APPENDIX 4.4
SPECIALIST STUDIES

APPENDIX 4.4.1.
ENGINEERING PLANNING REPORT

NOSILLA 27JU ENGINEERING PLANNING REPORT

ENGINEERING PLANNING REPORT FOR THE PROPOSED DEVELOPMENT OF NOSILLA 27JU

DATE: February 2021
MBB PROJECT NO: N1949
REPORT NO: N1749/1

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1 INTRODUCTION

MBB Consulting Engineers (Nelspruit) was appointed by Mr Pieter du Preez to compile an Engineering Planning Report for the proposed development of Macadamia Orchards on the farm Noscilla 27JU, situated between White River and Hazyview in Mpumalanga.

This report will form part of the Bulk Water Supply Masterplan for the Farm and will be submitted to the relevant authorities as annexures for the EIA and Water Use License Application.

The long term vision is to establish approximately 218.3 hectares (gross) of crops broken down as follows:

- 10 Ha Blue Berries (Full Irrigation)
- 136.5 Ha Irrigated Macadamia Orchards (Supplemental Irrigation)
- 71.8 Ha of Dryland Macadamia Orchards

The purpose of this report is to serve as a road map of what is planned, with some technical insight. This report will be included as annexures to the EIA and WULA applications.

It is important to note that this report is not a detail design. It provides a development guide, focusing on bulk water supply, highlighting design and operational principles to be incorporated in the detail design stage.

The aim is to reduce the risk of water supply which is key to the production of quality produce in a sustainable manner. The availability of irrigation water is seen to be the most important factor for successful and sustainable production on this enterprise. This report identifies and addresses the critical water related and operational issues to be implemented, optimising water harvesting.

A general layout drawing of the proposed farm development is given in **Annexure A**.

2 NATURAL RESOURCES

2.1 SOIL

Based on the observations from the site, and 1:250 000 Geological Maps published by the Department of Mineral and Energy Affairs (1986), the area in general is underlain by grey to white, coarse grained biotite granite (Zn) from the Nelspruit Suite. A mantel of transported soil and weathered material is situated on top of this base layer.

Site observations indicate that the available soils are suitable for irrigation and the production of Macadamias, Ginger and Blue Berries. These crops are currently being grown on the neighbouring farms with success.

2.2 RAINFALL

The area has an average rainfall of approximately 1113mm per annum, obtained from the weather station at KlipKopjie Dam. The highest rainfall months are November to March when 862mm, or 77% of the annual rain can be expected.

Dry spells during crucial months make irrigation essential for successful macadamia farming. Irrigation is therefore critical during the months of August, September and October, when flowering and fruit set occurs (highest irrigation demand and lowest rainfall). The months of July and August have the lowest rainfall (7mm and 12mm respectively). This rainfall is very low, indicating the need to irrigate during these times. The average monthly rainfall for the area is shown in Figure 1.

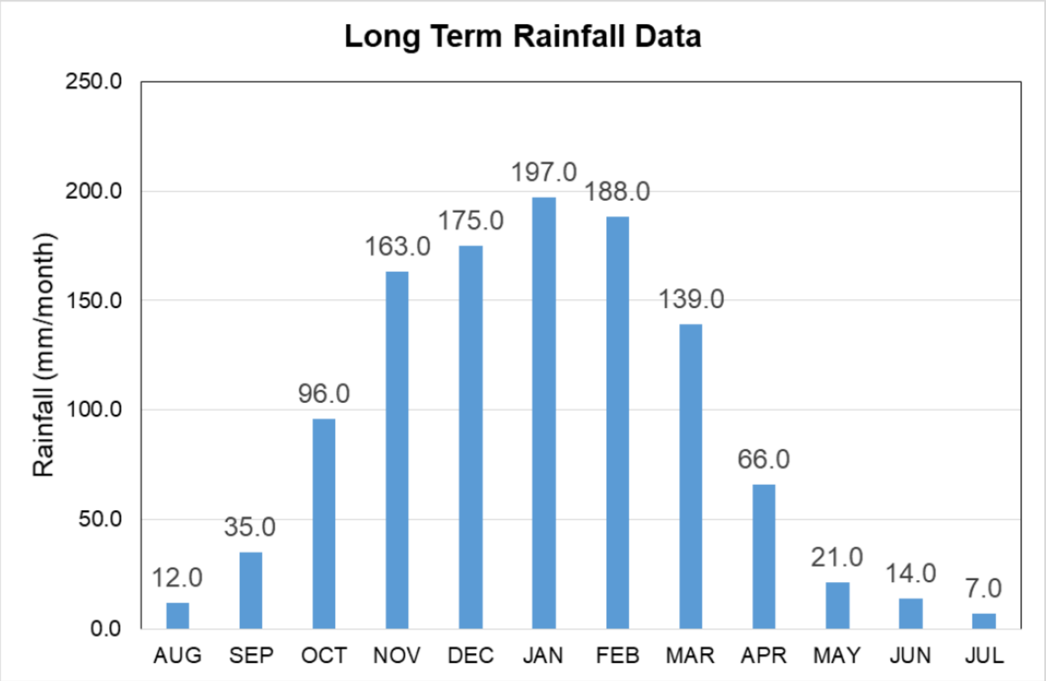


Figure 1: Average Rainfall for Project Area

With the relatively high rainfall and moderate climate, we expect the area to be suitable for the production of Macadamias, Blueberries and Ginger. Availability of irrigation water during critical periods needs to be addressed.

2.3 EVAPORATION

An average A Pan evaporation of 1689mm per annum is expected with the highest evaporation in November with 5.9mm per day. A design peak evaporation of 6.5mm per day is recommended. The average evaporation (mm per day) for each month is indicated in Figure 2.

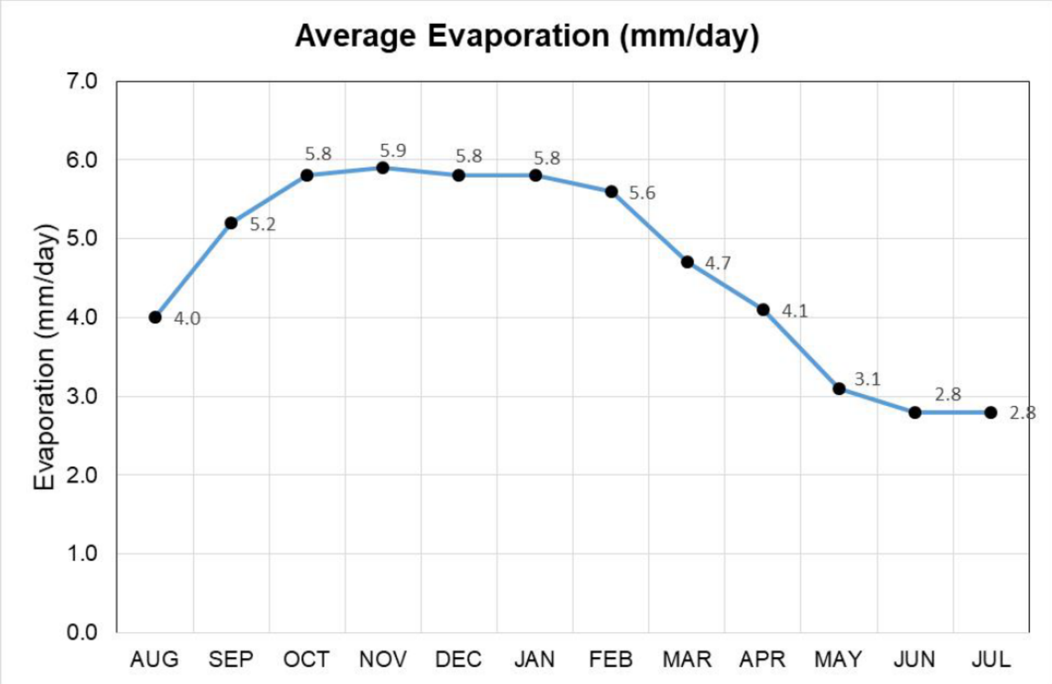


Figure 2: Average Evaporation (mm/day)

2.4 WATER SOURCES FOR PRODUCTION OF CROPS

Water for irrigation is dependent on surface runoff water from catchments on the property. The aim of the project is to remove 187 Ha of commercial forestry and use this water made available (through increased runoff) for irrigation.

3 OTHER INFRASTRUCTURE

3.1 TELECOMMUNICATION

There is cell phone signal in the area which can possibly be used for pump station control and data feedback.

3.2 ROADS

The R40 paved road located just to the west of the farm, running from White River to Hazyview provides excellent access to the farm.

3.3 ELECTRICITY

ESKOM power lines are available as indicated on the Map. A new connection point will need to be made to supply power to the proposed pump stations.

4 PLANNED INFRASTRUCTURE

The following bulk water infrastructure is planned for the farm, to be implemented in phases:

- Two small weirs in non-perennial streams
- Two small pump stations
- Two pipelines
- Three off channel storage dams (125 000m^3 Capacity)
- Electricity supply (Overhead Power Lines)

The location of this infrastructure is shown on the drawings in **Annexure A**.

5 HYDROLOGY

IWR Water Resources was appointed to quantify the water resources that could be harnessed on the farm by removing approximately 187 Ha of commercial forestry from the property. This water will be harvested by placing suitable water infrastructure in strategic positions on the farm. This report is given in **Annexure B**.

The table below shows how much water can be sustainably pumped from the two abstraction points (Weir 1 and Weir 2).

Catchment	Catchment area (km^2)	SFR available for pumping (m^3/annum)	Maximum pumping capacity (l/s)
Weir 2	1.17	53 800	3.5
Weir 1	3.74	125 100	10.0
Total	**4.91**	**178 900**	**13.5**

Pumping will only be allowed from November through to May in any year. The water harvested will then be stored in off-channel balancing dams. These dams will be built in an existing forestry plantation. The recommended storage is 125 000m^3.

It is important to note that the above estimates are not guaranteed and are based on the hydrology information available. Implementation may change depending on the flows observed in time.

If possible, these flows, although possibly unrepresentative this year due to above normal rainfall, should be measured to confirm that the assumptions are correct.

6 BULK WATER SUPPLY PLAN

The bulk water supply plan is planned to be implemented as follows:

- Phase 1:
  - Weir 2
  - Pump Station 2
  - Pipeline 2 (ND160 Pipeline from Weir 2 to Balancing Dam 1)
  - 1 x 40 000m3 Off Channel Balancing Dam 1
  - Power Supply to Weir 2
- Phase 2:
  - Weir 1
  - Pump Station 1
  - Upgrade Pump Station 2
  - Pipeline 1 (ND160 Pipeline from Weir 1 – Weir 2)
  - 1 x 40 000m3 Off Channel Balancing Dam 2
  - Pipeline linking Dam 1 and Dam 2
  - Power Supply to Weir 1
- Phase 3:
  - 1 x 40 000m3 Balancing Dam 3
  - Pipeline linking Dam 2 and Dam 3

7 BULK WATER SUPPLY COMPONENTS

7.1 WEIRS

Two weirs will be constructed as broad crested weirs, with buttresses for support using reinforced concrete. The weirs will be a maximum of 3m high and will have the following characteristics, given in the table below.

	Weir 1	**Weir 2**
Phase Implemented	2	1
Estimated Crest Height	885	939
Estimated Capacity at FSL (m^3)	1053	1482
Estimated Surface Area at FSL (m^2)	1090	1453
Maximum Weir Height (m)	3	3
Flood Recurrence Interval Allowed Over Weir	1:10 years	1:10 years
Design Flow Allowed over Weir (m^3/s)	22	7
Spillway Width and Overflow Depth	20m wide, 0.8m depth	13m wide @ 0.5m depth

Each weir will have an outlet pipe to release the EWR downstream. On 2 February a site inspection was held to have a look at the weir positions and identify suitable founding material. Good bed rock was found at both weir sites. The weirs will be founded on this bedrock. See photos taken during the site inspection in Annexure C. A typical drawing of a weir is shown in Annexure A

7.2 PUMP STATIONS

Two small pump stations will be constructed to house the electrical equipment required for the project. Due to their high efficiency at low flows, submersible pumps will be used. These will be placed in the weirs at suitable positions.

Each pump station will have the following characteristics:

	Pump Station 1	**Pump Station 2**	
Phase Implemented	2	1	
Pumping Route	Weir 1 – Weir 2	Weir 2 – B/Dam 1	
Building Size (m^2)	4	4	
PS2 Initial Flow = W2 Flow PS2 Final Flow = W1+ W2 Flow		Initial Flow Phase 1	Final Flow Phase 2
Max Pump Flow (l/s) (Hydrology Report)	10	3.5	13.5
Selected Pump Flow (l/s)	**13.2**	**6.3**	**19.5**
Pump Head (m)	65	110	115
Power Requirement (kW)	11	11	30
Estimated Pumping Hours (h/annum)	2632	2597	2621

The selected pump flow is larger than that proposed maximum flow rate in the Hydrology Report due to the following:

- Weir 1
  - At a flow rate of **10l/s**, there are not enough pumping hours available in the month to pump the available water for the months of February and March. These are the two critical months where the most water is theoretically available for pumping.
  - It is recommended that the flow rate be increased to **13.2l/s**. This flow rate is then enough to pump all the water available in those months within the time available.
- Weir 2
  - At a flow rate of **3.5l/s**, there are not enough pumping hours available in the month to pump the available water for the months of January, February and March. These are the three critical months where the most water is theoretically available for pumping.
  - It is recommended that the flow rate be increased to **6.3l/s**. This flow rate is then enough to pump all the water available in those months within the time available.

For their better efficiencies, submersible pumps will be installed. It is expected that a 50kVa transformer will be required for these two pump stations.

7.3 PIPELINES

Four bulk water supply pipelines will be installed in phases on the property. The pipelines will follow existing roads, minimizing disturbance to the natural environment.

The pipelines will have the following characteristics:

	Pipeline 1	Pipeline 2
Phase Implemented	2	1
Pipeline Length (m)	525	1080
Pipeline Diameter	ND 160	ND 160

Pipelines 3 and 4 will be gravity pipelines running between the balancing dams. These will be sized as these dams are constructed.

7.4 OFF CHANNEL BALANCING DAMS

Three 40 000m^3 HDPE lined off channels balancing dams will be constructed on the property, in phases. The dams will be not classified as dams with a safety risk as they fall outside the qualifying criteria, which is as follows:

- Volume greater than 50 000m^3 **AND**
- A wall height of 5m.

The dams will be constructed in existing forestry blocks, which will be removed. The areas earmarked for the dams have deep red soils, suitable for the construction of dams. The dams will be designed to have balanced cut to fill, meaning that no material will need to be imported to construct the dam. A typical drawing of a balancing dam to be constructed is shown in Annexure A

7.5 POWER SUPPLY

The power supply options for the farm and pump stations are as follows:

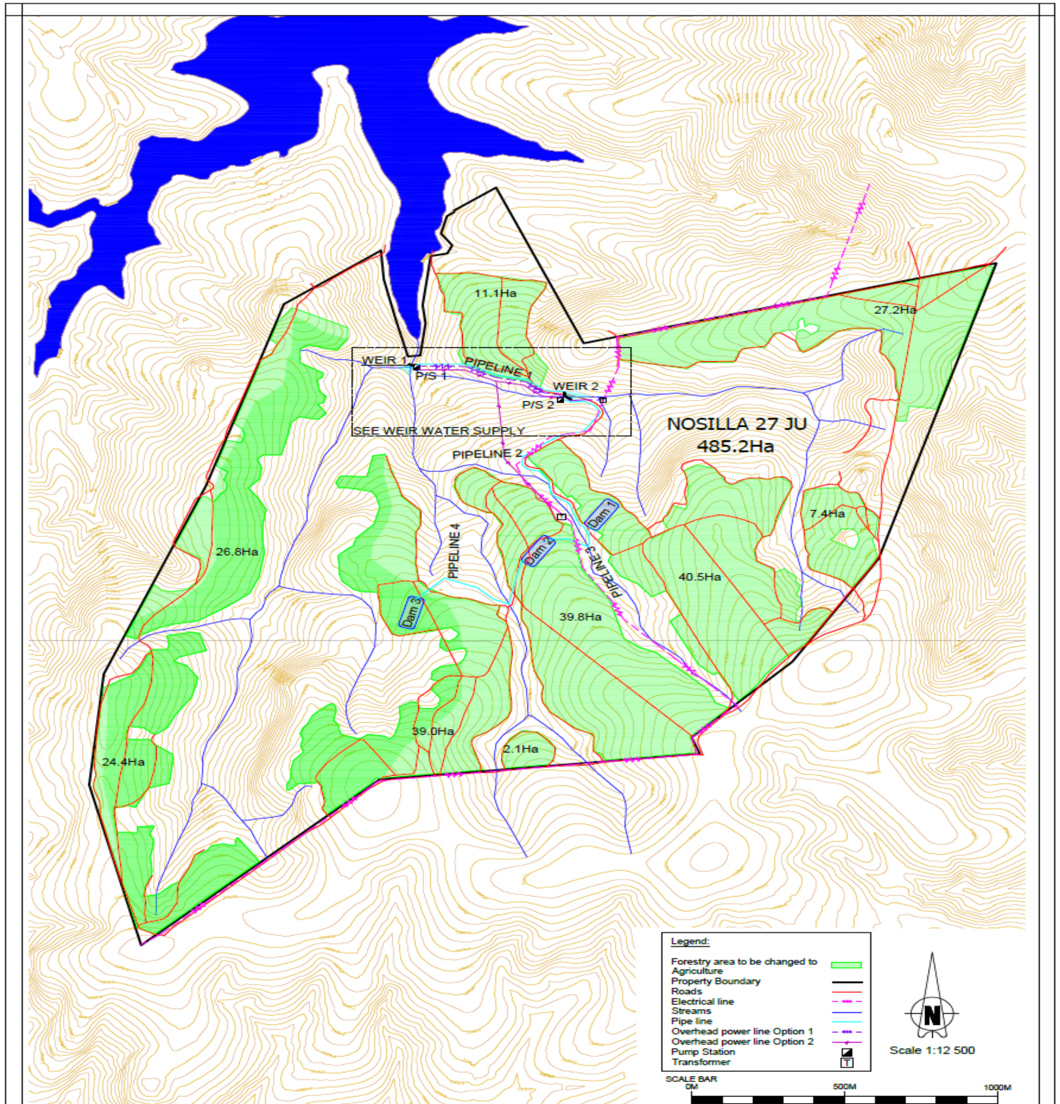
- Option 1:
    - Apply for a 50kVa point close to weir 2 on the existing power line. Construct a private overhead powerline running from the offtake point to weir 2, and onto weir 1. This options implies that a second power point, still to be determined, will be installed at the balancing dams to supply power to the pump stations there,
- Option 2:
    - Apply for one large power point, still to be determined, close to the balancing dams. Construct a new private overhead powerline running directly down the hill, then splitting and going to each pump station. This will enable only a single power point on the farm, saving on monthly connection fees, when no pumping is occurring at the weirs.

It is recommended that provision is made for both options in the EIA.

8 CONCLUSION

This engineering planning report forms a good understanding of the development to come. It provides information for the formulation of a development strategy. This plan will be incorporated in to the long term Bulk Water Master Plan. Water security will add to the value and profitability of this farming enterprise.

B Marx Pr Eng
MBB Consulting Services (Nelspruit) (Pty) Ltd



PIETER DU PREEZ

NOSILLA

BULK WATER SUPPLY

USE : FOR INFORMATION ONLY			
Drawn	A. Cronje	Surveyed	
Date	February 2021	Designed	JvR
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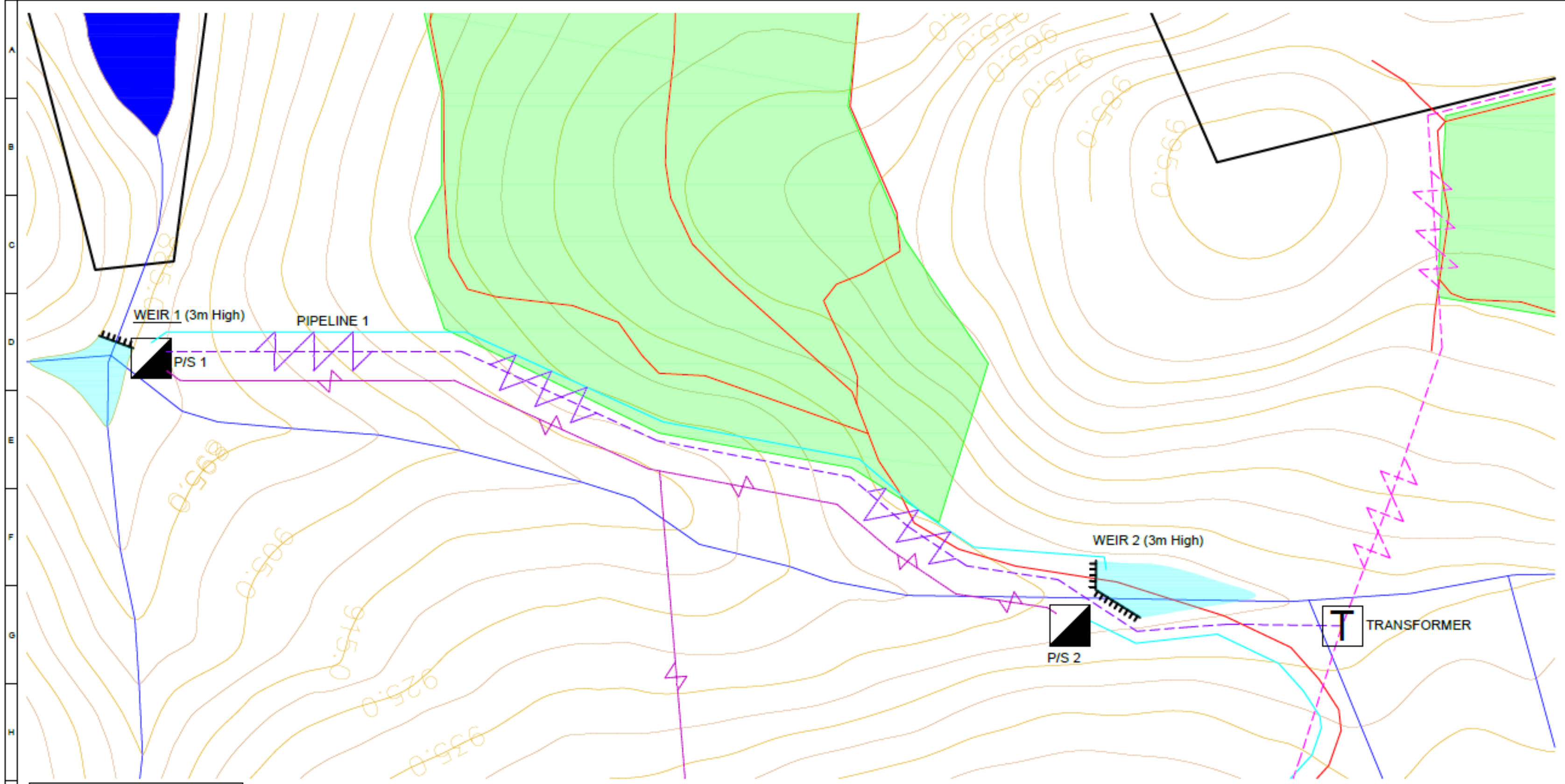
A3



Legend:

- Forestry area to be changed to Agriculture
- Property Boundary
- Roads
- Electrical line
- Streams
- Pipe line
- Overhead power line Option 1
- Overhead power line Option 2
- Pump Station
- Transformer

Weir	Co-ord	Capacity
1	25° 9'52.72"S 31° 1'7.48"E	1053

Weir	Co-ord	Capacity
2	25° 9'56.96"S 31° 1'25.36"E	1482

Pipeline	Length	Static Head
1	525m	54m
2	1078m	95m

Scale 1:2 000

SCALE BAR 0M 100M 200M

PIETER DU PREEZ
NOSILLA
WEIR WATER SUPPLY

USE : FOR INFORMATION ONLY			
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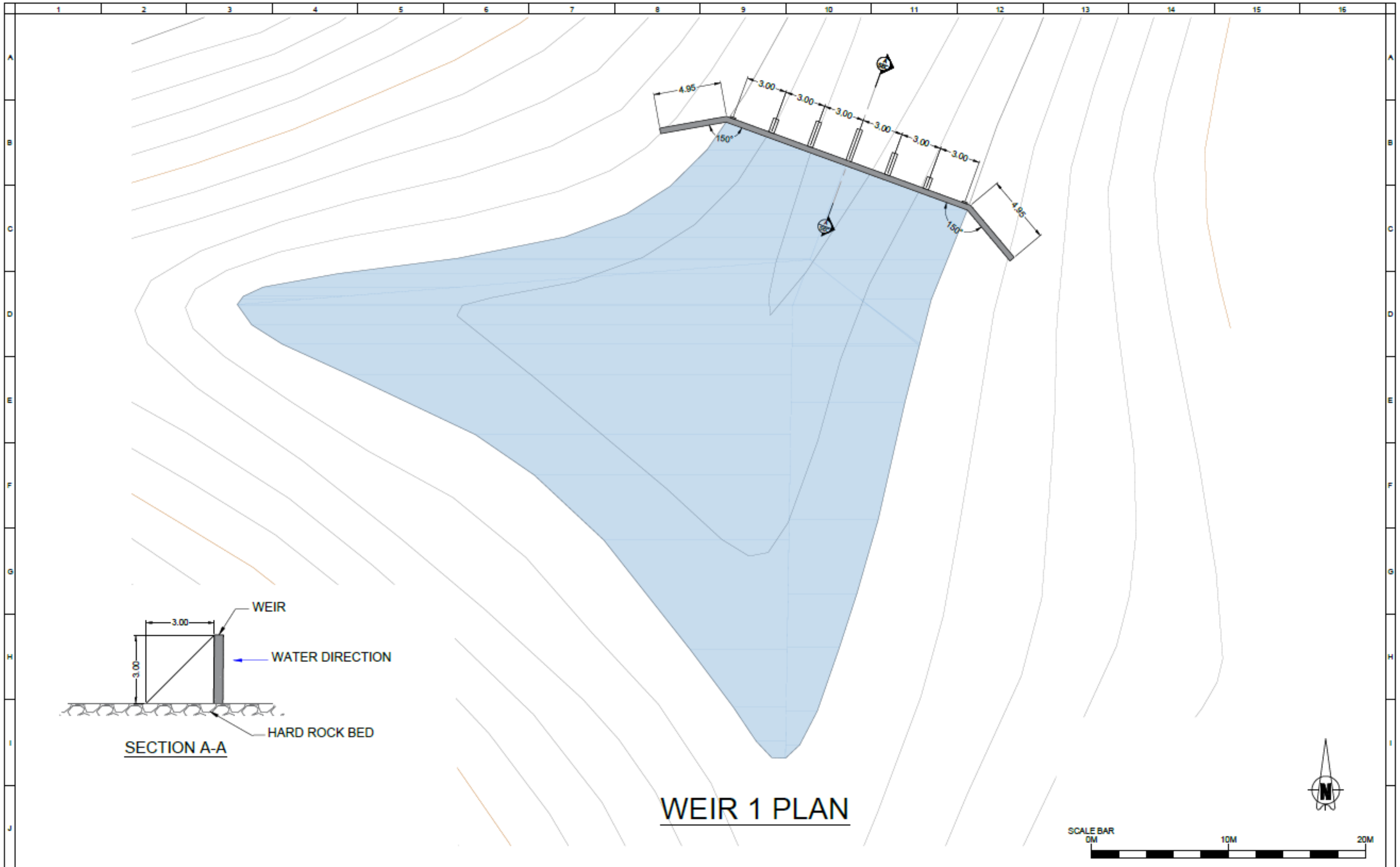

PIETER DU PREEZ
NOSILLA
WEIR 1 PLAN

USE : FOR INFORMATION ONLY			
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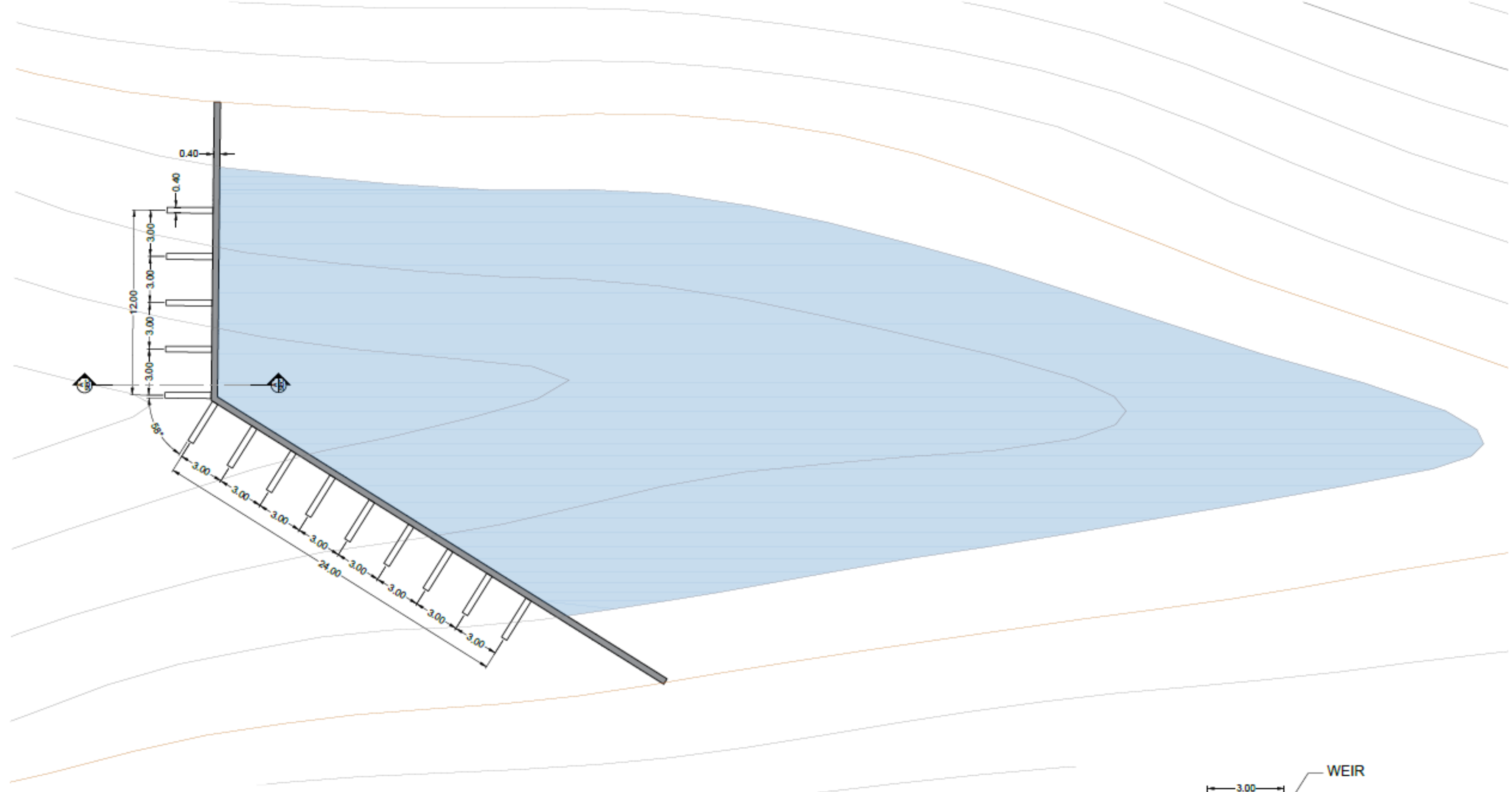
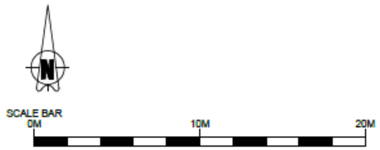
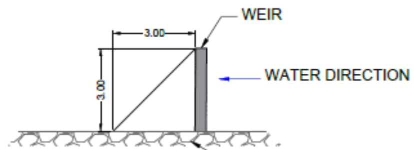




WEIR 2 PLAN



SECTION A-A

PIETER DU PREEZ
NOSILLA
WEIR 2 PLAN

USE : FOR INFORMATION ONLY

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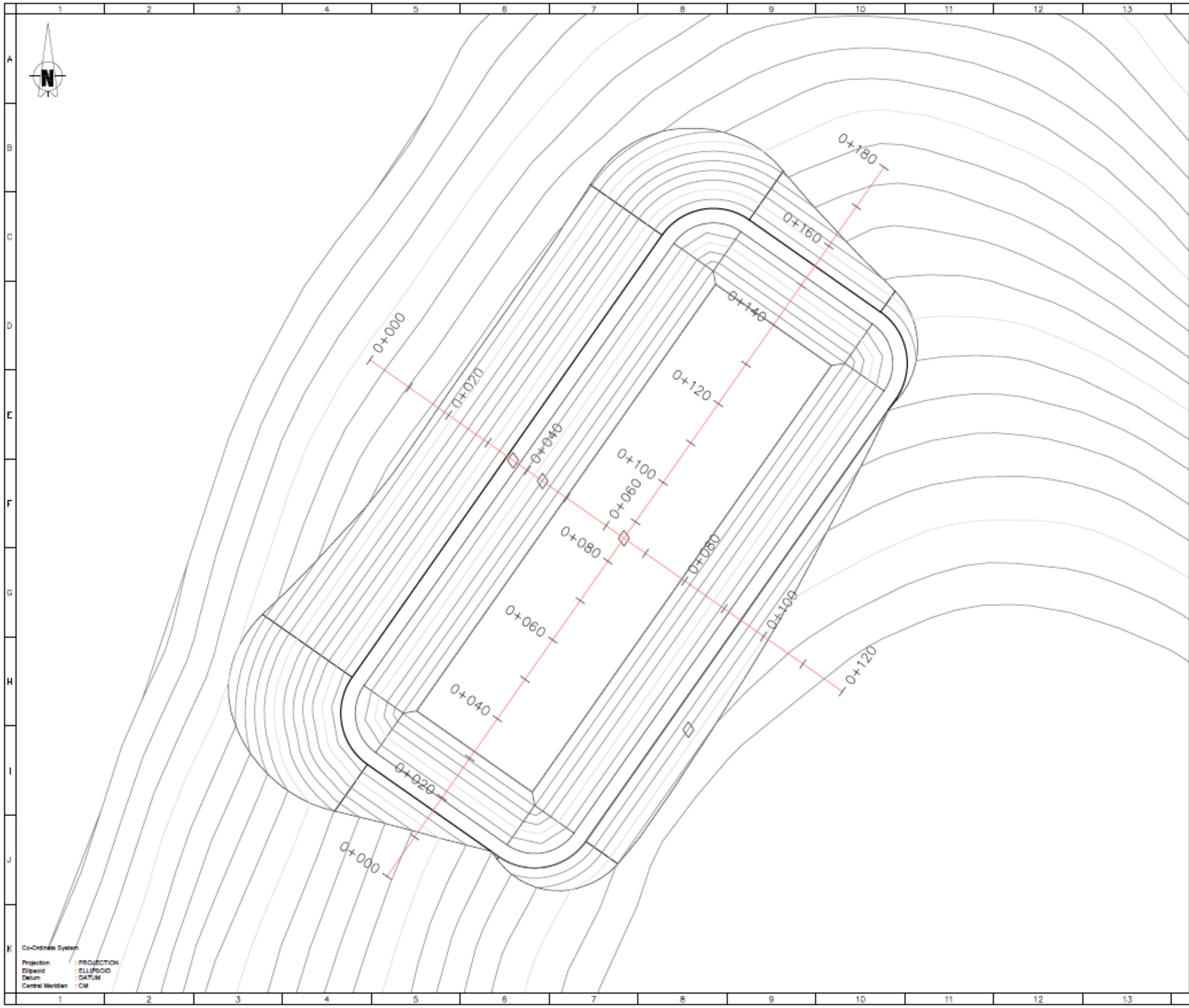

SCALE BAR

Rev.	Date	Grid	Description	By	Chkd

Revisions

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Civil, Agricultural, Structural, Environmental, Project Management

For MBB CONSULTING ENGINEERS (NEL)

Pr Eng .... Date ....

NOSCILLA 27JU

BALANCING DAM

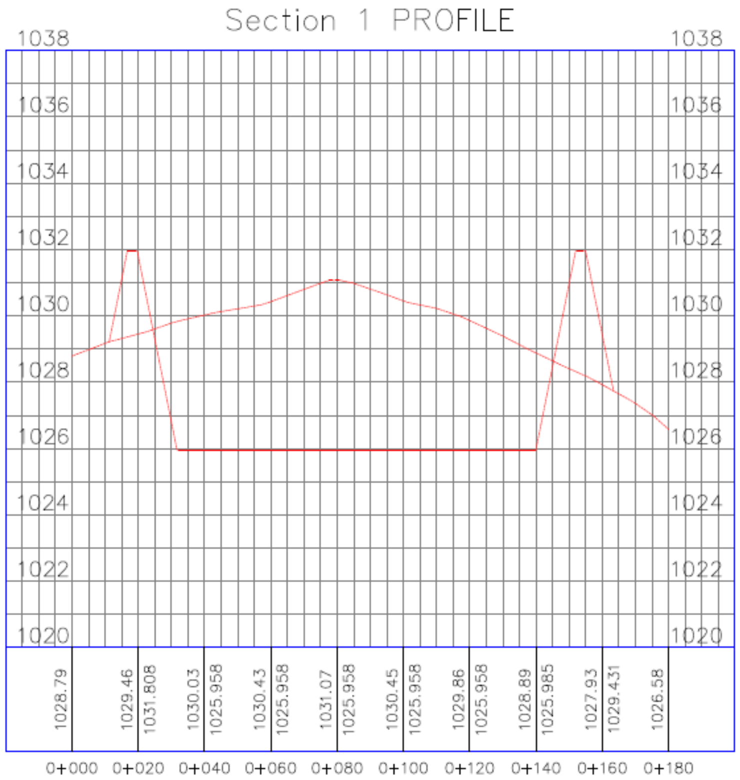
TYPICAL PLAN DRAWING

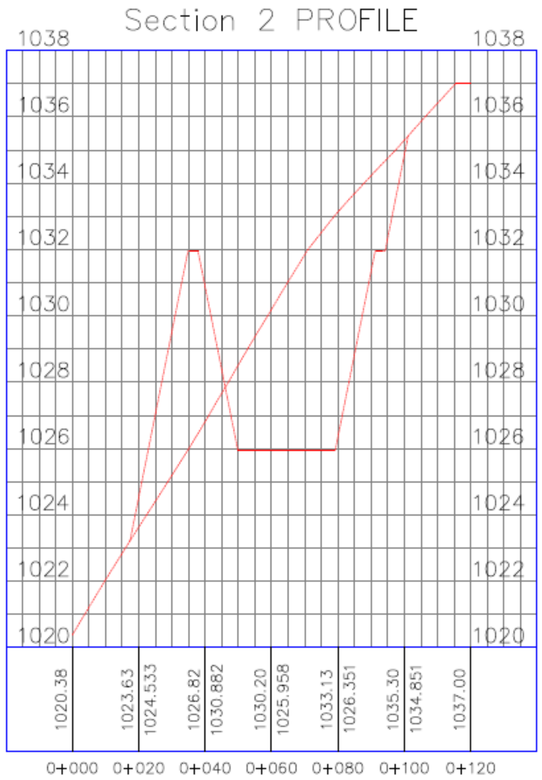
USE : FOR INFORMATION ONLY

Drawn	B. MARX	Surveyed	
Date	Feb 2021	Designed	B. MARX
Scale	1:750	Checked	

DRAWING NUMBER: N 1 9 4 9 5 0 0

A3





Co-Ordinate System

Projection : PROJECTION
Ellipsoid : ELLIPSOID
Datum : DATUM
Central Meridian : CM

SCALE BAR

Rev.	Date	Grid	Description	By	Chkd

Revisions

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CONSULTING ENGINEERS
(NELSPRUIT)

For MBB CONSULTING ENGINEERS (NEL)

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NOSCILLA 27JU

BALANCING DAM

TYPICAL SECTIONAL DRAWING

USE : FOR INFORMATION ONLY

Drawn	B. MARX	Surveyed	
Date	Feb 2021	Designed	B. MARX
Scale	1:1250	Checked	

DRAWING NUMBER: N 1 9 4 9 6 0 0

A3

Photo 1: Weir 1 Site

Photo 2: Weir 2 Site. See Bedrock on Surface

APPENDIX 4.4.2.
WATER RESOURCES ANALYSIS OF A FORESTRY TO IRRIGATION CONVERSION ON THE PROPERTY NOSILLA 27 JU

Water Resources Analysis of a Forestry to Irrigation Conversion on the property Nosilla 27JU, Mpumalanga

January 2021

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ABREVIATIONS AND ACRONYMS

DWS	Department of Water and Sanitation
DWA	Department of Water Affairs
EWR	Ecological Water Requirement
Ha	Hectare
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MAE	Mean Annual Evaporation
m^3/annum	Cubic metres per annum

1 INTRODUCTION

IWR Water Resources were appointed by Mr Pieter du Preez to quantify the water resources that could be harnessed on the farm Nosilla 27 JU from removing approximately 187 ha of commercial forestry from the property. See Figure 1.1. Removal of the forestry will increase the runoff which can either be abstracted directly or stored in an off-channel dam. In the case of this development, two small weirs will be constructed from which water will be pumped to off-channel storage with a combined storage of 150 000 m^3. The location of the proposed weirsare shown in Figure 1.2.

The intention is to utilise the water to irrigate Blueberries, Ginger and Macadamias.

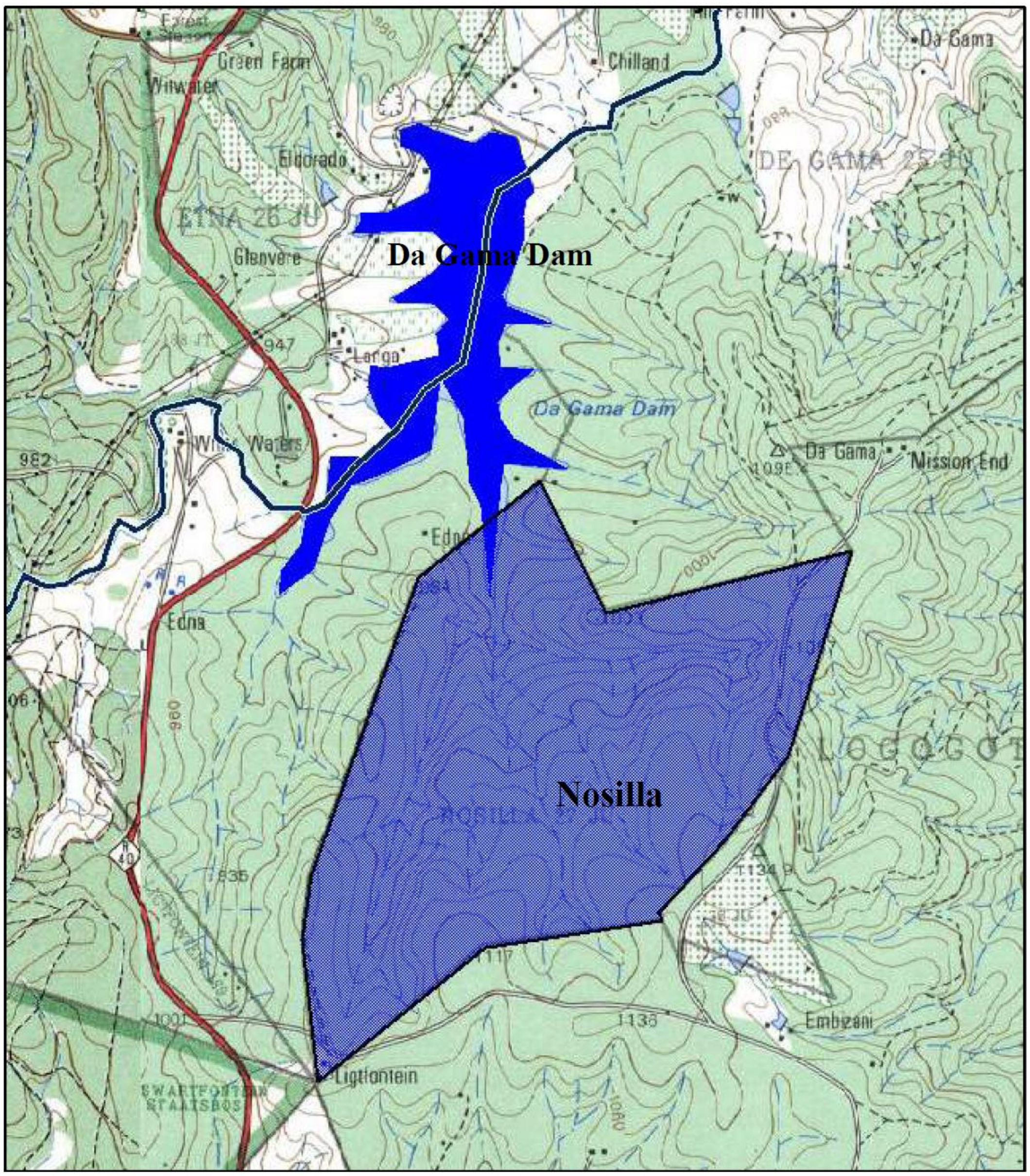


Figure 1.1: Location of the farm Nosilla 27 JU

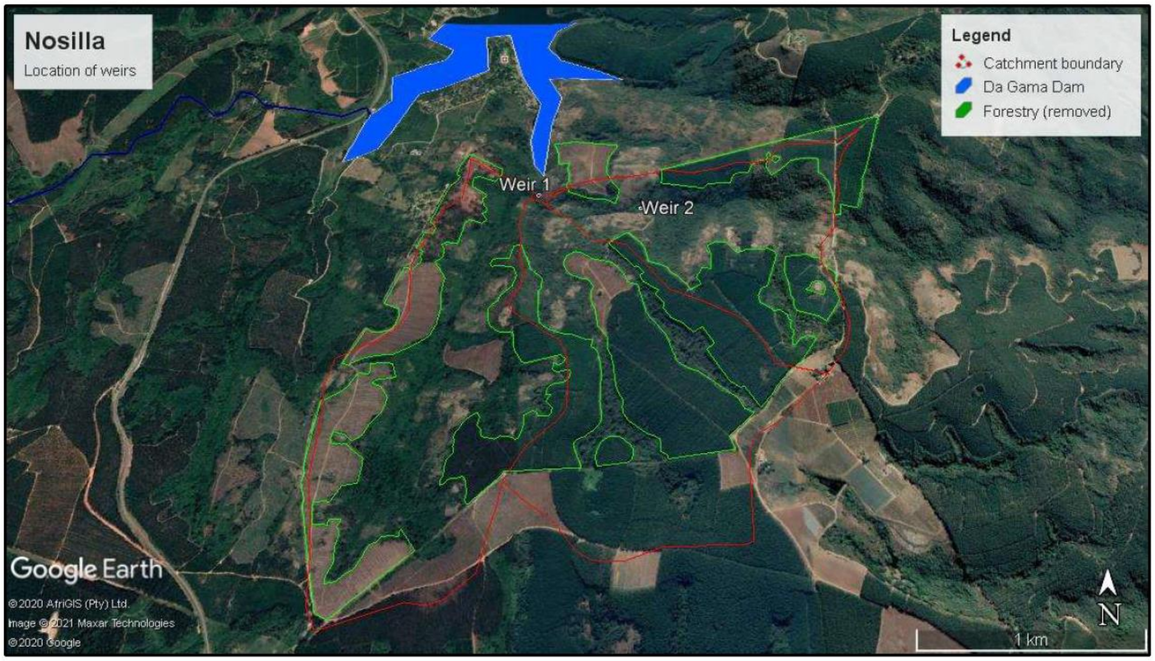


Figure 1.2: Location of proposed weirs

The analysis of how much water could become available through this process was carried out with a water resources model and conducting what is generally referred to as a, Yield Analysis. A Yield Analysis determines how much water can be abstracted from a dam (or river) on a sustainable basis. For domestic use this would be done assuming a high assurance of use, typically 98%, which means that users should obtain all the water they required 98% of the time. Irrigators typically receive their water at a lower assurance of 70 to 80%. Since the water will be used for irrigation the yield was calculated at 80% assurance.

