
Duration	Medium term (2)
Consequence	Low (5)
Probability	Possible
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Medium
Preferred Alternative	None

Activity 4. Site establishment area and footbridge.

Aspect 4.1: Vegetation clearing.

Impact 15: Loss of riparian habitat and potential habitat for local biota, including corridors and buffers.

Applicable Phase: Clearing phase

Applicable activity: Loss of riparian habitat.

Nature of impact: Loss of habitat and fragmentation of riparian corridor.

Mitigation of Impact 15:

Both the site establishment areas will be outside any buffer areas or riparian corridors, however the footbridge will cross the spillway-created stream where some riparian vegetation have established after dam construction. Any special habitat should be avoided such as rocky areas and outcrops.

Table 61: Loss of riparian habitat: Criteria used to determine the consequence of the impact.

ISSUE:	Vegetation clearing
Project Phase	Construction
Nature	Negative
Extent	Site (1)
Intensity	Low (1)
Duration	Short term (1)
Consequence	Very low (3)
Probability	Possible
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Medium

Preferred Alternative	None

Impact 16: Damage to large trees or shrubs.

Applicable Phase: Construction phase

Applicable activity: Loss of large trees.

Nature of impact: Loss of habitat.

Mitigation of Impact 16:

During site clearing, large trees should be left intact as they can become incorporated as shade and garden features in the site establishment areas. Indigenous vegetation should be planted during rehabilitation of the cleared areas.

Table 62: Loss of large trees: Criteria used to determine the consequence of the impact.

ISSUE:	Vegetation clearing
Project Phase	Construction
Nature	Negative
Extent	Site (1)
Intensity	Low (1)
Duration	Medium term (2)
Consequence	Very low (4)
Probability	Possible
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Medium
Preferred Alternative	None

Impact 17: Fragmenting the riparian corridor by removing riparian bushes or river bank vegetation and compromise the function of riparian continuity.

Applicable Phase: Construction phase

Applicable activity: Fragmenting the riparian corridor.

Nature of impact: Impacting on the riverine integrity.

Mitigation of Impact 17:

It is not foreseen that clearing the site establishment areas and footbridge will fragment the riparian corridor. Care should be taken during all construction phases not to impact on the riparian zone and remain in the demarcated footprint

Table 63: Fragmenting the riparian corridor: Criteria used to determine the consequence of the impact.

ISSUE:	Vegetation clearing
Project Phase	Construction
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Medium term (2)
Consequence	Low (5)
Probability	Possible
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Medium
Preferred Alternative	None

Aspect 4.2: Erosion and siltation

Impact 18: Clearing of site establishment areas will create bare areas, channelling storm water and surface run-off, etc. which could cause erosion of sediment and resulting in the siltation of the river.

Applicable Phase: Construction phase

Applicable activity: Erosion and siltation.

Nature of impact: Cleared sites being eroded and silt ends up in the river.

Mitigation of Impact 18:

If appropriate mitigation is carried out, including strict adherence to anti-erosion actions given in the EMP, this impact could be reduced to low significance. All areas susceptible to erosion must be identified and protection measures be implemented. In any areas where the risk of erosion is evident, appropriate temporary or permanent works and water energy dispersion structures must be installed. Cleared or bare areas prone to erosion should be monitored and rehabilitation should be implemented wherever indications of potential erosion become evident. Mitigation and management measures are to be specified in order to ensure that areas susceptible to potential erosion are protected both during the construction and operational phase of the development.

Table 64: Erosion and siltation: Criteria used to determine the consequence of the impact.

ISSUE:	Erosion and siltation
Project Phase	Construction
Nature	Negative
Extent	Local (2)
Intensity	Low (1)
Duration	Medium term (2)
Consequence	Low (5)
Probability	Possible
Degree to which impact cannot be	Low

reversed	
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Medium
Preferred Alternative	None

Activity 5. Alien invading vegetation

Aspect 5.1: Introduction of alien vegetation

Impact 19: Alien plants are in competition with indigenous vegetation – the spreading of alien invasive plants will impact on indigenous plant communities in the area and spread further, therefore promote the invasion of alien species into the intact indigenous vegetation.

Applicable Phase: Construction phase

Applicable activity: Alien invasive vegetation.

Nature of impact: In competition with indigenous vegetation.

Mitigation of Impact 19:

All aggressive alien species should be removed. In terms of the Conservation of Agricultural Resources Act (CARA, Act No. 43 of 1984), alien species need to be managed and controlled in terms of their respective categories, where category 1 must be removed. Species specific and area specific eradication recommendations: Footprint areas should be kept as small as possible when removing alien plant species. Control involves killing the plants present, killing the seedlings which emerge, and establishing and managing an alternative plant cover to limit re-growth and re-invasion. Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge.

Table 65: Introduction of alien vegetation: Criteria used to determine the consequence of the impact.

ISSUE:	Alien invasive vegetation
Project Phase	Construction
Nature	Negative
Extent	Local (2)
Intensity	Medium (2)
Duration	Medium term (2)
Consequence	Medium (6)
Probability	Possible
Degree to which impact cannot be reversed	Medium
Degree to which Impact may cause irreplaceable loss of resources	Medium
Confidence level	Medium
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Medium

Preferred Alternative	None

Phase: Operational

Activity 6: Haul route – both sides of the river

Aspect 6.1: Dust

Impact 20: Dust may affect photosynthesis, respiration, transpiration of plants along haul roads and therefore impact on the local ecology. .

Applicable Phase: Operational phase

Applicable activity: Dust impacts.

Nature of impact: Impacts on indigenous vegetation.

Mitigation of Impact 20:

Vehicle-entrained particulate emissions from unpaved roads are significant sources of dust, especially where there are high traffic volumes on a road. Dust incidences can be treated by either watering, alternative material choices or using dust binders. If dust binders are used they should be used with care especially when they could affect the local groundwater. Moisture will act as a binding agent and reduce wind erosion emission by around 50%, depending on the amount of water applied. Alternatives include re-vegetation of temporarily exposed surfaces on which infrastructure will not be constructed.

Table 66: Dust impacts: Criteria used to determine the consequence of the impact.

ISSUE:	Dust impacts
Project Phase	Operational
Nature	Negative
Extent	Local (2)
Intensity	Medium (2)
Duration	Medium term (2)
Consequence	Medium (6)
Probability	Definite
Degree to which impact cannot be reversed	Medium
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	Medium
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Medium
Preferred Alternative	None

Activity 7: Alien invading vegetation.

Aspect 7.1: Spreading of alien vegetation.

Impact 21: Alien species are already present in the valley and will colonise any area of disturbance should they not be actively controlled.

Applicable Phase: Operational phase

Applicable activity: Alien invasive vegetation.

Nature of impact: In competition with indigenous vegetation.

Mitigation of Impact 21:

Invasive alien plant management plan. Invasive alien plant species pose the second largest threat to biodiversity after direct habitat destruction. The purpose of an Alien Plant and Open Space Management Plan is to provide a framework for the management of alien and invasive plant species during the construction and operation of infrastructure. The broad objectives of the plan include the following:

• Ensure alien plants do not become dominant in parts of the site, or the whole site, through the control and management of alien and invasive species presence, dispersal and encroachment.

• Develop and implement a monitoring and eradication programme for alien and invasive plant species.

• Promote the natural re-establishment and planting of indigenous species in order to retard erosion and alien plant invasion.

This plan should be updated throughout the life-cycle of the operation, as required in order to ensure that appropriate measures are in place to manage and control the establishment of alien and invasive plant species and to ensure compliance with relevant legislation.

Table 67: Introduction of alien vegetation: Criteria used to determine the consequence of the impact.

ISSUE:	Alien invasive vegetation
Project Phase	Operational
Nature	Negative
Extent	Local (2)
Intensity	Medium (2)
Duration	Medium term (2)
Consequence	Medium (6)
Probability	Possible
Degree to which impact cannot be reversed	Medium
Degree to which Impact may cause irreplaceable loss of resources	Medium
Confidence level	Medium
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Medium
Preferred Alternative	None

Impact Assessment Summary

Table 68: A summary of the impact assessment post mitigation.

Impact #	Issue and aspect	Phases	Significance without mitigation	Significance with mitigation
Phase: Construction				
Activity 1. Stabilizing the berm and toe drain.				
Aspect 1.1 Vegetation clearing.				
1	Loss of riparian habitat and potential habitat for local biota, including corridors and buffers.	Clearing phase	Medium (-ve)	Low (-ve)
2	Damage to riparian large trees or shrubs.	Clearing phase	Medium (-ve)	Low (-ve)
3	Fragmenting the riparian corridor by removing riparian bushes or river bank vegetation and thus compromise the function of riparian connectivity.	Clearing phase	Medium (-ve)	Low (-ve)
Aspect 1.2: Disturbance - Altering the bed, banks, course of a watercourse.				
4	The covering of indigenous riverine vegetation will be associated with the construction of the berm and toe drain.	Construction phase	Medium (-ve)	Medium (-ve)
5	Covering the marginal vegetation on the embankment will lead to loss of potential habitat and biodiversity.	Construction phase	Medium (-ve)	Medium (-ve)
6	Erosion of cleared areas will lead to siltation of the downstream aquatic habitat.	Construction phase	Medium (-ve)	Low (-ve)
Aspect 1.3: Disturbance - Noise and movement				
7	Vehicle and human movement and sounds will disturb riparian fauna in the vicinity of the construction activities.	Construction phase	Medium (-ve)	Low (-ve)
Aspect 1.4: Impacting the Ngodwana catchment seep on the western slope.				
8	Impacting the flow and water quality of this near-pristine mountain stream due to construction activities.	Construction phase	High (-ve)	Low (-ve)
Activity 2. Raising of the right flank embankment				
Aspect 2.1: Vegetation clearing				
9	Loss of riparian habitat and potential habitat for local biota, including corridors and buffers.	Clearing phase	Medium (-ve)	Low (-ve)
Aspect 2.2: Topping soil on the embankment				
10	Erosion of dumped soil will lead to siltation of the downstream aquatic habitat.	Construction phase	Medium (-ve)	Low (-ve)
Activity 3. Haul route – both sides of the river				
Aspect 3.1: Vegetation clearing.				
11	Removal of indigenous riparian	Construction	High (-ve)	Medium (-ve)