2 HYDROLOGICAL AND CATCHMENT INFORMATION

The farm Nosilla 27 JU is located in the X31H-2 quinary catchment on a tributary of the White Waters River, which is a tributary of the Sabie River. See Figure 2.1. The relevance of this is that water resources and hydrological information is readily available at quaternary and quinary catchment scale from the IWAAS study (DWA, 2009). This information was used in a water resources simulation to estimate how much water could be abstracted from the river.

The hydrological information for the X31H-2 catchment is summarized in Table 2.1.

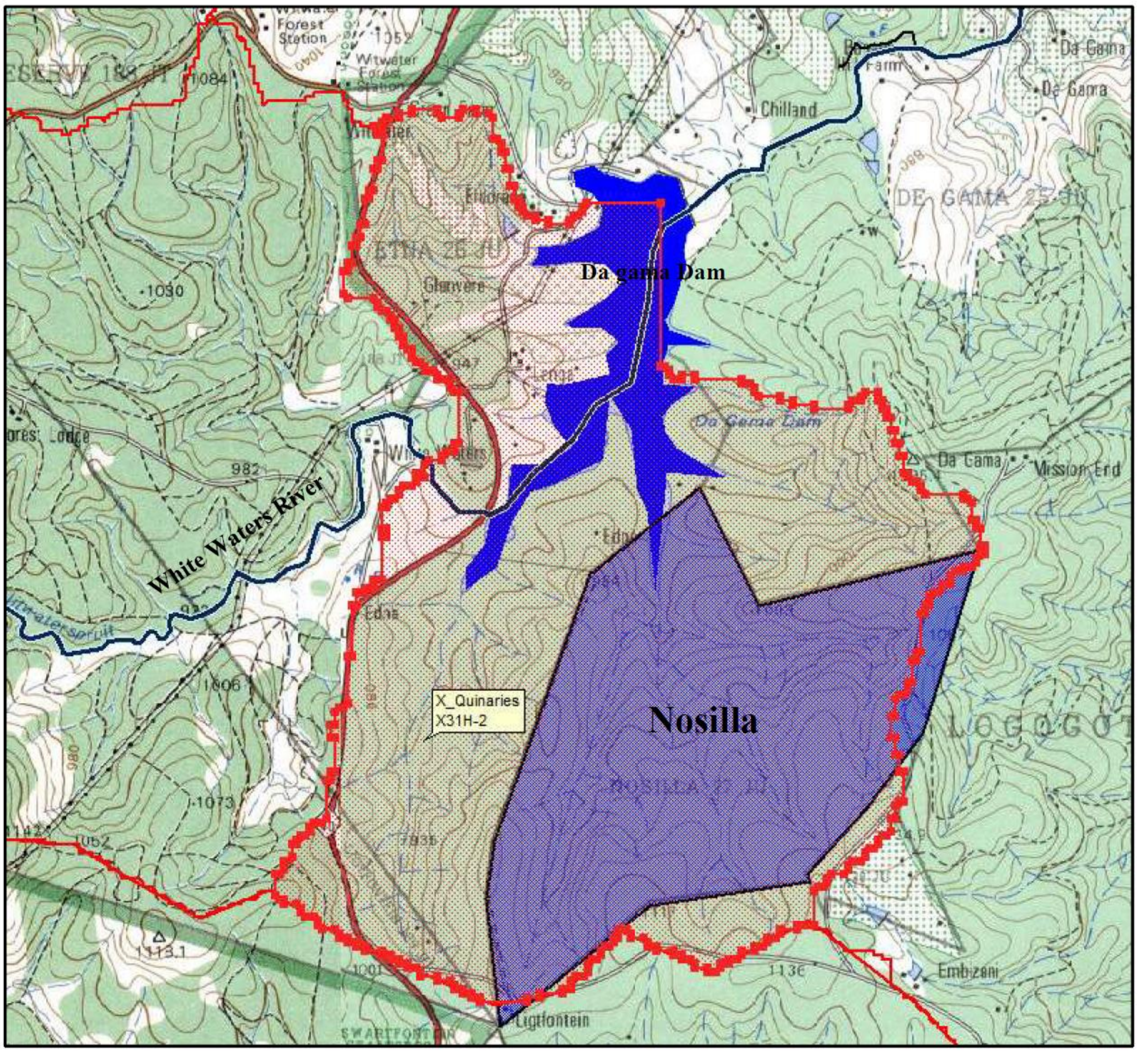


Figure 2.1: Location of the farm Nosilla catchment within the X31H-2 quinary catchment

Table 2.1: Summary of climate and hydrology information for the X31H-2 catchment

Catchment	Area (ha)	Mean Annual Evaporation (mm)	Mean Annual Precipitation (mm)	Mean Annual Runoff (million m^3/annum)
X31H-2	13.7	1 400	1 178	3.54

3 WATER RESOURCES ANALYSIS

3.1 Determination of natural flow

It is accepted practice when dealing with ungauged sub-catchments within a quaternary catchment t scale the natural hydrology for the quaternary catchment linearly. This is demonstrated below.

X31H-2 catchment area: 13.7 km^2

Catchment area of weir 1: 3.74 km^2. See Figure 3.1
Catchmetn area of weir 2: 1.09 km^2.

X31H-2 MAR: 3.54 million m^3/annum

Natural MAR at Weir 1 = (3.74/13.7) x 3.54
= 0.97 million m^3/annum

Natural MAR at Weir 2 = (1.09/13.7) x 3.54
= 0.28 million m^3/annum

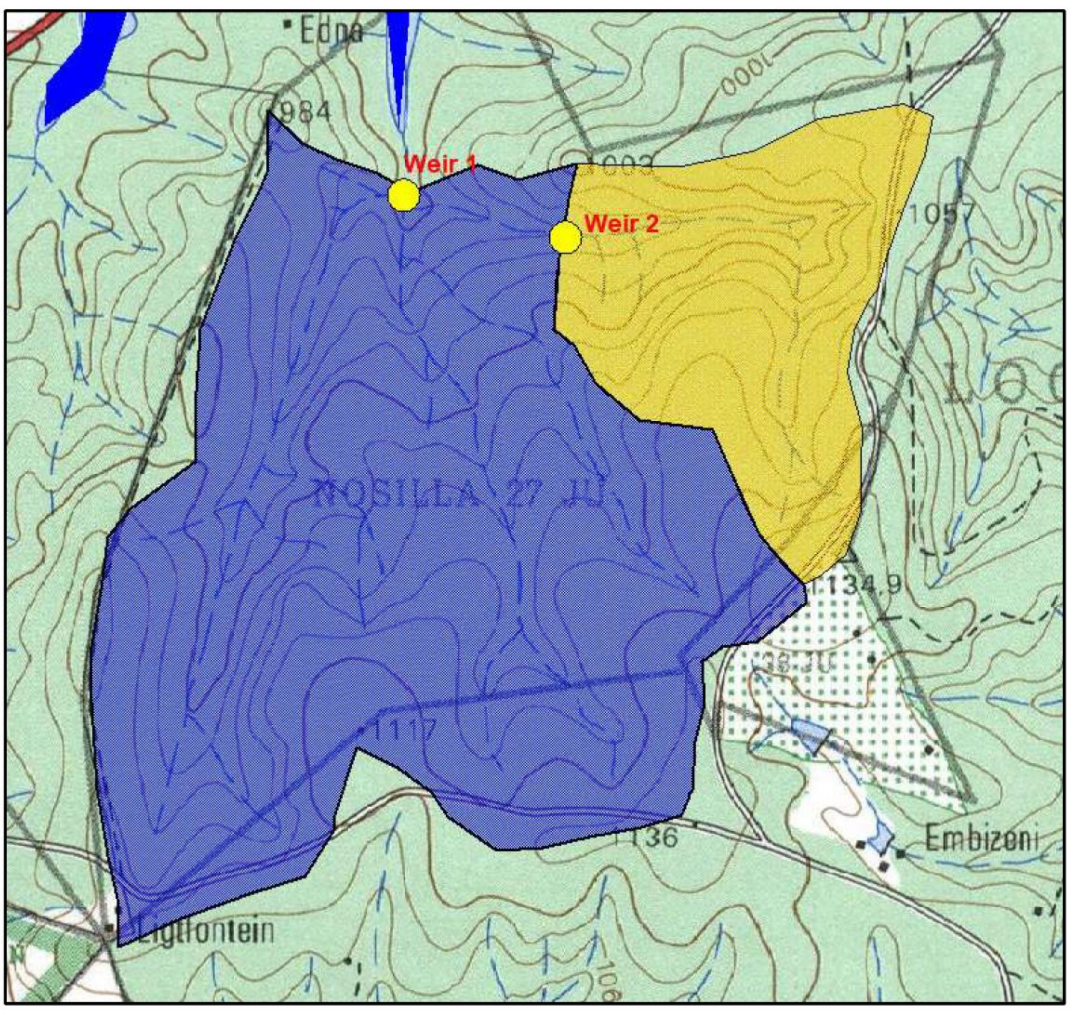


Figure 3.1: Weir catchments

The time series of the natural runoff into the two weirs is shown in Figure 3.2. It is important to note the high variability in the flow. This is due to the seasonal rainfall, with high rainfall in summer and very little rain in winter. Figure 3.3 shows the monthly distribution of the natural flow.

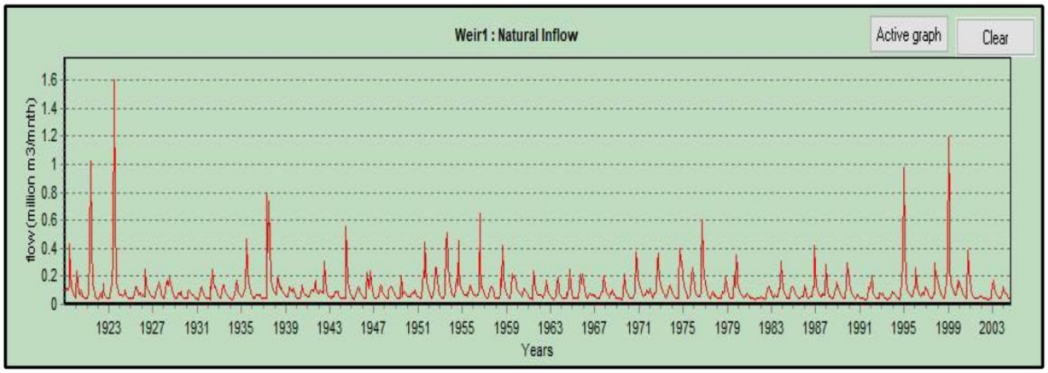


Figure 3.2: Natural flow time series at the abstraction point

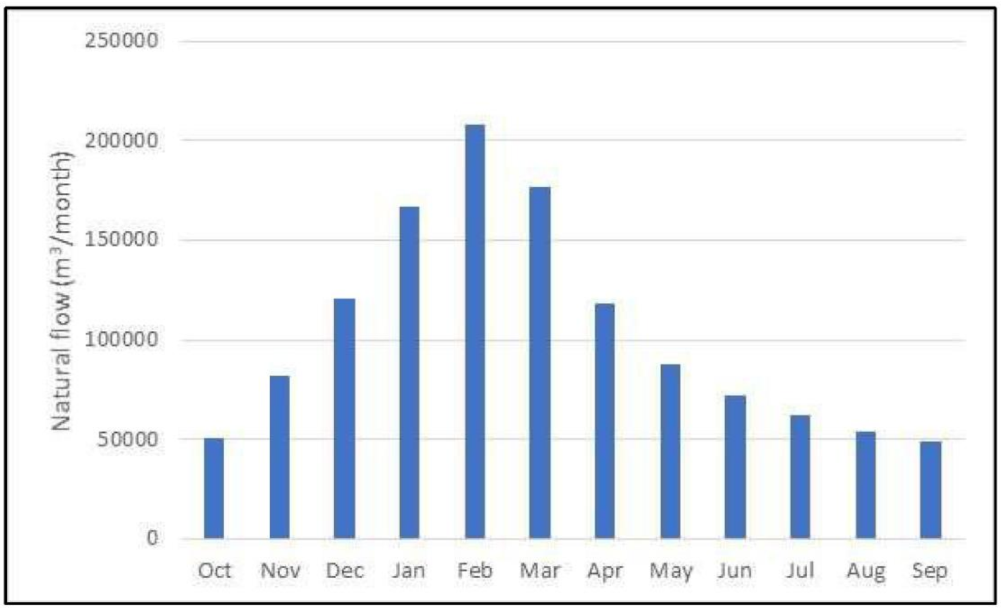


Figure 3.3: Monthly distribution of the natural flow at the abstraction point

3.2 Ecological water requirements

The Ecological Water Requirements (EWR) of the Sabie River catchment have been determined and published in the Government Gazette. While there is no specific EWR requirement for the White Waters River or its tributaries. However, it is possible to extrapolate the EWR determined for the Sabie River to the catchment of the abstraction point based purely on hydrological aspects. This was done using the Hughes Desktop Model (Hughes and Hannart, 2003).

Assuming a C Class for the ecological status of the catchment, which implies a partially developed catchment, the EWR requirement was estimated to be 31% of the natural runoff, that is, 1.31 million m^3/annum ***on average***. The EWR is however not a constant flow but varies with the natural flow. Figure 3.4 shows the EWR and the Natural flow on the same axis in order to demonstrate this point.

The EWR Class B/C Rule curve applicable at the abstraction X31H-2 catchment is attached as Appendix A. The EWR for the abstraction point was scaled down according its catchment area relative to that of the X31H-2 quinary catchment.

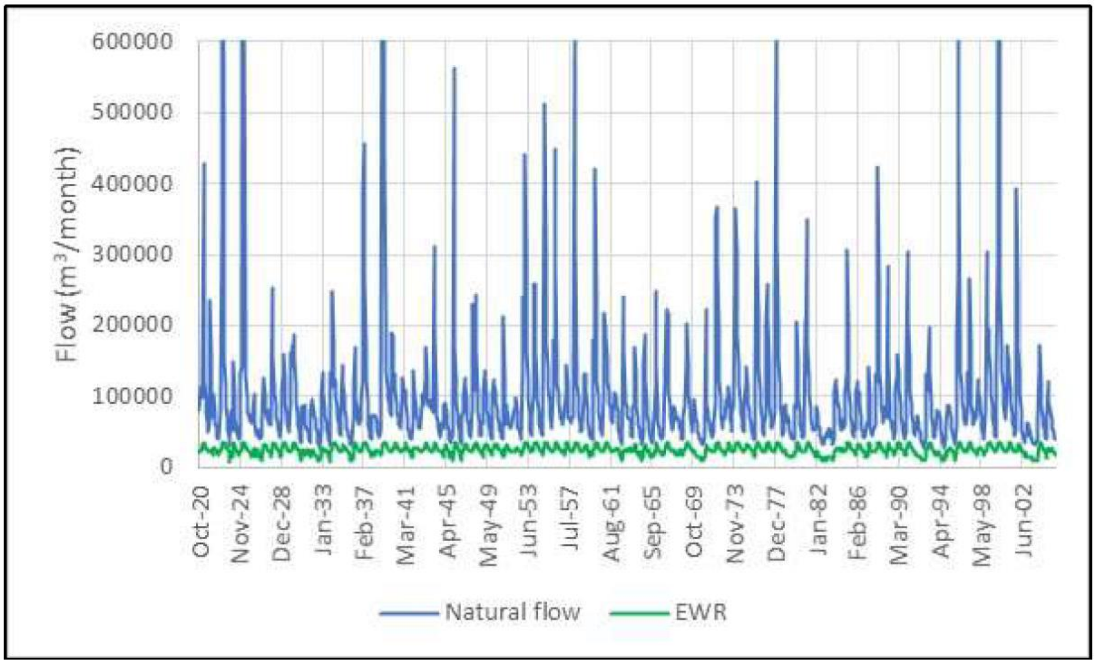


Figure 3.4: Time series of the Ecological Water Requirements compared to natural flow

While the EWR, as described above, was used to estimate the yield of the two dams based on the increased flow due to the removal of forestry, it would be unrealistic to expect a farmer to determine and implement EWR releases on a monthly basis. A simpler approach is therefore suggested in which the EWR is simplified to 12 monthly values equivalent to the 80 percentile of the EWR requirement. See Table 3.1.

Table 3.1: Simplified EWR release in m^3 based on the 80 percentile requirement

Month	Weir 2	Weir 1
January	6 000	19 011
February	6 967	21 134
March	7 071	21 936
April	6 843	21 228
May	6 642	20 474
June	6 013	18 398
July	5 571	17 549
August	5 143	16 086
September	4 769	14 152
October	4 500	13 893
November	4 769	14 152
December	5 143	16 086

4 YIELD ANALYSIS

4.1 Water-use in the catchment

It is a well-established fact that exotic plantations such as Pine and Eucalyptus reduce the natural runoff from a catchment in most South African catchments (Gush et al, 2002). The reason for this is that exotic plantations, which are evergreen, replace natural grasslands or savanna which is mostly deciduous. Also, indigenous grass has shallow roots and cannot access much of the soil moisture, while exotic trees, and especially Eucalyptus, have deep roots which can access much more soil moisture than indigenous grass and shrubs. Large trees with well-developed canopies also intercept much more rainfall than short grass or small indigenous shrubs and trees. This increased rainfall interception also reduces runoff from the natural state.

This topic of reduction in runoff has been studied in detail over many years and is recognized in the National Water Act of 1998 as a water use – referred to as ***Streamflow Reduction (SFR)*** and a water use license is required in order to undertake a streamflow reduction activity. To date, only commercial forestry has been declared a streamflow reduction activity.

Since the forestry located on the farm Nosilla 27 JU is an existing lawful streamflow reduction activity the water that becomes available from removing the forestry can be used for a different purpose, for example: irrigation. Figure 4.1 shows the location of the forestry to be removed. The area to be removed was estimated to be 185 ha with a streamflow reduction of 187 035 m^3/annum.

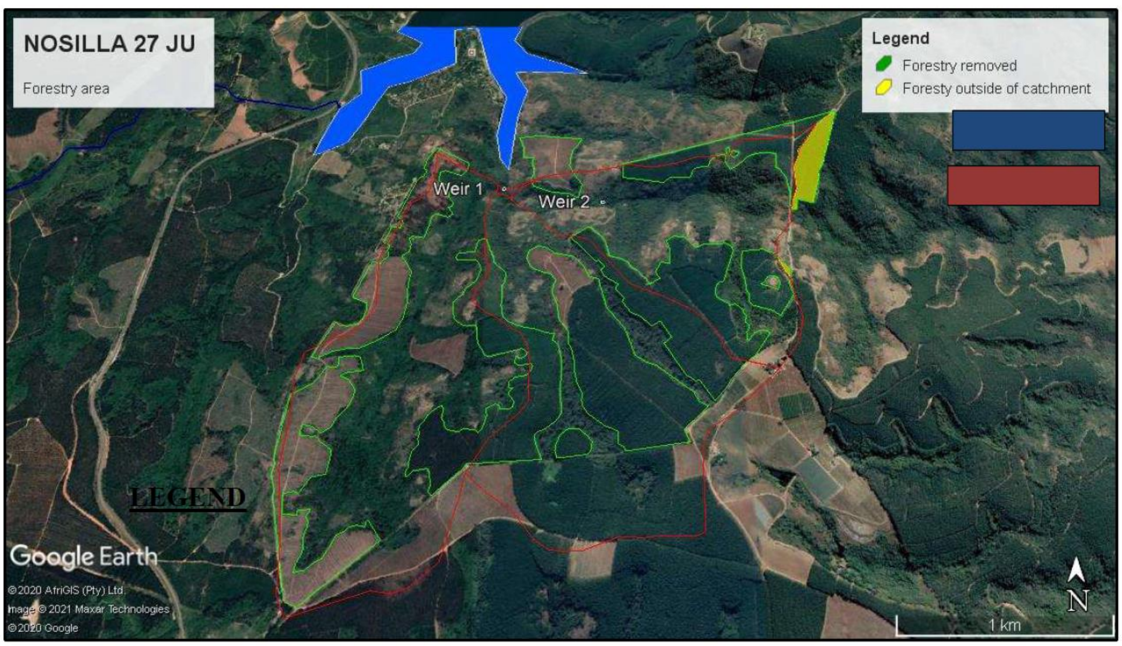


Figure 4.1: Forestry within the catchment of the proposed dam site

Note that there is a small area of forestry on the north-east boundary of the farm which lies in the catchment of Noord-Sand River. It will not be able to harness the increased runoff from this area, estimated to be 7.7 ha, from either of the two proposed abstraction points and has therefore been excluded from the analysis. The affective area of forestry is therefore 177.3ha with a streamflow reduction of 178 900 m^3/annum.

Streamflow reduction is highly variable, approximately following the pattern of natural flow. See Figure 4.2 which shows a time series of the SFR of 178 900 m^3/annum (177ha). Water use for irrigation, on the other hand, is generally more uniform, with water required throughout the year. The conversion of streamflow reduction to a water use must therefore be carried out with caution so as not to impact on downstream users or the ecological water requirement.

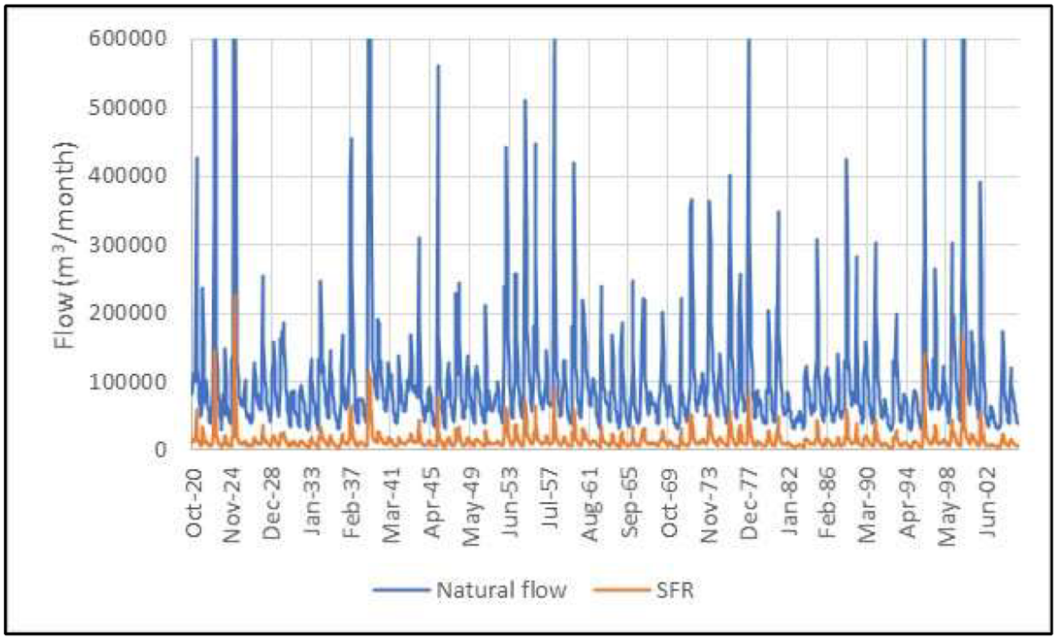


Figure 4.2: Streamflow reduction and natural flow

4.2 Conversion of SFRA to yield for irrigation

It is a well-established fact that exotic plantations such as Pine and Eucalyptus reduce the natural runoff from a catchment in most South African catchments (Gush et al, 2002). The reason for this is that exotic plantations, which are evergreen, replace natural grasslands or savanna which is mostly deciduous. Also, indigenous grass has shallow roots and cannot access much of the soil moisture, while exotic trees, and especially Eucalyptus, have deep roots which can access much more soil moisture than indigenous grass and shrubs. Large trees with well-developed canopies also intercept much more rainfall than short grass or small indigenous shrubs and trees. This increased rainfall interception also reduces runoff from the natural state.

This topic of reduction in runoff has been studied in detail over many years and is recognized in the National Water Act of 1998 as a water use – referred to as ***Streamflow Reduction (SFR)*** and a water use license is required in order to undertake a streamflow reduction activity. To date, only commercial forestry has been declared a streamflow reduction activity.

Since the forestry located on the Nosilla property is an existing lawful streamflow reduction activity, the water that becomes available from removing the forestry can be used for a different purpose, for example, irrigation. However, the monthly distribution of the increased runoff due the removal of the forestry the crop water requirements is very different, with the increased runoff occurring mostly in summer while the irrigation requirement is in spring. See Figure 4.3.

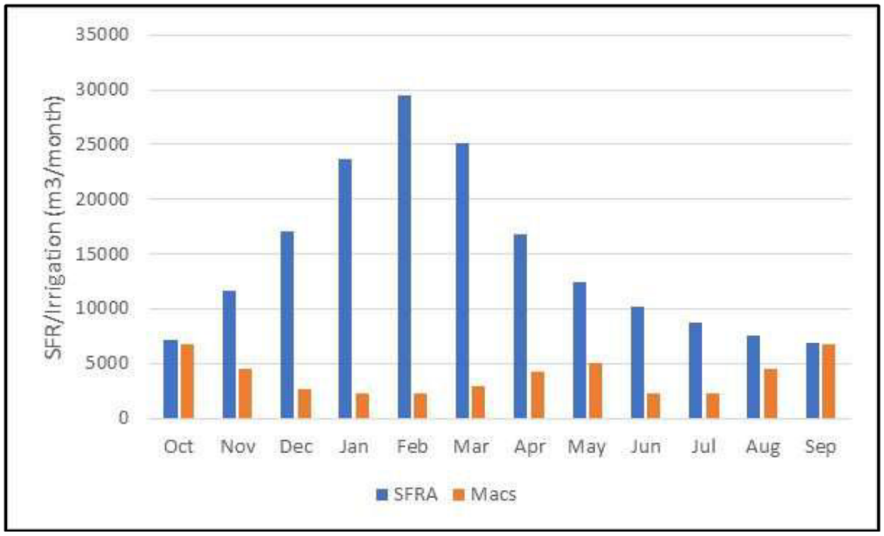


Figure 4.3: Monthly distribution of SFR and Irrigation requirement

This counter-seasonality problem can be overcome by providing storage, either in-stream of off-channel, to store the high summer flows for use early in spring. Due to the negative environmental impact of in-stream storage, off-channel storage of 150 000 m^3 is being constructed on the farm to store the water.

The method used to estimate how much water can be made available by pumping the increased runoff due to forestry removal to off-channel dams is to carry out a Yield Analysis. For simple situations involving a single catchment this can be done using an Excel spreadsheet while more complex situations require a water resources model. The Water Resources Modelling Platform (WReMP) (Mallory et al, 2013) was used for this particular analysis. In its simplest terms the analysis entails determining how much water can be abstracted sustainably (referred to as yield) from the dam. This particular analysis for the Nosella farm allows for pumping from two locations, Weir 1 and Weir 2. The parameters for these two catchments are summarized in Table 4.1.

Catchment	**Catchment area (km^2)**	**SFR available for pumping (m^3/annum)**	**Maximum pumping capacity (l/s)**
Weir 2	1.17	53 800	3.5
Weir 1	3.74	125 100	10.0
Total	**4.91**	**178 900**	**13.5**

Based on recent feedback from the licencing authorities relating to a similar application to this, pumping of water freed up by the removal of exotic plantations will only be allowed during the high flow months so as not to reduce the low flow. Hence the recommended pumping regime is as shown in Figure 4.4.

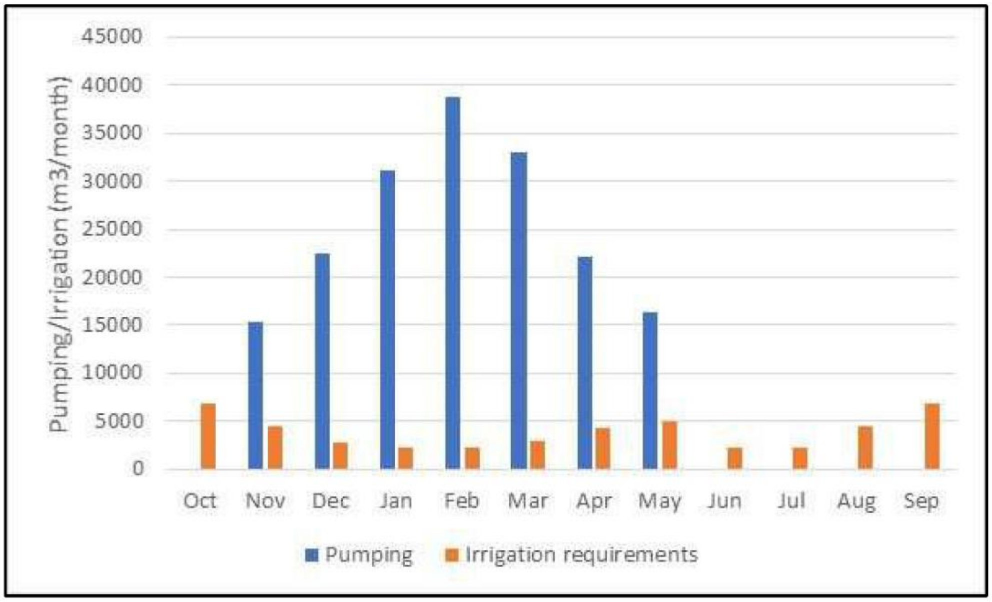


Figure 4.4: Pumping to off-channel and Irrigation Requirements

The modelled storage in the off-channel dam with a full supply capacity of 150 000 m^3 is shown in Figure 4.5 with an abstraction targeting 170 000 m^3/annum which can be supplied at 80% assurance. Note that full utilization of the dam will imply that it will usually be empty at the end of winter. During extreme droughts, such as the early 90's and 2002, the dam will be empty for several months.

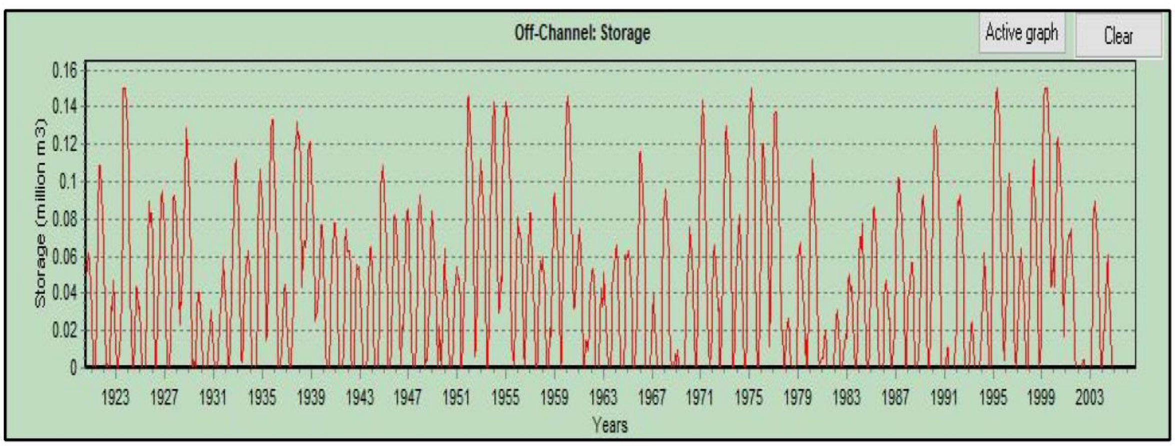
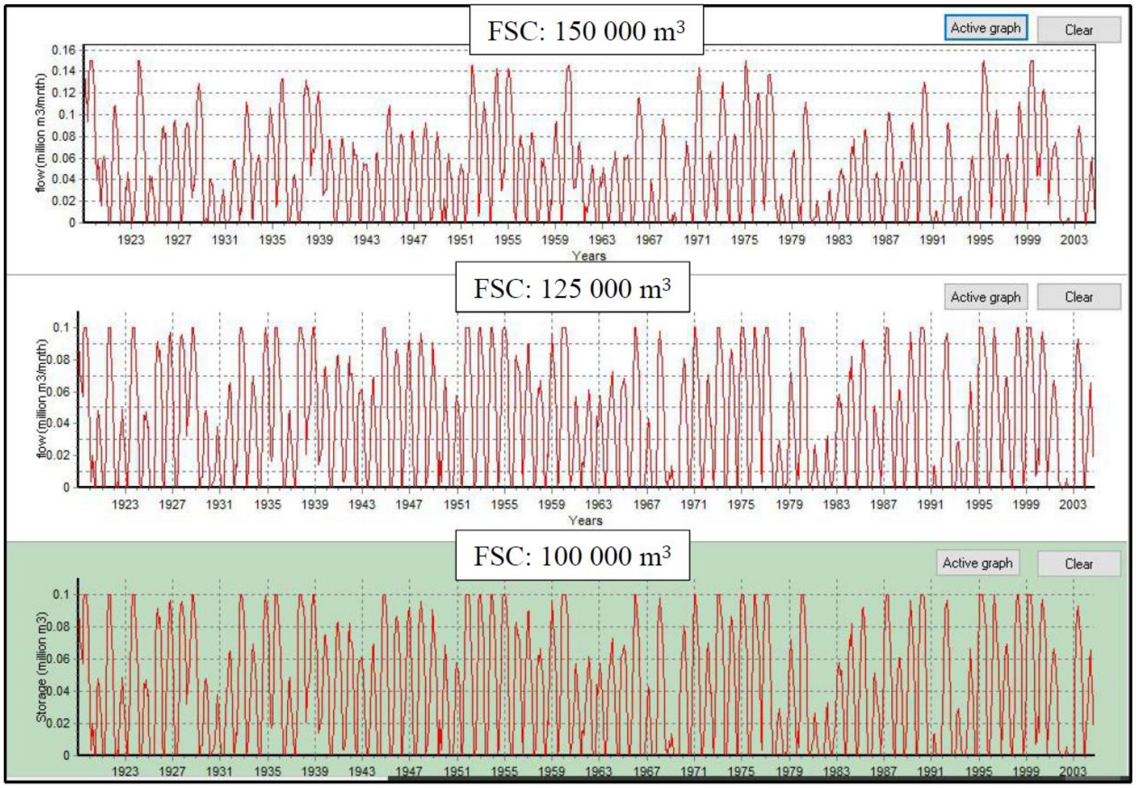


Figure 4.5: Modelled storage in a 150 000 m^3 off channel dam

4.3 Alternative off-channel dam storage

The analysis presented in section 4.2 is for a dam with a full supply capacity of 150 000 m^3. However, the simulation show that the dam will very seldom fill – not even once every decade. This would suggest that the dam is too large for the amount of water available to pump. At the request of the dam engineers, alternative full supply capacities were analysed. A dam with a full supply capacity of 125 000 m^3 will still deliver the same volume of water, while a further reduction to 100 000 m^3 results ina decrease in the available yield of about 5%. A full supply capacity of 125 000 m^3 is therefore recommended.



FSC: 150 000 m³
Active graph
Clear
flow (million m3/mnth)
Years
FSC: 125 000 m³
Active graph
Clear
flow (million m3/mnth)
Years
FSC: 100 000 m³
Active graph
Clear
Storage (million m3)

5 DOWNSTREAM IMPACT AND LOW FLOW ANALYSIS

The increase in runoff due to forestry removal will be approximately 178 900 m^3/annum within the White Water catchment while the recommendation is to abstract not more than 170 000 m^3/annum. Since it is highly likely that the farm will be incorporated into the soon-to-be established water User Association, the scheme will in all likelihood be subjected to the same restrictions applied to irrigators supplied out of the Da Gama Dam. The actual supply of water over the long term, taking into account restriction and droughts, is estimated to 153 000. m^3/annum. Hence this conversion from SFR to irrigation will benefit downstream users by 25 900 m^3/annum. This increase in flow will occur mostly in the high rainfall months.

An analysis of the low flow was carried out and the flows expressed as duration curves. See Figure 5.1.

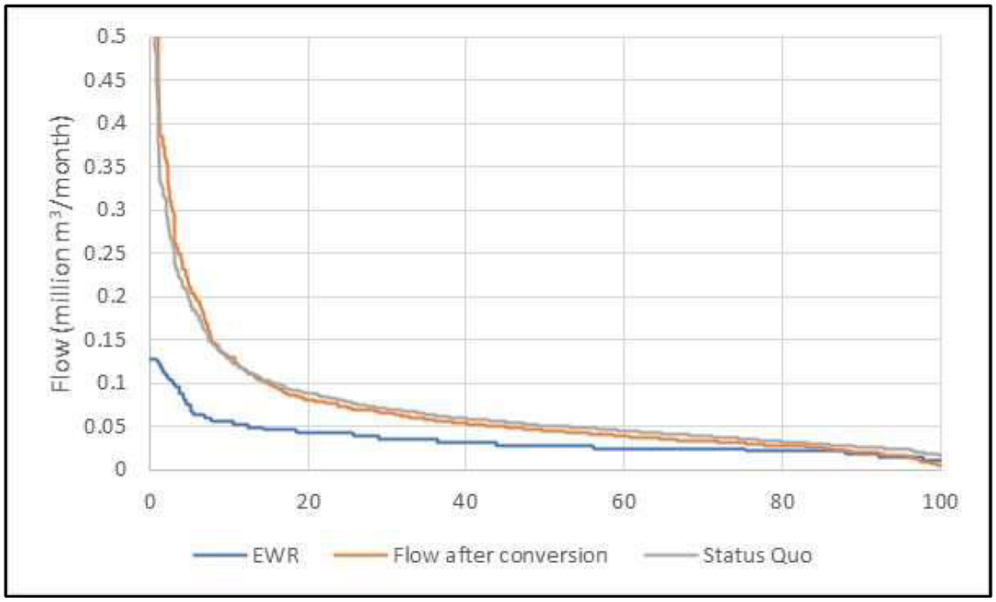


Figure 5.1: Low flow analysis

The low flow analysis shows that the removal of forestry and transferring the increase flow to an off-channel dam could result in a small decrease in the low flow, even though the EWR will still be met. As an additional safegaurd to secure the low-flow, it is recommended that the a condition of the water use licence be that a minimum flow of 11 l/s must always flow out of the lower weir and the this must be metered.

6 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

IWR Water Resources were appointed by Mr Pieter du Preez to quantify the water resources that could be harnessed on the farm Nosilla 27 JU from removing approximately 187 ha of commercial forestry from the property. Removal of the forestry will increase the runoff by an estimated 187 000 m^3/annum. A small portion of this increased flow will accrue to the Noord-Sand River to the East of the farm while the remaining 178 900 m^3/annum will flow into the catchment of the White Waters River. The intention is the pump this water in the high flow months of November through to the end of May into an off-channel dam with a full supply capacity of 150 000 m^3. The estimated yield of this scheme is 170 000 m^3/annum at 80% assurance with an average long-term supply of 153 000 m^3/annum.

An analysis of alternative off-channel storage showed that the full supply capacity of the dams can be reduce to 125 000 m^3 without reducing the yield of the system.

The intention is to utilize the water to irrigate Blueberries, Gingers and Macadamias.

The proposed water allocation and long-term supply after taking into account droughts and water restrictions will result in a nett increase of flow exiting the farm of approximately 25 900 m^3/annum. A low flow analysis shows that the removal of forestry and transferring the increase flow to an off-channel dam could result in a small decrease in the low flow, even though the EWR will still be met. As an additional safegaurd to secure the low-flow, it is recommended that the a condition of the water use licence be that a minimum flow of 11 l/s must always flow out of the lower weir and the this must be metered.