	vegetation, considering coves of White Stinkwood along the western haul route.	phase		
Aspect 3.2: Fragmentation or riparian corridor				
12	Impacting on indigenous riparian vegetation, fragmenting the riparian corridor.	Construction phase	High (-ve)	Medium (-ve)
Aspect 3.3: Impacting stream flow of the Ngodwana catchment seep on the western slope.				
13	Impacting the flow and water quality of this near-pristine mountain stream due to construction activities.	Construction phase	High (-ve)	Medium (-ve)
Aspect 3.4: Erosion and siltation.				
14	Disturbing the soil during the construction of roads, clearing areas and create bare patches, channelling storm water and road run-off, etc. will cause erosion and siltation of the river.	Construction phase	Medium (-ve)	Low (-ve)
Activity 4. Site establishment area and footbridge.				
Aspect 4.1: Vegetation clearing.				
15	Loss of riparian habitat and potential habitat for local biota, including corridors and buffers.	Clearing phase	Medium (-ve)	Low (-ve)
16	Damage to large trees or shrubs.	Construction phase	Medium (-ve)	Low (-ve)
17	Fragmenting the riparian corridor by removing riparian bushes or river bank vegetation and compromise the function of riparian continuity.	Construction phase	Medium (-ve)	Low (-ve)
Aspect 4.2: Erosion and siltation				
18	Clearing of site establishment areas will create bare areas, channelling storm water and surface run-off, etc. which could cause erosion of sediment and resulting in the siltation of the river.	Construction phase	Medium (-ve)	Low (-ve)
Activity 5. Alien invading vegetation				
Aspect 5.1: Introduction of alien vegetation				
19	Alien plants are in competition with indigenous vegetation – the spreading of alien invasive plants will impact on indigenous plant communities in the area and spread further, therefore promote the invasion of alien species into the intact indigenous vegetation.	Construction phase	Medium (-ve)	Low (-ve)
Phase Operational				
Activity 6: Haul route – both sides of the river				
Aspect 6.1: Dust				
20	Dust may affect photosynthesis, respiration, transpiration of plants along haul roads and therefore	Operational phase	Medium (-ve)	Low (-ve)

	impact on the local ecology.			
Activity 7: Alien invading vegetation.				
Aspect 7.1: Spreading of alien vegetation.				
21	Alien species are already present in the valley and will colonise any area of disturbance should they not be actively controlled.	Operational phase	Medium (-ve)	Low (-ve)

5.8 Conditions for inclusion in the environmental authorisation (Step 2.3 – Table 7).

Step 2.3 Identify compromises and solutions that minimise impacts on biodiversity and conflicts in land-use.

These conditions are based on the identification of mitigation measures and solutions that minimise impacts on biodiversity and conflicts in land-use by making use of use of CBA maps in the Environmental Impact Assessment (see Table 7). The steps used in this section correspond with the steps which are obtained from the Mpumalanga Biodiversity Sector Plan (2014).

a) Retain natural habitat and connectivity in CBAs and ESAs (Step 2.3.1 – Table 7): Retain natural habitat and connectivity in CBAs and ESAs: The avoidance of environmentally sensitive areas identified during the Sensitivity Mapping exercise is regarded as the single most effective possible mitigation measure for mitigating impacts on the ecology of the project area.

- The proposed clearing of areas should not impact on any CBA or ESA features:

  The entire project footprint of the proposed project is situated in a Critical Biodiversity Area: CBA Irreplaceable (Terrestrial CBA). According to the categories in terms of management objectives and permissible land-uses (MBSP Handbook 2014), the establishment of roads and other linear structures are land-uses that will compromise the biodiversity objective and are not permissible.

  However, due to the fact that most of the routes are planned on existing roads and tracks, these activities will probably not impact significantly on the ecology of the project area. If any of this CBA in the project footprint is earmarked for development (laydown areas, material stockpile, dam wall rehabilitation), it is suggested that the areas with some alien trees and areas cleared in the past should be utilised first.

  Implementing riverine buffer zones emphasize the importance of the drainage line and wetlands (important FEPA sub-catchment and Fish Support Area) will certainly augment the importance of the ecology in the project area.

- Avoid environmentally sensitive areas identified on the Sensitivity Mapping exercise:

  With its “Very High” ecological value and sensitivity, the valley drainage lines and its associated riparian zone should be protected against impacts emanating from the project area. By adding an 18-24m buffer around the entire riverine area in the vicinity, and adhere to strict rules not to impact on the area inside the buffer, this sensitive area will be safe from further development and local impacts.

None of the construction activities are planned in the riparian area and even roads to the project areas should be outside the riparian corridor, as the example in Figure 58 illustrates.

- Wherever possible, sites must be chosen that have already been cleared or altered (old mining area, servitudes, existing tracks and roads, areas with invading alien trees and areas cleared in the past for construction).

  Avoid environmentally sensitive areas identified on the Sensitivity Mapping exercise. Wherever possible, choose sites that already have been cleared or altered (Heavily modified portions). Limit the removal of vegetation to the development footprint only.

- Maximise connectivity in CBAs and ESAs, the retention of intact natural habitat and avoid fragmentation:

  The buffer around the valley drainage line will protect the connectivity of the riparian corridor. No new structures or development are planned that will compromise connectivity in CBAs and ESAs.

b. Apply the mitigation hierarchy (Step 2.3.2 – Table 7):

Identify the best practicable environmental options by avoiding loss of biodiversity and disturbance to ecosystems, especially in CBAs, by applying the **mitigation hierarchy** and the land-use guidelines (Tables 44 to 46). In particular:

- **Maximise connectivity in CBAs and ESAs, the retention of intact natural habitat and avoid fragmentation:** No new structures or development are planned that will compromise connectivity in CBAs and ESAs. The project area will be connected to the game reserve around the dam area and fauna will be able to move into that extensive area to the west and the east during the height of the construction phase.
- **Minimise unavoidable impacts:** It is proposed that, when the footprint areas are cleared for construction, the clearing activities should be restricted to the designated areas, and that cleared vegetation should not be dumped on adjacent habitats or burned in areas not earmarked for clearing.
- **Take opportunities to conserve biodiversity:** At this stage of the development, none of the remaining project footprint is assigned to further development, and the valley with its buffered drainage line will match up with the Ngodwana Dam Nature Reserve without jeopardising the integrity of the reserve.
- **Remedy habitat degradation and fragmentation through rehabilitation**: After completion of the project, rehabilitation of the area presents opportunities to restore degraded areas (old mining and laydown areas). The current poor state the old mining area could be reversed when some topsoil will be left on the temporary stockpile area and planted with indigenous vegetation. The laydown areas can be converted into parks and picnic sites.
- **Promote long-term persistence of taxa of special concern:** By safeguarding the area not developed, the taxa of special concern will also be conserved, especially those species expected to be present (see Section 4.3).

c) Secure priority biodiversity in CBAs and ESAs through biodiversity stewardship (Step 2.3.3 – Table 7)

Set aside land of high biodiversity importance for conservation through biodiversity stewardship options. Where biodiversity losses are unavoidable, set aside another piece of land of equivalent or greater biodiversity importance for conservation:

At this stage of the development, none of the remaining Ngodwana Dam project area is assigned to further development, and the near-natural Legogote Sour Bushveld and buffered drainage lines will match up with the Ngodwana Dam Nature Reserve without jeopardising the integrity of the reserve. By safeguarding the area not developed, the taxa of special concern will also be conserved, especially those species expected to be present

d) Remedy degradation and fragmentation through rehabilitation (Step 2.3.4 – Table 7):

It is important that flows from the seepage wetlands are not interrupted and be allowed to connect with the main stream without any obstructions.

e) Promote long-term persistence of taxa of special concern (Step 2.3.5 – Table 7)

By safeguarding the area not developed, the taxa of special concern will also be conserved, especially those species expected to be present. It is possible that species of special concern or species protected in terms of the Nature & Environmental Conservation Ordinance (19 of 1974) or the National Forest Act (Act 84 of 1998) occur within the work areas. Should there be any doubt regarding whether such a species exists, then no clearing of that species should take place without verification from the ECO.

f) Integrating *in situ* biodiversity-sensitive management into the overall design and operation of the proposed land-use development

In order to avoid unnecessary disturbance, vegetation clearing must be strictly contained to orchard areas and defined work areas. Cleared bush should be stockpiled and used for firewood. Only the excess must be stockpiled and burnt within the cleared area.

Retain as much native vegetation as possible. View the un-cleared areas as a resource to be conserved.

5.9 Monitoring requirements

Environmental performance monitoring should be designed to ensure that mitigation measures are implemented. The monitoring programme should clearly indicate the linkages between impacts, indicators to be measured, measurement methods and definition of thresholds that will signal the need for corrective actions.

The applicant must appoint an independent ECO that will have the responsibility of monitoring and reporting on compliance with the conditions of the Environmental Authorisation (EA, as well as monitoring and reporting on the implementation of the approved EMPr.

5.10 Reasoned opinion

The potential impacts of the project on biodiversity of the study area are assessed under five broad impacts (Section 5.7). The following list provides a summary of the impact assessment, indicating the changes from pre-mitigation to post mitigation.

Main Impact 1: The clearing of vegetation or covering of habitat in the project footprint area for construction purposes.

Many different areas will be cleared and covered during the proposed project construction period. By adhering to the main mitigation aspects, a “Medium” significance can be mitigated to a “Low” significance:

- Care must be taken not to impact on areas outside the demarcated route and unnecessary clearing of areas should also be avoided.
- Removing large trees should be avoided as far as possible.
- Whenever tall trees are removed on haul roads, these trees must be replaced in order to mimic the natural habitat impacted on.
- During site clearing, large trees should be left intact as they can become incorporated as shade and garden features in the site establishment areas.
- Refrain from fragmenting the riparian corridor by respecting the buffer zones.
- No indigenous plants of Special Concern must be impacted on.
- Indigenous vegetation should be planted during rehabilitation.
- Corridors and buffers must be respected and the riparian zone must not be disturbed at all.

Main Impact 2: Altering bed, banks or course of a watercourse.

The Ngodwana Dam project area surrounds a network of riverine wetland areas which could be impacted adversely by the proposed project activities. By adhering to the main mitigation aspects, a “Medium” significance can be mitigated to a “Low” significance:

- All riverine wetlands should be treated with care throughout the construction phase.
- Respect buffer zones.
- No covering of material or dumping of any rubble will be allowed into the wetland system.
- Water flow in drainage lines and wetland systems must not be obstructed.
- Construction activities inside the riparian buffer zone must proceed with special care.

Main Impact 3: Erosion and siltation.