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APPENDIX A: ECOLOGICAL FLOW REQUIREMENTS

Summary of IFR rule curves for : X31H2
Total Runoff : Runoff : RREGIO
Regional Type : E.Escarp
EMC = C

Data are given in m^3/s mean monthly flow

Month	% Points 10%	20%	30%	40%	50%	60%	70%	80%	90%	99%
Oct	0.027	0.027	0.027	0.027	0.026	0.024	0.022	0.018	0.014	0.011
Nov	0.038	0.038	0.037	0.037	0.035	0.033	0.029	0.024	0.017	0.012
Dec	0.048	0.048	0.047	0.046	0.044	0.041	0.036	0.029	0.020	0.014
Jan	0.061	0.057	0.053	0.050	0.046	0.040	0.035	0.029	0.021	0.015
Feb	0.148	0.134	0.122	0.111	0.100	0.082	0.071	0.055	0.037	0.023
Mar	0.066	0.062	0.059	0.055	0.052	0.046	0.040	0.033	0.024	0.017
Apr	0.046	0.046	0.046	0.045	0.043	0.041	0.036	0.030	0.022	0.016
May	0.034	0.034	0.034	0.034	0.033	0.031	0.028	0.023	0.018	0.014
Jun	0.032	0.032	0.032	0.031	0.030	0.029	0.026	0.022	0.017	0.013
Jul	0.029	0.029	0.028	0.028	0.027	0.026	0.024	0.020	0.015	0.012
Aug	0.027	0.027	0.026	0.026	0.025	0.024	0.022	0.019	0.014	0.011
Sep	0.025	0.025	0.025	0.024	0.024	0.023	0.020	0.017	0.014	0.011

Reserve Flows without High Flows

Oct	0.023	0.023	0.023	0.022	0.022	0.021	0.019	0.016	0.012	0.010
Nov	0.025	0.025	0.025	0.025	0.024	0.023	0.020	0.017	0.014	0.011
Dec	0.027	0.027	0.027	0.026	0.026	0.024	0.022	0.018	0.014	0.011
Jan	0.032	0.032	0.032	0.031	0.030	0.028	0.026	0.021	0.017	0.013
Feb	0.041	0.040	0.040	0.039	0.038	0.036	0.032	0.027	0.021	0.016
Mar	0.038	0.038	0.037	0.037	0.035	0.033	0.030	0.025	0.019	0.015
Apr	0.037	0.037	0.037	0.036	0.035	0.033	0.030	0.025	0.019	0.015
May	0.034	0.034	0.034	0.034	0.033	0.031	0.028	0.023	0.018	0.014
Jun	0.032	0.032	0.032	0.031	0.030	0.029	0.026	0.022	0.017	0.013
Jul	0.029	0.029	0.028	0.028	0.027	0.026	0.024	0.020	0.015	0.012
Aug	0.027	0.027	0.026	0.026	0.025	0.024	0.022	0.019	0.014	0.011
Sep	0.025	0.025	0.025	0.024	0.024	0.023	0.020	0.017	0.014	0.011

Natural Duration curves

Oct	0.082	0.067	0.063	0.052	0.049	0.045	0.045	0.041	0.034	0.034
Nov	0.147	0.108	0.096	0.085	0.081	0.069	0.062	0.050	0.042	0.039
Dec	0.231	0.157	0.138	0.116	0.101	0.090	0.082	0.071	0.063	0.041
Jan	0.385	0.261	0.183	0.142	0.131	0.116	0.101	0.090	0.078	0.063
Feb	0.517	0.360	0.260	0.178	0.153	0.136	0.116	0.103	0.083	0.062
Mar	0.302	0.220	0.194	0.164	0.138	0.116	0.105	0.093	0.082	0.056
Apr	0.189	0.166	0.147	0.127	0.120	0.104	0.089	0.085	0.077	0.054
May	0.142	0.119	0.108	0.097	0.090	0.082	0.071	0.067	0.063	0.049
Jun	0.112	0.096	0.089	0.081	0.077	0.073	0.062	0.058	0.054	0.042
Jul	0.093	0.078	0.071	0.067	0.063	0.060	0.056	0.049	0.045	0.037
Aug	0.078	0.067	0.063	0.060	0.056	0.052	0.049	0.045	0.041	0.034
Sep	0.073	0.062	0.058	0.054	0.050	0.046	0.046	0.042	0.039	0.031

APPENDIX B: VERIFIED SFR

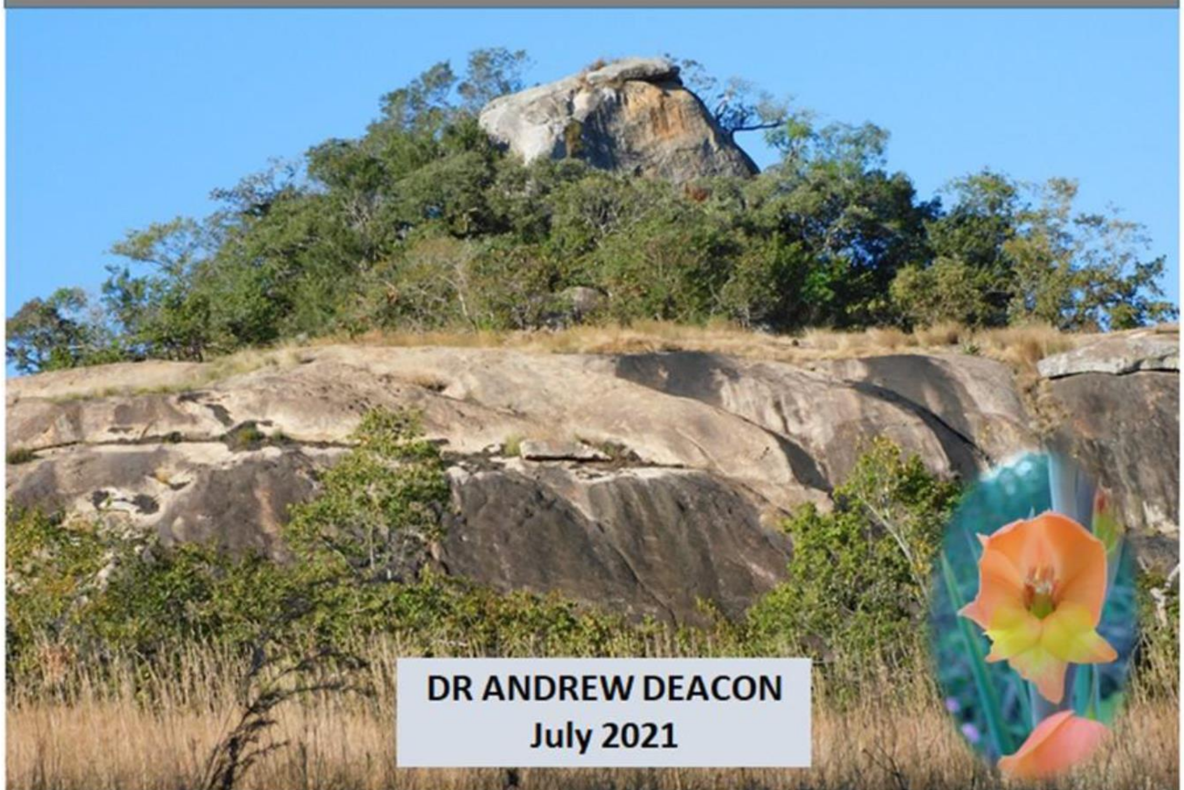
Table 3: ***Water use entitlements and water uses – stream flow reduction activity (SFRA)***

Description & Reference	Forestry Extent (ha)	Stream Flow Reduction (m^3/year)
Lawful water use in terms of the Water Act, 1956 (Act 54 of 1956) *3	185	187,035
Estimated SFRA – Qualifying Period *4	185	187,035
Registered SFRA *2	185	184,578
Proposed Existing Lawful SFRA*5	**185**	**187,035**

APPENDIX 4.4.3.
TERRESTRIAL ECOLOGY, BIODIVERSITY AND RIPARIAN ECOLOGY

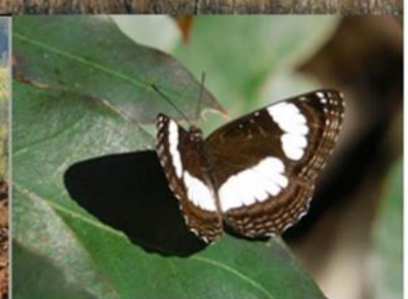
NOSILLA FARM: THE DEVELOPMENT OF A 218 HA CROP FARM.

A specialist ecological study for the Environmental Impact Assessment



DR ANDREW DEACON
July 2021





NOSILLA FARM: THE DEVELOPMENT OF A 218 HA CROP FARM.

A specialist ecological study for the Environmental Impact Assessment on the farm Nosilla in the White River area (Mpumalanga)

SPECIALIST STUDY: ECOLOGICAL ASSESSMENT.

July 2021

Dr Andrew Deacon (PhD Zoology)

Registered with the South African Council for Natural Scientific Professions
(Registration number: 116951)

Executive Summary

The management of the Farm Nosilla is in the process of removing approximately 187 ha of commercial forestry, which will increase the runoff on the farm by an estimated 187 000 m^3 /annum. Although the cleared areas will be utilised for the establishment of approximately 218.3 hectares of crops, the conversion from Streamflow Reduction (SFR) to irrigation will benefit downstream users by 25 900 m^3 /annum.

The two proposed in-stream weirs which will function as abstraction weirs, will both cover relatively small surface areas in the non-perennial drainage systems (2014 sqm and 1300 sqm respectively). Both the weir sites are surrounded by dense valley bush and the small weir footprints are unlikely to have a detrimental impact on the riverine core areas and associated riparian corridor.

During the ecological studies of the stream system, no fish were sampled in the small seasonal system. With no fish or other organisms that will need to migrate up the small stream, the installation of a fishway in the weir will not be necessary.

Due to the negative environmental impact of an in-stream storage, an off-channel storage facility of 125 000 m^3 is being constructed on the farm to store the water. The three off-channel balancing dams will be constructed on cleared forestry blocks and therefore this activity will not impact on any natural vegetation. Pumping of water freed up by the removal of exotic plantations will only be allowed during the high flow months so as not to reduce the low flow in the drainage system.

As per to the buffer requirement, a buffer of 20 m wide is required around the small streams is required to protect the unnamed drainage lines in their current condition from degradation. Furthermore, most of the drainage system and ecological buffer around the riparian corridor is protected by an additional safeguard of natural woodland which will enhance the integrity of the acquired buffer.

Aerial views of the farm show that the areas originally planted for timber were mainly located on the crests of the undulating landscape and the steeper slopes and valley bottom was left largely intact.

The applicant intends to only develop the cleared areas, while the remaining slopes and valleys will be conserved in their current, near natural state. According to the Mpumalanga Biodiversity Sector Plan, the untransformed valleys are a mixture of Optimal Critical Biodiversity Areas and Other Natural Areas. These areas will thus be maintained in a natural state while the cleared crest areas (previously forestry) will be farmed.

The valleys on the farm will function as natural corridors, connecting the upstream landscape with the downstream corridors towards the Da Gama Dam. The valleys with their broad, dense untransformed woodland, serve as a good example of the concept “retaining natural habitat and connectivity in an Optimal CBA”.

By implementing all the mitigation measures and managing the system as prescribed on a continuous basis, all the impacts will be addressed to a satisfactory level. It is apparent from the reasoned opinion that the overall project outcome might even improve certain aspects in the way the farm was managed historically. Therefore, it is proposed that the project should be authorised with the provision that the mitigation measures prescribed in this document are included in the EMPr.

Table 1: General Requirements for EAPs and Specialists including Content of Specialist Reports in terms of Appendix 6 of the EIA Regulations, 2014

	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	The specialist who prepared the report; and	
(a) i	The expertise of that specialist to compile a specialist report including a curriculum vitae;	The title page of this report.
(a) ii	A declaration that the specialist is independent in a form as may be specified by the competent authority;	Section 1.6 Details of the Author; Appendix 2 of this report.
(b)	An indication of the scope of, and the purpose for which, the report was prepared;	Appendix 1 of this report: Details of specialist and the declaration of interest following this section.
(c)	An indication of the quality and age of base data used for the specialist report;	1.3 Terms of Reference.
(cA)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	1.4 Database Review
(cB)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	5.4 Assessment of impacts 5.3 Land-use planning and Decision-making 5.3.5 Land-use guidelines 5.3.6 Desired management Objective
(d)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	2. Methodology - Baseline Data
(e)	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;	2. Methodology
(f)	The specialist who prepared the report; and	5.2 Sensitivity mapping. 5.5 Conditions for inclusion in the environmental authorisation
(g)	The specialist who prepared the report; and	5.3.6 Desired management Objective
(h)	The expertise of that specialist to compile a specialist report including a curriculum vitae;	5.3 Land-use planning and Decision-making: 5.3.4 Buffer zones 5.3.5 Protected area buffers
(i)	A declaration that the specialist is independent in a form as may be specified by the competent authority;	1.5 Assumptions, Limitations and Knowledge gaps
(j)	An indication of the scope of, and the purpose for which, the report was prepared;	5.4 Assessment of impacts
(k)	An indication of the quality and age of base data used for the specialist report;	5.4. Impact Assessment
(l)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	5.5 Conditions for inclusion in the environmental authorisation.

	Specialist reports and reports on specialist processes Checklist	STATUS
(m)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	5.6 Monitoring requirements
(n)	a reasoned opinion -	
.i	As to whether the proposed activity, activities or portions thereof should be authorised;	5.7.2 Reasoned opinion
(iA)	Regarding the acceptability of the proposed activity or activities; and	5.7.2 Reasoned opinion
.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;	5.7.1 Summary of mitigation measures
(o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	5.7.3 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

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

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Abbreviations

ADU	Animal Demographic Unit
AQV	Aquatic Vegetation
ASPT	Average Score per Taxon
BGIS	Biodiversity Geographic Information System
BODATSA	Botanical Database of Southern Africa
°C	Degrees Celsius
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Areas
Dr	Doctor
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
EFR	Environmental Flow Requirements
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EN	Endangered
ESA	Ecological Support Area
EWR	Environmental Water Requirements
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
HDPE	High-density polyethylene
HQI	Habitat Quality Index
IHAS	Integrated Habitat Assessment System
IUCN	International Union for Conservation of Nature
km	Kilometre
km^2	Kilometre square
KML	Keyhole Markup Language
KNP	Kruger National Park
l/s	Litre per second
LUDS	Land-Use Decision Support Tool
m	Metre
m^2	Square metre
m^3	Cubic metre
mamsl	Metres above mean sea level
MAP	Mean annual precipitation
MBCP	Mpumalanga Biodiversity Conservation Plan
MBSP	Mpumalanga Biodiversity Sector Plan
MIRAI	Macro-invertebrate Response Assessment Index
mm	Millimetre
MNCA	Mpumalanga Nature Conservation Act
Mr	Mister
MTPA	Mpumalanga Tourism and Parks Agency
MV	Marginal Vegetation

n/a	Not applicable
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMBA	National Environmental Management & Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas
No	Number
NP	National Park
NPAES	National Protected Area Expansion Strategy
NSBA	National Spatial Biodiversity Assessment
ONA	Other Natural Areas
PAR	Register of Protected Areas
PES	Present Ecological State
PESEIS	Present Ecological State, Ecological Importance and Ecological Sensitivity
PhD	Doctor of Philosophy
POSA	Plants of Southern Africa
Pr. Sci. Nat	Natural Scientific Professionals
Reg. no.	Registration number
RHP	River Health Programme
S	South
SA	South Africa
SAIAB	South African Institute for Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SARCA	South African Reptile Conservation Assessment
SASS5	South African Scoring System version 5
SCC	Species of Conservation Concern
SCF	Saint Cloud Farming
SFRA	Streamflow Reduction Activity
SHI	Site Fish Habitat Integrity Index
SIC	Stones In Current
SOOC	Stones Out Of Current
SQ	Sub-quaternary
Sqm	Square metre
SQR	Sub-quaternary Reach
SSC	Species of Special Concern
TOPS	Threatened or Protected Species
VEGRAI	Riparian Vegetation Response Assessment Index
WMA	Water Management Area

1. Introduction

Rhengu Environmental Services were appointed by Mr. Pieter du Preez to undertake an Environmental Impact Assessment (EIA) on the farm Nosilla 27JU, situated between White River and Hazyview in Mpumalanga. This specialist ecological study forms part of the EIA process for the proposed project (Figure 1).

This project and the report below, are based on the EIA guidelines provided in the Mpumalanga Biodiversity Sector Plan (MBSP, 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.

1.1 Project Description

The applicant, Mr Pieter du Preez, of the Nosilla Farm wishes to establish crops in an area situated just south of the Da Gama Dam (Figure 2). The long-term vision is to establish approximately 218.3 hectares (gross) of crops as follows (MBB Consulting Services, 2021):

- 10 ha Blue Berries (Full Irrigation)
- 136.5 ha Irrigated Macadamia Orchards (Supplemental Irrigation)
- 71.8 ha of Dryland Macadamia Orchards

Site observations indicate that the available soils are suitable for irrigation and the production of Macadamia, Ginger and Blue Berries. These crops are currently being grown successfully on the neighbouring farms.

The removal of approximately 187 ha of commercial forestry from the property will increase the runoff which can either be abstracted directly or stored in an off-channel dam.
Dry spells during crucial months make irrigation essential for successful macadamia farming. Irrigation is therefore critical during the months of August, September and October, when flowering and fruit set occurs (highest irrigation demand and lowest rainfall). The months of July and August have the lowest rainfall (7mm and 12mm respectively). This rainfall is very low, indicating the need to irrigate during these times.

With the relatively high rainfall and moderate climate, it is expected that the area will be suitable for the production of macadamia, blueberries and ginger. Availability of irrigation water during critical periods needs to be addressed.

Water for irrigation is dependent on surface runoff water from catchments on the property. The aim of the project is to remove 187 Ha of commercial forestry and use this water made available (through increased runoff) for irrigation.
Project Specifics include:

- Construct two in-stream weirs to function as abstraction weirs: Dimensions of the proposed weirs: Wall Height 3m; Wall Length 28m-46m.
- Construction of two pump houses.
- The water will be stored as per the existing entitlements registered against the farm.
- No new water will be used for this process.

The purpose of this assessment process is to investigate the impact of implementing such activities at Remaining Extent of the Farm Nosilla 27JU.

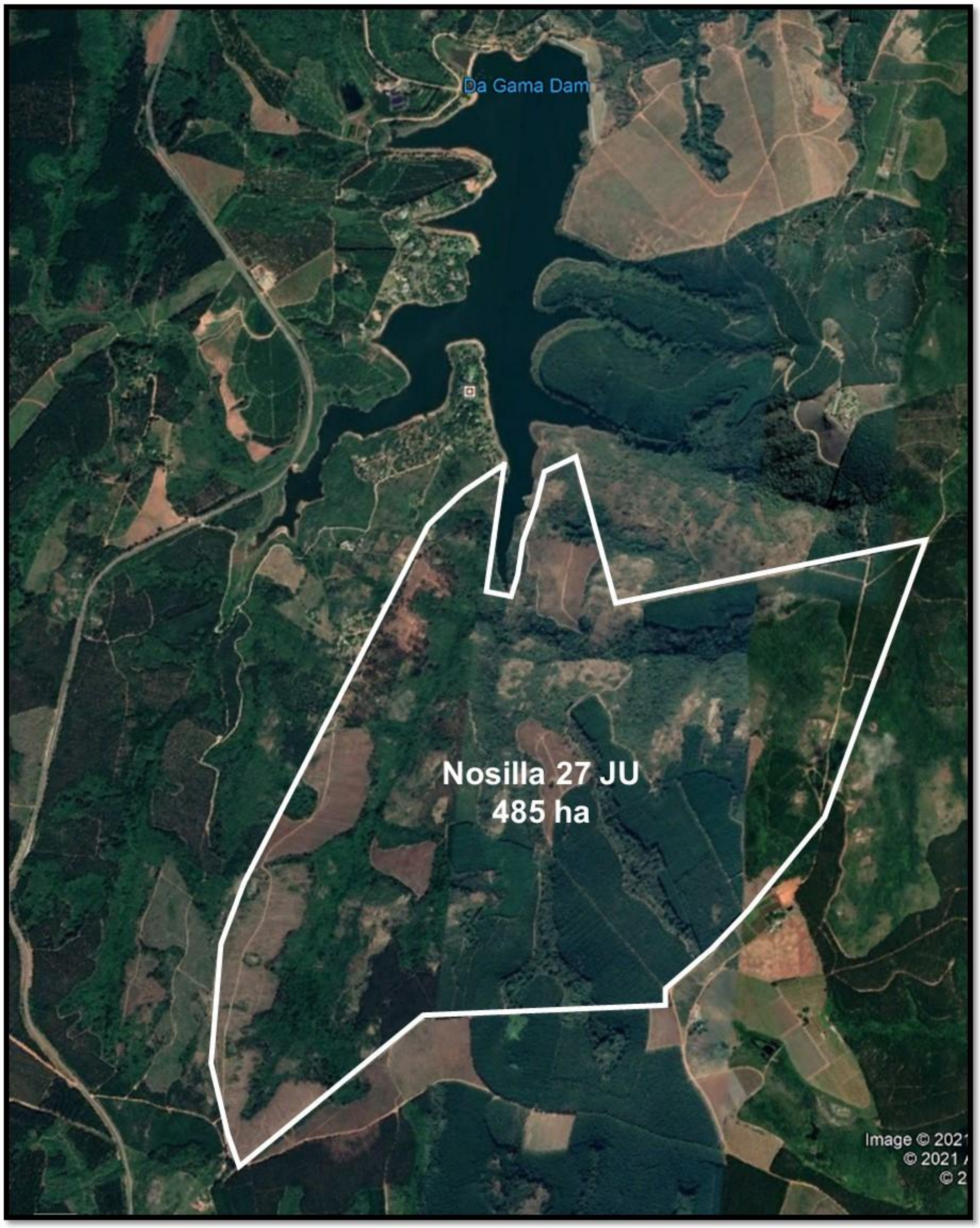


Figure1: The Nosilla Farm location just south of the Da Gama Dam.

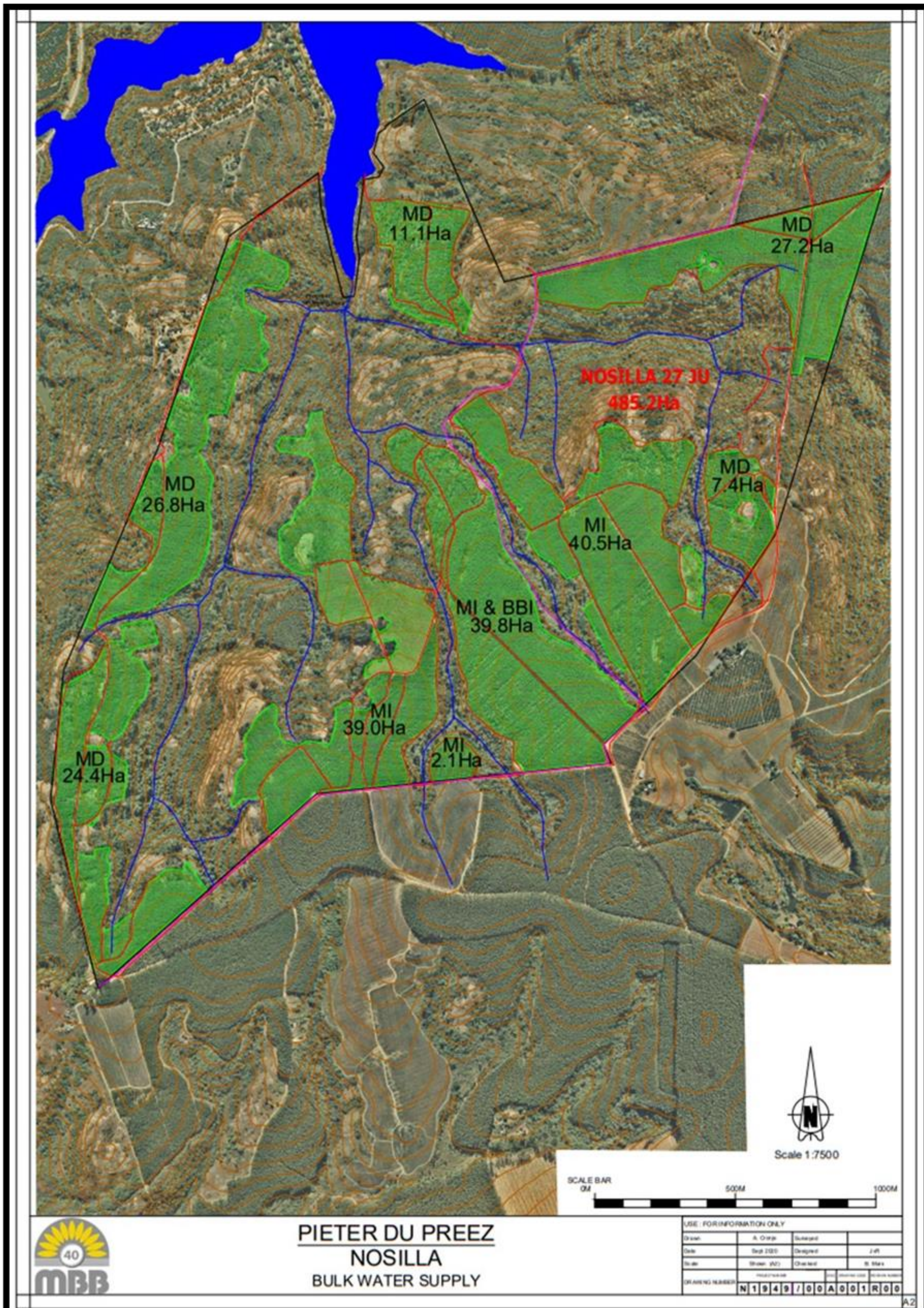


Figure 2: The removal of 187 Ha of commercial forestry to be replace by orchards.

The following bulk water infrastructure is planned for the farm, to be implemented in phases (MBB Consulting Services, 2021):

- Two small weirs in non-perennial streams
- Two small pump stations
- Two pipelines
- Three off channel storage dams (125 000m^3 Capacity)
- Electricity supply (Overhead Power Lines)

IWR Water Resources was appointed to quantify the water resources that could be harnessed on the farm by removing approximately 187 ha of commercial forestry from the property. This water will be harvested by placing suitable water infrastructure in strategic positions on the farm.

The farm Nosilla 27 JU is located in the X31H-2 quinary catchment on a tributary of the White Waters River, which is a tributary of the Sabie River. The hydrological information for the X31H-2 catchment is summarised in Table 2.

Table 2: A summary of the hydrological information for the X31H-2 catchment.

Catchment	Area (ha)	Mean Annual Evaporation (mm)	Mean Annual Precipitation (mm)	Mean Annual Runoff (million m^3 /annum)
X31H-2	13.7	1 400	1 178	3.54

The Ecological Water Requirements (EWR) of the Sabie River catchment have been determined and published in the Government Gazette. While there is no specific EWR requirement for the White Waters River or its tributaries, it is possible to extrapolate the EWR determined for the Sabie River to the catchment of the abstraction point based purely on hydrological aspects. This was done using the Hughes Desktop Model (Hughes and Hannart, 2003).

Assuming a C Class for the ecological status of the catchment, which implies a partially developed catchment, the EWR requirement was estimated to be 31% of the natural runoff, that is, 1.31 million m3 /annum on average. The EWR is however not a constant flow but varies with the natural flow. The EWR is simplified in Table 3 to 12 monthly values equivalent to the 80 percentile of the EWR requirement.

Table 3: Simplified EWR release in m^3 based on the 80 percentile requirement (IWR Water Resources, 2021).

Month	Weir 2	Weir 1
January	6 000	19 011
February	6 967	21 134
March	7 071	21 936
April	6 843	21 228
May	6 642	20 474
June	6 013	18 398
July	5 571	17 549
August	5 143	16 086
September	4 769	14 152
October	4 500	13 893
November	4 769	14 152
December	5 143	16 086

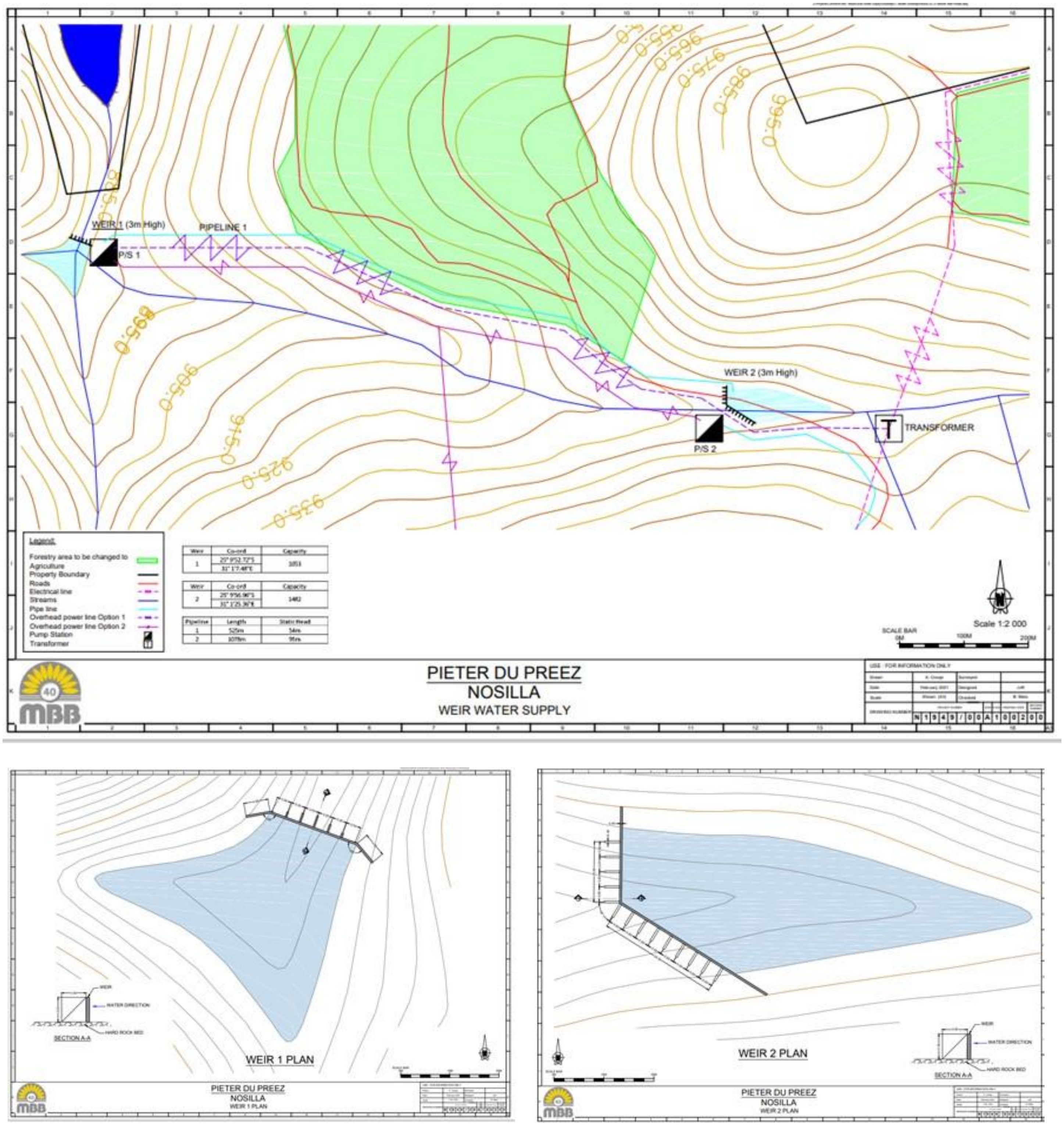


Figure 3: The two weirs are proposed in small unnamed tributaries of the White Waters River which flow into the Da Gama Dam.

Based on recent feedback from the licencing authorities relating to a similar application to this, pumping of water freed up by the removal of exotic plantations will only be allowed during the high flow months so as not to reduce the low flow.

Pumping will only be allowed from November through to May in any year. The water harvested will then be stored in off-channel balancing dams. These dams will be built in an existing forestry plantation. The recommended storage is 125 000m^3.

Two weirs will be constructed as broad crested weirs, with buttresses for support using reinforced concrete. The weirs will be a maximum of 3m high. Each weir will have an outlet pipe to release the EWR downstream (Table 3 contains the Simplified EWR release).

Table 4: This table shows how much water can be pumped sustainably from the two abstraction points (Weir 1 and Weir 2).

Catchment	Catchment area (km^2)	SFR available for pumping (m^3 /annum)	Maximum pumping capacity (l/s)
Weir 2	1.17	53 800	3.5
Weir 1	3.74	125 100	10.0
Total	4.91	178 900	13.5

The low flow analysis shows that the removal of forestry and transferring the increased flow to an off-channel dam could result in a small decrease in the low flow, even though the EWR will still be met. As an additional safeguard to secure the low flow, it is recommended that the a condition of the water use licence be that a minimum flow of 11 l/s must always flow out of the lower weir and this must be metered.
Two small pump stations will be constructed to house the electrical equipment required for the project. Due to their high efficiency at low flows, submersible pumps will be used. These will be placed in the weirs at suitable positions.

Four bulk water supply pipelines will be installed in phases on the property. The pipelines will follow existing roads, minimising disturbance to the natural environment.
Three 40 000m^3 HDPE lined off channels balancing dams will be constructed on the property, in phases. The dams will be not classified as dams with a safety risk as they fall outside the qualifying criteria, which is:

- volume greater than 50 000m^3 and
- a wall height of 5m.

The dams will be constructed in existing forestry blocks. The areas earmarked for the dams have deep red soils, suitable for the construction of dams. No material will be required to be imported to construct the dam. All on-site material will be used for dam construction.

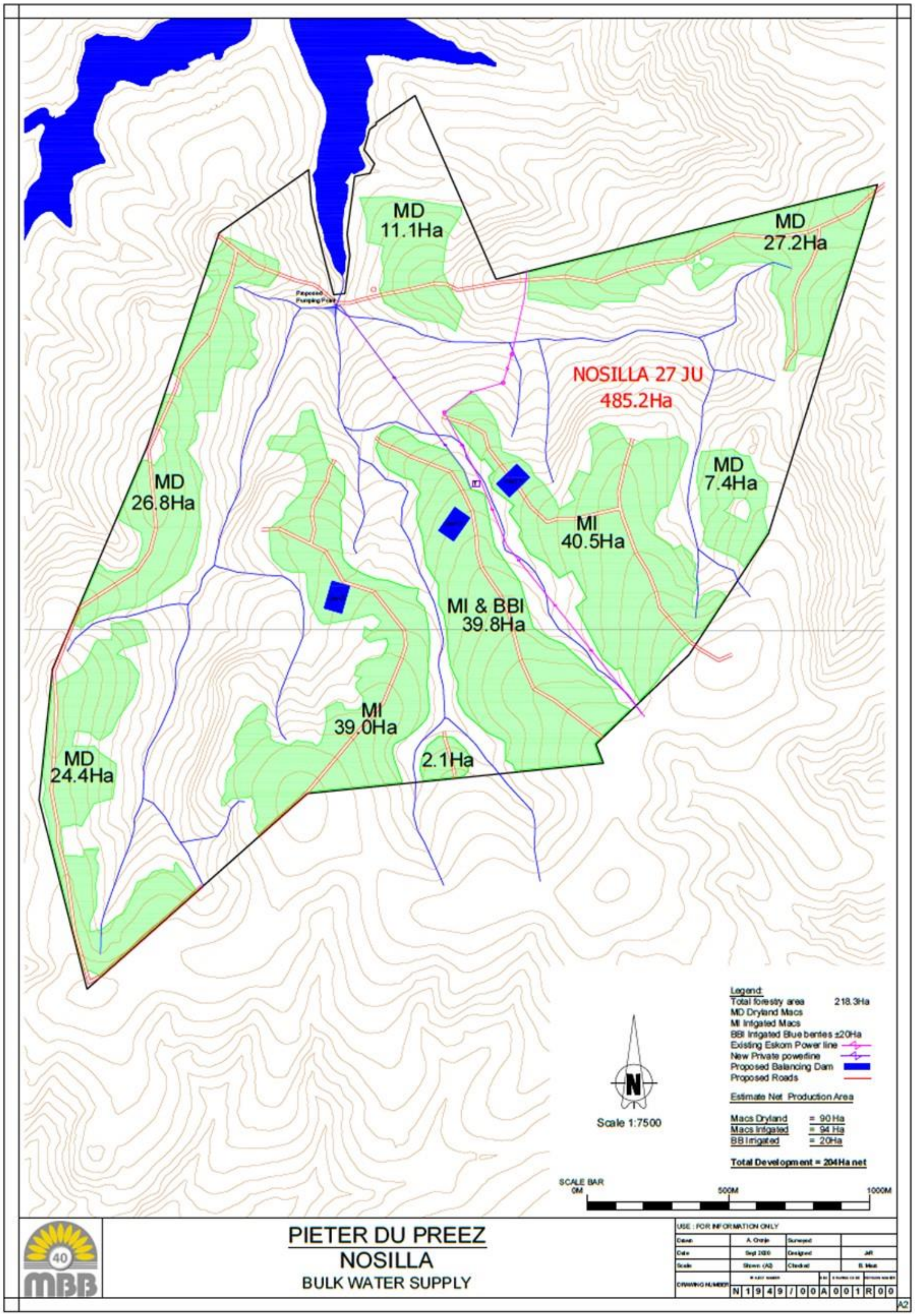


Figure 4: The positioning of the balancing dams in the project area.

1.2 Legislative Requirements

The new Environmental Impact Assessment Regulations came into effect on the 4 December 2014. These regulations were amended in 2017 and with this in mind it is proposed that the procedure as described in Chapters 4 and 6 of Notice 326 and Listed in Government Gazette No. 40772, published on 7 April 2017 is followed. Notice is given in terms of Regulation 41 of this notice to carry out the following activities:

Property Description and Location:

Nosilla Weir Project: Remaining Extent of the Farm Nosilla 27JU near White River. Weir Nr. 1: Latitude: 25º 9’ 52.72″ Longitude: 31º 17’ 48″. Weir Nr. 2: Latitude: 25º 9’ 56.96″ Longitude: 31º 1’ 25.36″.

In terms of Government Notices 327 and 324 a Basic Environmental Impact Assessment is required in terms of the following listed activities that the applicant wishes to implement:

Government Notice: No: 327 of 7 April 2017 Gazette Number: 40772:
Activity 12: The development of-
(v) weirs, where the weir infrastructure and water surface area exceed 100sqm in size,
Where such development occurs-
(a) within a water course or (c) …within 32m of a water course.
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-(i) a watercourse.

Government Notice: No: 324 of 7 April 2017 Gazette Number: 40772:
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.
Activity 14: The development of-
(i) dams or weirs…...and infrastructure exceeding 10 sqm in size or
(ii) infrastructure or structures with a physical footprint of 10sqm or more
Where such development occurs-
(a) within a water course or (c) …………within 32m of a water course.

Application Submission to the Responsible Authority: Water Use License:

The Water Use Authorisation Application will be submitted to the Inkomati-Usuthu Catchment Management Agency (IUCMA) in terms of Regulations GN267.

The nature and locality of the water uses to which the application refers:

The Applicant is developing Blue Berry and Macadamia orchards on the Remaining Extent of the Farm Nosilla 27JU, situated between White River and Hazyview in Mpumalanga. The farm is drained by four tributaries of the White Waters River which feeds the Da Gama Dam within Quaternary Catchment X31H and within the Inkomati-Usuthu Water Management Area.

The Applicant aims to reduce the risk of water supply which is key to the production of quality produce in a sustainable manner. The availability of irrigation water is seen to be the most important factor for a successful and sustainable production of this enterprise. During the application process, critical water related and operational issues to be implemented will be addressed to optimise water harvesting.

The Water Use Authorisation Application constitutes converting Stream Flow Reduction Activities (SFRAs) to taking water from a water resource and storage of water, i.e., removing forestry to effect the release of water into the nearby watercourses for the purpose of abstraction and storage for agricultural irrigation purposes. To this effect new weirs and off-stream balancing dams are proposed.

NWA Section 21 Water Uses:

- S21 (a) Taking water from a water resource: Converting SFRAs to section 21 (a) - Abstraction from two (2) weirs and three (3) balancing dams.
- S21 (b) Storing Water: Three (3) new off-stream balancing dams, each with a storage volume of less than 50 000 m^3 and a dam wall height of less than 5m; and two (2) new weirs.
- S21 (c) and (i): Impeding or diverting the flow of water in a watercourse and altering the bed, banks, course or characteristics of a watercourse – Two (2) new weirs each with a pumpstation in non-perennial watercourses; and surface water abstraction from the new weirs.

1.3 Terms of Reference

This report forms part of the Specialist Study for of the EIA: An assessment of the local Ecology (fauna and flora) and an Environmental Evaluation of the study area. The following services/specialist components will be addressed:

1: Specialist Studies for the EIA.

Specialist reports and reports on specialist processes as per EIA Regulations will be addressed and the following specialist reports will be completed for the EIA report:

1a: Vegetation studies (according to the MTPA Minimum Requirements) (see Appendix 1a).
1b: Faunal studies (according to the MTPA Minimum Requirements) (see Appendix 1b), including herpetofauna, avifauna and mammals.
1c: Riparian Wetland studies (according to the MTPA Minimum Requirements), including a section on riparian wetland delineation.

2. General Reporting

- **Master Layout Plan:** Planned infrastructure will be included (supplied by the developers), and flood lines will be supplied (requested from the Engineer). All these features need GPS boundaries, so that they could be overlain on a plan.
- Discuss existing land and water use impacts (and threats) on the characteristics of the area.
- List and map sensitive environments in proximity of the project locality-sensitive environments.
- Suggest and discuss mitigation measures relating to the proposed project.

1.4 Database 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 2531AA in the Mpumalanga Tourism & Parks Agency's (MTPA) (2021).
- Mpumalanga Species of Conservation Concern 2018.
- 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, Government Gazette, 2019.
- MTPA Minimum Criteria Guideline
- Vegetation Map for South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006).
- Riparian delineation and habitat evaluation was undertaken 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) (2021).
- SANBI Red List of South Africa 2021.
- Buffer Zone Tools (Macfarlane and Bredin, 2017).

Aquatic Macro-invertebrates

- Level I Ecoregion and the geomorphological zone, according to the method of Dallas (2007).
- SASS5 sampling technique (Dickens and Graham 2002).
- Aquatic habitat assessment (Kleynhans & Louw, 2008).

Fish:

- Fish distribution data sourced from 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).
- MTPA Minimum Criteria Guideline.
- Fish reference Frequency of Occurrence (FROC) database (Kleynhans, Louw, & Moolman, 2007).
- Fish Response Assessment Index (FRAI) (Kleynhans 1999; Kleynhans *et al*. 2005).

Frogs:

- Red Data: IUCN, 2019.
- Du Preez, L. & Carruthers, V. 2009.
- Frog atlas project (Minter *et al* 2004).
- Detailed frog distribution records (Jacobsen 1989).

Reptiles:

- Reptile Atlas Project - Animal Demographic Unit (ADU), 2010.
- Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland: Bates, et al, 2014.
- Red Data: IUCN, 2019.

Birds:

- Red Data: IUCN, 2019.
- Harrison, et al. 1997.
- MTPA Minimum Criteria Guideline
- Important bird areas of southern Africa (Barnes, K.N. (ed.), 1998)

Mammals:

- Red list: Child *et al*, 2016.
- Red Data: IUCN, 2019.
- MTPA Minimum Criteria Guideline.

Rivers

- Desktop Present Ecological State, Ecological Importance and Ecological Sensitivity per sub-Quaternary reaches in South Africa (DWS 2014).
- Ecoregion - Water Resource Classification System (DWS, 2005).
- DWS PESEIS documents (DWS, 2014).
- Identification and delineation of wetland and riparian areas – DWS 2005 and 2008, MacKenzie and Rountree, 2007.

General

- Google Earth coverage dated June 2021.
- MTPA. 2014. Mpumalanga Biodiversity Sector Plan Handbook.
- Mpumalanga LUDS maps (BGIS, 2015). Land-Use Decision Support Tool (LUDS) (2021).
- National Web based Environmental Screening Tool (2021).
- Protected areas: https://www.environment.gov.za/ Register of Protected Areas (PAR).
- DWS Risk Matrix Impact Assessment method (GN 509).

1.5 Assumptions, Limitations and Knowledge gaps

Assumptions, Limitations and Knowledge gaps associated with this study include the following: The assumption has been made that:

- 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.
- 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.
- 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.

- It must be noted the absence of protected species on the proposed site does not conclude that the species is not present on the site. Therefore, before construction can occur a site visit must take place to ensure there are no protected species on site.

1.6 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).

2. Methodology

Methods and Approach

This project and report, are 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 (May 2021). 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 Nosilla project 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 species encountered to facilitate obtaining the necessary permits.

Minimum requirements guidelines from the Mpumalanga Tourism and Parks Agency:

1. A map indicating the total area (ha) of disturbance/transformation on the property, including the proposed development.
2. A map indicating vegetation communities and sensitive areas on the property. The map should include the delineation of a 30m buffer zone around any sensitive areas.
3. A map indicating all surrounding land use on adjacent properties.
4. A list of threatened plants species (Red Data Listed) that may potentially occur in the area should be submitted.
5. A floristic survey should be conducted during the growing season with at least two visits undertaken (± November and ± February). Visits during other seasons will be determined by the flowering and fruiting times of species that do not occur during the summer season.
6. The MTPA should be supplied with a list of all plant taxa encountered during the surveys. The following should be investigated: threatened species (Red Data Listed), important medicinal species, protected species (Mpumalanga Conservation Act, 1989) as well as endemic taxa.
7. Plants that have been surveyed and which may be of conservation importance should be identified down to species level.
8. The MTPA should be supplied with a detailed list of all threatened species, including their locality information as well as details regarding date, GPS location and spatial resolution.
9. A list of threatened species that could potentially occur but were not found during site visits should be provided separately. In respect of each such species an opinion on the likelihood of that species occurring on the site and the reason for that opinion should be provided.
10. A list of alien plant species occurring on the property should be provided.
11. The invasion extent of category 1 & 2 plants (CARA: Act 43 of 1983, Regulation 15) should be investigated.
12. Any existing or planned eradication programs of alien vegetation should be indicated in the report.
13. Relocation plans of plants of conservation importance should be included and this relocation should be undertaken by specialists that have expertise in the area of environmental concern (EIA Guideline Document).

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 2531AA 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

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 Nosilla proposed development.

Vegetation communities identified in the desktop phase were ground-truthed during a field visit in May 2021. 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 15 sites were surveyed and floristic data is summarised in Table 14. 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.

2.1.1 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 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.

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 considered:

- 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 5.
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.