Due to the proximity of the Ngodwana River and associated network of riverine wetland areas, erosion and siltation originating from construction activities could be impacted adversely by the proposed project activities. By adhering to the main mitigation aspects, a “Medium” significance can be mitigated to a “Low” significance:

- Best Practice measures should be implemented during construction and rehabilitation.
  Mitigation and management measures are to be specified in order to ensure that areas susceptible to potential erosion are protected both during the construction and operational phase of the development.
- Stringent mitigation measures must be imposed during construction to minimize runoff and stop possible silt run-off.
- The contamination of water leaving the site could be controlled by the use of silt-fencing, rows of hessian bags, mulch, brushwood and deflection berms.
- All areas susceptible to erosion must be identified and protection measures be implemented.
- In any areas where the risk of erosion is evident, appropriate temporary or permanent works and water energy dispersion structures must be installed.
- Cleared or bare areas prone to erosion should be monitored and rehabilitation should be implemented wherever indications of potential erosion become evident.

Main Impact 4: Noise, movement and dust.

Proposed construction activities over a period of time will result in noise, movement and dust which will impact negatively on local fauna and flora. By adhering to the main mitigation aspects, a “Medium” significance can be mitigated to a “Low” significance:

- The disturbance will be for a relative short period, no major activities other than routine maintenance should be allowed during the Operational Phase.
- All activities will be contained to the dam wall and roads leading tot the construction site.
- Workers should be restricted to the construction site.
- Dust incidences can be treated by either watering, alternative material choices or using dust binders.
- Alternatives include re-vegetation of temporarily exposed surfaces on which infrastructure will not be constructed.

Main Impact 5: Introduction of alien vegetation.

Proposed construction activities and transport of material into the project area have the potential to spread further and impact on indigenous plant communities in the area. By adhering to the main mitigation aspects, a “Medium” significance can be mitigated to a “Low” significance:

- All aggressive alien species should be removed.
- Footprint areas should be kept as small as possible when removing alien plant species.
- Control involves killing the plants present, killing the seedlings which emerge, and establishing and managing an alternative plant cover to limit re-growth and re-invasion.
- Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge.
- Implement an invasive alien plant management plan. The broad objectives of the plan include the following:

    - Ensure alien plants do not become dominant in parts of the site, or the whole site, through the control and management of alien and invasive species presence, dispersal and encroachment.
    - Develop and implement a monitoring and eradication programme for alien and invasive plant species.
    - Promote the natural re-establishment and planting of indigenous species in order to retard erosion and alien plant invasion.

5.11 Consultation process

The input from Mr. Carel van der Merwe regarding the project background and local environment was very valuable during the field surveys. The input of Mr. Mervyn Lotter regarding the Mpumalanga Threatened Species Database is appreciated.

REFERENCES

Animal Demographic Unit (ADU). 2010. Reptile Atlas- Southern African reptile conservation assessment. Department of Zoology, University of Cape Town.

Alexander, G & Marais, J. 2007. A guide to the reptiles of southern Africa. Struik Publishers. 408 pp.

Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. & De Villiers, M.S. 2014. Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. Suricata 1. SANBI, Pretoria.

BRANCH, W. R. 1988. South African Red Data Book – Reptiles and Amphibians. SA National Scientific Programmes Report No 151. Foundation for Research Development, Pretoria. 241 pp.

Cadman, Mandy & Petersen, Caroline & Driver, Amanda & Sekhran, Nik & Maze, Kristal & Munzhedzi, Shonisani. (2010). Biodiversity for Development. South Africa's landscape approach to conserving biodiversity and promoting ecosystem resilience.

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

Department of Water Affairs and Forestry, 1999. Ecoregional typing. Version 1.0: M:/f_rdm_october/rivers/version 1.0/riv_appR1_version1.0.doc.

Department of Water Affairs and Forestry. 2005. A level 1 River Ecoregional Classification System for South Africa, Lesotho and Swaziland. = (Kleynhans, CJ, Thirion, C and Moolman, J (2005). *A Level I River Ecoregion classification System for South Africa, Lesotho and Swaziland.* Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.)

Department of Water Affairs and Forestry. 2005. A practical field procedure for identification and delineation of wetland and riparian areas. DWAF, Pretoria. Republic of South Africa.

DMV Nelspruit Incorporated (2020). Preliminary assessment of haul roads for SAPPI, Ngodwana Dam Rehabilitation. Project 20828.

DWAF (2008). *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas,* prepared by M. Rountree, A. L. Batchelor, J. MacKenzie and D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

Department of Water and Sanitation (DWS). 2014. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Compiled by RQIS-RDM: https://www.DWS.gov.za/iwqs/rhp/eco/peseismodel.aspx

Department of Agriculture, Forestry and Fisheries. 2019. A list of all protected tree species under Section 12 of the National Forest Act, 1998 (Act No 84 of 1998). Notice 635 of 2019. National Forests Act, 1998 (ACT No. 84 of 1998). Staatskoerant, 6 Desember 2019. No. 42887.

Du Preez, L. & Carruthers, V. 2009. A complete guide to the frogs of Southern Africa. Struik Nature, Cape Town.

DWAF (2008) *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas,* prepared by M. Rountree, A. L. Batchelor, J. MacKenzie and D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

Ecoleges Environmental Consultants. 2020. Application for a General and Environmental Authorisation for the Sappi Dam Remediation, on Farm Ngodwana 1030 JT, Ngodwana, Mpumalanga Province. Notification & background information document (BID).

Ferrar, A.A. & Lötter, M.C. 2007. Mpumalanga Biodiversity Conservation Plan Handbook. Mpumalanga Tourism & Parks Agency, Nelspruit.