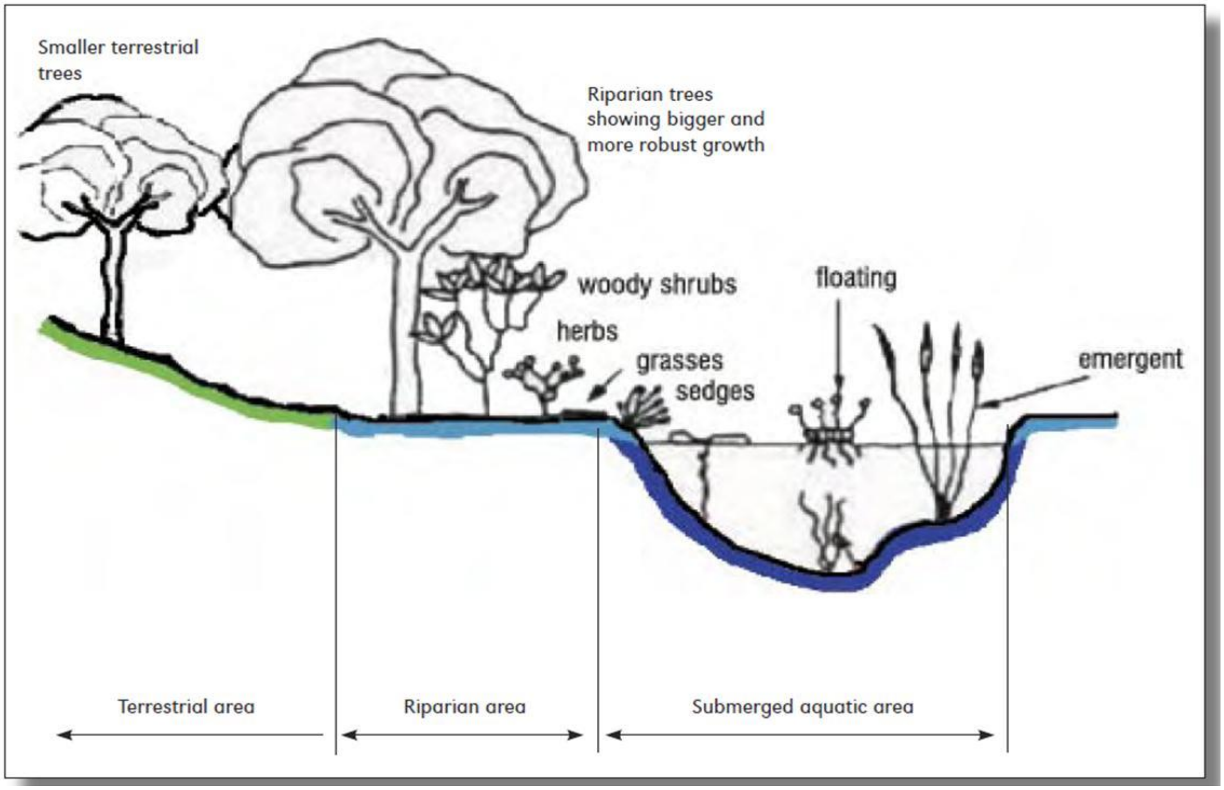


Figure 5: A cross section through a typical riparian area (DWAF Manual, 2008).

2.1.2 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 6.

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.

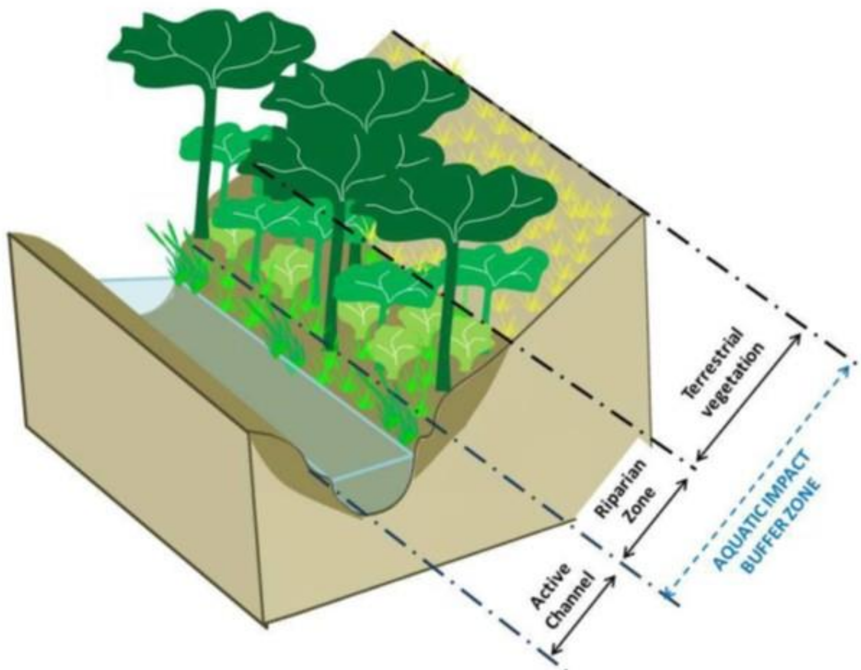


Figure 6: Schematic diagram indicating the boundary of the active channel and riparian habitat, and the areas potentially included in an aquatic impact buffer zone (Macfarlane et al, 2015).

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 stepwise assessment process for buffer zone determination (Macfarlane and Bredin, 2017) is illustrated if Figure 7.

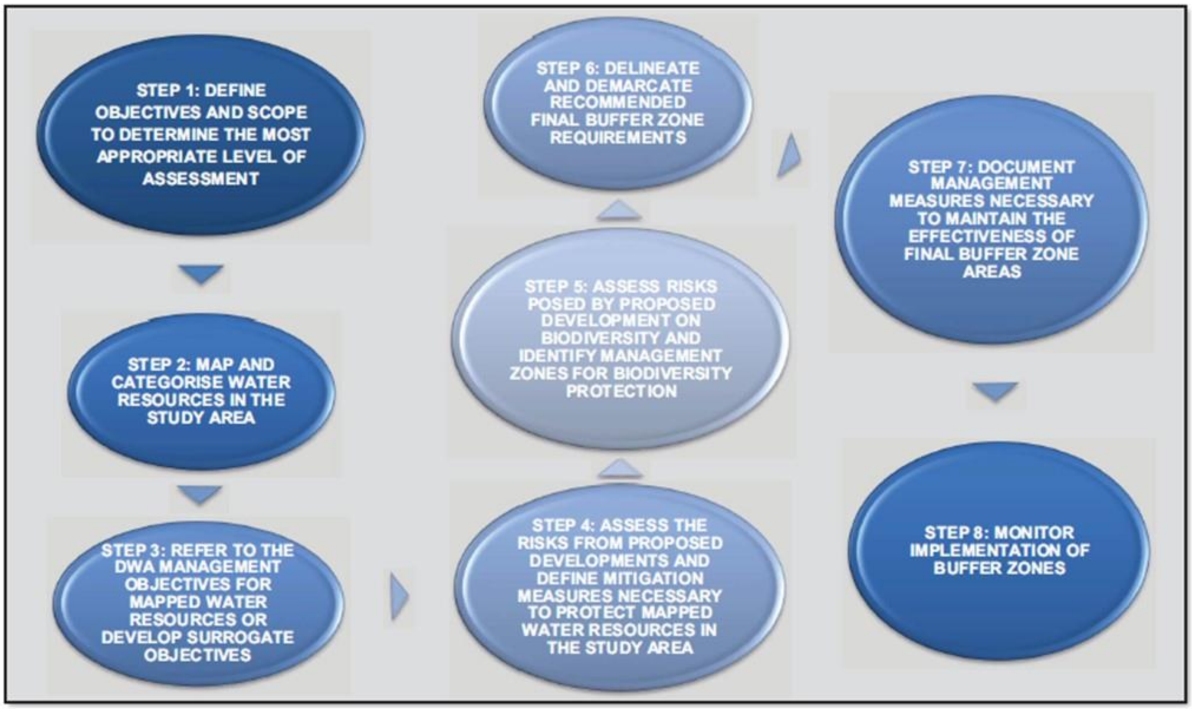


Figure 7: Overview of the stepwise assessment process for buffer zone determination (Macfarlane and Bredin, 2017).

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.

2.1.3 Riparian Habitat Surveys (Riparian Vegetation Index — VEGRAI)

The general components of the VEGRAI are specified as following:

- It is a practical and rapid approach to assess changes in riparian vegetation condition.
- It considers the condition of the different vegetation zones separately but allows the integration of zone scores to provide an overall index value for the riparian vegetation zone as a unit.
- The vegetation is assessed based on woody and non-woody components in the respective zones and according to the different vegetation characteristics which include, inter alia:
    - Cover
    - Abundance
    - Recruitment
    - Population structure
    - Species composition
- It provides an indication of the causes for riparian vegetation degradation.
- It is impact based. This means that the reference condition will only be broadly defined and based on the natural situation in the absence of impacts. Where possible, however, reference conditions should be derived based on reference sites or sections.

The index is based on the interpretation of the influence of riparian vegetation structure and function on in-stream habitat. Although biodiversity characteristics are used in assessing the riparian vegetation condition, it is not a biodiversity assessment index *per se.* For this study the Level 3 VEGRAI will be used as Level 3 is applied by the River Health Programme (RHP) and for rapid Ecological Reserve purposes. This level will be aimed at general aquatic ecologists.

2.2 Specialist Assessment: Aquatic Studies

Aquatic Ecosystem Classification

Aquatic ecosystems were classified according to a hierarchical system described by Ollis *et al*. (2013).

Aquatic Biota 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 incorporating 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. The following recognised bio-parameters and methods will be 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.

2.2.1 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 (30cm x 30cm square with 0.5mm mesh netting) was used for the collection of the organisms. The available biotopes at each site were identified on arrival. Each of the biotopes was then sampled separately and by different methods. Sampling of the biotopes was done as follows:

- **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 undertaken using the kick-sampling method, except 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 represents the overhanging grasses, bushes, twigs and reeds from the riverbank. Sampling is undertaken 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 metre.

The organisms sampled in each biotope were identified and their relative abundance is also noted on the SASS5 datasheet. Habitat assessments, according to the habitat sampled, were performed due to the fact that changes in habitat can be responsible for changes in SASS5 scores. This was achieved by applying the 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 in all three of the main habitat assemblages: stones, vegetation and sand/mud/gravel. The associated habitat types 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.

Aquatic invertebrates were sampled using a standard SASS net and identified to at least family level according to the SASS5 sampling technique (Dickens and Graham 2002). The SASS5 results were classified into one of six Present Ecological State categories, ranging from Natural (Category A), to very Critically Modified (Category F). The limits for each category varied depending on the Level I Ecoregion and the geomorphological zone, according to the method of Dallas (2007) (Figure 8).

The quality of each instream habitat where macro-invertebrates were sampled was assessed in terms of the suitability for aquatic macro-invertebrates using a simple, five-point scale (0 = absent; 1=very poor; 5=highly suitable). Each habitat category was assigned a weighted importance value that varied according to the geomorphological stream type. The weighted values were multiplied by the suitability rating (0-5), and the results were expressed as a percentage, where 100% = all habitats highly suitable. The percentage values were converted to a category (A to F), to allow easy comparison among sites or sampling events.

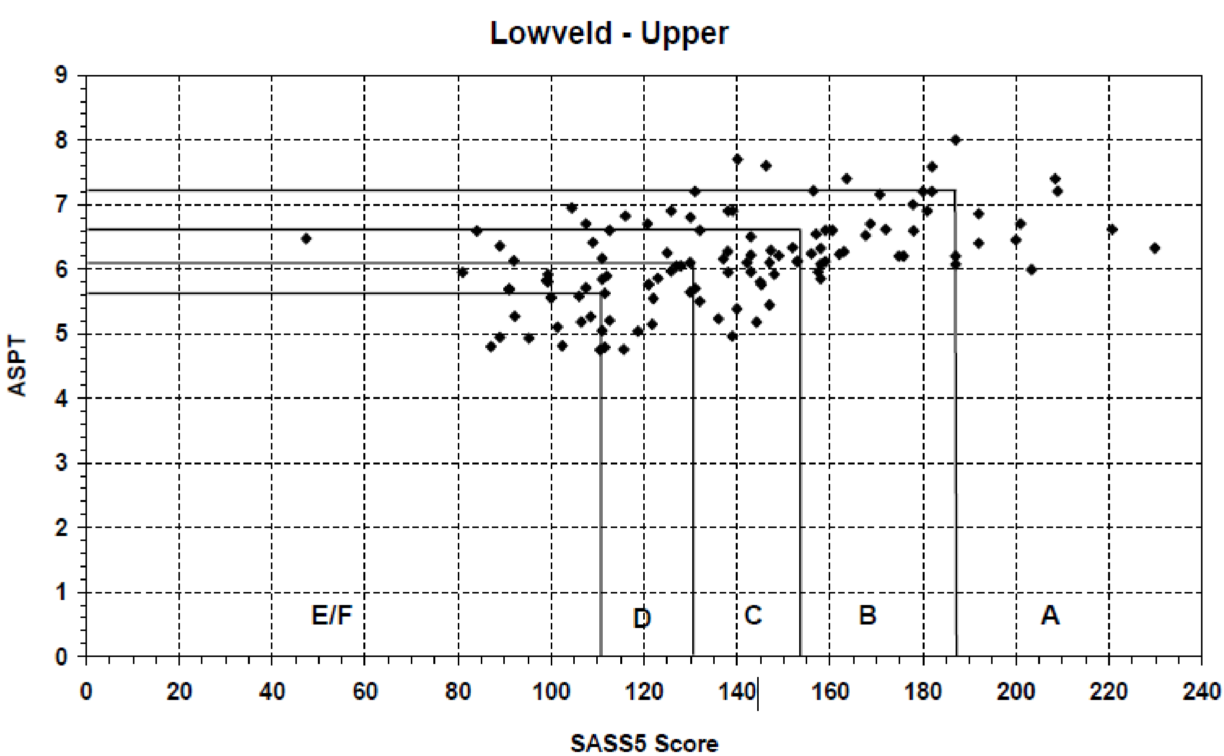


Figure 8. Guidelines used to delineate the Present Ecological State Categories in terms of SASS5 biomonitoring results in the upper portions of the Lowveld Ecoregion (Dallas 2007).

2.2.2 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 include 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 habitat types available on that particular day at that particular flow. A site diagram is compiled indicating the different habitat types and the various components thereof. Sampling takes place in each of the different habitat types. These different habitat types are sampled separately using different methods.

a) Electro-shocking

Electro-shocking commences in the downstream component of the habitat types. 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 surveyed. Each habitat shocked is timed. It is necessary to take care (as far as possible) when shocking so as not to disturb the remainder of the habitat still to be surveyed. As each habitat is completed the fish species caught, are identified, recorded and released back into their respective habitat types.

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 habitat types: 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 habitat types. As with method (a) all aspects of the habitat type are recorded including the fish species, numbers, age class and health. The number of throw efforts per habitat is also recorded.

2.2.3 Ecological Flow Requirements

Ecological Flow Requirements (EFR) were assessed by Stephen Mallory using the Desktop Reserve Model (Hughes and Hannart 2003).

2.3 Specialist assessment of terrestrial fauna for the Nosilla project

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 5-8).

The potential occurrence of threatened species was also evaluated from historical records, available literature, habitat availability and personal experience. The fauna species list thus represents the majority of species occurring in the study area and provides a solid basis from which the project can continue to develop a comprehensive species list. The following detailed desktop studies and baseline animal assessments 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 programmes 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.

The current status of the faunal environment and an evaluation of the extent of site-related effects were determined using selected ecological indicators. At the same time all rare and endangered species, protected species, sensitive species and endemic species (conservation important faunal species) were identified and used to update and supplement existing studies. Ideally faunal surveys should cover the summer season, stretching from October to February. The surveys were conducted during May 2021. The surveys included the following faunal groups:

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 mammal 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.

Minimum requirements guidelines from the Mpumalanga Tourism and Parks Agency:

Mammals/Birds

1. The Mpumalanga Biobase Report should be consulted for obtaining background on the conservation value of land and areas of sensitivity within the Mpumalanga Province. This report is obtainable from the Mpumalanga Tourism and Parks Agency (MTPA).
2. A list of all potential species should be submitted. The following should be highlighted for threatened (Red Data) species.
    i. International Red Data status (Latest version of IUCN Red Data List)
    ii. National Red Data status (Latest version)
    iii. Endemic status of each species
    iv. Protection status of each species (Mpumalanga Nature Conservation Act 10 of 1998)

3. A full survey to determine species richness should be undertaken. The time of year to conduct surveys should depend on the activity pattern of the species. The survey area should not be restricted to the proposed site of development but should include all habitat types over the entire property as well as adjacent areas. These surveys should be performed by specialists with expertise in the area of environmental concern (EIA Guideline document).
4. A list of all species recorded during the survey should be supplied to the MTPA. Species data (GPS point locality, species name and date) should be forwarded to the MTPA.
5. Where total destruction is going to take place:
    i. Specified faunal species must be captured and relocated to suitable habitat in the area.
    ii. The operations must be handled by specialists with expertise in the area of environmental concern (GIS Guideline document).
    iii. Species data (GIS point locality, species name and date) must be forwarded to the MTPA.
6. Maps indicating
    i. Areas of sensitivity
    ii. Areas already disturbed/transformed and size (ha)
    iii. Proposed development and size
    iv. Land-use on surrounding properties.
    v. Location of important species as well as roosting and hibernation sites e.g., caves of ecological importance, in relation to the proposed development.
7. Recommendations on buffer zones will only be made once comprehensive species lists have been received and reviewed in the EMPr/EIA Reports.
8. A list of threatened species that can potentially occur but were not found during site visits or surveys should be provided. In respect of each such species an opinion on the likelihood of that species, occurring on the site and the reason for that opinion should be provided.
9. A list of exotic/introduced vertebrate species occurring on the property should be provided.
10. An ethically accepted plan for the eradication or removal of any exotic/introduced species posing a threat to indigenous species should be included in the report.
11. Any existing and/or planned actions to prevent free movement/roaming of domestic animals such as dogs, cats, goats and pigs should be provided.

Field surveys and habitat evaluation.

Terrestrial vertebrate surveys

- **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 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 were recorded to establish habitat preferences. All major habitat types were assessed. 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 conducted 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 support 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

2.4.1 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 (Figures 38 and 39), so it makes sense to consider these proactively, either prior to, or during, the EIA process (MBSP Handbook, 2014).
The following are extracts from the MBSP Handbook (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.

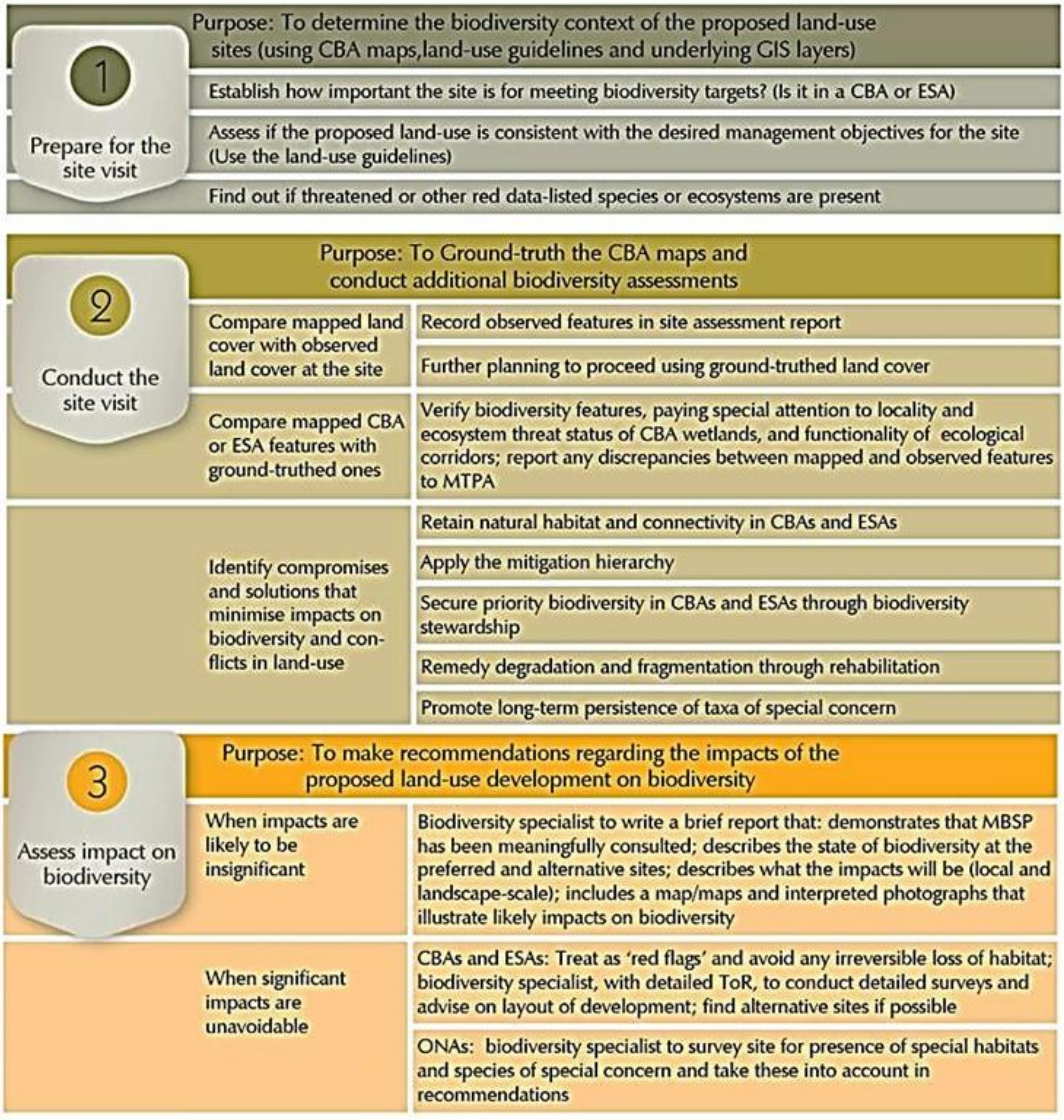


Figure 9**:** A summary of the first three steps to be followed in using the CBA maps proactively in environmental impact assessments.

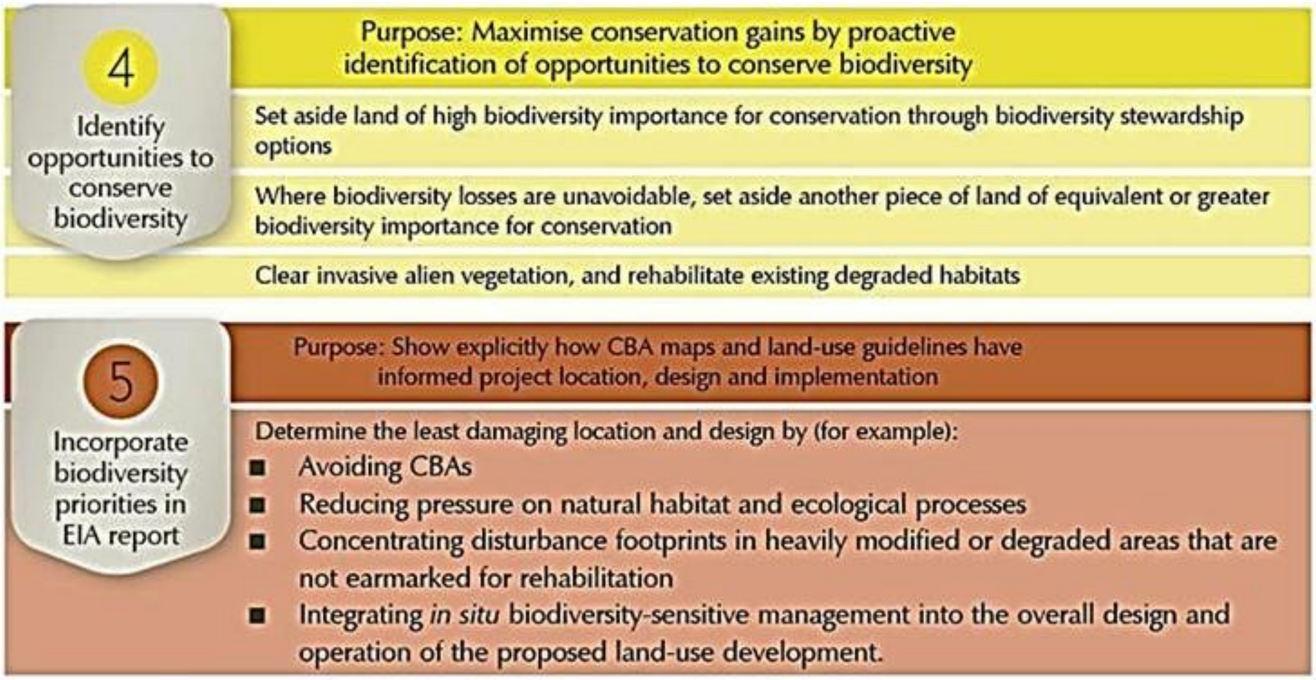


Figure 10: A summary of steps 4 and 5 to be followed in using the CBA maps proactively in environmental impact assessment.

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 (Figure 11).

Figure 11: The Mitigation Hierarchy consists of 4 steps: avoid and prevent, minimise, rehabilitate and offset.

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?

2.4.2 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 (MTPA 2014: Lötter et al, 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 5). 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 5. 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 5: 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, cultural value). • Low ability to respond to disturbance (low resilience, dominant species very old).	• 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.
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	• 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.

	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 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 (MBSP: Lötter et al, 2014).

2.4.3 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 6: 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 5km 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 7).

Table 7: 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 8: 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 9: 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.

3. Description of the study area

3.1 Present Ecological State of the study area

This report covers the Farm Nosilla 27JU project in the Da Gama Dam area, Mpumalanga. The study area is located within the quarter degree grid 2531AA. The site is located within the Ehlanzeni District Municipality, Mpumalanga Province.

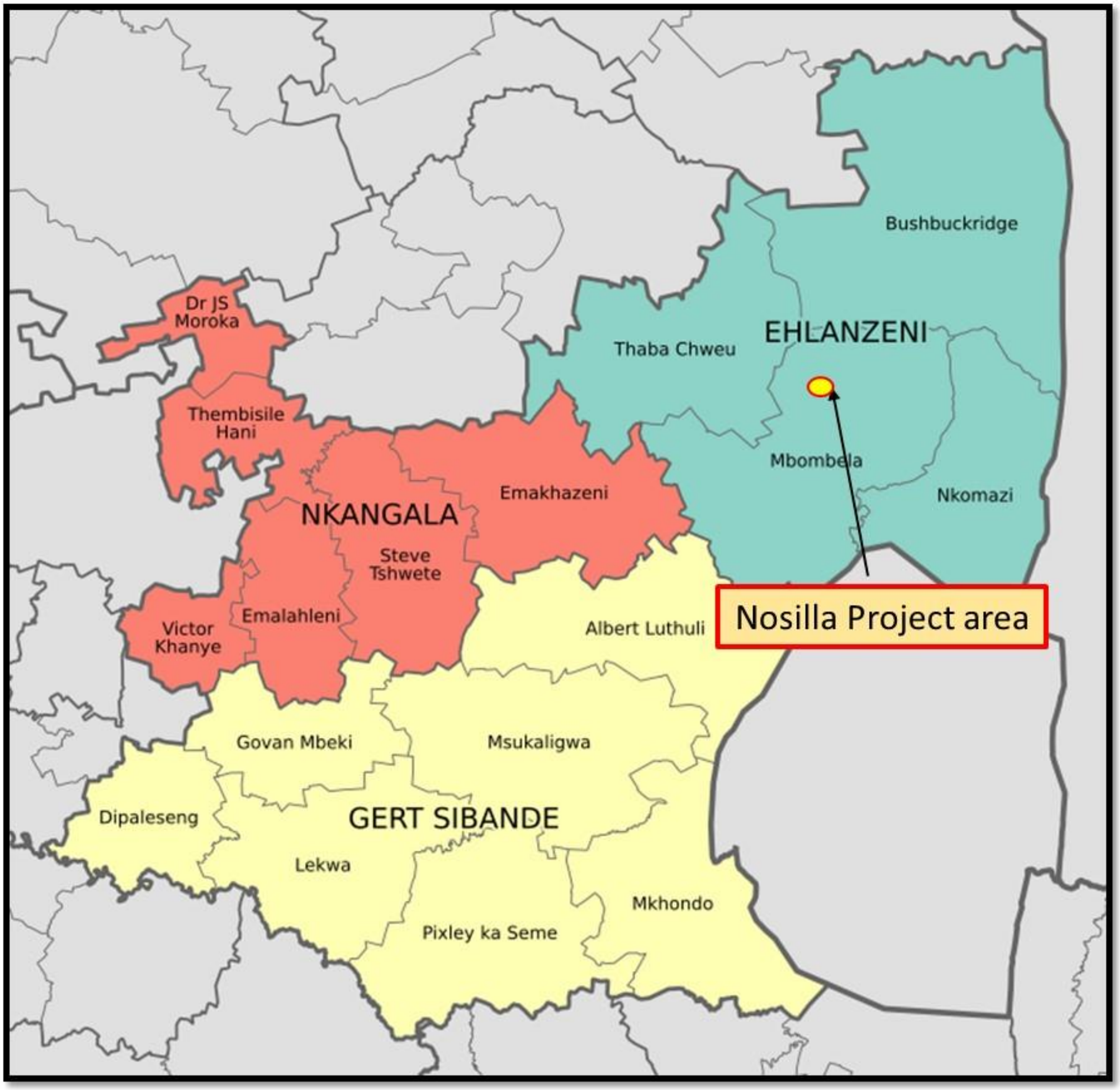


Figure 12: Location of the Nosilla Project area.

Figure 13: The Nosilla project area, illustrating the surrounding towns, roads and dams. (Obtained from Screening Tool – National Geographic maps)

Local Municipality

The Ehlanzeni District Municipality is a Category C municipality situated in the north-east of the Mpumalanga Province. It makes up just over a third of the province's geographical area. The district is comprised of four local municipalities: Bushbuckridge, City of Mbombela, Nkomazi and Thaba Chweu.

Commercial farming began in White River region after the 1904 Transvaal Land Department survey of the area. Citrus, tobacco, vegetables and plantations were farmed well into the 20th century although the environment took a harsh toll on the crops. By the end of the century, citrus and tobacco had disappeared, replaced by eucalyptus plantations interspersed with macadamia and avocado orchards.

Agriculture, plantation forestry, mining and ecotourism based on wildlife and nature-based adventure sports, form the backbone of Mpumalanga's economy. The agricultural sector is the single biggest land-user in Mpumalanga, with 19% of the province's land surface under cultivation, followed by plantation forestry, which covers 9% of the land surface area. In addition, a notable proportion (7%) of the province's landscape is made up of 'old lands', or secondary grasslands which are no longer cultivated (MTPA, 2014).

The high-altitude grassland areas of the province are well-suited to cultivation of commercial softwood timber (such as pine), whilst the warmer savannah regions are favoured for the cultivation of fruit, sugarcane and hardwood timber (such as blue gum). In addition, both the grassland and savannah regions are used extensively as rangelands for livestock by both commercial and subsistence farmers, and a growing number of farmers are converting to farming with game, or mixed game/domestic livestock operations (MTPA, 2014).

The new generation of farmers have branched into designer fruit and vegetables, plantations are giving way to more macadamias whilst avocados remain a key crop. The farms are relatively small however the agriculture is intensive with tropical and citrus fruits in abundance, and vegetables and cut flowers readily available.

Large sections on the Nosilla property were covered in blue gum plantations (see Figures 2 and 4), which are currently being converted into agricultural lands (macadamias). Figure 20 illustrates the land cover for the Nosilla project obtained from the Mpumalanga LUDS maps (BGIS, 2015), showing areas discussed in this section.

Farm Nosilla borders Saint Cloud Farm (SCF), which has been an agricultural farm since 1981. Saint Cloud Farming produces Macadamias, Blueberries and Ginger. Passion Fruit is also planted from time to time. Nosilla, which is a Timber property came up for sale in early 2020 and being the neighbouring property, it made good business sense for the owners of SCF to acquire the property to integrate with their current operations.

It is envisaged to develop Nosilla to cultivate Macadamias and about 10-15 ha of Blueberries. Ginger will be planted annually as a cash crop prior to the establishment of the Macadamias. The region annually receives about 1200mm of rain which will greatly reduce the amount of irrigation water required for the project.

Following a massive boom in the South African and global macadamia industry, South Africa is now the largest producer of macadamia nuts in the world. The South African market is largely driven by exports and, as demand increases, we have seen hectares under macadamias trees increasing rapidly in South Africa's macadamia growing areas (https://www.bizcommunity.com/Article/196/358/175342.html).

It is estimated that, just over the past year, roughly 650 ha of forestry plantations were converted to more lucrative crops such as macadamia and avocado in the White River, Hazyview and Sabie area alone, and significant areas are still in the process of being converted. Timber as young as two to three years is being felled and areas de-stumped to make way for the new orchards. The economic benefits that these new crops bring to the landowners and to the region far outweigh the returns from forestry. Roughly 95% of the South African macadamia crops are exported and the weak Rand ensures very good returns to macadamia growers (http://saforestryonline.co.za/news/changing-face-forestry-lowveld/).

Macadamias, adapted to the fringes of subtropical rainforests of coastal, eastern Australia, are resilient to mild water stress. Even after a prolonged drought, it is difficult to detect stress in commercial trees. Despite this, macadamia orchards in newer irrigated regions produce more consistent crops than those from traditional, rain-fed regions. Crop fluctuations in the latter tend to follow rainfall patterns. The benefit of irrigation in lower rainfall areas is undisputed, but there are many unanswered questions about the most efficient use of irrigation water. Water is used more efficiently when it is less readily available, causing partial stomatal closure that restricts transpiration more than it restricts photosynthesis.

Limited research suggests that macadamias can withstand mild stress. In fact, water use efficiency can be increased by strategic deficit irrigation. However, macadamias are susceptible to stress during oil accumulation. There may be benefits of applying more water at critical times, less at others, and this may vary with each cultivar. Currently, it is common for macadamia growers to apply about 20-40 L of water per tree per day to their orchards in winter and 70-90 L of water per tree per day in summer.

3.2 Physiography of the study area

Ecoregion and River Characteristics

The vegetation type of the project area consists of **Legogote Sour Bushveld** (**SVI 9**; Mucina & Rutherford, 2006).

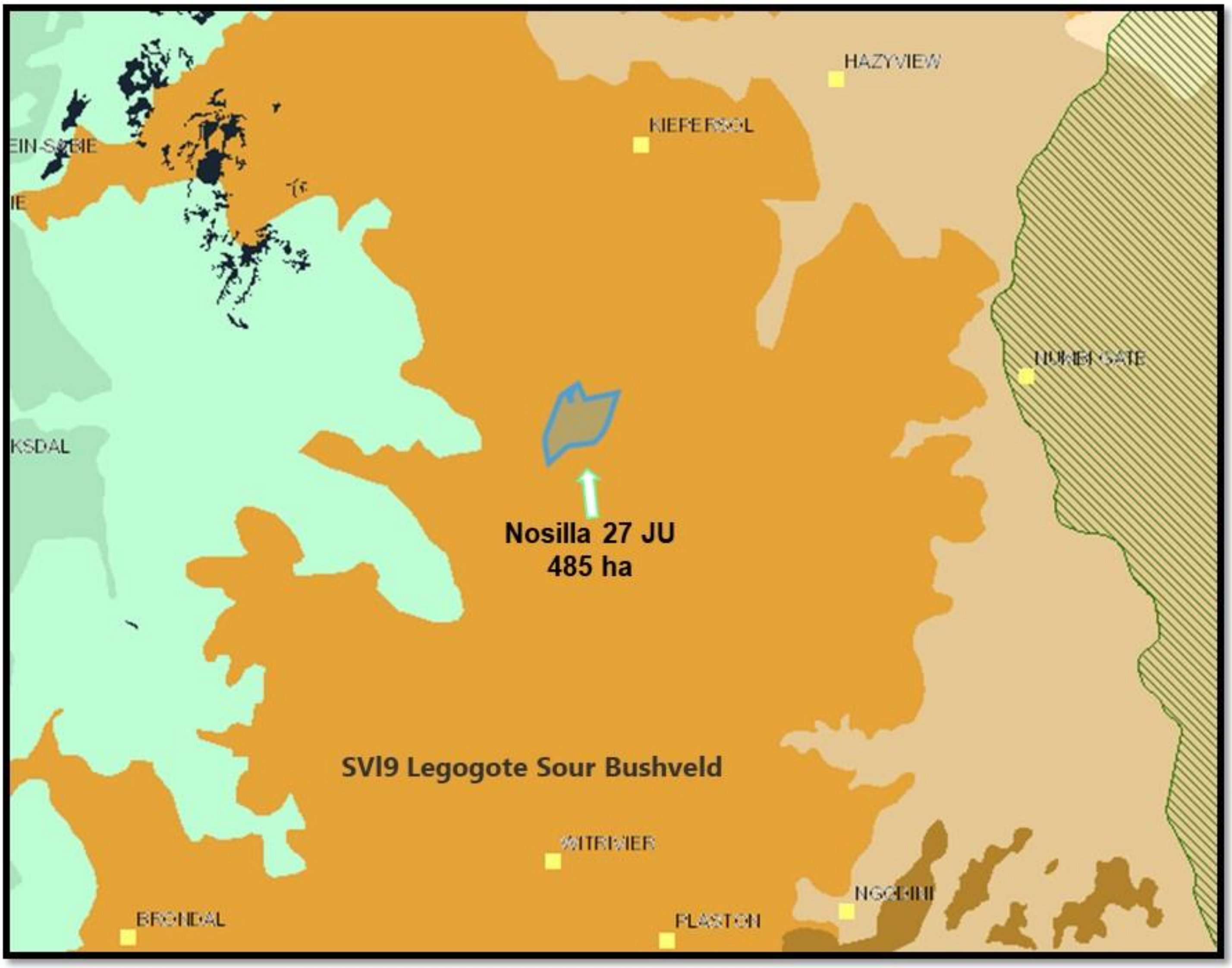


Figure 14: A broad-scale overview of the Nosilla project area in the Legogote Sour Bushveld vegetation type (BGIS, 2018; Mucina & Rutherford, 2006).

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.

Table 10: Dominant and common plant taxa of the Legogote Sour Bushveld (Mucina & Rutherford, 2006).

Plant group	Species
Tall Trees:	*Pterocarpus angolensis, Sclerocarya birrea subsp. caffra.*
Small Trees:	*Vachellia davyi, A. sieberiana var. woodii, Combretum zeyheri, Erythrina latissima, Parinari curatellifolia, Terminalia sericea, Trichilia emetica, Vernonia amygdalina, Vachellia caffra, Antidesma venosum, Erythroxylum emarginatum, Faurea rochetiana, F. saligna, Ficus burkei, F. glumosa, F. ingens. F. petersii, Heteropyxis natalensis, Peltophorum africanum, Piliostigma thonningii, Pterocarpus rotundifolius, Schotia brachypetala.*
Succulent Tree:	*Euphorbia ingens.*
Tall Shrubs:	*Diospyros lycioides subsp. sericea, Erythroxylum delagoense, Olea europaea subsp. africana, Pachystigma macrocalyx, Pseudarthria hookeri var. hookeri, Rhus pentheri.*
Low Shrubs:	*Diospyros galpinii. Flemingia grahamiana, Agathisanthemum bojeri, Eriosema psoraleoides, Gymnosporia heterophylla, Hemizygia punctata, Indigofera filipes, Myrothamnus flabellifolius, Rhus rogersii.*
Succulent Shrubs:	*Aloe petricola, Euphorbia vandermerwei, Huernia kirkii.*
Woody Climbers:	*Vachellia ataxacantha, Bauhinia galpinii, Helinus integrifolius, Sphedamnocarpus pruriens subsp. pruriens.*
Graminoids:	*Bothriochloa bladhii, Cymbopogon caesius, C. nardus, Hyparrhenia cymbaria, H. poecilotricha , Hyperthelia dissoluta, Panicum maximum, Andropogon schirensis, Paspalum scrobiculatum, Schizachyrium sanguineum.*
Herbs:	*Gerbera ambigua, G. viridifolia, Hemizygia persimilis, Hibiscus sidiformis, Ocimum gratissimum, Waltheria indica.*
Geophytic Herbs:	*Gladiolus hollandii, Hypoxis rigidula.*
Succulent Herbs:	*Orbea carnosa subsp. carnosa, Stapelia gigantea.*
Endemic Taxon Succulent Herb:	*Aloe simii.*

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.

Based on the observations from the site, and 1:250 000 Geological Maps, the area in general is underlain by grey to white, coarse grained biotite granite from the Nelspruit Suite. A mantel of transported soil and weathered material is situated on top of this base layer

Climate: Summer rainfall with dry winters. MAP from about 700 mm on the foot slopes 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.

Rainfall: The area has an average rainfall of approximately 1113mm per annum, obtained from the weather station at Klipkoppie Dam. The highest rainfall months are November to March when 862mm, or 77% of the annual rain can be expected.

Conservation: Endangered. 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 *Solanum 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 11: 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	Endangered
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	Savannah Biome
Name of Group (only differs from Bioregion in Fynbos)	Lowveld Bioregion
Name of Bioregion (only differs from Group in Fynbos)	Lowveld Bioregion

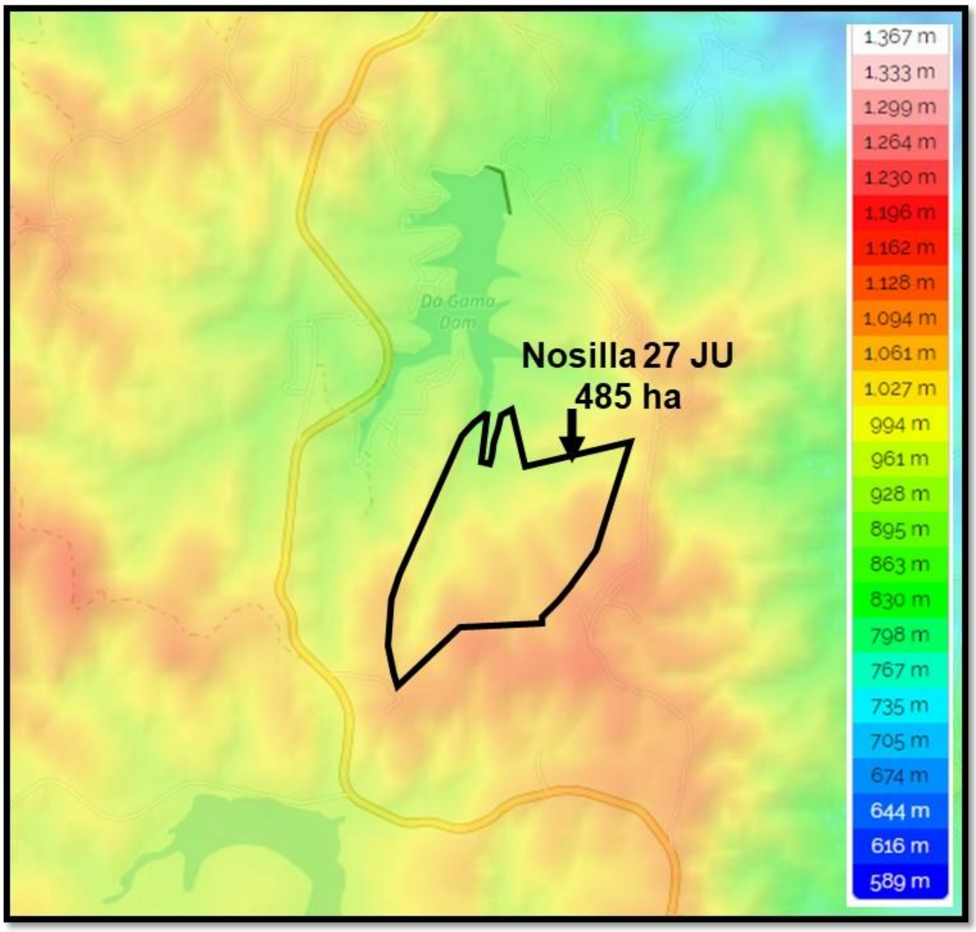


Figure 15: Altitude across the project area varies from *c*. 928 to 1094 mamsl and comprises hilly areas to the south of the farm, draining down the slope towards the Da Gama Dam on the northern boundary of the farm.

Catchment and Wetland Setting

The Portion 27 JU of the farm Nosilla is situated in the Sabie River Sub-Water Management Area which form part of the Komati River drainage system (Figure 16).

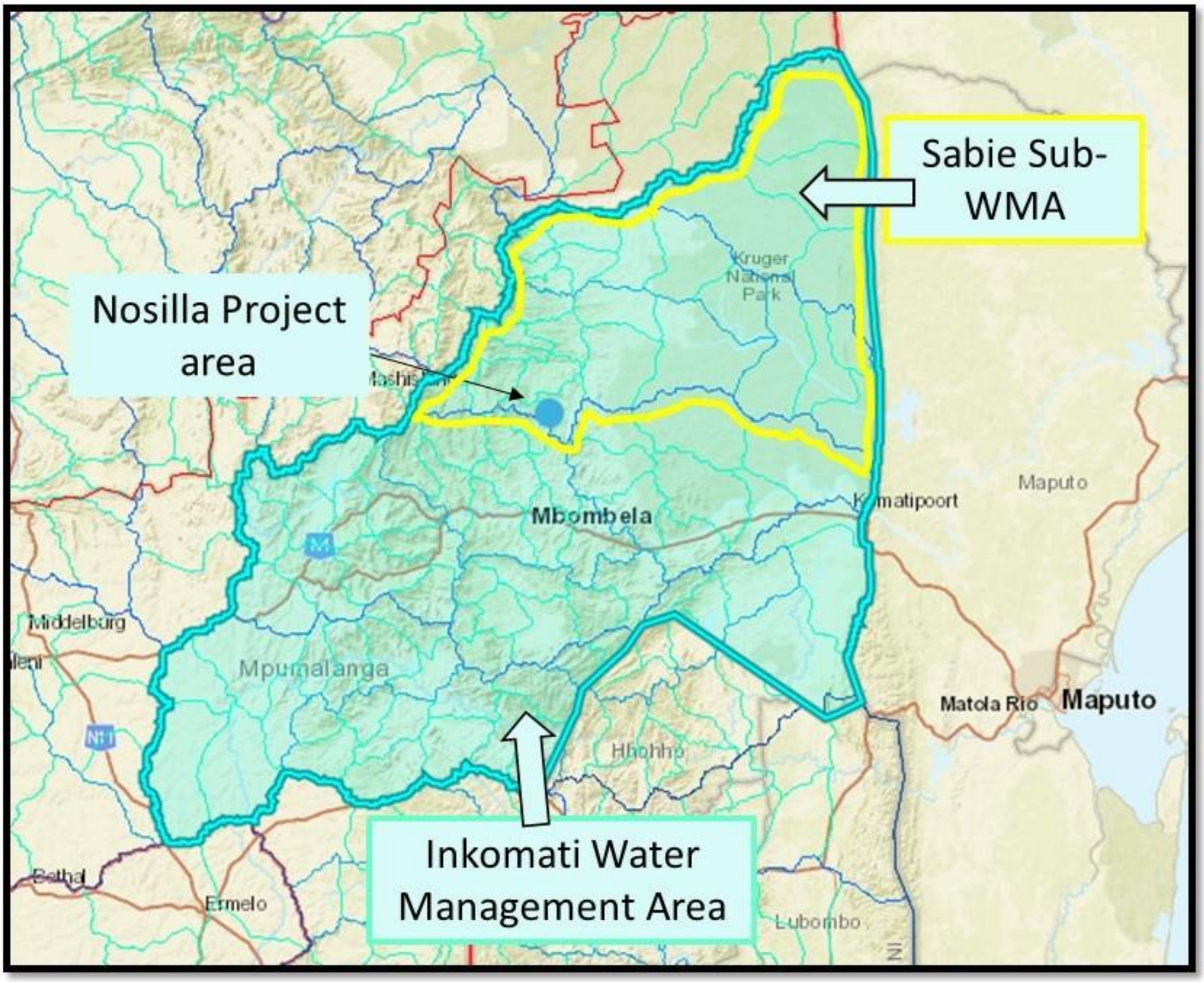


Figure 16: The study area is situated in the Sabie Sub-WMA, which is included in the Inkomati WMA.

Ecoregion 3: Lowveld (Figure 18)

This hot and dry region is characterised by plains with a low to moderate relief and vegetation consisting mostly of Lowveld Bushveld types. Open hills with high relief and low mountains with high relief are present towards the west on the boundary with the North Eastern Highlands. In the north Mopane Bushveld and Mopane Shrubveld occur (Kleynhans et al., 2005).

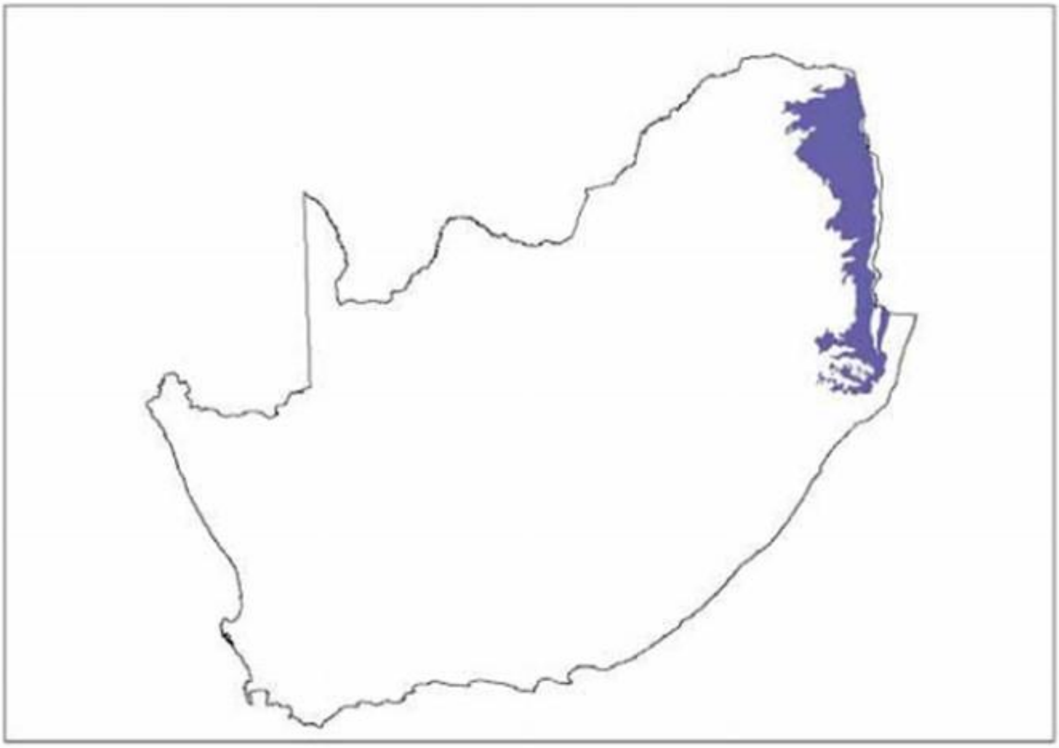


Figure 17: Preliminary Level I River Ecoregional classification System for South Africa: Ecoregion 3.07: Lowveld Ecoregion.

General: Although several large perennial streams traverse this region, e.g., White and Black Umfolozi, Mkuze, Pongolo, Great Usutu, Komati, Crocodile, Sabie, Olifants, Letaba and Luvuvhu, few perennial streams originate here.

- Mean annual precipitation: Tends to be moderate towards the west, but low over most of the region.
- Coefficient of variation of annual precipitation: Mostly moderate.
- Drainage density: Mostly low, but high in some of the central areas.
- Stream frequency: Mostly low to medium but high in some of the central areas.
- Slopes 80% of the area.
- Median annual simulated runoff: Mostly low/moderate, but moderate in areas.
- Mean annual temperature: High to very high.

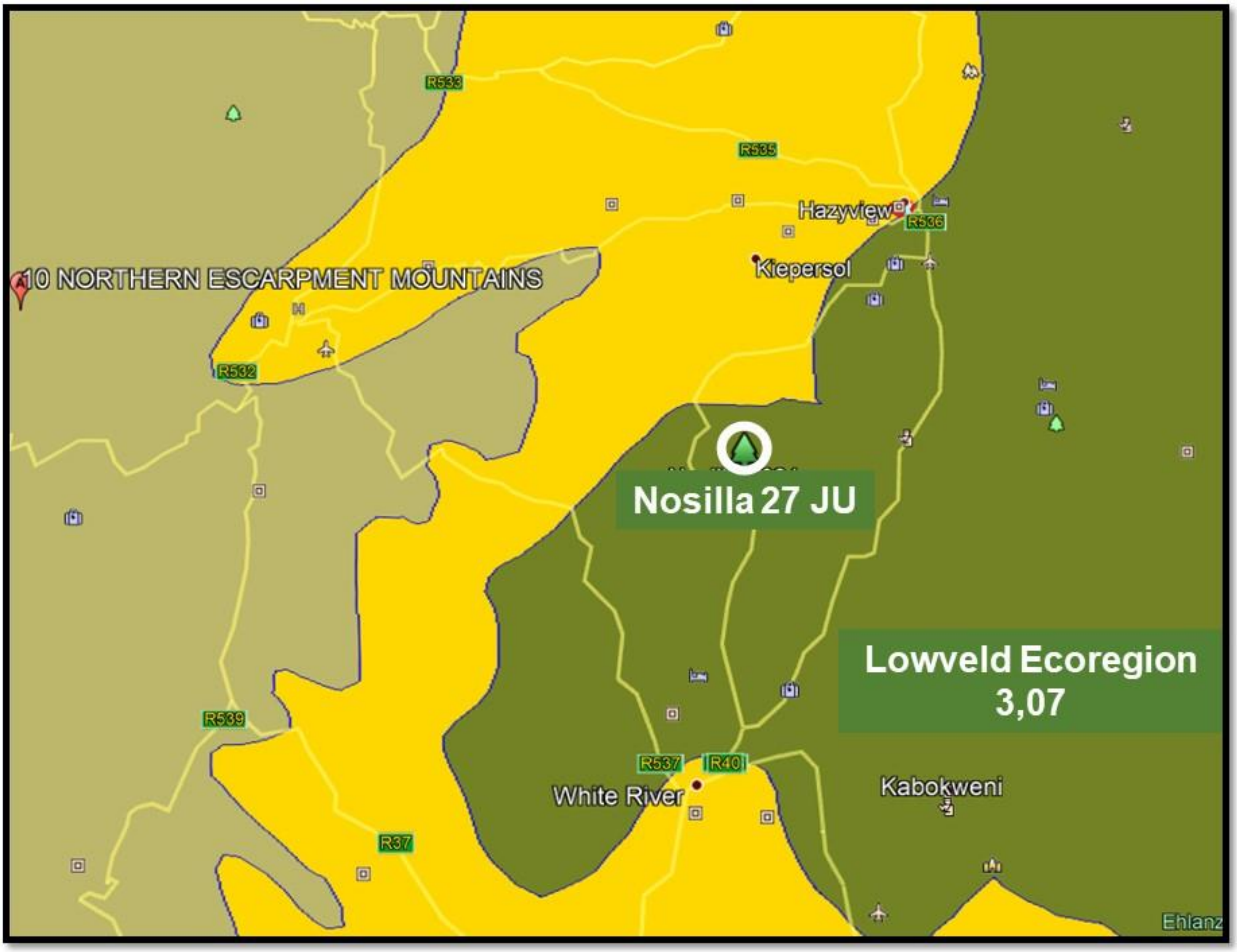


Figure 18: The project site is located in the Lowveld (3.07) Ecoregion according to the Water Resource Classification System (DWS, 2005).

Table 12: Main attributes of the Lowveld Ecoregion.

MAIN ATTRIBUTES	NORTH EASTERN HIGHLANDS
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief; Plains; Moderate Relief; Lowlands, Hills and Mountains; Moderate and High Relief (limited)
Vegetation types (dominant types in bold) (Primary)	Mopane Bushveld; Mopane Shrubveld; Mixed Lowveld Bushveld; Sour Lowveld Bushveld
Altitude (m.a.m.s.l) (primary)	0-700; 700-1300 limited
MAP (mm) (modifying)	200 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 35
Rainfall concentration index	30 to >65
Rainfall seasonality	Early to late summer
Mean annual temp. (°C)	16 to >22
Mean daily max. temperature (°C): February	24 to 32
Mean daily max. temperature (°C): July	18 to >24
Mean daily min. temperature (°C): February	14 to >20
Mean daily min temperature (°C): July	4 to >10
Median annual simulated runoff (mm) for quaternary catchment	10 to >250

The catchment reference numbers were obtained from the DWS PESEIS documents and the Google Earth image in Figure 19 indicates the location of the Nosilla Project Area. The project site is located in quaternary catchment X31H and the property is drained by four tributaries of the White Waters River (Sub-Quaternary Reach X31H-00819) which feed the Da Gama Dam. The unnamed tributary, which is earmarked for the proposed weirs and thus it is not viewed as a significant tributary by DWS and therefore this drainage line was not addressed by the Department of Water and Sanitation Desktop PESEIS assessment process.

Figure 19: A Google Earth image indicating the location of the Nosilla project position in the X31H catchment and associated catchment reference numbers.

1. **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 (Figure 14) within **Legogote Sour Bushveld** (**SVI 9).**

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

Figure 20 illustrates the land cover surrounding the Nosilla project area. Most of the project area was transformed by forestry before the removal of forestry began.

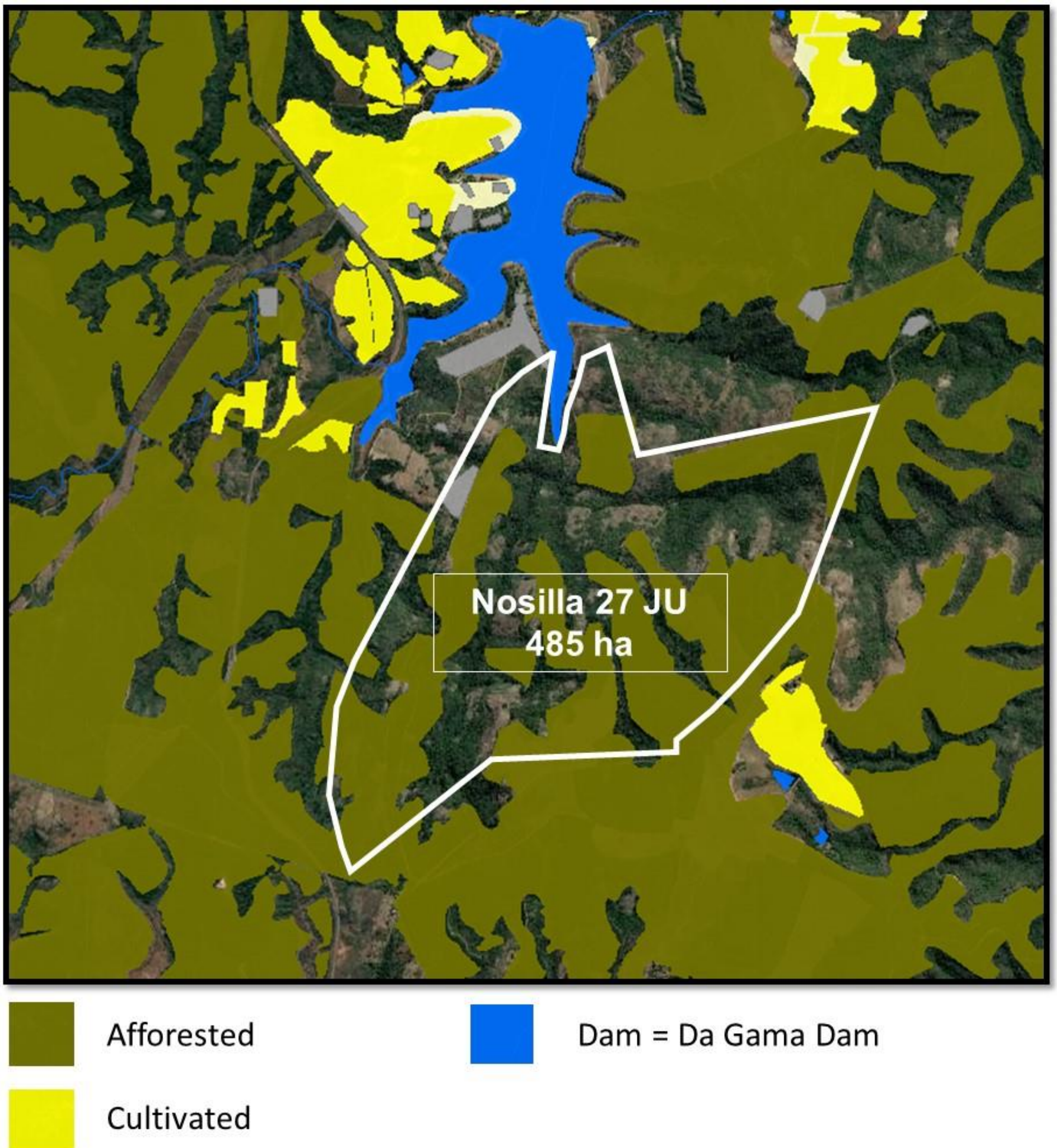


Figure 20: The broad-scale vegetation units or ground cover of the Nosilla project area, dominated by commercial forestry which is currently in the process of being converted into agricultural lands (LUDS).

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

A total of three units consisting of untransformed vegetation/habitat and three units comprising transformed vegetation/habitat were identified (Figure 21 and 22). These six units are listed below, and each unit is later described in more detail.

Vegetation units and land cover type:

Untransformed vegetation/habitat

1. Riverine drainage – Riparian woodland and streams
2. Sour bushveld
3. Rocky outcrops or Granite Inselbergs

Transformed vegetation/habitat

4. Forestry in process to be cleared – Designated orchards
5. Current cultivation
6. Infrastructure

Vegetation and land cover types identified for the ecological surveys

1. Riverine drainage – Riparian woodland and streams

Several smaller seasonal tributaries to the White Waters River enter the farm from the southern and eastern sides. These tributaries include the unnamed tributaries (Weir Tributary for this report) that is earmarked for the proposed weirs (tributaries not DWS labelled). Most of these drainage lines have been impacted upon by forestry, roads and some orchards, but there are still extensive pockets of unaltered riverine woodland associated with these systems.

2. Sour bushveld

This bushveld type is found on the lower eastern slopes and foothills of the Drakensberg from 550-900m. Soils are deep and sandy to sandy-loam in uplands and clayey in valleys; the underlying geology is granite or gneiss. The vegetation structure varies from open to dense bushveld.

3. Rocky outcrops or Granite Inselbergs

Landscapes in the eastern lowveld of Mpumalanga are characterised by the presence of boulder-strewn granite inselbergs that rise out of the surrounding savannah-covered plains (MTPA, 2014). These inselbergs provide a great number and variety of ecological niches and thus support a host of plant communities and animal species. They are characterised by a number of endemic plant species. Forest margins and nearby rocky outcrops generally support a different plant community to the forest proper. Short thickets dominated by *Vachellia ataxacantha* occur on rocky sites in the study area. The large granite outcrops do not have much vegetation cover, though smaller forb species do grow in the crevices where soil and litter have collected.

This woodland around rocky outcrops is found on rocky terrain that varies from level to mildly steep. The soil is shallow on the higher-lying rocky areas and varies from shallow to moderately deep in the lower-lying more level areas. Soil texture is sandy to loam with some clay present.

Figure 21: A map illustrating the main land cover types on the Nosilla Farm. Most of the orchards stem from forestry that was removed and untransformed areas in between are a mixture of densely wooded drainage lines and inselbergs.

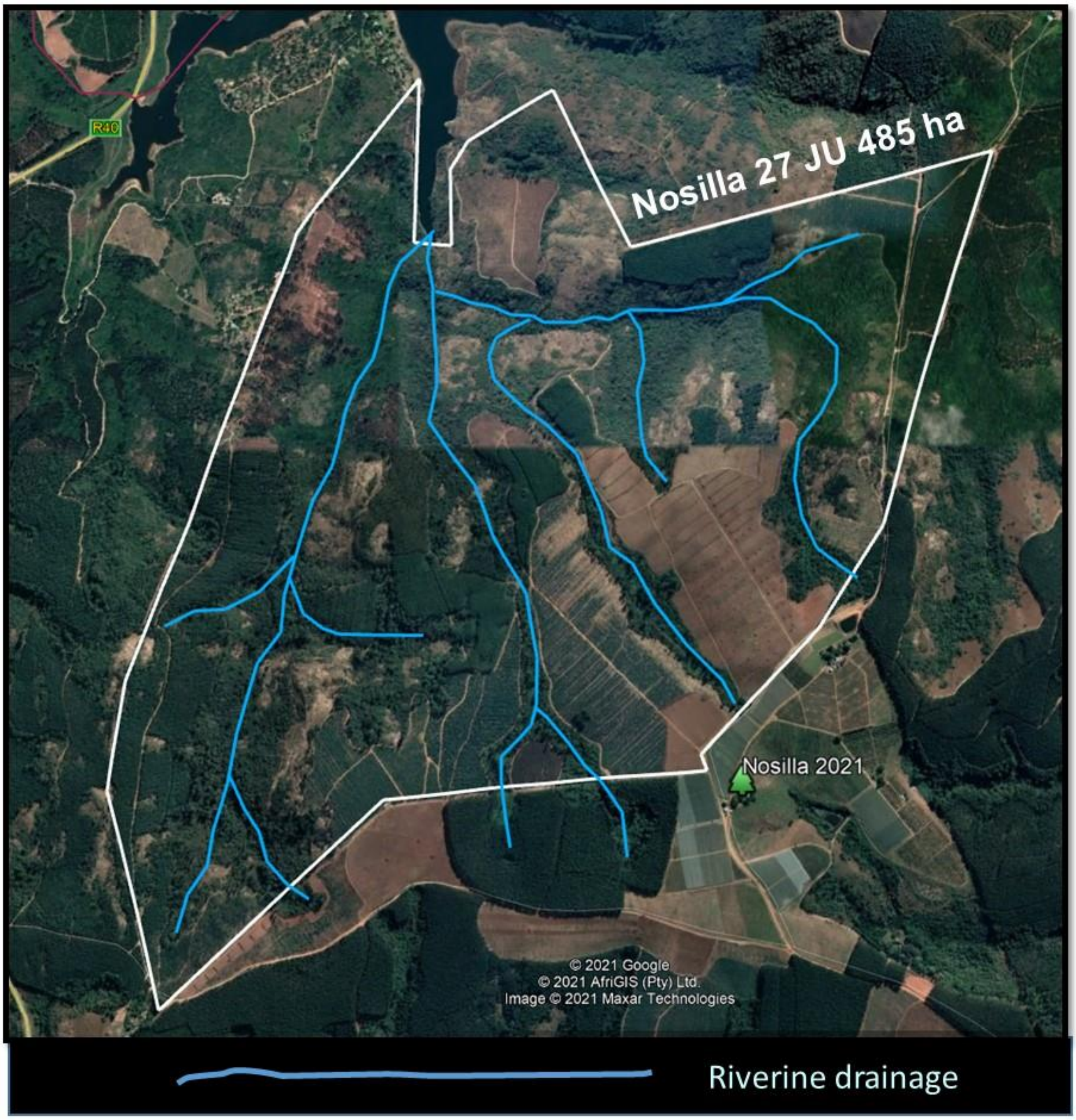


Figure 22: A Google Earth map illustrating the network of small drainage lines which drains the Nosilla project area.

Figure 23: Riverine drainage – Riparian woodland and streams.

Figure 23a: The drainage lines are flanked by dense riparian woodland.
Figure 23b: During the rainy season some of the drainage lines will have surface flows for extended periods.
Figure 23c: A small stream in the narrow channel of the drainage line. Most of these streams flowing down the slopes are small and seasonal.
Figure 23d: In areas less steep, shallow marshy areas develop with emergent macrophytes.

Figure 24: Sour bushveld

Figure 24a: Patches of grassland and thicket are scattered throughout the bushveld.

Figure 24b: Denser woodland occurs on the hilly slopes.

Figure 24c: The shady environment inside a thicket.

Figure 24d: A diverse mixture of grassland, thickets and granite inselbergs on the slope towards the valley.

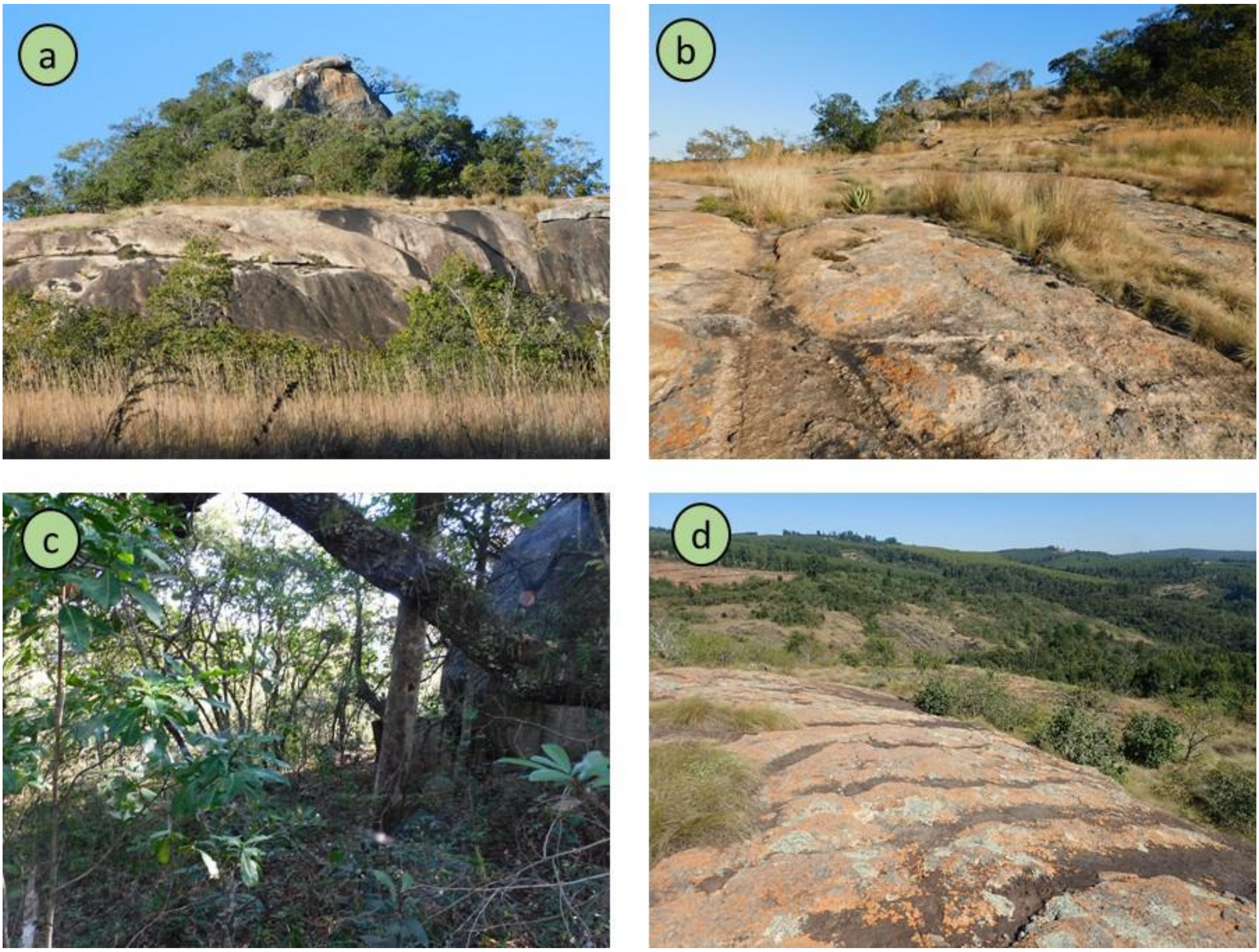


Figure 25: Rocky outcrops or Granite Inselbergs

Figure 25a: A granite inselberg with a higher outcrop on the crest.

Figure 25b: A typical habitat formed by the granite bedrock.

Figure 25c: The shady environment inside the dense woodland associated with these inselbergs.

Figure 25d: There are an abundance of granite inselbergs in the project area and they contribute by and large to the biodiversity of potential habitat types for the local fauna.

3.Transformed vegetation/habitat

Transformation refers to the removal or radical disturbance of natural vegetation, for example by crop agriculture, plantation forestry, mining or urban development. Transformation mostly results in a serious and permanent loss of biodiversity and fragmentation of ecosystems, which in turn leads to the failure of ecological processes. Remnants of biodiversity may survive in transformed landscapes (Ferrar and Lötter, 2007).

The most widespread cause for terrestrial biodiversity loss in Mpumalanga is crop- and timber cultivation. All forms of production agriculture will benefit from applying codes of best practice, such as have been developed in the timber growing industry, to reduce impact on biodiversity (Ferrar and Lötter, 2007). Half of Mpumalanga's natural habitat has already been irreversibly modified, mostly through large-scale agriculture, plantation forestry and mining (MTPA, 2014).

By using the Google Earth facility, the landcover of the project area was delineated with the assistance of the BGIS maps (Figure 21) and information supplied by the land owners.

4. Forestry - in process to be cleared

Large-scale commercial afforestation in South Africa and elsewhere in the world, can potentially have a profound impact on the biota inhabiting the regions afforested, in addition to having far-reaching water-budget-, economic- and sociological implications. This is not surprising, considering the radical extent of the habitat changes brought about by timber cultivation, especially when open and largely treeless ecosystems are transformed to monocultures of closed-canopy forests consisting of alien tree species. This issue is currently intensely relevant to efforts to conserve biodiversity.

The Mpumalanga Province covers an area of 8.3 million ha. Approximately 7% is afforested (roughly 580,000 ha). Commercial afforestation is not evenly distributed throughout Mpumalanga Province but is concentrated in a north-south strip, largely corresponding with the escarpment between the coastal lowlands and the interior plateau. Most plantations occur at elevations between 1000 and 2000 m in the areas receiving more than 850 mm of rainfall annually.

Commercial plantations, such as Pine and Eucalyptus, reduce the natural runoff from a catchment. Eucalyptus, have deep roots which can access much more soil moisture than indigenous grass and shrubs. This topic of reduction in runoff has been studied in detail over many years and is recognised in the National Water Act of 1998 as a water use – referred to as Streamflow Reduction (SFR) and a water use license is required in order to undertake a streamflow reduction activity (IWR, 2021).

As the forestry located on the farm Nosilla 27 JU is an existing lawful streamflow reduction activity, the water that becomes available from removing the forestry can be used for a different purpose, for example: irrigation. The area to be removed was estimated to be 185 ha with a streamflow reduction of 187 035 m^3 /annum. Therefore, removal of commercial forestry from the property will increase the runoff, which can either be abstracted directly or stored in an off-channel dam.

Large sections on the Nosilla property were covered with commercial plantations (see Figures 26a and b), which are currently being converted into agricultural lands. Figure 20 illustrates the land cover for the Nosilla project obtained from the Mpumalanga LUDS maps (BGIS, 2015), showing areas discussed in this section.

Figure 26: Forestry in process to be cleared.

Figure 26a: Historically, much of the area was planted with commercial forestry.

Figure 26b: *Eucalyptus* plantations covered large areas in this region.

Figure 26c: The plantations are currently in the process of being removed and replaced by orchards.

Figure 26d: A total of 185 ha of plantations will eventually be removed from the farm.

5. Current cultivation

With the relatively high rainfall and moderate climate, the area is suitable to produce Macadamias, Blueberries and Ginger. These crops are currently being grown on the neighbouring farms with success.

Figure 27: Current cultivation.
Figure 27a-d: The Nosilla farm produces Macadamias, Blueberries and Ginger.

6. Infrastructure

There are some buildings and other infrastructure on the farm, covering a small portion of the farm.

4.2 Ecological survey transects in the Nosilla 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 prevailing habitat and all associated fauna. GPS readings provide fixed locations of these transects for future monitoring (Table 13; Figure 28).

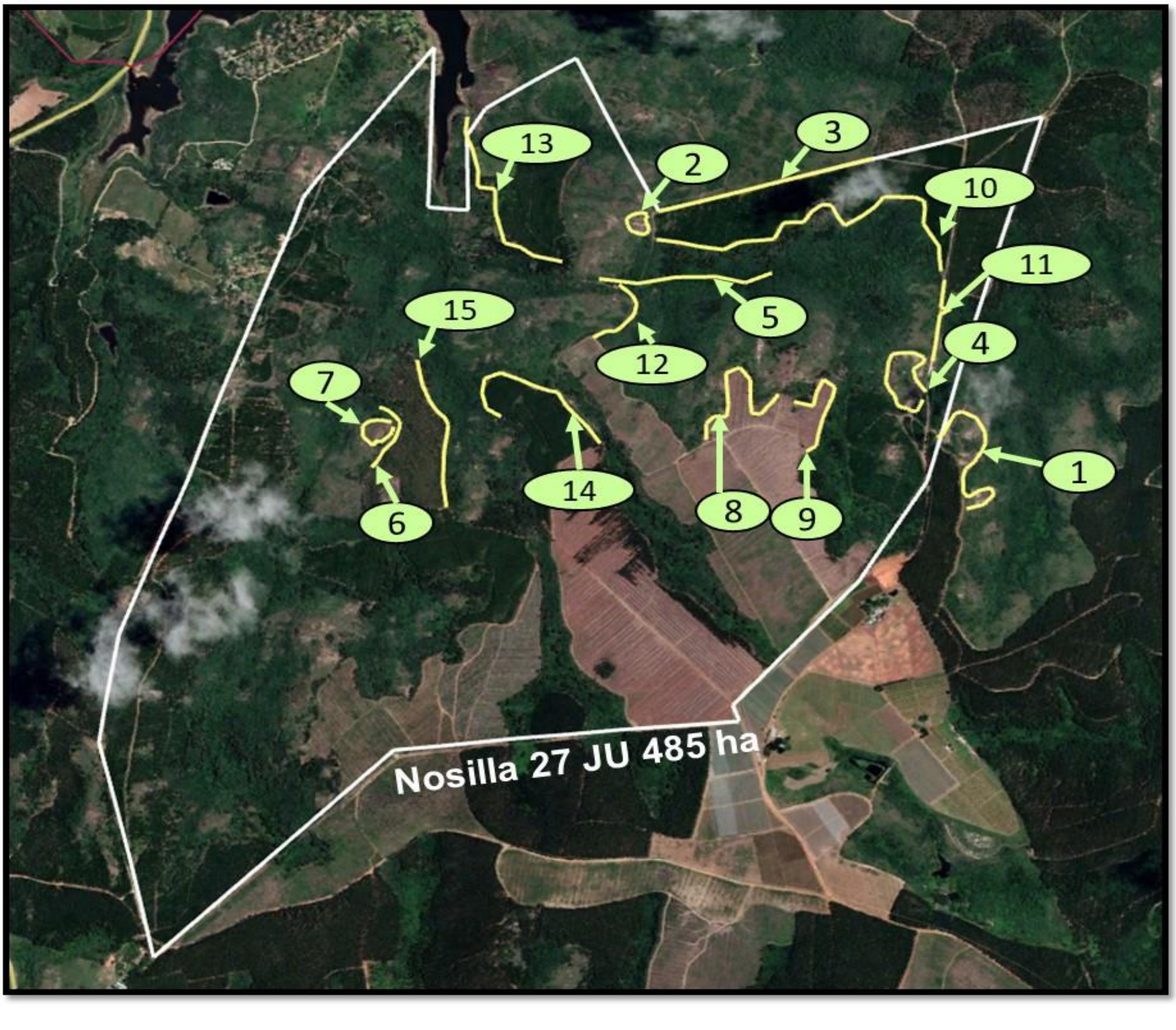
Table 13: Description of transects or point counts conducted for habitat, micro-habitat, influences and impacts, birds, mammal signs and herpetofauna (May 2021).

Habitat	Coordinates		Length (m)	Total (m)
	Start	End		
Untransformed vegetation/habitat				
1. Riverine drainage – Riparian woodland and streams				
Transect 5	25° 9'55.38"S 31° 1'18.43"E	25° 9'56.19"S 31° 1'36.54"E	523	
			Total	523
2. Sour bushveld				
Transect 3 Shared with forestry transect	25° 9'48.62"S 31° 1'32.36"E	25° 9'43.21"S 31° 1'56.54"E	679	
Transect 4 Shared with outcrop transect	25°10'8.72"S 31° 2'1.93"E	25°10'8.78"S 31° 1'57.14"E	566	
Transect 6 Shared with forestry transect	25°10'11.05"S 31° 1'0.61"E	25°10'18.02"S 31° 0'59.23"E	307	
Transect 7 Shared with outcrop transect	25°10'13.88"S 31° 1'2.20"E	25°10'14.23"S 31° 0'59.25"E	257	
Transect 8 Shared with cleared transect	25°10'14.38"S 31° 1'37.61"E	25°10'9.60"S 31° 1'45.79"E	563	
Transect 9 Shared with cleared transect	25°10'7.54"S 31° 1'50.56"E	25°10'15.95"S 31° 1'48.68"E	314	
Transect 10 Shared with forestry transect	25° 9'55.53"S 31° 2'4.20"E	25° 9'51.76"S 31° 1'32.00"E	1217	
Transect 11	25° 9'57.49"S 31° 2'4.10"E	25°10'7.22"S 31° 2'2.70"E	382	
Transect 12	25° 9'57.69"S 31° 1'28.91"E	25°10'2.70"S 31° 1'25.07"E	237	
Transect 13 Shared with cleared transect	25° 9'54.29"S 31° 1'21.39"E	25° 9'37.81"S 31° 1'10.17"E	713	
Transect 14 Shared with forestry transect	25°10'15.07"S 31° 1'25.72"E	25°10'11.69"S 31° 1'14.44"E	639	
Transect 15 Shared with forestry transect	25°10'5.54"S 31° 1'4.88"E	25°10'22.05"S 31° 1'8.53"E	540	
			Total	6414
3. Rocky outcrops or Granite Inselbergs				
Transect 1	25°10'13.99"S 31° 2'2.14"E	25°10'22.66"S 31° 2'6.54"E	761	
Transect 2	25° 9'48.82"S 31° 1'31.47"E	25° 9'51.27"S 31° 1'29.72"E	251	
Transect 4 Shared with bushveld transect	25°10'8.72"S 31° 2'1.93"E	25°10'8.78"S 31° 1'57.14"E	566	
Transect 7 Shared with bushveld transect	25°10'13.88"S 31° 1'2.20"E	25°10'14.23"S 31° 0'59.25"E	257	
			Total	1835

4. Forestry in process to be cleared				
Transect 3 Shared with bushveld transect	25° 9'48.62"S 31° 1'32.36"E	25° 9'43.21"S 31° 1'56.54"E	679	
Transect 6 Shared with bushveld transect	25°10'11.05"S 31° 1'0.61"E	25°10'18.02"S 31° 0'59.23"E	307	
Transect 10 Shared with bushveld transect	25° 9'55.53"S 31° 2'4.20"E	25° 9'51.76"S 31° 1'32.00"E	1217	
			Total	2203
5. Cleared land and orchards				
Transect 8 Shared with bushveld transect	25°10'14.38"S 31° 1'37.61"E	25°10'9.60"S 31° 1'45.79"E	563	
Transect 9 Shared with bushveld transect	25°10'7.54"S 31° 1'50.56"E	25°10'15.95"S 31° 1'48.68"E	314	
Transect 13 Shared with bushveld transect	25° 9'54.29"S 31° 1'21.39"E	25° 9'37.81"S 31° 1'10.17"E	713	
			Total	1590

GPS coordinates, acquired in the field (Table 13), were added to Google Earth (Figure 28) to illustrate and demarcate the study area and survey transects. Fifteen 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 28: The Nosilla study area (white border) and transects completed (yellow lines) in the different vegetation units (Section 4.1).



4.3 Biodiversity assessments

The fieldwork component of this study was conducted during May 2021. 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 of the Nosilla project environment, 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 (Section 4.1).

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 surveys (2021) 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 based on 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), Threatened or Protected Species (NEMBA) and all South African endemic taxa.

Conservation-important plant species listed for the quarter-degree grid 2531AA 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 a decrease in their numbers 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

The vegetation communities of the Nosilla study area are classified as Legogote Sour Bushveld.

Three untransformed vegetation communities were identified within the study area (Figure 21) based on distinctive vegetation structure (grassland, wetland, thicket, etc), floristic composition (dominant and diagnostic species) and position in the landscape (mid-slopes, terrace, crest, etc). The other three communities are transformed communities which include forestry, cultivation and infrastructure. The detail of the species found in the untransformed community and different morphological levels are listed in Table 14.

Plant surveys

A total of 82 indigenous plant species were recorded during fieldwork (Table 14); as well as 7 exotic species, some declared alien invaders.

Table 14: Vegetation assemblages and relevant plant species in the identified morphological levels in the project footprint. Vegetation types: 1= Riverine drainage; 2= Sour bushveld; 3= Granite Inselbergs (Shaded cells indicate presence of the species).

Plant species	1	2	3
Trees			
Black bird-berry (*Psychotria capensis*)			
Bladdernut *(Diospyros whyteana)*			
Bluebush (*Diospyros lycioides*)			
Broom cluster fig (*Ficus sur*)			
Broad-leaved beechwood (*Faurea rochetiana*)			
Buffalo-thorn (*Ziziphus mucronata*)			
Bushman's grape (*Rhoicissus tridentata*)			
Cabbage tree (*Cussonia spicata*)			
Cape beech (*Rapanea melanophloeos*)			
Cape holly (*Ilex mitis*)			
Common coral tree (*Erythrina lysistemon*)			
Common forest grape *(Rhoicissus tomentosa)*			
Common hook thorn *(Senegalia caffra)*			
Common wild currant (*Searsia pyroides*)			
Corky thorn *(Vachellia davyi)*			
Climbing turkey-berry (*Keetia gueinzii*)			
Cross-berry *(Grewia occidentalis)*			
False assegai *(Maesa lanceolata)*			
False olive *(Buddleja saligna)*			
Forest bushwillow (*Combretum kraussi*)			
Forest fever tree *(Anthocleista grandiflora)*			
Forest lavender tree (*Heteropyxis canescens*)			
Gland-leaf brides bush (*Pavetta edentula*)			
Kiaat /Transvaal teak (*Pterocarpus angolensis*)			
Koko tree (*Maytenus undata*)			
Krantz aloe *(Aloe arborescens)*			
Lowveld chestnut *(Sterculia murex)*			
Hairy rock fig (*Ficus glumosa*)			
Mobola plum (*Parinari curatellifolia)*			
Mitzeeri (*Bridelia micrantha*)			
Orange Climber (*Toddalia asiatica*)			
Pigeonwood (*Trema orientalis*)			
Pride-of-De Kaap (*Bauhinia galpinii*)			
Quilted bluebush (*Diospyros lycioides guerkei*)			
Red-leaved fig (*Ficus ingens*)			
River climbing thorn (*Senegalia schweinfurthii*)			
Silver dombeya (*Dombeya pulchra*)			
Small knobwood (*Zanthoxylum capense*)			
Stamvrug *(Englerophytum magalismontanum)*			
Stainpod *(Flemingia grahamiana)*			
Tassel berry (*Antidesma venosum*)			
Thorny rope (*Dalbergia armata*)			
Tree fuscia (*Halleria lucida*)			
Velvet bushwillow (*Combretum molle*)			
Velvet wild-medlar (*Vangueria infausta*)			
Water berry (*Syzygium cordatum*)			
Water pear *(Syzygium guineense)*			

Weeping lavender tree (*Heteropyxis natalensis*)			
White pear (*Apodytes dimidiata*)			
White thorn (*Acacia polyacantha*)			
Wild custard-apple (*Annona senegalensis*)			
Wild mulberry (*Trimeria grandifolia*)			
Forbs			
Buck's horn (*Lobelia coronopifolia*)			
Caustic vine (*Sarcostemma viminale*)			
Common kalanchoe *(Kalanchoe rotundifolia)*			
Crassula sarcocaulis sarcocaulis			
Crassula swaziensis swaziensis			
Droog-my-keel (*Cyphostemma cirrhosum*)			
Fever tea (*Lippia javanica*)			
Gladiolus dalenii (African gladiolus)			
Grand jaybee *(Jamesbrittenia grandiflora)*			
Hedgehog sage (*Coleus livingstonei*)			
Helichrysum lepidissimum			
Lopholaena disticha			
Monkey's tail *(Xerophyta retinervis)*			
Nonwhite stonecrop (*Crassula alba*)			
Polygala uncinata			
Resurrection plant (*Myrothamnua flabellifolius*)			
Thorny rope *(Smilax anceps)*			
Black-eyed Susan (*Thunbergia alata*)			
Wahlenbergia krebsii			
Wild foxglove (*Ceratotheca triloba*)			
Ferns			
Ethiopian spleenwort *(Asplenium aethiopicum)*			
False Staghorn Fern *(Dicranopteris linearis)*			
Grass and sedges			
Broad-leaved bristle grass (*Setaria megaphylla*)			
Broad-leaved leonotis *(Leonotis intermedia)*			
Giant three-awn *(Aristida meridionalis)*			
Natal red top (*Melenis repens*)			
Rooigras *(Themeda triandra)*			
Fungi			
Artist's bracket *(Ganoderma applanatum)*			
Thin-walled Maze Polypore (*Daedaleopsis confragosa*)			
Twisted Deceiver (*Laccaria tortilis*)			
Alien invading plants			
*Bluemink (*Ageratum houstonianum*)			
*Black wattle *(Acacia mearnsii)*			
*Bugweed (*Solanum mauritianum*)			
*Christmas berry (*Lantana camara*)			
*Guava (*Psidium guajava*)			
*Peanut senna (*Senna didymobotrya*)			
*Periwinkle (*Catharanthus roseus)*			

Species of Concern: Plants

During the survey, one of the protected trees (Government Gazette, 2019; Department of Agriculture, Forestry and Fisheries, 2019) was observed in the project area:

- Wild teak (*Pterocarpus angolensis*)

Protected trees: Notice of the list of protected tree species under the National Forest Act, 1998 (Act No. 48 of 1998). "No person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any manner require or dispose of any protected tree or any forest product derived from a protected tree, except under a licence or exemption granted by the Minister of Agriculture, Forestry and Fisheries to an applicant and subject to such period and conditions as may be stipulated."

Figure 29: The extensive list of species (fauna and flora) for the 2531AA grid have been narrowed down to the area demarcated in the area indicated as "Extent of assessment".