Friedman, Y., Daly, B. 2004. Red Data Book of the Mammals of South Africa. A conservation assessment: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust. South Africa.

Gibbons, G., Maclean, G. 1997. Roberts' Multimedia: Birds of Southern Africa. Southern African Birding cc.

Hagen, DJ. 2019. Review of Dam Safety Risk and proposed remedial work associated with Category 3 Ngodwana Dam, Mbombela. SAPPI Letter Report 20191203.

Harrison, J.A., Allan, D.G., Underhill, M., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. 1997. The atlas of Southern African Birds. Volume 1: Non-passerines. Avian Demography Unit. Birdlife SA. Pp 786.

Harrison, J.A., Allan, D.G., Underhill, M., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. 1997. The atlas of Southern African Birds. Volume 2: Passerines. Avian Demography Unit. Birdlife SA. Pp 786.

Henning G.A., Terblanche R.F. and Ball J.B. 2009. South African Red Data Book: Butterflies. *SANBI Biodiversity Series* 13. South African National Biodiversity Institute, Pretoria.

Hockey, PAR., Dean, WJR, Ryan PG. (eds.) 2005. Roberts Birds of South Africa, VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town.

IUCN, 2019.IUCN Red List of Threatened Species. Website: www.iucn.org/redlist

Jacobsen, N.H.G. 1989. A Herpetological Survey of the Transvaal.Project TN 6/4/1/30.The distribution and conservation status of reptiles and amphibians in the Transvaal. Final report 1989; 3 vol.

Kleynhans, C.J. 1999. The development of a fish index to assess the biological integrity of South African rivers. *Water SA*. **25** 265-278.

Kleynhans, C.J., Louw, M.D., Thirion, C., Rossouw, N.J. & Rowntree, K. 2005. River EcoClassification: Manual for EcoStatus determination (Version 1). Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. KV 168/05.

Kleynhans CJ, Louw MD, Moolman J. 2007. Reference frequency of occurrence of fish species in South Africa. Report produced for the Department of Water Affairs and Forestry (Resource Quality Services) and the Water Research Commission.

Kleynhans, C.J., Louw, M.D. 2008. River Classification manual for EcoStatus determination. WRC Report no TT 329/08.

Macfarlane, D.M., Bredin IP, Adams, JB., Zungu, MM., Bate, GC. and Dickens, CWS. 2015. Preliminary guideline for the determination of Buffer Zones for rivers, wetlands and estuaries. Consolidated Report. To the Water Research Commission by **t**he Institute of Natural Resources.

Macfarlane, D.M. and Bredin IP. 2017. Buffer Zone Guidelines for Rivers, Wetlands and Estuaries. Part 1: Technical Manual. WRC Report No. TT 715-1-17.

MacKenzie and Rountree, 2007. *Draft riparian delineation methods prepared for the Department of Water Affairs and Forestry, Version 1.0* (unpublished field notes).

Minter, L.R., M. Burger, J. A. Harrison, H.H. Braack, P.J. Bishop, and D. Kloepfer, eds. 2004. *Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland.*SI/MAB Series #9.Smithsonian Institution, Washington, DC.

MTPA. 2014. Mpumalanga Biodiversity Sector Plan Handbook. Compiled by Lötter M.C., Cadman, M.J. and Lechmere-Oertel R.G. Mpumalanga Tourism & Parks Agency, Mbombela (Nelspruit).

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

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

Roux F., Selepe, M. Kleynhans CJ, Thirion, C. Diedericks G. Hoffmann AC, Marais, H. 2013. Ecostatus of the Crocodile River Catchment, Komati River System. Inkomati Usuthu Catchment Management Agency. Mpumalanga Tourism and Parks Agency (MTPA).

Roux F. Diedericks G. Hoffmann AC, Selepe, M. 2016. Mpumalanga Tourism and Parks Agency (MTPA). Ecostatus of the Elands River Catchment. www.iucma.co.za.

SCHMIDT, E., LÖTTER, M. & MCCLELAND, W. (2002). *Trees and Shrubs of Mpumalanga and Kruger National Park*. Jacana, Johannesburg.

Taylor, MR, Peacock, F, Wanless, RW (eds). 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Birdlife South Africa, Johannesburg, South Africa.

Appendices

Appendix 1: Declaration of interest

The specialist appointed in terms of the Regulations_

10.4 The Specialist

Note: Duplicate this section where there is more than one specialist.

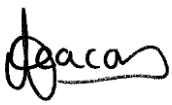
I …Dr Andrew Richard Deacon…, as the appointed specialist hereby declare/affirm the correctness of the information provided as part of the application, and that I:

- in terms of the general requirement to be independent (tick which is applicable):

X	other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or

	am not independent, but another EAP that is independent and meets the general requirements set out in Regulation 13 has been appointed to review my work (Note: a declaration by the review specialist must be submitted);

- have expertise in conducting specialist work as required, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- will ensure compliance with the EIA Regulations 2014;
- will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the application;
- will take into account, to the extent possible, the matters listed in regulation **18** of the regulations when preparing the application and any report, plan or document relating to the application;
- will disclose to the proponent or applicant, registered interested and affected parties and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority or the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority (unless access to that information is protected by law, in which case I will indicate that such protected information exists and is only provided to the competent authority);
- declare that all the particulars furnished by me in this form are true and correct;
- am aware that it is an offence in terms of Regulation 48 to provide incorrect or misleading information and that a person convicted of such an offence is liable to the penalties as contemplated in section 49B(2) of the National Environmental Management Act, 1998 (Act 107 of 1998).