Conservation-important plant species listed for the quarter-degree grid 2531AA in the Mpumalanga Tourism & Parks Agency's (MTPA) threatened species database (obtained from Dr 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 2531AA grid have been narrowed down to the area demarcated in Figure 29 and listed in Table 15. The following farms were analysed for the presence of threatened species:

Table 15: Farms analysed for the presence of threatened species.

Saint Cloud Klipkopje Ligfontein Nosilla	Zwartfontein Logogoto Witwater Forest Reserve	White Waters Etna Da Gama

The listed plant species which were recorded on the farm portions are:

White Waters

- *Eriosema naviculare*: (Conservation status for South Africa – Endangered; Conservation status for Mpumalanga – Endangered; Endemic – South Africa)

Etna

- *Adenia gummifera* var. *gummifera*: (Conservation status for South Africa – Declining; Conservation status for Mpumalanga – Declining; Endemic – No)

SA Endangered

FABACEAE: *Eriosema naviculare*
2011– Endangered in SA.

Habitat: Flats at the base of granite outcrops in Pretoriuskop Sour Bushveld. Threat: Threatened by ongoing habitat loss and degradation as a result of expansion of rural settlements and agriculture, overgrazing, too frequent fire and clearing of woody vegetation between Hazyview and Numbi Gate. Fifty percent of this species' very restricted habitat of about 1 000 km^2 falls outside the Kruger National Park and is nearly completely transformed and degraded.

Mpumalanga – Declining

Family Passifloraceae: *Adenia gummifera var. gummifera*
The stems, roots and leaves are used for various traditional medicinal and magical purposes throughout its range. In southern Africa traditional medicine markets, the chopped-up stems are popularly traded.

Habitat: Forested ravines, forest patches and forest margins, forest scrub, miombo woodland, savannah, dune forest, on stony slopes, termitaria and littoral bush, 0-1 800 m.

Figure 30: According to the Species Status Report of the MTPA for the quarter-degree grid: 2531AA, the conservation status of *Adenia gummifera var. gummifera* for Mpumalanga is: “Declining”**.**

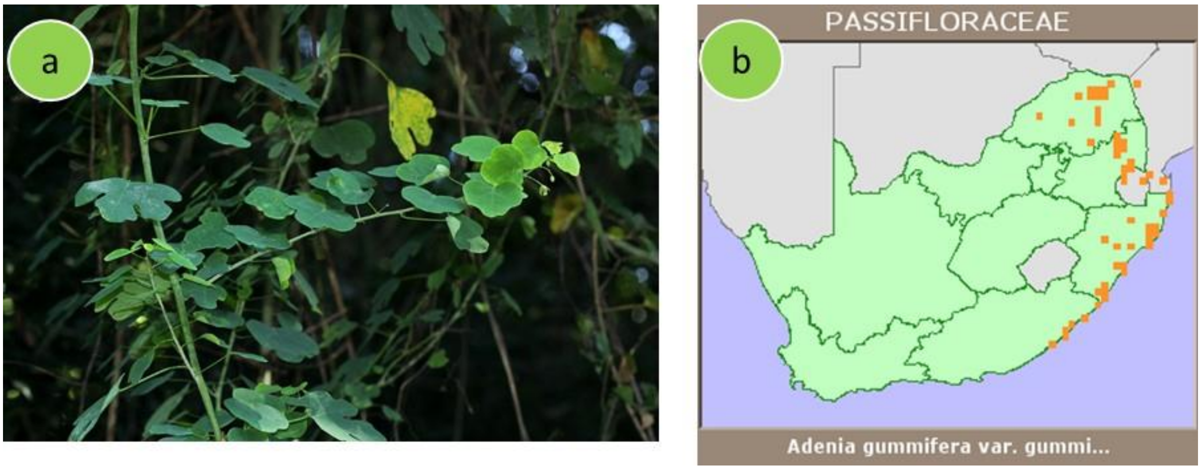


Figure 31: a) *Adenia gummifera var. gummifera* (Declining). b) Distribution of *Adenia gummifera var. gummifera***.**

Additionally, information which was obtained from the Screening Tool exercise, lists the environmental sensitivity of the project region (Figure 37) and also recorded certain Species of Special Concern (SSC) for the Animal and Plant species themes expected in the footprint. These assemblages will also be evaluated as part of the expected SSC lists. However, according to the SANBI section relating to EIA Data Requests, the following rules should be adhered to:

“The Screening Tool report includes lists of bird, mammal, reptile, amphibian, butterfly and plant species of conservation concern known or expected to occur on the proposed development footprint. Some of these SCC are sensitive to illegal harvesting. Such species have had their names obscured and are listed as a sensitive plant unique number / sensitive animal unique number. Should such species appear in the Screening Tool report the Environmental Assessment Practitioner (EAP) is required to email eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifier. SANBI will release the actual species name after the details of the requester have been documented.

As per the best practise guideline that accompanies the protocol and screening tool, please, remember that the name of the sensitive species may not appear in the final EIA report nor in any of the specialist reports released into the public domain. It should be referred to as sensitive plant or sensitive animal and its threat status may be included, e.g., critically endangered sensitive plant or endangered sensitive animal.”

Table 16 lists the sensitive and threatened species expected to occur in the project region according to the Environmental Screening Tool. Two of these species have unique identifier codes. After requested the listing of the listed sensitive species with their unique identifier, SANBI released the actual species name on the above terms and conditions. It is now the responsibility of the Specialist Scientist to be aware of these species and ensure that the correct prescribed procedures are followed whenever these species are encountered.

Table 16: Sensitive and threatened species expected to occur in the project region according to the Environmental Screening Tool results (compare with Figure 37).

Theme	Sensitivity	Feature
Plant Species Theme	Medium	*Wooda singularis*
		Sensitive species 136
		Sensitive species 575

Species of Special Concern - Environmental Screening Tool

<u>Rare</u> (Listed by the Environmental Screening Tool)

APOCYNACEAE: *Woodia singularis* (Conservation status for South Africa – Rare; Conservation status for Mpumalanga – Rare).

Known from three small, disjunct subpopulations and likely to be a paleoendemic species occupying the edges of a former larger range. Habitat: Various habitats in bushveld and grasslands.

Figure 32: Distribution of *Woodia singularis*

Table 17 summarises the expected SSC plants, the habitat where they would be expected to occur and the threatened status per species.

Table 17: A list of plants of special concern that have distribution ranges and habitat preferences that overlap with the study area (Grid: 2531AA). The description of the status categories is available in Appendix 4.

Species	Habitat (SANBI 2019)	Status (SANBI 2019)
Adenia gummifera var. gummifera	Forested ravines, forest patches and forest margins, forest scrub, miombo woodland, savannah, dune forest, on stony slopes, termitaria and littoral bush, 0-1 800 m.	SA Red Data: Least Concern; Declining; This taxon is regularly found in medicinal markets and local declines have been observed.
Eriosema naviculare	Flats at the base of granite outcrops in Pretoriuskop Sour Bushveld.	Threatened by ongoing habitat loss and degradation because of expansion of rural settlements and agriculture, overgrazing, too frequent fire and clearing of woody vegetation between Hazyview and Numbi Gate.
Woodia singularis	Various habitats in bushveld and grasslands.	Known from three small, disjunct subpopulations and likely to be a paleoendemic species occupying the edges of a former larger range.
Sensitive species 136		Endangered
Sensitive species 575		Critical Endangered

4.3.2 Riverine Ecology

<u>4.3.2.1 The extent of the riparian habitat</u>

Unnamed stream and associated riparian zone

Viewing the Google Earth image (Figures 20 and 21), it is clear that the whole drainage network is surrounded by a rather broad corridor of dense riparian and valley vegetation which acts as a natural buffer from the current development in the Nosilla catchment. No riparian buffers have been considered historically.

The riparian zone is relatively narrow (15 to 25 metres wide) in the headwaters of the drainage system which is surrounded by areas of cleared forestry. Further down in the catchment the riparian zone is wider (20 to 50 metres wide) and well buffered by dense woodland on steep hill slopes.

The river itself is a small stream (2.0 to 4.0 m wide) with a deep organic soil stream bed and emergent hydrophytic vegetation.

The vegetation in the riverine area consists of larger trees in the marginal areas, especially mitzeeri and water berry, while the non-marginal areas are covered with dense terrestrial woodland on steep hill slopes. Hygrophilous vegetation (adapted for growth in a damp or wet environment) lines the lower portions of the riparian zone (Figures 23a - d).

Of the 52 tree species on the farm, eight riparian indicator species have been observed, as well as five alien species.

Table 18: Riparian indicator plant species observed in the riparian zone along the stream reach during the survey.

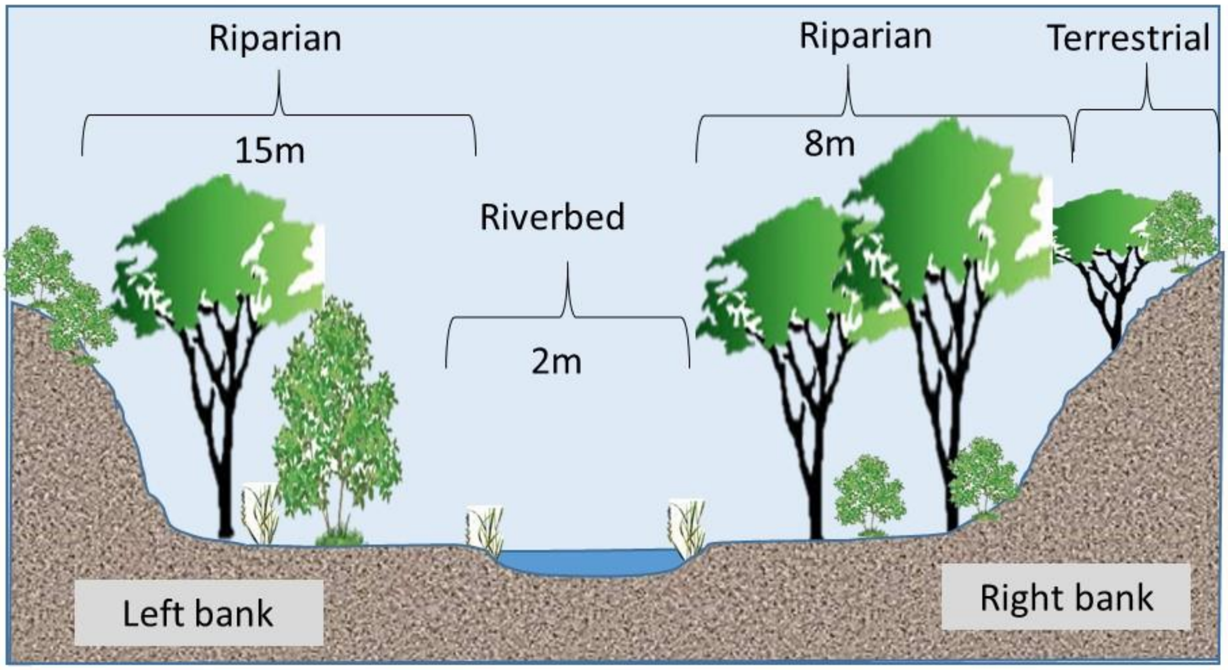
FAMILY	TAXON	HABITAT
ANNONACEAE	*Annona senegalensis*	Sandy soils along rivers, also in mixed scrub or woodland, on rocky outcrops and in swamp forest.
EUPHORBIACEAE	Mitzeeri *(Bridelia micrantha)*	Riverine forest; patches of relic forest, or in open woodland.
MYRSINACEAE	False assegai *(Maesa lanceolata)*	Margins of evergreen forest, almost always along rivers and streams, occasionally in open mountain grassland.
MYRTACEAE	Water berry (*Syzygium cordatum subsp. 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.
MYRTACEAE	Water pear *(Syzygium guineense subsp. Guineense)*	Open deciduous woodland at medium to low altitudes, frequently fringing vleis, sometimes along riverbanks.
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.
STERCULIACEAE	Silver dombeya (*Dombeya pulchra)*	In wooded river valleys and along stream banks, also on mountain sides at high altitudes.
ULMACEAE	Pigeonwood (*Trema orientalis*)	Variety of habitats, usually moist soils, on forest margins, along watercourses, often a constituent of riverine fringe thicket, also in ravines and valleys and even along dry, sandy riverbeds (smaller in drier habitats).

Figure 33: Riverine drainage – Riparian woodland and streams.

Figure 33a-b: The unnamed stream consists of a narrow channel in the drainage line.
Figure 33c: The marginal zones of the drainage lines are covered by hydrophytic vegetation.
Figure 33c: In slower flowing areas the stream has a deep organic soil bed and some floating vegetation.
Figure 33d: Where the stream flows wider, shallow marshy areas develop with emergent macrophytes.

During the site visit to the Nosilla project area, two riverine survey sites were earmarked for assessment. At each of these survey sites, a transect was surveyed: from the edge of the riparian area (left and right bank) and through the streambed to the other side. The site information is summarised in one representative figure due to the similarity of the two sites (Figure 34).

Transects 1 and 2



Riparian width		Riverbed		Transect	#1
Left bank	15m	Width	2m	Transect length	30m
Right bank	8m				
Riparian vegetation - Left bank		Riverbed cover		Riparian vegetation - Right bank	
Water berry (*Syzygium cordatum subsp. cordatum*)		Emergent hydrophytes		Mitzeeri *(Bridelia micrantha)*	
False assegai *(Maesa lanceolata)*		Surface water		Buffalo thorn *(Ziziphus mucronata)*	
Pigeonwood (*Trema orientalis*)		Organic soil bottom		Water berry (*Syzygium cordatum subsp. cordatum*)	
*Black wattle *(Acacia mearnsii)*				Thorny rope (*Dalbergia armata*)	
River climbing thorn (*Senegalia schweinfurthii*)				River climbing thorn (*Senegalia schweinfurthii*)	
Terrestrial					
Orchards				Orchards	

*Alien invader plant

Figure 34: Transects 1 and 2 (combined), indicating the riverine properties of the Nosilla reach.

4.3.2.2 Aquatic habitat assessment

Aquatic surveys and biomonitoring are essential components of the system ecology 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 survey, aquatic habitats surveyed at Transect 1 and 2, consisted of a narrow channel flanked by hydrophytic vegetation and large riparian trees and in areas the riverbed will widen into shallow, marshy reaches with emergent hydrophytes.

The following habitat parameters were measured - IHAS (Integrated Habitat Assessment System) and HQI (Habitat Quality Index) with the results summarised in Table 19.

Table 19: The combined habitat parameters as measured at the two drainage lines sites within the unnamed stream.

SITE	**IHAS%**	**CATEGORY**	**HQI%**	**CATEGORY**
SITE 1 & 2	64	Fair	60	Fair

During the May 2021 survey, the IHAS and HQI scores were mostly moderate due to the lack of deep-water habitat and fast flows, thus classified as a “Fair” category at these transects (Table 19).

Surveys of Aquatic Invertebrates and Fish

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 incorporating the habitat aspects, a proper basis for biological diversity can be obtained.

4.3.2.3 Aquatic invertebrate assessment

The macro-invertebrates were sampled according to the SASS5 method at the combined site, and Table 20 lists the macro-invertebrates sampled at the site and reflects the SASS5 scores for the May2021 survey.

Table 20: SASS5 scores of the different habitat types at the sampling pool site (a complete table of this summarised version can be viewed in Appendix 3).

TAXON	Stones	Vegetation	GSM	Total
Potamonautidae 3		1	1	1
Coenagrionidae 4			B	B
Gomphidae 6			A	A
Libellulidae 4			1	1
Gerridae 5			A	A
Notonectidae 3			A	A
Dytiscidae 5		A		A
Gyrinidae 5		A		A
Tipulidae 5		1		1
SASS Score	0	18	25	40
No of families	0	4	6	9
ASPT	0	4.5	4.1	4.4

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

Table 21: A summary of the IHAS, HQI and SASS scores in the Nosilla project area.

SURVEY SITE	Habitat scores		SASS5 Scores		
	IHAS %	HQI %	SASS score	Number of families	ASPT
Nosilla drainage line	64	60	40	9	4.4

Judging from Table 21, the habitat scores are moderate and are thus categorised as “Fair” (Table 22). The lack of deep-water habitat and fast flows over stones, but presence of good overhanging vegetation, resulted in overall “Fair” SASS scores.

Table 22: 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

4.3.2.2 Fish communities - Fish Response Assessment Index (FRAI)

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.

During the May 2021 aquatic survey, it became clear that no fish can venture this far upstream into the small unnamed drainage line on the Nosilla property. These systems are seasonal and when it stops flow during the dry season, no aquatic habitat remains for fish to survive in. Steep rocky cascades and stream reaches overgrown with emergent vegetation, prevent fish from penetrating far up into these systems.

Therefore, although the system has favourable water quality and suitable local habitat, fish are not able to reach these areas and therefore the fish assessment could not conclude the FRAI assessment process.

4.3.3 Terrestrial ecology

4.3.3.1 Invertebrates

Although no in-depth surveys were done for invertebrates, most insects observed were photographed, but not identified to species level yet. During the transect surveys, it was kept in mind that the listed species might be present in the area. These 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

A sub-section of the 2531AA quarter-degree grid square was demarcated (Figure 29) 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 SCC were listed for the area evaluated, however the Environmental Screening Tool listed two species of concern (Table 23).

Table 23: Sensitive and threatened species expected to occur in the project region according to the Environmental Screening Tool results (compare with Figure 37).

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

Table 23 summarises the expected SSC invertebrates and below are descriptions of the species, the habitat where they would be expected to occur and the threatened status per species (Henning *et al,* 2009).

Vulnerable insects

Irving's Blue (*Lepidochrysops irvingi)*

In recent years three further sub-populations have been found in a protected area in Swaziland, in a protected area near Barberton and in the mountains above Ohrigstad. None of these populations are threatened and all appear to be stable.

Restricted to montane grassland in Swaziland and Mpumalanga. The sub-populations at Nelshoogte, Sabie and Graskop are experiencing ongoing decline in habitat quality as a result of fire suppression for Pine plantation management (the host plant requires fire) and invasion by alien plants. The taxon thus qualifies globally under the IUCN criteria as Vulnerable under criterion B.

SA Endangered

Jambila Seedpod Shieldback *(Thoracistus jambila)*
This species is associated with open, tall grassy habitat.
The threat status of the Jambila Seedpod Shieldback (*Thoracistus jambila*) is Endangered under criterion B1. Its extent of occurrence is small (~1,000 km^2), it has only been recorded in four locations, and the quality of its habitat is expected to be in decline due to grazing pressure, cultivation, invasive alien plants and climate change.

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 Nosilla 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 27 frog species are expected to be present in the study area. Of these frog species that are expected to occur in the riverine habitats within the study area, we anticipate 22 species will reside here, accommodated by potential habitat in the area. During surveys of the frog species (May 2021), 11 of the 22 expected species were encountered in the Nosilla project area (See Appendix 5 for detail):

- African common toad (*Sclerophrys gutturalis*)
- African split-skin toad (*Schismaderma carens)*
- Painted reed frog (*Hyperolius marmoratus taeniatus*)
- Tinker Reed Frog (*Hyperolius tuberilinguis)*
- Bubbling kassina (*Kassina senegalensis*)
- Dwarf puddle frog **(***Phrynobatrachus mababiensis*)
- Natal dwarf puddle frog (*Phrynobatrachus natalensis*)
- Anchieta's ridged frog (*Ptychadena anchietae*)
- Muller's platanna *(Xenopus muelleri)*
- Delelande's river frog (*Amietia delalandii*)
- Natal sand frog (*Tomopterna natalensis*)

Most of the expected species were present in the riverine habitats, dams and grassland areas of the Nosilla project area.

Species of Special Concern: Frogs

Species of special concern consists of 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, no endemic species are expected to occur in the Nosilla project area. Currently no threatened frog species is expected to occur in the area.

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

According to Alexander and Marais (2007), the habitats around the Nosilla project area is considered savannah. Savannah is the most extensive ecoregion in the subregion, occurring over much of the northern parts of southern Africa. Savannah 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 savannah reptiles are classified as threatened, and many have extensive ranges (Alexander & Marais, 2007).

According to the distribution of reptiles in South Africa, 68 species have distribution ranges extending into the region. Of the 68 species, 64 species are expected to occur in the Nosilla project area (Jacobsen, 1989; Animal Demographic Unit, 2010) as adequate habitat is available. During the surveys of reptile species (2021), 16 of the 64 expected species were recorded in or reported for the project area (See Appendix 6 for detail). Additional species observed by the local inhabitants were also added to the list:

1. Turner's giant gecko *(Chondrodactylus turneri)*
2. Common dwarf gecko *(Lygodactylus capensis capensis)*
3. Common tropical house gecko (*Hemidactylus mabouia*)
4. Southern African python (*Python natalensis*)
5. Western yellow-bellied sand snake (*Psammophis subtaeniatus*)
6. Brown house snake *(Boaedon capensis)*
7. Cape wolf snake *(Lycophidion capense capense)*
8. Spotted bush snake (*Philothamnus semivariegatus*)
9. Boomslang (*Dispholidus typus typus*)
10. Mozambique spitting cobra (*Naja mossambica*)
11. Black mamba (*Dendroaspis polylepis*)
12. Rainbow rock skink (*Trachylepis margaritifer*)
13. Striped skink (*Trachylepis striata*)
14. Variable skink (*Trachylepis varia*)
15. Yellow-throated plated lizard (*Gerrhosaurus flavigularis*)
16. Wilhelm's flat lizard *(Platysaurus intermedius wilhelmi)*

Species of Special Concern: Reptiles

Species of special concern includes threatened, endemic and rare species.
Threatened reptile species are rated by standards established by the *International Union for Conservation of Nature (IUCN) 2014,* 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 5 endemic reptile species that have distribution ranges overlapping the study area and expected in the riverine habitats (SA endemic - Including Lesotho & Swaziland):

- Kwazulu Natal purple-glossed snake *(Amblyodipsas concolor)*
- Southern brown egg-eater *(Dasypeltis inornata)*
- Montane dwarf burrowing skink (*Scelotes mirus*)
- Wilhelm's flat lizard (*Platysaurus intermedius wilhelmi*)
- Distant's ground agama *(Agama aculeata distanti)*

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

- Southern African python (*Python natalensis*). NEMBA TOPS (2015): Protected,

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 source 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 breeds in southern Africa.

Bird surveys

During May 2021, the project area of Nosilla farm was surveyed for bird species. A total of 318 bird species were observed in this region during the Bird Atlas project (Harrison *et al.* 1997) (Appendix 7). If bird distribution and local habitat are evaluated, it is clear that a total of 306 species of birds are likely to utilise the habitat types the Nosilla study area.

During the May 2021survey, all the untransformed habitat types were surveyed and a total of 28 bird species across all the transects were observed in the project area (See Appendix 7 for detail):

1. African fish eagle (*Haliaeetus vocifer*)
2. Long-crested Eagle *(Lophaetus occipitalis)*
3. Purple-crested Turaco (*Tauraco porphyreolophus*)
4. Freckled nightjar (*Caprimulgus tristigma*)
5. Red-faced Mousebird *(Urocolius indicus)*
6. Lesser honeyguide *(Indicator minor)*
7. Golden-tailed Woodpecker (*Campethera abingoni*)
8. Dark-capped Bulbul (*Pycnonotus tricolor)*
9. Sombre Greenbul *(Andropadus importunus)*
10. Kurrichane Thrush (*Turdus libonyana*)
11. African Stonechat *(Saxicola torquata)*
12. Yellow-breasted Apalis *(Apalis flavida)*
13. Tawny-flanked prinia (*Prinia subflava*)
14. Southern Black Flycatcher (*Melaenornis pammelaina*)
15. Cape Batis *(Batis capensis)*
16. Common Fiscal *(Lanius collaris)*
17. Black-backed puffback (*Dryoscopus cubla*)
18. Southern Boubou *(Laniarius ferrugineus)*
19. Gorgeous Bushshrike *(Chlorophoneus quadricolor*)
20. Grey-headed Bushshrike *(Malaconotus blanchoti)*
21. White-crested Helmet-Shrike *(Prionops plumatus)*
22. Amethyst Sunbird *(Chalcomitra amethystina)*
23. Southern double-collared sunbird (*Cinnyris chalybeus*)
24. Cape white-eye *(Zosterops capensis)*
25. African Firefinch (*Lagonosticta rubricata*)
26. Pin-tailed Whydah (*Vidua macroura*)
27. Yellow-fronted Canary *(Crithagra mozambicus*)
28. Streaky-headed Seedeater *(Crithagra gularis)*

Species of Special Concern: Birds

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 19 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 six endemic bird species are expected to occur in the area:

- Forest Buzzard *(Buteo trizonatus)*
- Knysna Turaco *(Tauraco corythaix)*
- Chorister Robin-Chat *(Cossypha dichroa)*
- Buff-streaked Chat *(Oenanthe bifasciata)*
- Cape Rock Thrush *(Monticola rupestris*
- Greater Double-collared Sunbird *(Cinnyris afer)*

The following threatened bird species (IUCN, 2018; NEMBA, 2014; Red Data Book, 2015) can make use of the Nosilla habitats for feeding, perching or nesting:

1. Abdim’s stork (*Ciconia abdimii*) - SA Red Data (Taylor 2015): Near-threatened. Mpumalanga: Near threatened. IUCN 2016 Status: Least concern.
2. Cape Vulture *(Gyps coprotheres)* - IUCN 2015: EN Endangered; SA Red Data (Taylor 2015): Endangered. NEMBA TOPS (2007): Endangered species.
3. Secretary bird (*Sagittarius serpentarius*) - IUCN 2017 VU Vulnerable; SA Red Data (Taylor 2015): Vulnerable. NEMBA (TOPS 2007): Vulnerable species.
4. Ayres's Hawk-Eagle *(Hieraaetus ayresii)* - SA Red Data (Barnes 2000): Near-threatened.
5. Martial Eagle *(Polemaetus bellicosus)* - IUCN 2015 Status: Near-threatened; SA Red Data (Taylor 2015): Endangered; NEMBA TOPS (2015): Endangered species.
6. African Crowned Eagle *(Stephanoaetus coronatus)* - IUCN 2015 Status: Near-threatened. SA Red Data (Taylor 2015): Vulnerable. NEMBA (TOPS 2007): Vulnerable species. Mpumalanga: Vulnerable.
7. Lanner Falcon *(Falco biarmicus)* - SA Red Data (Taylor 2015): Vulnerable. IUCN 2017 Status: Least concern.
8. Black-bellied Bustard (*Lissotis melanogaster*) - SA Red Data (Barnes 2000): Near-threatened.
9. Swamp Nightjar (*Caprimulgus natalensis*) - IUCN 2020: Least Concern. SA Red Data (Taylor, 2015): Vulnerable.
10. Half-collared Kingfisher *(Alcedo semitorquata)* - SA Red Data (Taylor 2015): Near-threatened. Mpumalanga: Near threatened. IUCN 2015 Status: Least concern.
11. European Roller (*Coracias garrulus*) - SA Red Data (Taylor 2015): Near-threatened; IUCN 2018 Least concern.
12. Blue Swallow *(Hirundo atrocaerulea)* - IUCN 2015 VU Vulnerable; SA Red Data (Taylor, 2015): Critically endangered.
13. Orange Ground-Thrush *(Zoothera gurneyi)* - IUCN 2010 Status: Least concern. SA Red Data (Taylor, 2015): Near threatened.
14. Fan-tailed grassbird (*Schoenicola brevirostris*) - IUCN 2014 Status: Least concern; SA Red Data (Taylor 2015): Least concern. Mpumalanga: Near threatened. (Found on the Farm Da Gama – MTPA Data Base)

Species of Special Concern habitat requirements

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 for these birds, which will have a direct influence on their viability and estimated population size.

Comparing the habitat requirements of Species of Concern with habitat availability in the Nosilla biotopes, Table 24 evaluates the habitat assemblages that correspond with the optimal requirements of these birds.

Table 24: Habitat assemblages that correspond with the optimal requirements of SSC birds.

The potential of the area to supply habitat	**Riverine drainage – Riparian woodland and streams**	**Sour bushveld**	**Rocky outcrops or Granite Inselbergs**
Optimal	African Crowned Eagle *(Stephanoaetus coronatus)*	Martial Eagle *(Polemaetus bellicosus)*	Lanner Falcon *(Falco biarmicus)*
	Knysna Turaco *(Tauraco corythaix)*		
	Chorister Robin-Chat *(Cossypha dichroa)*		
Good		Cape Vulture *(Gyps coprotheres)*	
		European Roller (*Coracias garrulus*)	
Medium	Swamp Nightjar (*Caprimulgus natalensis*)	Fan-tailed grassbird (*Schoenicola brevirostris*)	
	Half-collared Kingfisher *(Alcedo semitorquata)*		
Low	Ayres's Hawk-Eagle *(Hieraaetus ayresii)*	Secretary bird (*Sagittarius serpentarius*)	
	Orange Ground-Thrush *(Zoothera gurneyi)*		
Poor		Blue Swallow *(Hirundo atrocaerulea)*	
		Black-bellied Bustard (*Lissotis melanogaster*)	

A final synopsis of habitat available in the project area and the preferred habitat available for expected SSC bird species, lists the species most likely to be present in the project area, or occasionally visit the area. Bird species with “Medium” to “Optimal” ratings to potentially utilise available habitat in the Nosilla project area, are listed below.

- African Crowned Eagle (*Stephanoaetus coronatus*)
- Knysna Turaco (*Tauraco corythaix*)
- Chorister Robin-Chat (*Cossypha dichroa*)
- Martial Eagle (*Polemaetus bellicosus*)
- Cape Vulture (*Gyps coprotheres*)
- European Roller (*Coracias garrulus*)
- Fan-tailed grassbird (*Schoenicola brevirostris*)
- Swamp Nightjar (*Caprimulgus natalensis*)
- Half-collared Kingfisher (*Alcedo semitorquata*)
- Lanner Falcon (*Falco biarmicus*)

4.3.3.5 Mammals

Of all the mammal species that have distribution ranges in the region, 122 coincide with the Nosilla project area (Friedman & Daly, 2004).

Under natural conditions the area had the potential to accommodate larger mammal species. However, due to persecution by humans and habitat loss, some of the expected larger game species are most likely lost to the area:

- Lion (*Panthera leo*)
- African elephant (*Loxodonta africana*)
- Plains zebra (*Equus quagga*)
- Hippopotamus (*Hippopotamus amphibius*)
- Blue wildebeest (*Connochaetes taurinus*)
- Tsessebe (*Damaliscus lunatus*)
- Impala (*Aepyceros melampus*)
- Sable antelope (*Hippotragus niger niger*)
- Cape buffalo (*Syncerus caffer*)
- Nyala (*Tragelaphus angasii*)
- Eland (*Taurotragus oryx*)
- Grey rhebok (*Pelea capreolus*)
- Reedbuck (*Redunca arundinum*)
- Mountain reedbuck (*Redunca fulvorufula*)
- Waterbuck (*Kobus ellipsiprymnus*)

If available habitat types in the Nosilla project area are evaluated, only 105 mammal species are likely to occur in the project area (excluding the listed large species). Although larger, more mobile species will not be resident, many of the smaller species will settle in the area and use the habitat available. Previously, a pack of African wild dog (*Lycaon pictus*) moved through the Nosilla area, but they did not stay for long and were probably a pack just looking for new habitat or prey.

During the 2021 surveys, signs and/or sightings or species observed were listed and species observed by local inhabitants were added. The number listed totalled 22 mammal species (See Appendix 8 for detail) as listed below (SSC in red font):

- Chacma baboon (*Papio ursinus*)
- Thick-tailed bush baby (*Otolemur crassicaudatus*)
- Southern lesser bushbaby (*Galago moholi*)
- Vervet monkey (*Cercopithecus aethiops*)
- Caracal (*Felis caracal*)
- Serval (*Leptailurus serval*)
- Wild dog (*Lycaon pictus*)
- Cape clawless otter (*Aonyx capensis*)
- Honey badger (*Mellivora capensis*)

- Small-spotted genet (*Genetta genetta*)
- African civet (*Civettictis civetta*)
- White-tailed mongoose (*Ichneumia albicauda*)
- Water mongoose (*Atilax paludinosus*)
- Banded mongoose (*Mungos mungo*)
- Dwarf mongoose (*Helogale parvula*)
- Bushpig (*Potamochoerus larvatus)*
- Red duiker *(Cephalophus natalensis)*
- Cape common duiker (*Sylvicapra grimmia grimmia*)
- Bushbuck (T*ragelaphus scriptus*)
- Cape Porcupine *(Hystrix africaeaustralis)*
- Tree squirrel (*Paraxerus cepapi*)
- Common Molerat *(Cryptomys hottentotus)*

Endemic

The Hottentot's golden mole (*Amblysomus hottentotus*) is an endemic mammal to South Africa.
Ten (10) of the 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 (see Appendix 8 for detail):

- Dark-footed forest shrew (*Myosorex cafer*) - SA Red Data (2016): Vulnerable**.** IUCN 2016: Least concern. TOPS: None.
- Swamp musk shrew (*Crocidura mariquensis)* - SA Red Data (2016): Near-threatened. IUCN 2016: Least concern.
- Percival's short-eared trident bat *(Cloeotis percivali)* - SA Red Data (2016): Endangered. IUCN (2016): Least concern.
- Brown hyaena *(Parahyaena brunnea*) - IUCN 2015: Near threatened; SA Red Data (Child 2016): Near threatened; NEMBA (TOPS 2007): Protected species.
- Leopard (*Panthera pardus*) - IUCN (2016): Vulnerable. SA Red Data (Child 2016) Vulnerable. NEMBA (TOPS 2015): Protected species.
- Serval *(Leptailurus serval*) - SA Red Data (Child 2016): Near threatened; NEMBA (TOPS 2015): Protected species. IUCN (2016) Least concern.
- Cape clawless otter (*Aonyx capensis*) - IUCN (2016): NT Near threatened; SA Red Data (Child 2016): Near-threatened; NEMBA (TOPS 2007): Protected species.
- Honey badger (*Mellivora capensis*) - NEMBA (TOPS) 2007: Protected species. IUCN (2014) Least concern. SA Red Data (Child 2016): Least concern.
- Temminck's ground Pangolin (*Smutsia temminckii*) - IUCN (2016) Vulnerable. SA Red Data (Child 2016): Vulnerable. NEMBA (TOPS 2015): Vulnerable species.
- African marsh rat (*Dasymys incomtus)* - SA Red Data (Child 2016): Near threatened; IUCN (2016): Least concern

Viability of habitat for SSC Mammals at Nosilla

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 mammals, which will have a direct influence on their viability and estimated population size.
Comparing the habitat requirements of Species of Concern with habitat availability in the Nosilla biotopes, the following habitat assemblages correspond with the optimal requirements of these mammals.

The potential of the area to supply habitat – "Optimal" for the following species.

Riverine drainage – Riparian woodland and streams

Serval *(Leptailurus serval*)
Cape clawless otter (*Aonyx capensis*)

Sour bushveld

Honey badger (*Mellivora capensis*)

The potential of the area to supply habitat – "Good" for the following species.

Riverine drainage – Riparian woodland and streams

Dark-footed forest shrew (*Myosorex cafer*)

Swamp musk shrew (*Crocidura mariquensis)*

Sour bushveld

Brown hyaena *(Parahyaena brunnea*)

The potential of the area to supply habitat – “Medium” for the following species.

Riverine drainage – Riparian woodland and streams

African marsh rat (*Dasymys incomtus)*

Rocky outcrops or Granite Inselbergs

Percival's short-eared trident bat *(Cloeotis percivali)*

The potential of the area to supply habitat – “Low” for the following species.

Sour bushveld

Temminck's ground Pangolin (*Smutsia temminckii*)

Rocky outcrops or Granite Inselbergs

Leopard (*Panthera pardus*)

A final synopsis of habitat available in the project area and the preferred habitat available for expected SSC mammal species, lists the species most likely to be present in the project area, or occasionally visit the area. Mammal species with “Medium” to “Optimal” ratings to potentially utilise available habitats in the Nosilla project area, are listed below.

- Serval *(Leptailurus serval*)
- Cape clawless otter (*Aonyx capensis*)
- Honey badger (*Mellivora capensis*)
- Dark-footed forest shrew (*Myosorex cafer*)
- Swamp musk shrew (*Crocidura mariquensis)*
- Brown hyaena *(Parahyaena brunnea*)
- African marsh rat (*Dasymys incomtus)*
- Percival's short-eared trident bat *(Cloeotis percivali)*

4.3.3.6 Summary of all vertebrate fauna

After analysing the fauna distribution data and habitat availability, 22 frog species, 64 reptile species, 206 bird species and 105 mammal species are expected to occur in the project area, a total of 397 animal species. The presence of these different faunal groups is however dependent on availability of potential habitat types in each distinct biotope.

Assessing the conservation status of species has become a critical aspect of monitoring trends in biodiversity conservation at both a national- and global level but identifying threatened species using internationally accepted criteria and through a standardised process is also a useful tool for the conservation of priority species.

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.

According to the project brief, the Red Data listed and endemic species requires a monitoring programme to assess their numbers and status in the project area. Twenty-three Species of Special Concern that have a medium to high probability of occurring in the region, are expected to frequent the Nosilla project area. 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. It also provides site specific EIA process- and review information and allows for the generation of a Screening Report referred to in Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended.
Following is an abstract from the original Screening Tool application:

Cadastral details of the proposed site

Table 25: Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	NOSILA	27	0	25°10'16.59S	31°1'17.74E	Farm
2	NOSILA	27	1	25°9'40.8S	31°1'7.8E	Farm portion
3	NOSILA	27	0	25°10'17.07S	31°1'17.87E	Farm portion

Table 26: Property details: Nearby developments and Environmental Management Frameworks (EMF) areas.

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 (EMF) relevant to the application	No intersections with EMF areas found.

Environmental screening results and assessment outcomes

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

Table 27: A summary of any development incentives, restrictions, exclusions or prohibitions.

Application classification	Agriculture - Forestry – Fisheries | Crop Production | Fisheries - Crop Production
Relevant development incentives, restrictions, exclusions or prohibitions	Strategic gas pipeline corridor

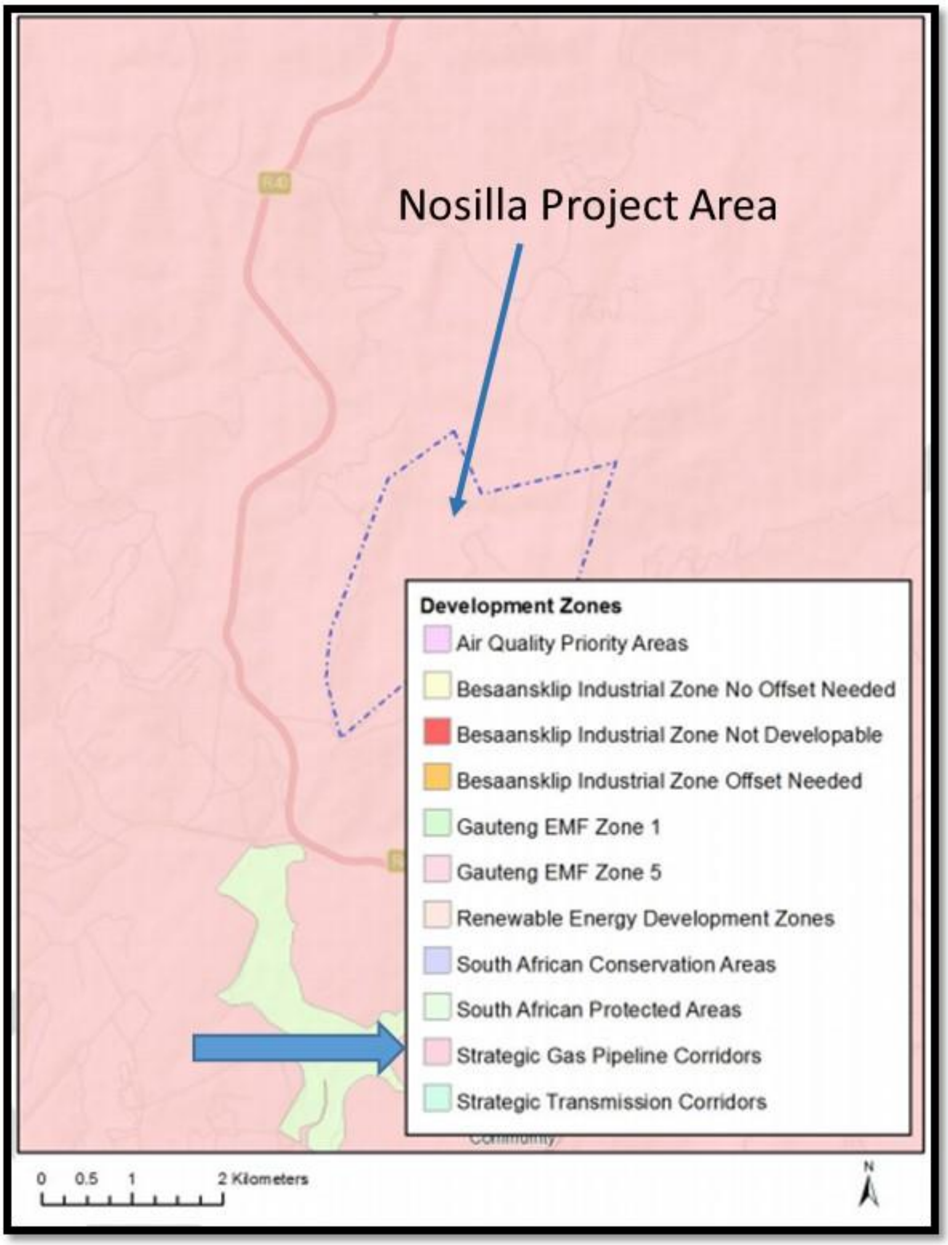


Figure 35: A map generated by the Screening Tool application. It indicates the proposed development footprint within an applicable development incentive, in this case a Strategic Gas Pipeline Corridor.

The Strategic Environmental Assessment for the Development of a Phased Gas Pipeline Network in South Africa, 2019 identified nine Strategic Gas Pipeline Corridors related to the phased development of a gas pipeline network (Figure 35). The Nosilla project area is incorporated into such a corridor, identified on the map as Phase 8.

The scope of this notice applies to an application for environmental authorisation for the following activities:

- where the activity is constructed below ground,
- or above -ground for the purpose of
    - connecting to above -ground infrastructure
    - such as pigging stations or compressor stations,
    - including any associated activities necessary for the realisation of such infrastructure.

Although the Nosilla project does not involve any of these activities, the presence of the corridor is acknowledged.

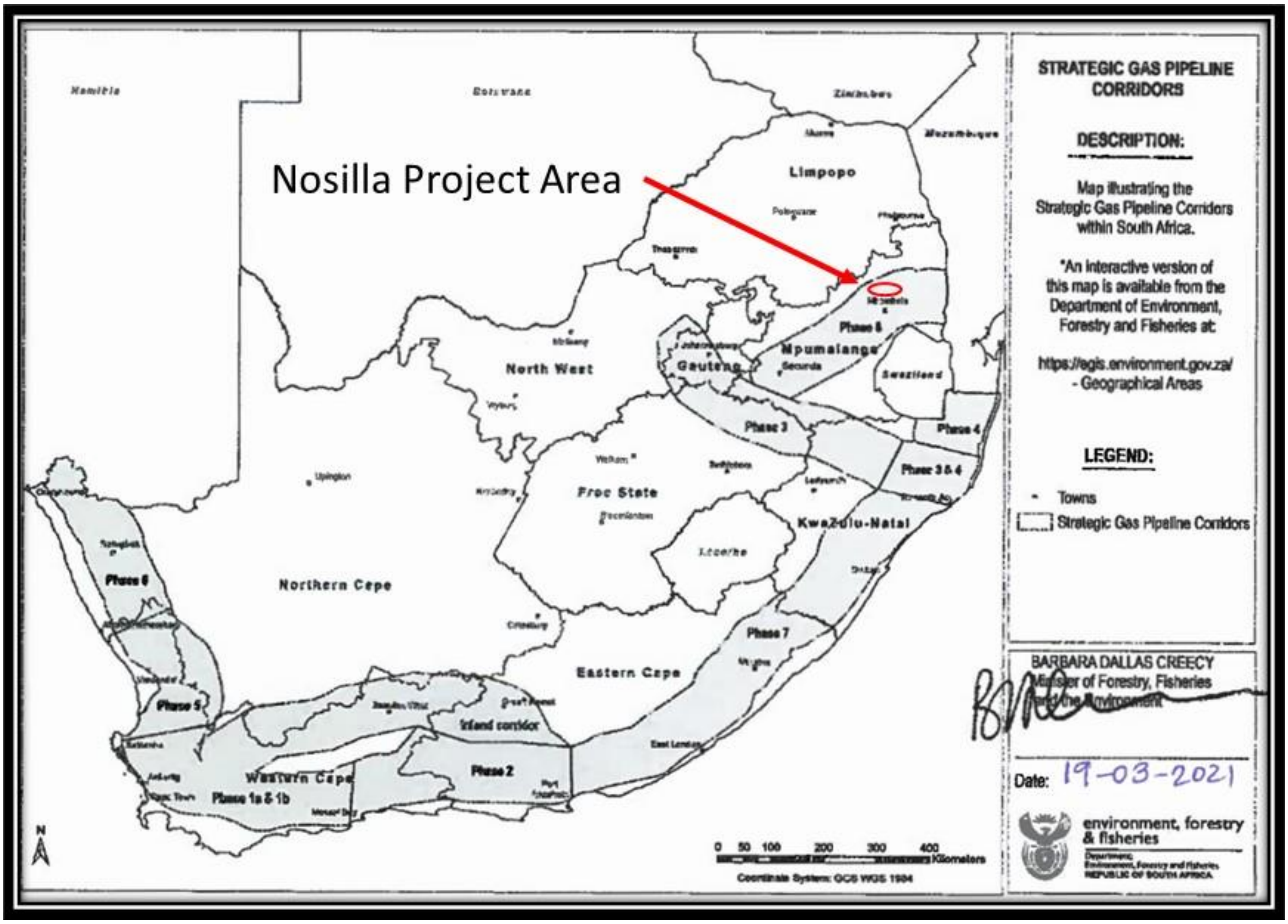


Figure 36: The map of the strategic gas pipeline corridors as illustrated in the Government Gazette, 7 May 2021.