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Signature of the specialist

Andrew Deacon Environmental Consultant

Name of company

18 February 2019

Date

Appendix 2: Curriculum Vitae

CURRICULUM VITAE - DR ANDREW RICHARD DEACON

Born in Klerksdorp, South Africa in 1951. Matriculated at the Goudveld High School in 1969. South African citizen. Married and with one child.

FORMAL EDUCATION

Ph.D., Zoology (RAU 1987) Thesis: "The nutritional ecology and physiology of *Tilapia rendalli* and *Oreochromis mossambicus* in a warm, sewage-enriched habitat".
M.Sc., Zoology (RAU 1983) Thesis: "The occurrence and feeding habits of *Anguilla*-species in selected rivers of the Transkei".
B.Sc., Hons. in Zoology (RAU 1980)
B.Sc., majors Zoology and Botany (PU for CHE 1974)

PROFESSIONAL EXPERIENCE

2012-ongoing Environmental consultant
1989-2012 Scientific Services, Kruger National Park, SANParks
2000-2012 Programme Manager: Small vertebrates
1989-2000 Senior Scientist: Freshwater Ecologist.
1988 Consulting - Technikon of RSA; Berghoek Nature Reserve; Klaserie Nature Reserve.
1985-1987 Lecturer (Part-time) - Witwatersrand Technikon. Biology for the Food Technologists.
1984-1986 Lecturer - Department of Zoology at RAU. Biology and Taxonomy.
1983 Lecturer - Goudstad College of Education. Zoology.
1979-1982 Research assistant - Department of Zoology at RAU.
1978 Research technician - Onderstepoort Veterinary Institute. Helminthology - Taxonomy and physiology of South African helminths.
1975 – 1977 Teacher - Biology and Science

National Biomonitoring Programme - Project leader for River Health Programme (1998 - 2010)
Olifants River Forum - Vice Chairman (1994)
Research Unit for Terrestrial and Aquatic Ecology (RAU) (1991-1996)
Water Research Commission Steering Committee (30 projects) (1990 - 2011)
Lowveld Pollution Incident Committee – collaborator (1991-1998)
Mpumalanga River Health Programme - Project leader (1999 - 2005)

CONSULTING PROJECTS (112 projects)

Specialist fields for environmental studies (surveys and monitoring):

Specialist studies for:
Environmental Impact Assessments – Specialist studies (10 studies)
Reserve Determination – Environmental Water Requirements (13 projects)

Aquatic ecosystem
Hydro-electrical projects (5 projects)
Fish, macro-invertebrates and riparian (37 project)
Fish-ways (3 projects)
Wetland delineation (3 projects)

Terrestrial ecosystems (Mammals, birds, reptiles, frogs, plants)
Fauna specialist studies (40 projects)

Faunal and ecosystems monitoring: (6 projects)
Biodiversity and Habitat integrity: (30 projects)
Vegetation studies (2 projects)

Lecturing & Training: Ecology (10 projects)

OTHER

Initiated the Olifants River Forum. Received the trophy for the ORF Top Project of the Year competition and awarded honorary life membership of the Olifants River Forum.
Completed the Environmental Impact Assessment short course at the University of Cape Town.
Submitted a proposal for the Limpopo floodplains to be declared as a Ramsar site.
Accredited for SASS4 Macro-invertebrate Biomonitoring Methods.
Completed: Wetland Introduction and Delineation – Centre for Environmental Management: University of the Free State
Scientific Advisor: Leadership for Conservation in Africa
10 scientific papers in refereed journals

Appendix 3: The Nature of the Red Listed categories

All taxa listed as Critically Endangered qualify for Vulnerable and Endangered, and all listed as Endangered qualify for Vulnerable. Together these categories are described as 'threatened'. The threatened species categories form a part of the overall scheme. It will be possible to place all taxa into one of the categories (see Figure 34).