Proposed Development Area Environmental Sensitivity

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

Table 28: The development footprint environmental sensitivities (Figure 37).

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**		
Defence Theme				**X**
Plant Species Theme			**X**	
Terrestrial Biodiversity Theme	**X**			

The following section with maps represents the results of the screening for environmental sensitivity of the proposed site for selected environmental themes associated with the project classification.
Table 29: Sensitivity features of the project area.

Theme	**Sensitivity**	**Feature**
Agriculture Theme	Very High	Land capability; 12 & 13. High-Very high
Animal species theme	Medium	Insecta - *Lepidochrysops irvingi* Invertebrate - *Thoracistus jambila* Mammalia - *Dasymys robertsii* Reptilia - *Kinixys natalensis*
Aquatic biodiversity	Very High	Strategic water source area
Archaeological and Cultural Heritage Theme	Low	Low sensitivity
Plant Species Theme	Medium	*Woodia singularis*
Terrestrial Biodiversity Theme	Very High	Critical Biodiversity Area 2 Strategic Water Source Area Focus Areas for land-based protected areas expansion Vulnerable ecosystem

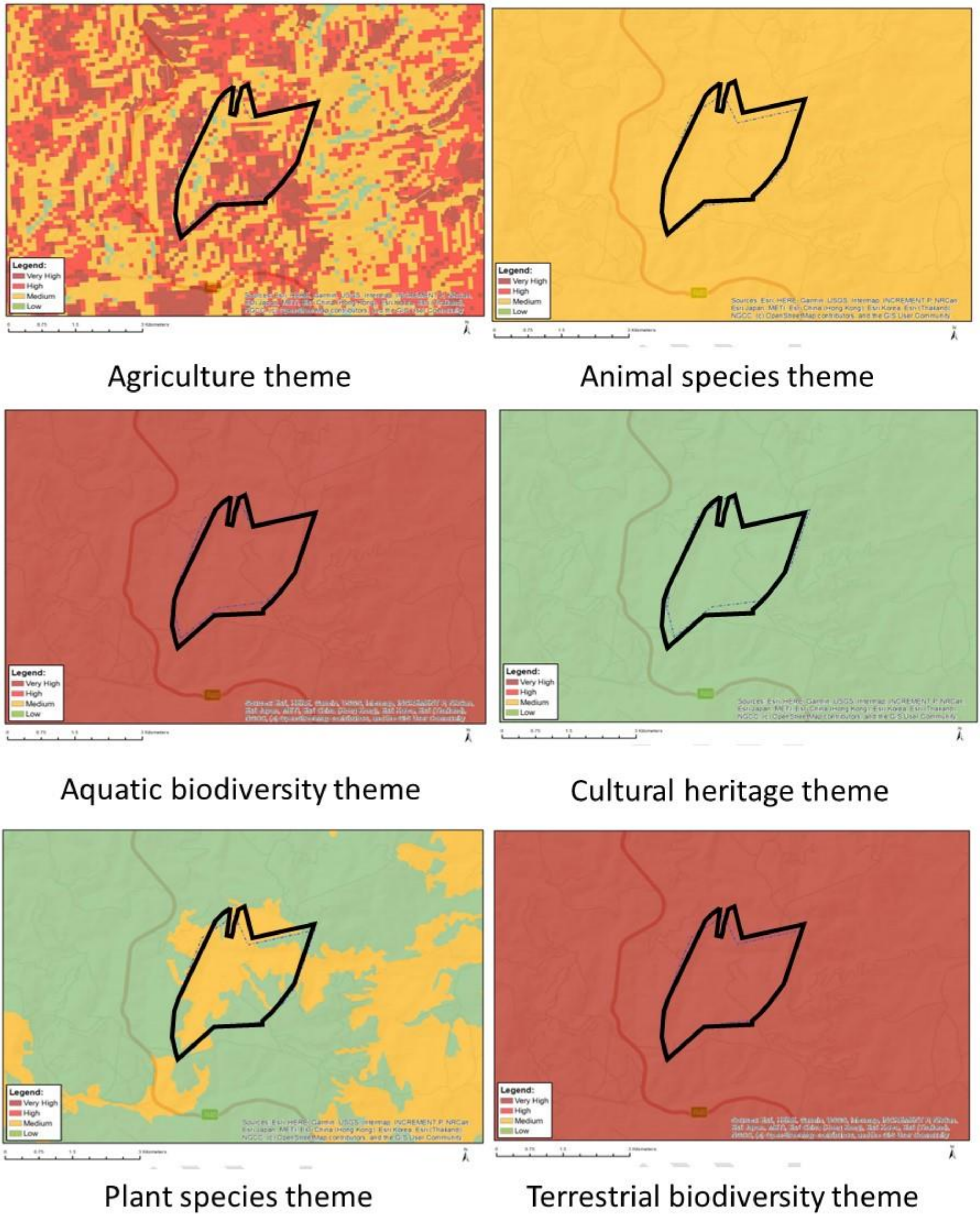


Figure 37: Maps of sensitivity for selected themes (Table 29).

5.2 Sensitivity mapping

Sensitivity assessments identify those sections of the study area that have a 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) or Species of Special Concern (SSC);
- 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 30.

Table 30: 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.

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**
Untransformed biotopes					
1. Riverine drainage	**Legogote Sour Bushveld** - Endangered	• CBA Optimal • Strategic Water Source Area • NFEPA River	**SSC:** 5 plants 6 reptiles; 20 birds; 10 mammals	High	**High**
2. Sour bushveld				Very high	**Very high**
3. Granite Inselbergs				Very high	**Very high**
Transformed biotopes					
4. Cleared forestry	**Legogote Sour Bushveld** - Endangered	• CBA Optimal • Strategic Water Source Area • NFEPA River	None	Negligible	**Negligible**
5. Current cultivation				Negligible	**Negligible**
6. Infrastructure				Negligible	**Negligible**

Whereas the main anthropological activities on the Nosilla Farm portion were forestry, these afforested areas are currently being cleared and converted into orchards. The initial forestry had a "Low" sensitivity status and the current cleared land status it classed as "Negligible".

Most of the areas planted with commercial forestry were on the crests of the area while the slopes towards the valleys and the valley bottom remained reasonably untransformed. The removal of forestry is fairly swift and the bare lands will be managed in such a way that no erosion and siltation will impact upon the downstream areas.

The sour bushveld vegetation on the slopes and the valleys with associated drainage lines is still in an untransformed state. The impact of years or forestry and associate siltation might have impacted on the drainage lines. Due to the lack of fish in these seasonal streams and forestry roads along many of these systems, the sensitivity of the "Riverine drainage" systems are classified as "High".

The remaining untransformed Sour bushveld and Granite Inselbergs biotopes with their rich biodiversity and intact ecology are all categorised with a "Very High" sensitivity (Table 30).

5.3 Land-use planning and Decision-making

5.3.1 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 into a wide range of planning and decision-making processes, frameworks and assessments in multiple land-use sectors (MBSP Handbook, Lötter *et al.* 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. Several 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 SVl 9 Legogote Sour Bushveld is "Endangered" 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 Nosilla Project Area falls within the planning domain of the Mpumalanga Biodiversity Sector Plan. 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 established 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?

Table 31: The key results of the LUDS Report as extracted for the Nosilla project area from national datasets available from BGIS.

National Data Set	Aspect	Present
National terrestrial information: Farm Nosilla 27JU Da Gama Dam area, Mpumalanga.		
South African District	Ehlanzeni	
South African municipal boundaries	Municipality name: Mombela	MP322
Quarter-degree grid square		2531AA
Terrestrial CBAs		
Bioregion	**National vegetation map**	**Status**
Savannah Biome (Lowveld bioregion)	SVl 9 Legogote Sour Bushveld	**Threatened ecosystem status:** Endangered
Critical Biodiversity Area	CBA Optimal	
Aquatic Critical Biodiversity Areas		
Water Management Area (WMA)	Inkomati WMA	
Sub Water Management Area	Sabie Catchment	
Strategic Water Source Area	Top 50% of Strategic Water Source Area	
NFEPA River	White Waters River	4_P_U
Ecoregion 1	Lowveld Ecoregion.	3.07

Critical Biodiversity Areas

Overlaying the BGIS Critical Biodiversity Areas map onto the Nosilla project area, resulted in the compilation of Figures 38 to 39 and Table 31. With reference to these maps and LUDS Report (Table 31) the project area falls into the following sensitive areas:

- Terrestrial:
  - Critical Biodiversity Area: CBA Optimal
  - Endangered Ecosystem Status: Legogote Sour Bushveld
- Aquatic:
  - Strategic Water Source Area: Top 50% of Strategic Water Source Area
  - NFEPA River: Catchment of White Waters River

With these landscape properties, it is paramount to approach the construction- and operation phases of the entire project with caution.

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 CBA map of the study area was compiled by using the Biodiversity Geographic Information System (BGIS) maps as illustrated in Figure 38. 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 20 illustrates the Present Ecological State of the project area as illustrated by the LUDS programme (BGIS, 2015) for Mpumalanga. It indicates the current and historically afforested areas and also the areas which are not impacted by forestry.

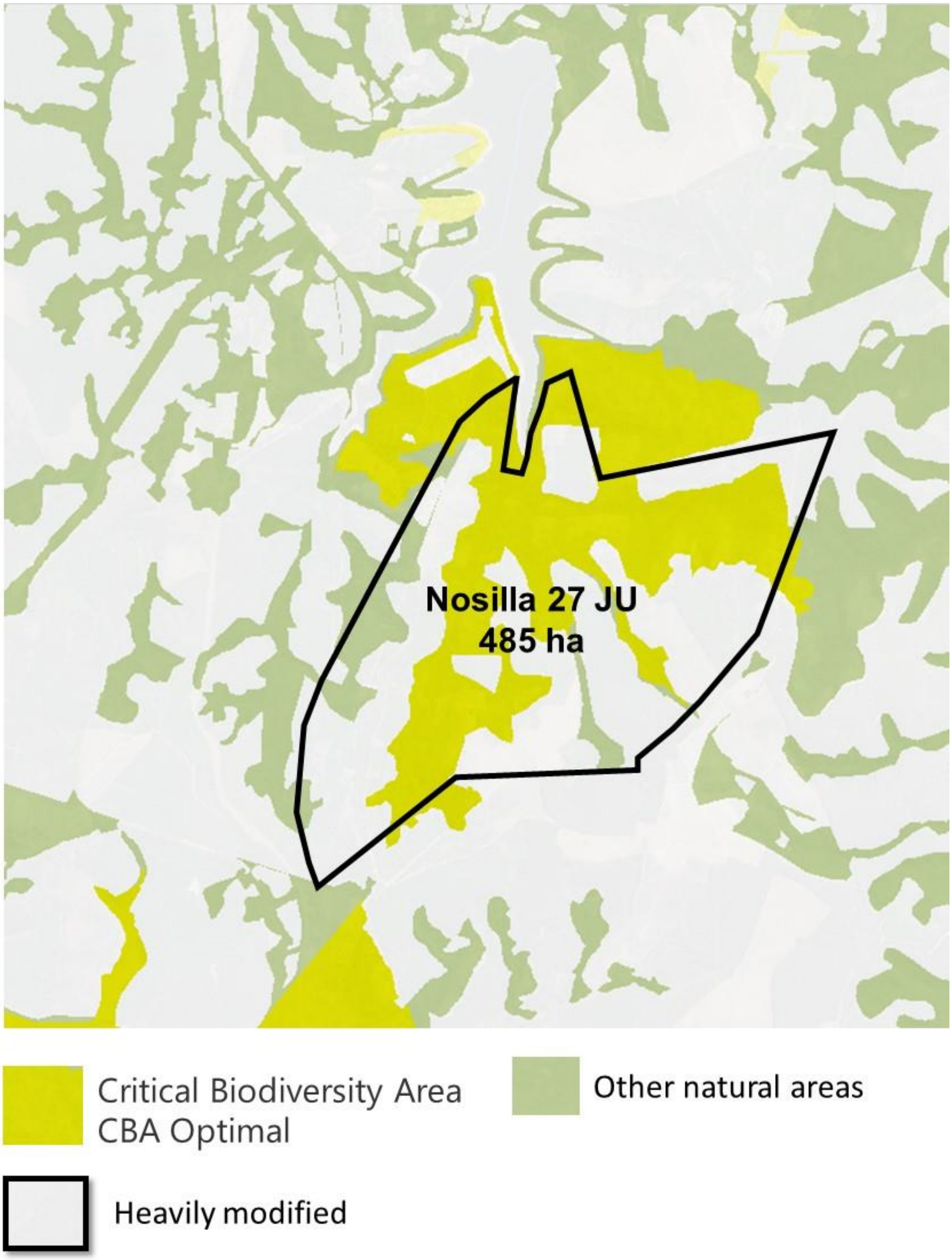


Figure 38: The Terrestrial Critical Biodiversity areas for the Nosilla Project Area as illustrated by the LUDS programme (BGIS, 2015) for Mpumalanga. Figures 38 and 39 illustrate the Critical Biodiversity areas for the Nosilla project area as compiled from the LUDS programme (BGIS, 2015) for Mpumalanga. Most of the area have been totally transformed by commercial forestry ("Heavily Modified"), with patches of Other Natural Areas in between. However, some of these untransformed habitats consist of Critical Biodiversity Areas: CBA Optimal.

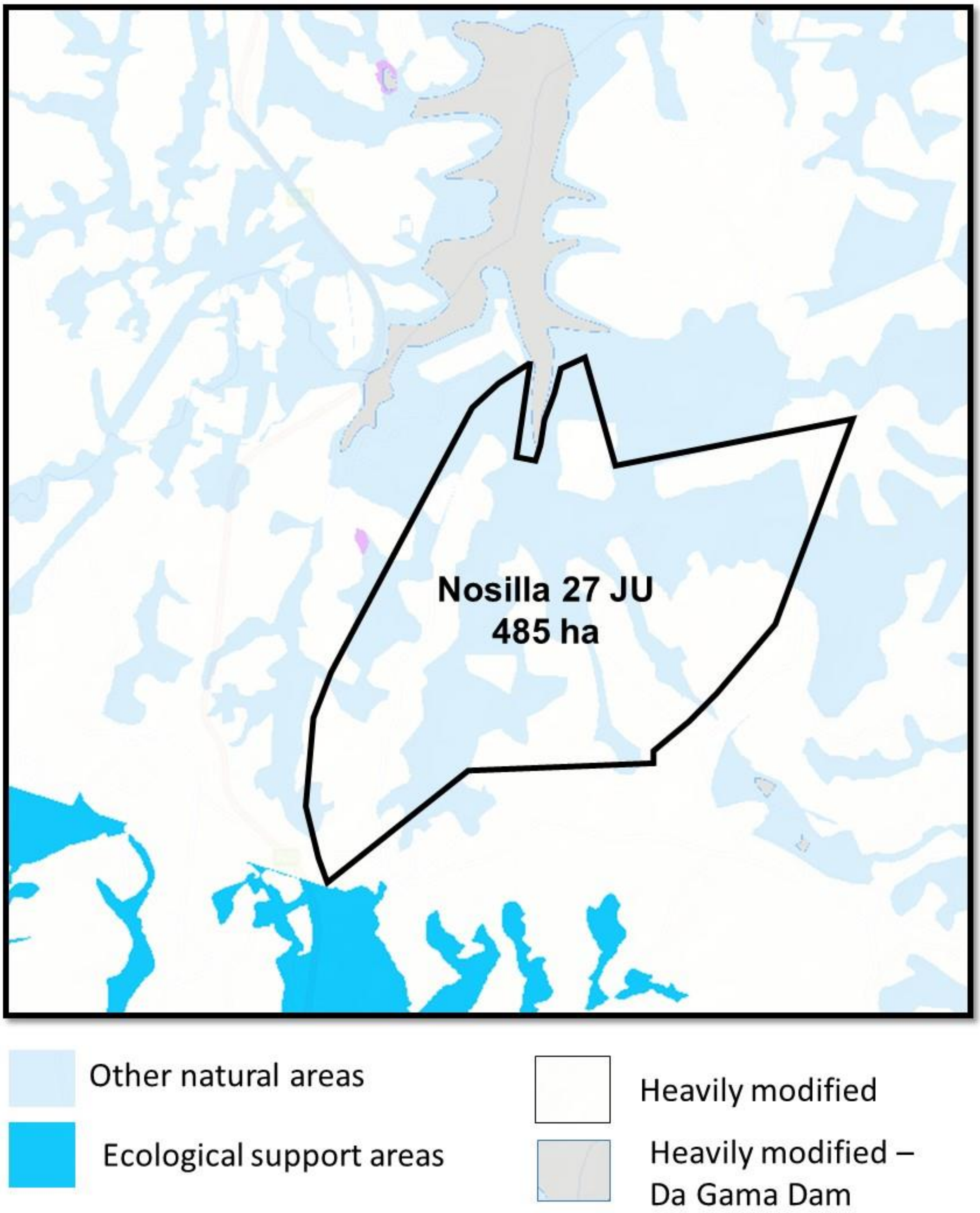


Figure 39: A map obtained from the 2014 Mpumalanga Biodiversity Sector Plan to indicate the Freshwater CBAs and ESAs in the project area, (blue dot). Light blue = Other Natural Areas; White = Heavily Modified Areas (Mpumalanga Biodiversity Sector Plan, 2014).

Freshwater Ecosystem Priority Areas (FEPAs) are 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. The White Waters River to the west of the property is a FEPA river but there are no FEPAs identified for the project area (Figure 39). As the Nosilla study area is situated in a Strategic Water Source Area, the Desired Management Objectives are to maintain ecosystem functionality across the whole catchment, particularly mindful of activities which impact water quality and quantity.

5.3.2 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 habitat type that is present in the buffer as the zone may also incorporate stream banks and terrestrial habitat, depending on the width of the aquatic impact buffer zone applied. Therefore, the riparian zone must be delineated before the buffer zone is established.

5.3.3 Riparian delineation

During the process of riparian delineation, two transects were surveyed. 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 illustrated in Figure 34 in the previous section.

Riparian delineation and habitat evaluation was undertaken according to the DWAF Guidelines (2005) and DWAF updated manual (2008) (see Methods Section 2.1.1 Vegetation). Figure 40 illustrates the Nosilla project area with the riparian zone delineated. The delineation is illustrated in the final development map in Appendix 9.

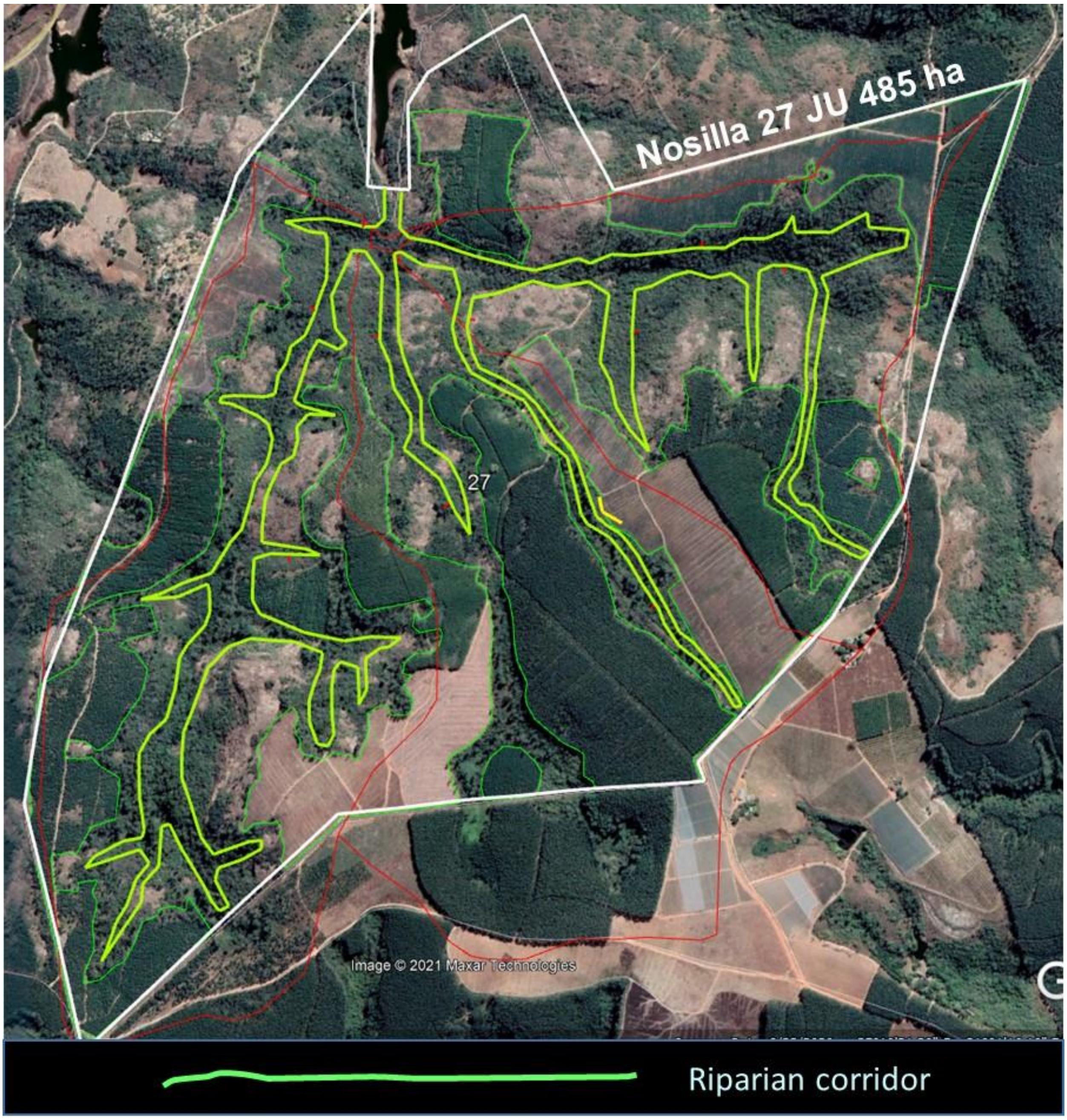


Figure 40: The riparian delineation of the Nosilla unnamed drainage line riparian zone (Appendix 9).

5.3.4 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 clearing- and operational phases of the Nosilla project area and the implemetation will be reaffirmed in the mitigation section (Section 5.4).

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. The protected riparian zone will serve as a mitigating measure for impacts created by the construction- and operational phases of the proposed project.

The aspects utilised to establish the Nosilla unnamed drainage line riparian buffer zone, are listed in Table 32 and the buffers obtained from these features are displayed at the end of the table as: 20m during the clearing phase and 20m for the operational phase.

Table 32: Site-based tool: Determination of buffer zone requirements for the drainage system.

Site-based tool: Determination of buffer zone requirements for river systems.	
Name of Assessor	Dr AR Deacon
Project details	Nosilla unnamed drainage
Date of Assessment	2021/07/14
Level of Assessment	Site-based
Approach used to delineate the riparian zone & active channel?	Site-based delineation
River type	Upper foothills
Present Ecological State	B. Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
Ecological importance & sensitivity (Current status)	Medium: Features that are considered to be ecologically important and sensitive at a local scale. The functioning and/or biodiversity of these features is not usually sensitive to anthropogenic disturbances. They typically play a small role in providing ecological services at the local scale.
Management Objective	Maintain current status
Sector	Agriculture
Sub-sector	Irrigated commercial cropland: The agricultural production of produce including crops, trees, seeds, fruit, vegetables or other plant material using conventional means of irrigation.
MAP Class	1001 - 1200mm
Rainfall intensity	Zone 4
Stream order	2nd order
Channel width	1 – 5m
Perenniality	Seasonal systems (3-9 months)
Average slope of rivers catchment	3-5%
Inherent runoff potential of the soil in the river's catchment	Mod. Low (B)
Longitudinal river zonation	Transitional river
Inherent erosion potential (K factor) of catchment soils	< 0.13
Retention time	Generally free flowing
Inherent level of nutrients in the landscape	Very low base status
Inherent buffering capacity	Neutral pH
Natural salinity levels	Non-saline (<200mS/m)
River depth to width ratio	0.25 – 0.75
Mean annual temperature	Zone 3 (16.9 - 18.2 Degrees C)
Level of domestic, livestock and contact recreational use	Low
Buffer attributes (Current status)	
Slope of the buffer	Moderate (10.1 - 20%)
Vegetation characteristics (Construction phase)	Ideal: Robust vegetation with high interception potential (e.g. vetiver grass filter strips / dense tall grass stands).
Vegetation characteristics (Rehabilitation phase)	Ideal: Robust vegetation with high interception potential (e.g., vetiver grass filter strips / dense tall grass stands).
Soil permeability	High: Deep well-drained soils (e.g., sand and loamy sand & sand).
Micro-topography of the buffer zone	Dominantly Non-uniform topography: Dominantly irregular topography with some major concentrated flow paths (i.e., erosion gullies, drains) that will substantially reduce interception.
Aquatic impact buffer requirement	
Clearing Phase	**20m**
Operational Phase	**20m**

According to the initial buffer requirement, it becomes apparent that, to protect the unnamed drainage line in its current condition from degradation, a buffer of 20 m wide on both sides of the drainage line is required. This buffer width is obtained whenever the following mitigation measures are applied to the model (Table 33).

Table 33: Mitigation measures to apply to the model in order to protect the unnamed tributary.

Clearing and Operational Phases

Threat Posed by the proposed land use/activity	**Justification for changes in threat ratings**
Increased sediment, nutrient and contaminants inputs	No impact on the wide natural buffer still in place around the natural riparian zone which will intercept any impact resulting from the agricultural activities.

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

Final aquatic impact buffer requirement: 20 m

Once protection requirements for water resources and associated biodiversity have been established, the buffer zone requirements have to be finalised and delineated on a layout plan and in-field. The final buffer zone of the unnamed drainage line (Figure 41) is illustrated in Appendix 9.

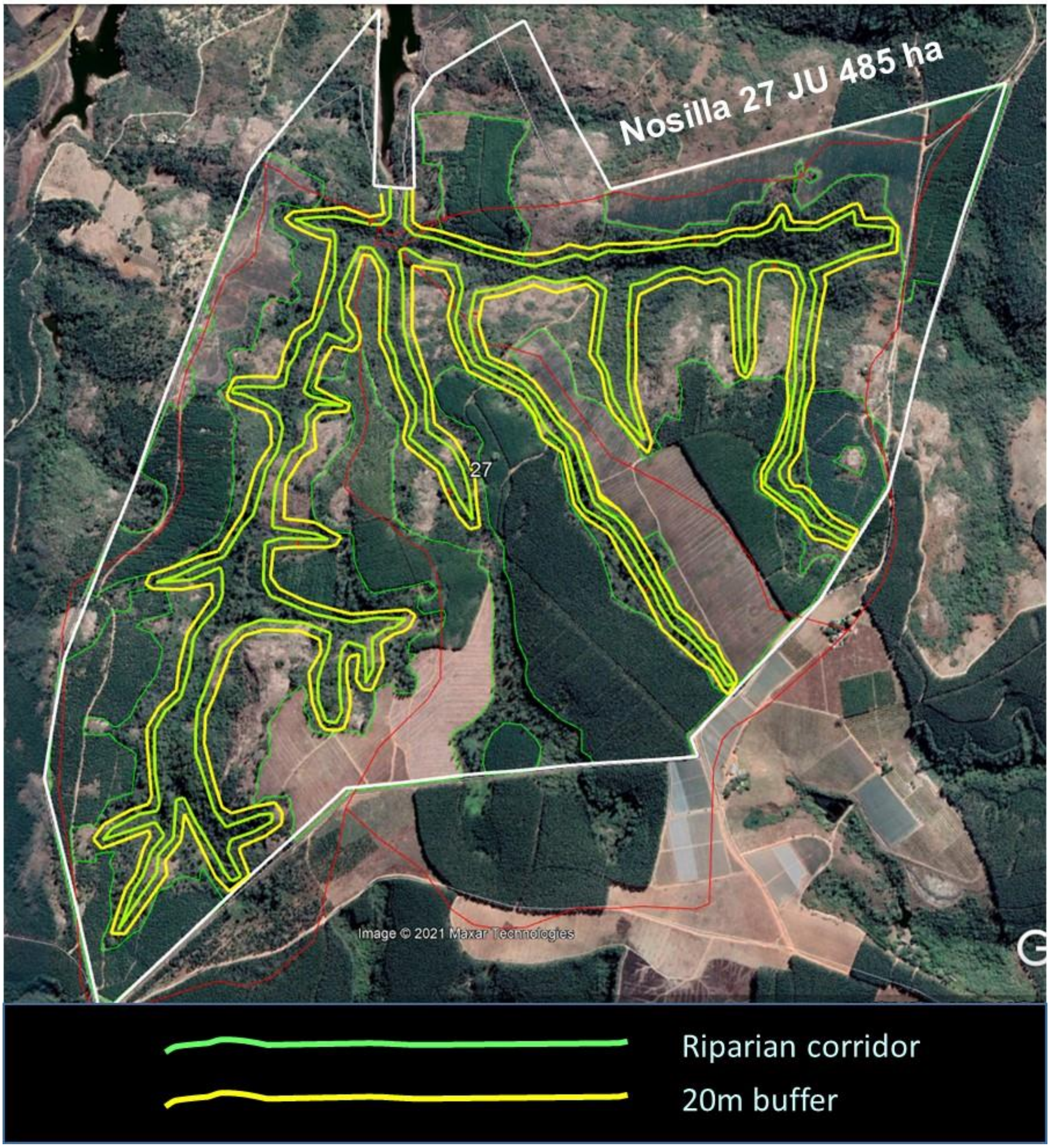


Figure 41: This figure outlines the proposed buffer of 20m (yellow line) in order to protect the riparian corridor (green line) and the unnamed drainage line. See Appendix 9.

5.3.5 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.

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 (MTPA, 2014).

Table 34: 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.
ESA: Protected Area Buffer	A buffer distance of either 10 km for National Parks; 5 km for all other PAs; and 1 km for Protected Environments.	Maintain or improve ecological and tourism functionality of a PA, ensuring none of the PA objectives are compromised by activities or land-use changes in the buffer zone.
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.

5.3.6 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.
According to the LUDS Report (Table 31) the project area falls into the following sensitive areas:

- Terrestrial:
    - Critical Biodiversity Area: CBA Optimal
- Aquatic:
    - NFEPA River: Catchment of White Waters River

The terrestrial CBA on the farm is classified as an Optimal CBA. The CBA Optimal Areas (previously called 'important and necessary' in the MBCP) are the areas optimally located to meet the various biodiversity targets. Although these areas are not 'irreplaceable' they are the most efficient land configuration to meet all biodiversity targets and design criteria. The primary objective of the biodiversity category will be to maintain the area in a natural state with no loss of ecosystems, functionality or species; some flexibility in land-use options

Table 35 summarises the final permissible land-uses that are proposed for the identified landforms on the Nosilla project area. The demarcated maps are found in Figures 38 and 39. The area is listed and rated as follows:

Table 35: Permissible land-uses that are set for the identified landforms on the Nosilla project area: CBA Optimal.

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

Acceptable land uses are those that are least harmful to biodiversity, such as conservation management, or extensive livestock or game farming. Large-scale cultivation, mining and urban or industrial development are not appropriate.

If small-scale land-use change is unavoidable, it must be located and designed to be as biodiversity-sensitive as possible. A specialist study must be part of the scoping and EIA process for all land-use applications in these areas, using the services of an experienced and locally knowledgeable biodiversity expert who is SACNASP registered. Provision for biodiversity offsets in exchange for biodiversity loss should only be considered as a last resort and at a ratio consistent with national policy

CBAs and listed activities in terms of the EIA Regulations.

Depending on specific activities, CBAs (and ESAs) trigger the need for basic assessments in terms of the EIA regulations and should inform the development of Terms of Reference for the biodiversity specialists appointed in the EIA process.

The specific activities requiring an environmental authorisation are listed in three notices, reflected in Government Notice R 544, R 545 and R546, as follows:

- *Listing Notice 1*: This states that a Basic Assessment (BA) is required for those activities with known impacts that can be avoided or reduced.
- *Listing Notice 2*: This refers to activities with unknown impacts that require specialist studies to be worked out. Such activities require a comprehensive scoping/environmental impact assessment.
- *Listing Notice 3*: This applies to activities in sensitive geographic areas, requiring a basic assessment and environmental authorisation before commencement of any land-use activity.

In Mpumalanga these sensitive geographic areas are CBAs and ESAs as defined in the MBSP.

5.4 Assessment of impacts

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

- **Activity 1:** The construction of two weirs in the non-perennial streams.
- **Activity 2.** Two small pump stations will be constructed to house the electrical equipment required for the project.
- **Activity 3.** Four bulk water supply pipelines will be installed in phases on the property.
- **Activity 4.** Three 40 000m^3 HDPE lined off-channels balancing dams will be constructed on the property.
- **Activity 5.** Two weirs completed in the unnamed tributaries.
- **Activity 6.** Farm operation.

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

Activity 1: The construction of two weirs in the non-perennial streams.

Impact 1.1: Clearing of the weir basin.

Applicable Phase: Construction phase
Aspect: Clearing the weir basin and manipulate the soil.

Nature of impact: Removing indigenous vegetation from the dam basin will impact adversely on the riparian corridor and riverine habitats. Clearing will also disturb the soils of the basin and the bare soil will be prone to erosion.

Mitigation of Impact 1.1:

Mitigation Description: Clearing for the dam site should take place during the dry period or when the stream is not flowing. However, as high rainfall can occur in any month of the year, all measures should be taken to prevent exposed soils from being washed into the downstream dam.
Obtain permission from the ECO to proceed with the clearing of vegetation. Only clear specified areas.

Levelling and landscaping of the site should follow natural drainage patterns as far as possible. Retain natural trees, shrubbery and grass species wherever possible. The remaining peripheral riparian woodland in the dam basin should be left intact in order to still create the denser riparian corridor.

Adequate erosion and sedimentation control measures must be put in place once the clearing of the dam basin is completed. This will prevent siltation to the downstream habitats.

Following the completion of any works, the water user must ensure that all disturbed areas are:
(i) cleared of construction debris and other blockages;
(iii) reshaped to free-draining and non-erosive contours, and
(iv) re-vegetated with indigenous and endemic vegetation suitable to the area.

Disturbed riparian areas must be rehabilitated immediately after construction of the dam and pipeline abstraction point, with indigenous species as required. Riparian habitat restoration will ensure that the integrity of a wildlife corridor is retained and links between habitat types are enhanced.

The two weirs in the unnamed, non-perennial drainage lines will cover relatively small surface areas in the system: Weir 1 = 2014 sqm; Weir 2 = 1300 sqm (Figure 42). The impact of the dammed areas in relation to the extent of the catchment is marginal and therefore the impact on the system is classified as low.

Table 36: Rating of Impact 1.1: Clearing of the weir basin.

ISSUE:	Clearing of the weir basin.
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	High
Significance Pre- Mitigation	**Low (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Low

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

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

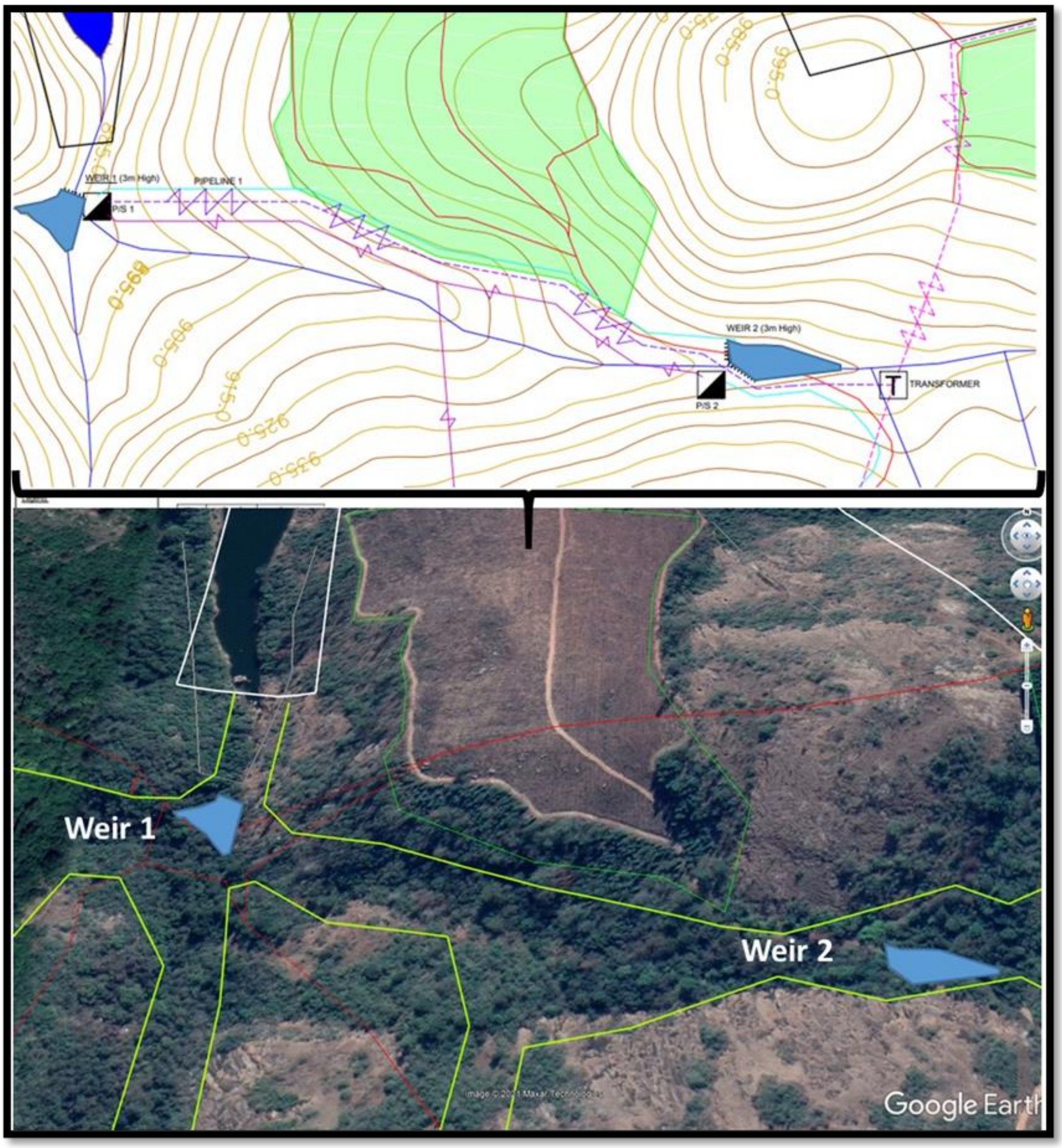


Figure 42: The two weirs in the unnamed, non-perennial drainage lines will cover relatively small surface areas in the system: Weir 1 = 2014 sqm; Weir 2 = 1300 sqm.

Impact 1.2: Construction of the weirs and coffer dams.

Applicable Phase: Construction phase
Aspect: Construction activities resulting in erosion and siltation.

Nature of impact: Construction of the weir has the potential to impact on the environment. The following activities can result in erosion and siltation:

- all clearing of vegetation (for dams, pumps and pipelines, roads and all watercourse crossings),
- construction and operation of cofferdams and diversion pipes,
- construction of dam walls and spillways,
- installation of pumps and pipelines.

Sedimentation in the stream due to disturbing soil layers during construction activities, will result in siltation of downstream aquatic habitats.

Mitigation of Impact 1.2:

Mitigation Description: It is generally specified that work in watercourses is carried out during periods of low average rainfall. This reduces the risks inherent in their construction. Furthermore, the lower stream flows reduce the risks of scour and disturbance of sediment in the riverbeds during construction.

The cofferdam construction shall be properly managed and maintained. Adequate erosion and sedimentation control measures must be put in place to prevent downstream impacts of the dam.

Table 37: Rating of Impact 1.2: Construction of the weirs and coffer dams.

ISSUE:	Construction of the weirs and coffer dams.
Project Phase	Construction
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Short term (1)
Consequence	Very Low (4)
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	Medium

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

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 1.3: Rehabilitation of coffer dams.

Applicable Phase: Construction phase
Aspect: Disturbing soil layers during the rehabilitation of coffer dams.

Nature of impact: This impact involves the sedimentation and siltation during removal and rehabilitation of the coffer walls. It must be kept in mind that water that accumulated in the cofferdam could deteriorate. Sudden release of sediment or polluted water can be disastrous for some aquatic biota.

Mitigation of Impact 1.3:

Mitigation Description: Ensure that pump outfalls and outfalls from any temporary treatment do not cause or generate erosion of land, banks or beds. This can be achieved by using baffles or other energy dissipating devices and scour protection.

Coffer dams must not be left in place for longer than 30 days. The cofferdam can serve to trap any sediments which may wash towards the downstream channel. Any such sediments must be physically removed from the channel before the cofferdam is removed.

In the event that submersible pumps are used for dewatering, they must be placed in sumps that isolate them from the base of the excavation in order to avoid the mobilisation of silt into suspension through turbulence.

Removal of the cofferdam should be planned and executed with the same degree of care as its installation, on a stage-by-stage basis.

Table 38: Rating of Impact 1.3: Rehabilitation of coffer dams.

ISSUE:	Rehabilitation of coffer dams.
Project Phase	Construction
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Short term (1)
Consequence	Very Low (4)
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	Medium

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

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 1.4: Pollution due to construction activities and human presence at the site.

Applicable Phase: Construction phase
Applicable activity: Construction activities resulting in pollution.

Nature of impact: Poor water quality or presence of contaminants impacting on aquatic biota at the site and in the downstream reach.

Hazardous substances associated with construction activities include hydrocarbons (oil, diesel) from construction machinery and toxic materials used in dam construction such as cement, shutter releasing fluid, paints, etc. In addition, washing soap, faeces, etc. from workers using the rivers and riparian zones for ablutions could pollute rivers.

Pollutants could be harmful to aquatic biota, particularly during low flows when dilution is reduced and could pose a health risk to locals using the river water for domestic purposes. Lime-containing (high pH) construction materials such as concrete, cement, grouts, etc., are highly toxic and can be lethal to fish and other aquatic biota. If dry cement powder or wet uncured concrete is exposed to surface run-off or river water, these compounds can elevate the pH to lethal levels. Thus, extreme care should be taken when these hazardous compounds are used near water.

Mitigation of Impact 1.4:

Mitigation Description: Carefully control all on-site operations that involve the use of cement and concrete.

Limit cement and concrete mixing to single sites where possible.

- Use plastic trays or liners when mixing cement and concrete: Do not mix cement and concrete directly on the ground.
- Dispose of all visible remains of excess cement and concrete after the completion of tasks. Dispose of in the approved manner (solid waste concrete may be treated as inert construction rubble, but wet cement and liquid slurry, as well as cement powder must be treated as hazardous waste).
- Contain water and slurry from cement and concrete mixing operations as well as from batching area wash bays. Direct such wastewater into a settlement pond or sludge dam for later disposal.
- Do not allow the washing of trucks delivering concrete anywhere but within designated wash bays equipped with runoff containment. Direct such wastewater into a settlement pond or sludge dam for later disposal.

Spills:

- Immediately clean any accidental oil or fuel spills or leakages.
- Do not hose oil or fuel spills into a storm water drain or sewer, or into the surrounding natural environment.

Table 39: Rating of Impact 1.4: Pollution due to construction activities and human presence at the site.

ISSUE:	Pollution due to construction activities and human presence at the site.
Project Phase	Construction
Nature	Negative
Extent	Local (2)
Intensity	Low (1)
Duration	Short term (1)
Consequence	Very Low (4)
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	Medium

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

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Activity 2. Two small pump stations will be constructed to house the electrical equipment required for the project.

<u>Impact 2.1:</u> Clearing of vegetation on footprint and construction activities.

Applicable Phase: Construction phase
Aspect: Clearing the construction area and building the pump stations.