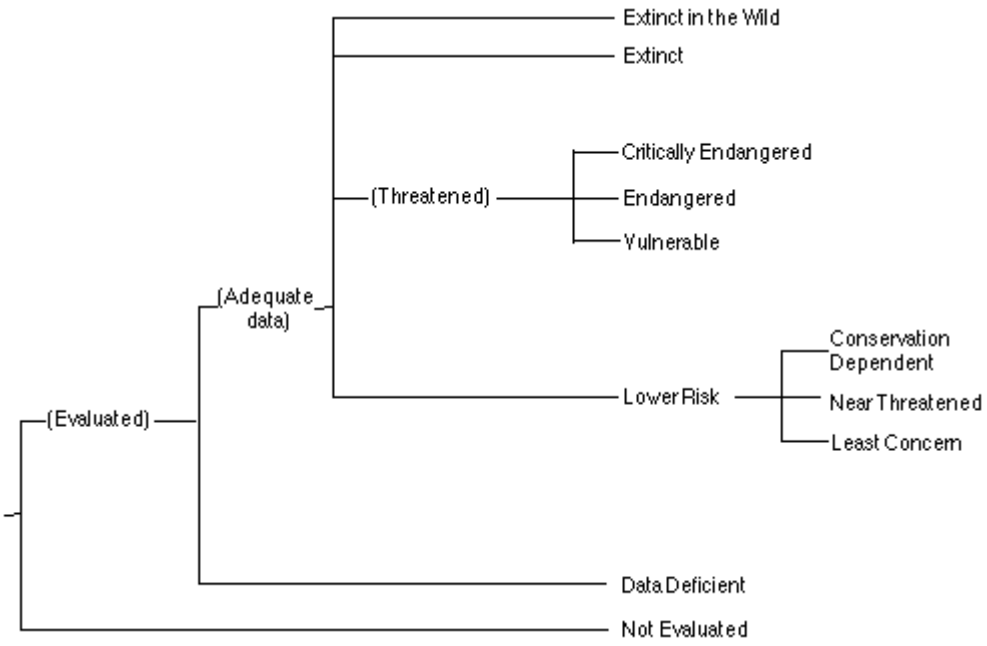

Figure 61: Red Listed categories

The categories

EXTINCT (EX) - A taxon is Extinct when there is no reasonable doubt that the last individual has died.

EXTINCT IN THE WILD (EW) - A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR) - A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) as described below.

ENDANGERED (EN) - A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) as described below.

VULNERABLE (VU) - A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to E) as described below.

LOWER RISK (LR) - A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. **Conservation Dependent (cd).** Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
2. **Near Threatened (nt).** Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
3. **Least Concern (lc).** Taxa which do not qualify for Conservation Dependent or Near Threatened.

DATA DEFICIENT (DD) A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE) A taxon is Not Evaluated when it is has not yet been assessed against the criteria.

Appendix 4: The complete SASS 5 form.

TAXON	Stones	Vegetation	GSM	Total
Porifera 5				
Coelenterata 3				
Turbellaria 3				
Oligochaeta 1				
Leeches 3				
Amphipoda 15				
Potamonautidae 3				
Atyidae (Shrimp) 8				
Palaemonidae 10				
Hydracarinae 8				
Notonemouridae 14				
Perlidae 12				
Baetidae 1 spp 4				
2 spp 6				
>2 spp 12				
Caenidae 6				
Ephemeridae 15				
Heptageniidae 10				
Leptophlebiidae 13				
Oligoneuridae 15				
Polymitarcyidae 10				
Prosopistomatidae 15				
Teloganodidae 12				
Tricorythidae 9				
Calopterydidae 10				
Chlorocyphidae 10				
Chlorolestidae 8				
Coenagrionidae 4				
Lestidae 8				
Platycnemidae 10				
Protoneuridae 8				
Zygoptera 6				
Aeshnidae 8				
Cordulidae 8				
Gomphidae 6				
Libellulidae 4				
Belostomatidae 3				
Corixidae 3				
Gerridae 5				
Hydrometridae 6				
Naucoridae 7				
Nepidae 3				
Notonectidae 3				
Pleidae 4				
Veliidae 5				
Corydalidae 8				
Sialidae 6				
Dipseudopsidae 10				
Ecnomidae 8				
Hydropsychidae 1= 4				
2spp = 6				
>2spp =12				
Philopotamidae 10				
Polycentropodidae 12				

Psychomyiidae/Xip. 8				
Barbarochthonidae 13				
Calamoceratidae 11				
Glossosomatidae 11				
Hydroptilidae 6				
Hydrosalpingidae 15				
Lepidostomatidae 10				
Leptoceridae 6				
Petrothrincidae 11				
Pisuliidae 10				
Sericostomatidae 13				
Dytiscidae 5				
Elmidae/Dryopidae 8				
Gyrinidae 5				
Haliplidae 5				
Helodidae 12				
Hydraenidae 8				
Hydrophilidae 5				
Limnichidae 8				
Psephenidae 10				
Athericidae 13				
Blepharoceridae 15				
Ceratopogonidae 5				
Chironomidae 2				
Culicidae 1				
Dixidae 13				
Emphididae 6				
Ephydridae 3				
Muscidae 1				
Psychodidae 1				
Simuliidae 5				
Syrphidae 1				
Tabanidae 5				
Tipulidae 5				
Ancylidae 6				
Bulininae 3				
Hydrobidae 3				
Lymnaeidae 3				
Physidae 3				
Planorbidae 3				
Thiaridae 3				
Viviparidae 5				
Corbiculidae 5				
Spaeridae 3				
Uniondae 6				
SASS Score				
No of families				
ASPT				

Estimated abundance: 1=1; A=2-10; B=11-100; C=101-1000; D=>1000

Appendix 5: Finer detail EC rating table.

Rating	Deviation from reference conditions	A- F Categories	Natural – Poor categories	Score
0	No change	A	Natural	≥ 92.01
		A/B		>87.4 and <92.01
1	Small change	B	Good	82.01 – 87.4
		B/C		>77.4 and <82.01
2	Moderate change	C	Fair	62.01 – 77.4
		C/D		>57.4 and <62.01
3	Large change	D		42.01 – 57.4
		D/E		>37.4 and <42.01
4	Serious change	E	Poor	22.01 – 37.4
		E/F		>17.4 and <22.01
5	Extreme change	F		0 - 17.4

Appendix 6: Ngodwana River Riparian Delineation

Appendix 7: Ngodwana River buffer

Appendix 8: Drainage buffer

Appendix 9: Seepage buffer

Appendix 10: Frogs

Appendix 11: Reptiles

Appendix 12: Birds

Appendix 13: Mammals