Nature of impact: Construction impacts on the immediate environment, including removing indigenous vegetation.

Mitigation of Impact 2.1:

<u>Mitigation Description</u>: Infrastructure establishment should preferably not take place during high rainfall periods and erosion protection measures should be put in place in case heavy rainfall occurs e.g., placement of stop-boards, covering with bidum or other suitable material. Prior to work commencing, the contractor must supply the ECO with a layout plan demarcating the location and physical extent of the construction dam works.

Identify and demarcate the extent of the site and maintain site demarcations as indicated on the approved Plan using danger tape with steel droppers. Do not paint or mark any natural feature. Marking for surveying and other purposes must be undertaken using pegs, beacons or rope and droppers.

All areas that were cleared or disturbed during construction activities must be rehabilitated to a natural vegetated state. Care must be taken to ensure that these rehabilitated areas merge with the immediate environment.

Clear and completely remove from site all construction plant, equipment, storage containers, temporary fencing, temporary services, fixtures and any other temporary works.
Due to their high efficiency at low flows, submersible pumps will be used. These will be placed in the weirs at suitable positions.

Table 40: Rating of Impact 2.1: Clearing of vegetation on footprint and construction activities.

ISSUE:	Clearing of vegetation on footprint and construction activities.
Project Phase	Construction
Nature	Negative
Extent	Site (1)
Intensity	Low (1)
Duration	Short term (1)
Consequence	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	**Low (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Low

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

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Activity 3. Four bulk water supply pipelines will be installed in phases on the property.

Impact 3.1: Pipeline activities: Trenching, excavation and rehabilitation.

Applicable Phase: Construction phase
Aspect: Clearing the line, trenching and rehabilitate.

Nature of impact: Trenching impacts on the immediate environment, especially when it involves the clearing of indigenous vegetation. These actions can result in erosion and siltation of the cleared area and disturbed soils. Inadequate erosion control along pipeline trenches could result in sediment or sediment-laden water entering the watercourses.
Laying of the pipelines

Mitigation of Impact 3.1:

Mitigation Description: The pipelines will follow existing roads, minimising disturbance to the natural environment. For pipelines, a servitude width of 15m is permitted for machine excavation, and 6m for manual excavation, unless otherwise specified by the ECO. This working servitude must accommodate all construction related activities, including materials storage, access routes etc.

In sensitive environments such as wetlands, indigenous forest, pristine grasslands and sensitive social environments, this working servitude may be reduced.

Laying of the pipelines will require soil to be stockpiled. This must be adequately protected (e.g., by covers or regular spraying with water) to prevent sedimentation of watercourses. Soil stockpiles should not be stored for extended periods i.e., pipeline laying should occur in stages.

Laying of the pipeline near watercourse crossings should be scheduled for average low rainfall periods (winter months). However, erosion protection measures should be put in place in case heavy rainfall occurs e.g., placement of bidum or other suitable material.

Table 41: Rating of Impact 3.1: Pipeline activities: Trenching, excavation and rehabilitation.

ISSUE:	Pipeline activities: Trenching, excavation and rehabilitation.
Project Phase	Construction
Nature	Negative
Extent	Local (2)
Intensity	Medium (2)
Duration	Short term (1)
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	High
Significance Pre- Mitigation	**Medium (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Medium

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

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Activity 4. Three 40 000m^3 HDPE lined off-channels balancing dams will be constructed on the property.

<u>Impact 4.1:</u> Balancing dams: Clearing the footprint.

Applicable Phase: Construction phase
Aspect: Balancing dams: Clearing of vegetation on the footprint.

Nature of impact: Removing all vegetation and associated habitats.

Mitigation of Impact 4.1:

<u>Mitigation Description</u>: The dams will be constructed on cleared forestry blocks (Figure 43). The areas earmarked for the dams have deep red soils, suitable for the construction of dams. The dams will be designed to use the onsite material. No imported material will be required.

Table 42: Rating of Impact 4.1: Balancing dams: Clearing the footprint.

ISSUE:	Balancing dams: Clearing the footprint.
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	**Low (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Low

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

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Figure 43: The three off-channel balancing dams will be constructed on cleared forestry sections.

Operational

Activity 5. Two weirs completed in the unnamed tributaries.

Impact 5.1: Inundating riparian habitats due to damming.

Applicable Phase: Operational phase
Aspect: Inundating riparian habitats.

Nature of impact: The integrity of a riparian corridor will be compromised by the inundation of the riverbank with the dammed water. The movement of mammals, herpetofauna and birds along a dense riparian corridor could be lost and replaced by an open aquatic habitat i.e., the dammed water.

Mitigation of Impact 5.1:

Mitigation Description: During the clearing phase of the weir basin, the remaining peripheral riparian woodland around the basin should be left intact to maintain the denser riparian corridor. Disturbed riparian areas must be rehabilitated immediately after construction of the weirs.

The weir sites are both surrounded with dense valley bush and the small weir footprints will not have a detrimental impact on the riparian corridor (Figure 44). The areas surrounding these weirs will also have a protective buffer which will safeguard these sites from further development and impacts (see Section 5.3.4).

Table 43: Rating of Impact 5.1: Inundating riparian habitats.

ISSUE:	Inundating riparian habitats.
Project Phase	Operational
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Short term (1)
Consequence	Very Low (4)
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	**Low (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Low

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

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Figure 44: The weir sites are both surrounded with dense, natural valley bush and rocky outcrops; therefore, the small weir footprints will not have a detrimental impact on the continuum of the riparian corridor.

Impact 5.2: Abstraction of water from the weirs

Applicable Phase: Operational phase.
Aspect: Abstraction of water from the river system.

Nature of impact: Dry spells during crucial months make irrigation essential for successful macadamia farming. Irrigation is therefore critical during the months of August, September and October, when flowering and fruit set occurs (highest irrigation demand and lowest rainfall). The months of July and August have the lowest rainfall (7mm and 12mm respectively). This rainfall is very low, indicating the need to irrigate during these times.

Storing or diverting water into weirs, alters the natural distribution and timing of stream flow. Changes in temporal and spatial characteristics of flow can have an impact on downstream habitat attributes such as an increase in duration of low flow season (or none-flow events), resulting in low availability of certain habitat types or availability of water at the start of the breeding, flowering or growing season of the riverine biota (aquatic and riparian).

Mitigation of Impact 5.2:

Mitigation Description: The removal of approximately 187 ha of commercial forestry will increase the runoff on the Farm Nosilla by an estimated 187 000 m^3 /annum. The intention is the pump this water during the high flow months of November through to the end of May into off-channel dams. Due to the negative environmental impact of in-stream storage, off-channel storage of 150 000 m^3 is being constructed on the farm to store the water. Pumping of water freed up by the removal of exotic plantations, will only be allowed during the high flow months so as not to reduce the low flow in the system.

A low flow analysis shows that the removal of forestry and transferring the increase flow to the off-channel dams could result in a small decrease in the low flow, even though the EWR will still be met. The conversion from Streamflow Reduction (SFR) to irrigation will benefit downstream users by 25 900 m^3 /annum. As an additional safeguard to secure the low flow, it is recommended that the condition of the water use licence be that a minimum flow of 11 l/s must always flow out of the lower weir (when there is flow in the system) and the this must be metered.

Table 44: Impact Rating of Activity 3: Abstraction of water from the river system.

ISSUE:	Abstraction of water from the river system.
Project Phase	**Operational**
Nature	Negative
Extent	Local (2)
Intensity	Low (1)
Duration	Long term (3)
Consequence	High (6)
Probability	Possible
Degree to which impact cannot be reversed	Medium
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

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

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 5.3: The dam wall as a migration barrier to aquatic animals.

Applicable Phase: Operational phase
Aspect: Migration barrier.

Nature of impact: Fish and other aquatic species being prevented from migrating upstream.
Dams and weirs disrupt riverine migration routes. Preventing the free passage of aquatic animals and fish. This disruption of migratory routes affects the lifecycle of anadromous species. Dam barriers prevent brood stock from reaching their spawning grounds during the breeding season, resulting in massive failure of recruitment and eventual extinction of the stock above the dam.

Mitigation of Impact 5.3:

Mitigation Description: During the ecological studies of the stream system, no fish were sampled in the small seasonal system. Fishways are devised specifically to create passage for aquatic fauna to overcome migration barriers, such as man-made dams and weirs. The reason for the lack of fish in the system could be the fact that this system is seasonal and there are a number of small waterfalls and cascades in the narrow stream, rendering the system a challenging environment to overcome.

With no fish or other organisms that will need to migrate up the small stream, providing a fishway in the weir will be unnecessary.

Table 45: Rating of Impact 5.3: Migration barrier.

ISSUE:	Migration barrier.
Project Phase	**Operation**
Nature	Negative
Extent	Local (1)
Intensity	Low (1)
Duration	Long term (1)
Consequence	Very Low (4)
Probability	Low
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	High
Confidence level	Low
Significance Pre- Mitigation	**Low (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Low

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

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Activity 6. Farm operation.

Different aspects which could impact on the riverine system can include roads, traffic, cleared surfaces, human activity, applying pesticides and herbicides, fertilisers, etc.
These aspects can lead to threats such as:

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

Aspects of these threats have been sorted into three groups under the heading: Operational activities impacting on the riverine system.:

- Trampling the riparian zone
- Erosion of the cleared lands and siltation of the non-perennial streams.
- Irrigation return-flows containing fertilisers and pesticides seeping towards the drainage line.

All of these threats have one shared mitigation measure and that is to introduce buffer zones to protect the water course. 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.

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.

In Section 5.3.4 a Site-based tool exercise has determined the buffer zone requirements for the Nosilla drainage system. According to this initial buffer requirement, it becomes apparent that, to protect the unnamed drainage line in its current condition from degradation, a buffer of 20 m wide on both sides of the drainage line is required.

Additionally, most of the drainage system and its ecological buffer around the riparian corridor, is also protected by a buffer of natural woodland which will increase the integrity of the acquired buffer (Figure 41).

Minimal impact should be permitted in riparian zones and buffer areas as these serve to contain water quality impacts. The riparian ecological buffers (or relevant buffers monitored by on-site supervision during fencing) should be adhered to.

Impact 6.1: Operational activities.

Applicable Phase: Operational phase
Aspect: Operational activities impacting on the riverine system: trampling the riparian zone.

Nature of impact: Roads

Mitigation of Impact 6.1:

Mitigation Description: Make use of existing roads and tracks where feasible, rather than creating new routes. Ensure that only authorised roads and access routes are used.

Any additional routes and turning areas required by the contractor must be approved by the ECO. Vehicles may not leave the designated roads and tracks and turnaround points will be limited to specific sites. Ensure that adequate vehicle turning areas are allowed for. No off-road driving is permitted, unless authorised by the ECO. Do not permit vehicular or pedestrian access into natural areas beyond the demarcated boundary of the Work Area.

Avoid routes through drainage lines and riparian zones wherever possible. Where access through drainage lines and riparian zones is unavoidable, only one road is permitted, constructed perpendicular to the drainage line. Routes should not traverse slopes with gradients more than 8%. Where this is unavoidable, stabilise the road surface.

In general, construction routes should not be wider that 3m in sensitive areas, with passing bays where two-way traffic is required. Clear up any gravel or cement spillage on roads.

Ensure that all access roads utilised during construction (which are not earmarked for closure and rehabilitation) are returned to a usable state and / or a state no worse than prior to construction.
Introduce the required buffer zone of 20 m.
Table 46: Rating of Impact 6.1: Impacting on the riparian zone by roads.

ISSUE:	Impacting on the riparian zone.
Project Phase	**Operational**
Nature	Negative
Extent	Local (2)
Intensity	Low (2)
Duration	Short term (1)
Consequence	Low (5)
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	**Low (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Low

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

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 6.2: Clearing of plantations for orchards.

Applicable Phase: Clearing phase
Aspect: Operational activities impacting on the riverine system**:** Erosion of the cleared lands and siltation of the non-perennial streams.

Nature of impact: Inadequate stormwater management and erosion control in the newly established fields could result in sediment or sediment-laden water entering the watercourses.

Mitigation of Impact 6.2:

Mitigation Description: Maintaining strips of natural vegetation between orchards is encouraged, if and where feasible, to assist with run-off control. Natural indigenous vegetation should also support insects required for pollination or pest control. The unnamed drainage lines are surrounded with dense valley bush which forms an additional protective buffer which will safeguard these systems from sedimentation (see Section 5.3.4).

Table 47: Rating of Impact 6.2: Clearing of plantations for orchards.

ISSUE:	Clearing of plantations for orchards.
Project Phase	**Clearing**
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Short term (1)
Consequence	Very Low (4)
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	**Low (-ve)**

Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Low

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

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 6.3: Farming activities and irrigation of the orchards.

Applicable Phase: Operational phase
Aspect: Aspect: Operational activities impacting on the riverine system: Irrigation return flows containing fertilisers and pesticides seeping towards the drainage line.

Nature of impact: During the operational or farming phase, chemical (inorganic) fertilisers and pesticides are likely to be used. The key pollutants associated with fertilisers are phosphates and nitrogen. Although pesticides are likely to be sprayed, rather than placed in-situ, during high rainfall periods, the pesticides can leach into the soil. Toxic pesticides or herbicides may negatively impact on riparian species.

Mitigation of Impact 6.3:

Mitigation Description: Maintaining strips of natural vegetation between orchards is encouraged, if and where feasible, to assist with run-off control. Natural indigenous vegetation should also support natural insects required for pollination or pest control. Only use environmentally friendly pesticides and herbicides. The unnamed drainage lines are surrounded with dense valley bush which forms an additional protective buffer which will safeguard these systems from sedimentation (see Section 5.3.4).

Table 48: Rating of Impact 6.2: Farming activities and irrigation of the orchards.

ISSUE:	Farming activities and irrigation of the orchards.
Project Phase	Operational
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Short term (1)
Consequence	Very Low (4)
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	**Low (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Low

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

- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact Assessment Summary:

Table 49: A summary of the impact assessment post mitigation.

Impact No	Issue and aspect	Phases	Significance without mitigation	Significance with mitigation
1.1	Clearing of the weir basin.	Construction	**Low (-ve)**	**Low (-ve)**
1.2	Construction activities resulting in erosion and siltation.	Construction	**Medium (-ve)**	**Low (-ve)**
1.3	Rehabilitation of coffer dams.	Construction	**Medium (-ve)**	**Low (-ve)**
1.4	Pollution due to construction activities and human presence at the site.	Construction	**Medium (-ve)**	**Low (-ve)**
2.1	Clearing of vegetation on footprint and construction activities.	Construction	**Low (-ve)**	**Low (-ve)**
3.1	Pipeline activities: Trenching, excavation and rehabilitation.	Construction	**Medium (-ve)**	**Low (-ve)**
4.1	Balancing dams: Clearing the footprint.	Construction	**Low (-ve)**	**Low (-ve)**
5.1	Inundating riparian habitats due to damming.	Operational	**Low (-ve)**	**Low (-ve)**
5..2	Abstraction of water from the river system.	Operational	**Medium (-ve)**	**Low (-ve)**
5.3	The dam wall as a migration barrier to aquatic animals.	Operational	**Low (-ve)**	**Low (-ve)**
6.1	Impacting on the riparian zone.	Construction and Operational	**Low (-ve)**	**Low (-ve)**
6.2	Clearing of plantations for orchards.	Clearing	**Low (-ve)**	**Low (-ve)**
6.3	Farming activities and irrigation of the orchards.	Operational	**Low (-ve)**	**Low (-ve)**

5.5 Conditions for inclusion in the environmental authorisation

These conditions are based on the identification of mitigation measures and solutions that minimise impacts on biodiversity and conflicts in land-uses by making use of CBA maps in the Environmental Impact Assessment (see Table 31). The steps used in this section correspond with the steps which are obtained from the Mpumalanga Biodiversity Sector Plan (2014). Step 2.3 listed in the Land-use planning and Decision-making table (Table 50), lists compromises and solutions that minimise impacts on biodiversity and conflicts in land-use, which are supported by the following five steps:

Step 2.3.1 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.

Figure 45 illustrates the area on the farm Nosilla to be cleared from commercial forestry and the cleared areas will be converted to orchards. It is clear that the areas planted for timber was mainly located on the crests of the hilly landscape and the steeper slopes and valley bottom were left mostly intact.

The developer intends to only develop the cleared areas, while the remaining slopes and valleys will be conserved in its current, near natural state. According to the Mpumalanga Biodiversity Sector Plan, the untransformed valleys are a mixture of Optimal Critical Biodiversity Areas and Other Natural Areas. These areas will thus be maintained in a natural state while the cleared crest areas (previously forestry) will be farmed.

The valleys on the farm will function as natural corridors, connecting the upstream landscape with the downstream corridors towards the Da Gama Dam. The valleys with their broad, dense untransformed woodland, serve as a good example of the concept “retaining natural habitat and connectivity in an Optimal CBA”.

As no fish were found in the stream, the weirs will not pose any migration barrier.

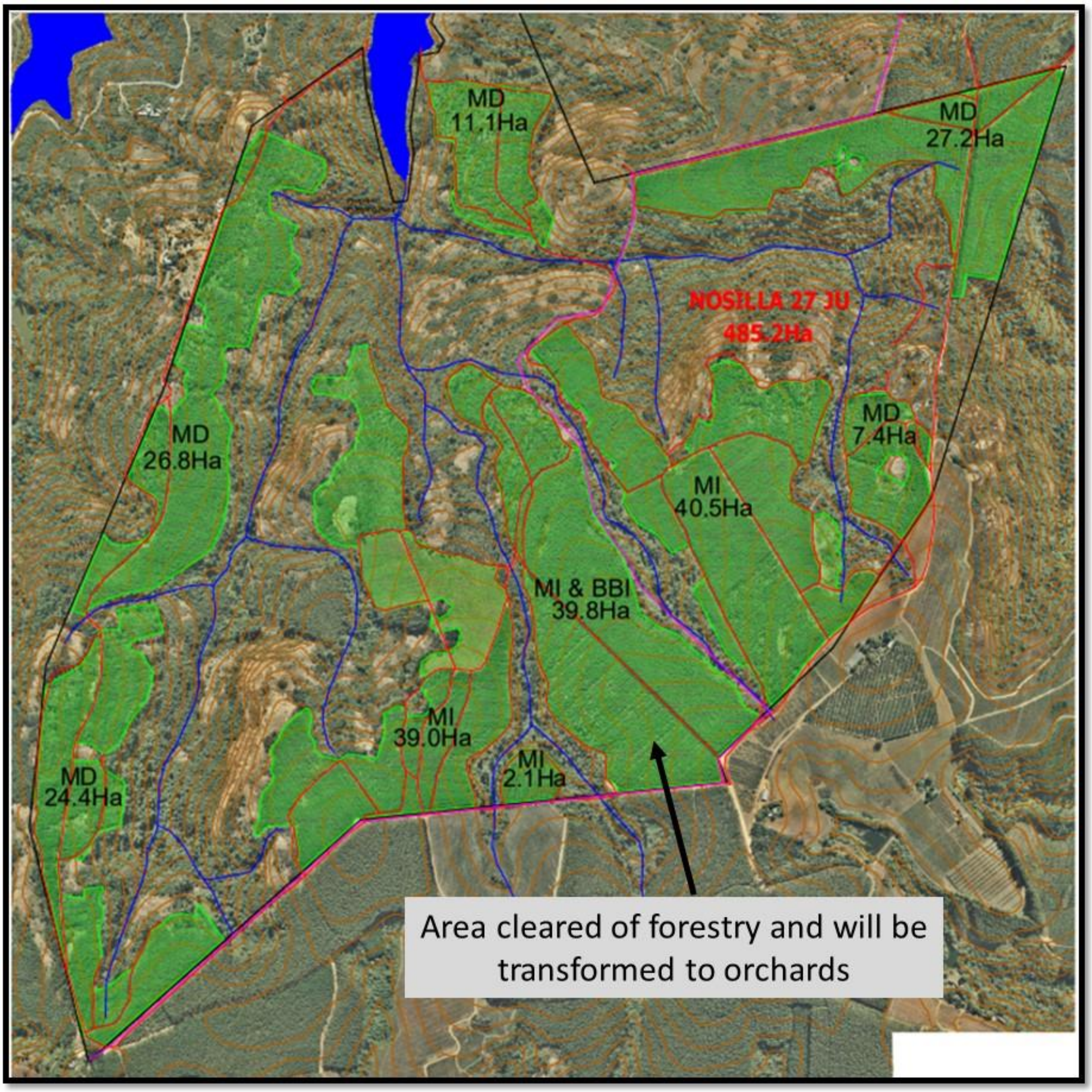


Figure 45: The old forestry portions to be cleared and then transformed to orchards.

Step 2.3.2: Apply the mitigation hierarchy: The mitigation hierarchy for dealing with negative impacts on biodiversity, consists of four activities (Figure 11):

- **Avoid and prevent:** Consider options in land-use location, siting, scale, layout, technology and phasing to avoid impacts on biodiversity, ecosystem services and people. This is the best option but not always possible.
    - The weir sites are both surrounded with dense valley bush and the small weir footprints will not have a detrimental impact on the riparian corridor (Figure 42). The areas surrounding these weirs will also have a 20m protective buffer which will safeguard these sites from further development and impacts (see Section 5.3.4).
- **Minimise:** Consider alternatives in land-use location, siting, scale, layout, technology and phasing to minimise impacts on biodiversity, ecosystem services and people.
    - Two small weirs will be constructed in the drainage line. From here the water will be pumped to three 40 000m^3 HDPE lined off-channels balancing dams, which will be constructed in the areas where commercial forestry was cleared. The reason for constructing these dams off-stream and not in the drainage, is because of the negative environmental impact that such a large impoundment will have on a natural drainage system.
- **Rehabilitate:** If impacts have been unavoidable, take measures to return impacted areas to a condition similar to the pre-impact or natural state — although this is important and necessary, rehabilitation can never replicate the diversity and complexity of an un-impacted natural site.
    - The cleared forestry areas will be stabilised and planted soon after clearing. The dense natural buffer and the established ecological buffer around the drainage lines (Figure 41) will be more than adequate to deter any adverse conditions from the cleared areas during the initial planting phases.
- **Offset:** As a last resort, compensate for remaining unavoidable negative impacts on biodiversity. When every other effort has been made to minimise or rehabilitate impacts to a degree of ‘no net loss’ of biodiversity against biodiversity targets, offsets can compensate for unavoidable negative impacts.
    - The removal of approximately 187 ha of commercial forestry will increase the runoff on the Farm Nosilla by an estimated 187 000 m^3 /annum. Due to the negative environmental impact of in-stream storage, off-channel storage of 125 000 m^3 is being constructed on the farm to store the water. Pumping of water freed up by the removal of exotic plantations, will only be allowed during the high flow months so as not to reduce the low flow in the system.
    - A low flow analysis shows that the removal of forestry and transferring the increase flow to the off-channel dams could result in a small decrease in the low flow, even though the EWR will still be met. The conversion from Streamflow Reduction (SFR) to irrigation will benefit downstream users by 25 900 m^3 /annum. As an additional safeguard to secure the low flow, it is recommended that the condition of the water use licence be that a minimum flow of 11 l/s must always flow out of the lower weir (when there is flow in the system) and this must be metered.

Step 2.3.3 Secure priority biodiversity in CBAs and ESAs through biodiversity stewardship: 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:

- By not impacting significantly on the untransformed valleys, approximately 267 ha of Optimal Critical Biodiversity Area (55% of project area) will be protected as a natural area on the farm.

Step 2.3.4 Remedy degradation and fragmentation through rehabilitation: 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.

- The valleys on the farm will act as natural corridors, connecting the areas from the south to the corridors situated downstream of the farm towards the Da Gama Dam.
- This is a good example of retaining natural habitat and connectivity in a CBA Optimal. Approximately 267 ha of Optimal Critical Biodiversity Area (55% of project area) will be protected as a natural area on the farm.

Step 2.3.5 Promote long-term persistence of taxa of special concern

- Environmental Water Requirement releases from the weirs will keep the downstream habitats ecologically sound.
- Eight bird species of special concern will utilise the intact habitat of the project area, including species such as African Crowned Eagle, Martial Eagle, Knysna Turaco and the Cape Vulture might overfly the area.
- Eight mammal species of special concern will utilise the intact habitats of the project area, including medium-sized species such as Serval, Cape clawless otter, Honey badger and Brown hyaena.

Table 50: 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)	
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	Project description (under section 1.1)
○ Step 1.1.2 Environmental Impact Assessments (EIA) and Freshwater Ecosystem Priority Areas (FEPA)	Mpumalanga Biodiversity Sector Plan (MBSP) and Threatened Ecosystems (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 New Project	3. Description 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)	5.3.5 Land-use guidelines
○ Step 1.2.1 Critical Biodiversity Area in the Project area	Figures 38 and 39 (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 assessments in the study area	**4.3 Biodiversity assessments**
Step 2.1 Compare mapped land cover with observed land cover at the site	**Figure 21:** The broad-scale vegetation units or ground cover of the Nosilla project area.
○ 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	2. Methodology 4.3 Biodiversity assessments Appendices 5 to 8

▪ Mammal surveys	
○ Step 2.1.2 Results of Ecological Surveys	4. Results
Vegetation	4.1 Vegetation units and land cover types within the study area
▪ Observed vegetation	4.3.1 Vegetation communities
▪ Riparian delineation	5.3.3 Riparian delineation
○ Fauna surveys	4.3 Biodiversity assessments
▪ Aquatic habitats and fauna	4.3.2 Riverine Ecology
▪ Aquatic habitat assessment	4.3.2.2 Aquatic habitat assessment
▪ Aquatic invertebrate assessment	4.3.2.3 Aquatic invertebrate assessment
▪ Fish Response Assessment Index	4.3.2.4 Fish communities
▪ 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	5.3 Land-use planning and Decision-making
Step 2.2 Compare mapped CBA or ESA features with ground-truthed ones	Vegetation and land cover types identified for the ecological surveys (under 4.1) – Figure 21: The broad-scale vegetation units or ground cover of the Nosilla project area. Compare with Figures 38 and 39 (under 5.3)
Step 2.3 Identify compromises and solutions that minimise impacts on biodiversity and conflicts in land-use	5.4 Assessment of impacts
○ Step 2.3.1 Retain natural habitat and connectivity in CBAs and ESAs	5.5 Conditions for inclusion in the environmental authorisation.
○ Step 2.3.2 Apply the mitigation hierarchy	5.5 Step 2.3.2: Apply the mitigation hierarchy
○ Step 2.3.3 Secure priority biodiversity in CBAs and ESAs through biodiversity stewardship	5.5 Step 2.3.3: Secure priority biodiversity in CBAs and ESAs through biodiversity stewardship
○ Step 2.3.4 Remedy degradation and fragmentation through rehabilitation	5.5 Step 2.3.4: Remedy degradation and fragmentation through rehabilitation
○ Step 2.3.5 Promote long-term persistence of taxa of special concern	5.5 Step 2.3.5: Promote long-term persistence of taxa of special concern
Step 3: Assess impact on biodiversity: Purpose: To make recommendations regarding the impacts of the proposed land-use development on biodiversity	5.4 Assessment of impacts
Step 3.1 When impacts are likely to be insignificant	5.4 Assessment of impacts
○ Step 3.2 When significant impacts are unavoidable	5.7.2 Reasoned opinion
○ Step 3.2.1 CBAs and ESAs	5.7.2 Reasoned opinion

○ Step 3.2.2 ONAs	5.7.2 Reasoned opinion
Step 4: Identify opportunities to conserve biodiversity: Purpose: Maximise conservation gains by proactive identification of opportunities to conserve biodiversity	Critical Biodiversity Areas (under 5.3)
○ Step 4.1 Set aside land of high biodiversity importance for conservation through biodiversity stewardship options	Critical Biodiversity Areas (under 5.3)
○ Step 4.2 Where biodiversity losses are unavoidable, set aside another piece of land of equivalent or greater biodiversity importance for conservation	Critical Biodiversity Areas (under 5.3)
○ Step 4.3 Clear invasive alien vegetation and rehabilitate existing degraded habitats	5.4 Assessment of impacts
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	Critical Biodiversity Areas (under 5.3)
○ 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.	5.4 Assessment of impacts
○ Step 5.1.3 Concentrating disturbance footprints in heavily modified or degraded areas that are not earmarked for rehabilitation	5.4 Assessment of impacts
○ Step 5.1.4 Integrating *in situ* biodiversity-sensitive management into the overall design and operation of the proposed land-use development	5.4 Assessment of impacts

5.6 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. A monitoring programme for the biodiversity associated with the project, would ideally be to record the reaction of the biota to changes in the environment due to the impacts of the project.

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.

Very little monitoring will be necessary during the operational phase of the project. Most of the mitigatory aspects, will be assessed by the ECO during construction. The only impact require monitoring during the operational phases of the project, is to ensure that the flow releases from the weirs will meet the requirements stipulated for the Environmental Water Requirement releases.

Aspect 1: Abstraction of water from the river system. Pumping of water freed up by the removal of exotic plantations, will only be allowed during the high flow months so as not to reduce the low flow in the system. As an additional safeguard to secure the low flow, it is recommended that the condition of the water use licence be that a minimum flow of 11 l/s must always flow out of the lower weir (when there is flow in the system) and the this must be metered.

Whatever system will be in place to release and measure flow releases must be monitored regularly in order to ensure the 11 l/s is released and be confirmed using the metering system. The weirs must be inspected frequently to maintain the system and ensure that the outlets are not blocked or not functioning properly. The results of the metering of flows should be made available to the relevant authority.

5.7 Recommendations

5.7.1 Summary of mitigation measures

The potential impacts of the project on biodiversity of the study area are assessed under six broad impacts (Section 5.4). The following table provides a summary of the impact assessment, indicating the changes from pre-mitigation to post mitigation.

Table 51: A summary of the impact assessment, indicating the changes from pre-mitigation to post mitigation.

Impact	Phase	Significance before and after mitigation		Mitigation
		Before	After	
Impact 1.1: Clearing the weir basin and manipulate soil.	Clearing	Low	Low	Following the completion of any works, the water user must ensure that all disturbed areas are: (i) cleared of construction debris and other blockages; (iii) reshaped to free-draining and non-erosive contours, and (iv) re-vegetated with indigenous and endemic vegetation suitable to the area.
Impact 1.2: Construction activities resulting in erosion and siltation.	Construction	Medium	Low	It is generally specified that work in watercourses is carried out during periods of low average rainfall. The cofferdam construction shall be properly managed and maintained. Adequate erosion and sedimentation control measures must be put in place to prevent downstream impacts of the dam.
Impact 1.3: Disturbing soil layers during the rehabilitation of coffer dams.	Construction	Medium	Low	Removal of the cofferdam should be planned and executed with the same degree of care as its installation, on a stage-by-stage basis.
Impact 1.4: Construction activities resulting in pollution.	Construction	Medium	Low	Carefully control all on-site operations that involve the use of cement and concrete (this applies to areas other than the batching plant).
Impact 2.1: Clearing the construction area and building the pump stations.	Clearing	Low	Low	Identify and demarcate the extent of the site and maintain site demarcations as indicated on the approved Plan. All areas that were cleared or disturbed during construction activities must be rehabilitated to a natural vegetated state. Care must be taken to ensure that these rehabilitated areas merge with the immediate environment.
Impact 3.1: Pipeline activities: Trenching, excavation and rehabilitation.	Construction	Medium	Low	Identify and demarcate the extent of the site and maintain site demarcations as indicated on the approved Plan. All areas that were cleared or disturbed during construction activities must be rehabilitated to a natural vegetated state. Care must be taken to ensure that these rehabilitated areas merge with the immediate environment.
Impact 4.1: Balancing dams: Clearing of vegetation on the footprint.	Clearing	Low	Low	The dams will be constructed on cleared forestry blocks.
Impact 5.1: Inundating riparian habitats due to damming.	Operational	Low	Low	Disturbed riparian areas must be rehabilitated immediately after construction of the weirs. The weir sites are both surrounded with dense valley bush and the small weir footprints will not have a detrimental impact on the riparian corridor.
Impact 5.2: Abstraction of water from the river system.	Operational	Medium	Low	The conversion from Streamflow Reduction (SFR) to irrigation will benefit downstream users by 25 900 m^3 /annum. As an additional safeguard to secure the low flow, it is recommended that the condition of the water use licence be that a minimum flow of 11 l/s must always flow out of the lower weir.

Impact 5.3: The dam wall as a migration barrier to aquatic animals.	Operational	Low	Low	With no fish or other organisms that will need to migrate up the small stream, providing a fishway in the weir will be unnecessary.
Impact 6.1: Operational activities impacting on the riverine system: trampling the riparian zone.	Operational	Low	Low	Make use of existing roads and tracks where feasible, rather than creating new routes. Ensure that only authorised roads and access routes are used.
Impact 6.2: Erosion of the cleared lands and siltation of the non-perennial streams.	Operational	Low	Low	Maintaining strips of natural vegetation between orchards is encouraged, if and where feasible, to assist with run-off control.
Impact 6.3: Erosion of the cleared lands and siltation of the non-perennial streams.	Operational	Low	Low	Erosion of the cleared lands and siltation of the non-perennial streams.
Impact 6.4: Irrigation return flows containing fertilisers and pesticides seeping towards the drainage line.	Operational	Low	Low	Maintaining strips of natural vegetation between orchards is encouraged, if and where feasible, to assist with run-off control.

5.7.2 Reasoned opinion

According to the General Requirements in terms of Appendix 6 (not an appendix to this report) of the EIA Regulations, 2014, a "Reasoned opinion" should include the rational as to whether:

- the proposed activity, activities or portions thereof should be authorised;
- regarding the acceptability of the proposed activity or activities;
- and 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.

The management of the Farm Nosilla is in the process of removing approximately 187 ha of commercial forestry, which will increase the runoff on the farm by an estimated 187 000 m^3 /annum. Although the cleared areas will be utilised for the establishment of approximately 218.3 hectares of crops, the conversion from Streamflow Reduction (SFR) to irrigation will benefit downstream users by 25 900 m^3 /annum.

The two proposed in-stream weirs which will function as abstraction weirs, will both cover relatively small surface areas in the non-perennial drainage systems (2014 sqm and 1300 sqm respectively). Both the weir sites are surrounded by dense valley bush and the small weir footprints are unlikely to have a detrimental impact on the riverine core areas and associated riparian corridor.

During the ecological studies of the stream system, no fish were sampled in the small seasonal system. With no fish or other organisms that will need to migrate up the small stream, the installation of a fishway in the weir will not be necessary.

Due to the negative environmental impact of an in-stream storage, an off-channel storage facility of 125 000 m^3 is being constructed on the farm to store the water. The three off-channel balancing dams will be constructed on cleared forestry blocks and therefore this activity will not impact on any natural vegetation. Pumping of water freed up by the removal of exotic plantations will only be allowed during the high flow months so as not to reduce the low flow in the drainage system.

As per to the buffer requirement, a buffer of 20 m wide is required around the small streams is required to protect the unnamed drainage lines in their current condition from degradation. Furthermore, most of the drainage system and ecological buffer around the riparian corridor is protected by an additional safeguard of natural woodland which will enhance the integrity of the acquired buffer.

Aerial views of the farm show that the areas originally planted for timber were mainly located on the crests of the undulating landscape and the steeper slopes and valley bottom was left largely intact.

The applicant intends to only develop the cleared areas, while the remaining slopes and valleys will be conserved in their current, near natural state. According to the Mpumalanga Biodiversity Sector Plan, the untransformed valleys are a mixture of Optimal Critical Biodiversity Areas and Other Natural Areas. These areas will thus be maintained in a natural state while the cleared crest areas (previously forestry) will be farmed.

The valleys on the farm will function as natural corridors, connecting the upstream landscape with the downstream corridors towards the Da Gama Dam. The valleys with their broad, dense untransformed woodland, serve as a good example of the concept "retaining natural habitat and connectivity in an Optimal CBA".

By implementing all the mitigation measures and managing the system as prescribed on a continuous basis, all the impacts will be addressed to a satisfactory level. It is apparent from the reasoned opinion that the overall project outcome might even improve certain aspects in the way the farm was managed historically. Therefore, it is proposed that the project should be authorised with the provision that the mitigation measures prescribed in this document are included in the EMPr.

5.7.3 Consultation process

The input from the following parties:

- Mr. Pieter du Preez regarding his support and information sharing;
- Mr Stephen Mallory - EWR reports and flow rates;
- Mr Barend Marx - information relating to the weirs and operation of releases;
- Dr. Mervyn Lotter regarding the Mpumalanga Threatened Species Database is appreciated;

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Appendices

Appendix 1: Declaration of interest

The specialist appointed in terms of the Regulations

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).

Signature of the specialist
Name of company: Andrew Deacon Environmental Consultant
Date: 31 July 2021

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 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 4: 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 Chart below).

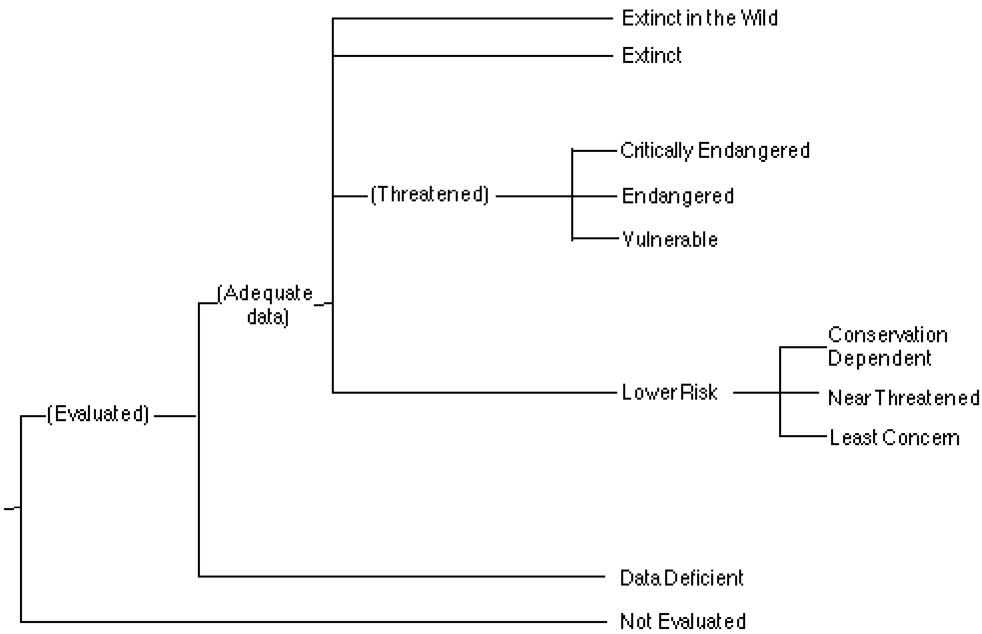


Chart: Red Listed categories

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 5: FROGS: Available habitat, expected occurrence and observed presence of frog species during surveys (Jacobsen, 1989: Interpreted distribution map; Minter et al, 2004).

Frogs expected to occur in the available natural habitats in the Nosilla project area are listed below. The words in **bold font** represent qualifying habitat (preferred habitat), and *underlined italics* disqualifying habitat (the reason why the organism will not occur in the area). The shaded cells indicate the species likely to occur in the specific habitat, and the number inside a cell gives the number of individuals observed or definite signs of the species detected during surveys.

FROG SPP	**All habitats**	**RSA STATUS**	**Nosilla**
Family: Arthroleptidae			
Mozambique forest tree frog (*Leptopelis mossambicus)*	Breeds in wooded savanna, sand forest and mangrove swamps **in the vicinity of streams** and pans. Burrows underground during dry periods.	Least concern.	
Family: Breviceptidae			
Common rain frog (*Breviceps adspersus*)	Savannah biome: Semi-arid habitats with sandy to sandy-loam soils. **Bushveld vegetation with a grassy ground layer and distinct upper layer of woody plants**. Breeds in burrows in open and closed woodland with sandy soils. No standing water needed.	Least concern. Does not appear to be at risk – game and cattle farming and reserves.	
Family: Bufonidae			
Northern pygmy toad *(Poyntonophrynus fenoulheti*)	Savannah biome: Variety of bushveld vegetation types, sometimes in adjacent grassland. Occasionally found in sandy areas, usually **occupy rocky outcrops in savannah or woodland**. Refuge between rocks or on soil under stones. Breed in temporary pools on flat rocky outcrops or in stony, sometimes barren regions. Tadpole metamorphosis complete after 19 days.	Least concern. Not considered to be at risk – habitat well protected.	
Garman's toad *(Amietophrynus garmani*)	Various bushveld vegetation types in the savannah biome. Prefer **well-wooded low-lying areas where there is relatively high rainfall (above 600mm/annum).** Breeds in vleis, pans and dams in open or wooded savannah. Occasionally in quiet backwaters of rivers and **pools along small, slow-flowing streams**. Tadpole metamorphosis complete after 64-91 days.	Least concern Common and widespread – habitat not threatened; range may have expanded.	
African common toad (*Sclerophrys gutturalis*)	Savannah, Grassland & Thicket biome: Breeds in open shallow pools, vleis, dams, **rivers, streams** or other more or less permanent water. Common in suburban gardens and farmland. Excavate burrows in soft ground. Tadpole metamorphosis complete after 5-6 weeks.	Least concern. Population trend: increasing. Not threatened. Relatively secure as it is widely distributed, locally abundant and highly adaptable to human settlement.	3
Hallowell's toad *(Sclerophrys maculatus*)	Associated with riverine habitats; medium and larger rivers. savannah and grassland, larger river valleys. Call from amongst reeds, **grass or rocks next to or in rivers and streams - fast flowing water.** Breeding habitat is riverine; alongside rivers in small shallow inlets and puddles created by rising and falling water, also rock pools. Breeds in rivers and streams in savannahs. Eggs in marginal pools and backwaters.	Least concern	
African split-skin toad (*Schismaderma carens)*	**Wide variety of vegetation types in savannah biome**, also in Rocky Highveld, and Grassland. Breeds in permanent, often fairly deep, muddy - pools, dams or waterholes in open or wooded savannah. Wanders to forage. Hibernates at a considerable distance from water, under stones, logs and piles of dead vegetation. Tadpole metamorphosis complete after 37-52 days. Breeds in permanent, often fairly deep, muddy - pools, dams or waterholes in open or wooded savannah.	Least concern. Not threatened. Adapts in disturbed areas. Tadpole survives in polluted water.	1
Family: Hemisotidae			
Marbled snout-burrower (*Hemisus marmoratus)*	Savannahs: *Semi-arid environments*. Marshy ground and in sandy riverbanks in bushveld savannah throughout sub-Saharan Africa. Breeds at the margins of pans, waterholes and isolated pools that form in riverbeds where there is exposed mud banks. Shallow, temporary water bodies.	Least concern.	

Family: Hyperoliidae. Subfamily: Hyperoliinae			
Golden banana frog (*Afrixalus aureus)*	Breeds in dense grass, sedges or bushes at the edges of *shallow semi-permanent pans*.	Least concern.	
Painted reed frog (*Hyperolius marmoratus taeniatus)*	Aestivates under stones and logs. Canopy of surrounding trees or emergent vegetation. Call sites: **emergent reeds and sedges, trees, grasses, bushes, floating vegetation.** Breeds in almost any permanent body of water in the lowveld and coastal regions. Temporary ponds, pans and vleis; permanent water bodies: marshes, reedbeds, sluggish rivers and streams.	Least concern	
Waterlily Frog (*Hyperolius pusillus)*	*Open grassy pans, ponds, vleis and dams in open savannah and grassland*; often found sitting on floating vegetation, such as water lily leaves. Breeds in pans and vleis especially where there are water lilies and other floating plants. Eggs are laid in clutches in a single layer between overlapping lily leaves on the water's surface or in clusters around aquatic vegetation.	Least concern.	
Family: Hyperoliidae Subfamily: Kassininae			
Bubbling kassina (*Kassina senegalensis*)	**Wide variety of vegetation types in savannah and Grassland biomes**. Breeds in both temporary and permanent water bodies: ponds, vleis, well-vegetated shallow pans, marshes and deeper dams in grassland. Tadpole metamorphosis slow: 2-3 months.	Least concern. Not threatened. Widely distributed and abundant. Does not require conservation attention. Dams improve breeding habitat. Population trend: stable.	2
Family: Microhylidae Subfamily: Phrynomerinae			
Banded rubber frog (*Phrynomantis bifasciatus*)	Variety of bushveld vegetation types in savannah biome. Hot semi-arid environments (50-1450m). Breeds in shallow temporary pans and **pools, or inundated grass in savannah** and Acacia. Also, small shallow dams.	Least concern. Common throughout it range – not threatened.	
Family: Phrynoatrachidae			
Dwarf Puddle Frog (*Phrynobatrachus mababiensis)*	Open to wooded savannah; less frequently grassland; high & low altitudes. Summer rainfall: 500-1000mm p.a. Calls from water's edge well concealed by vegetation. Breeds in any moist, marshy area, vlei, including those at edges of pans among emergent vegetation in permanent, semi-permanent and temporary habitats: shallow stagnant water amongst emerging vegetation on the edges of grassy pans, small dams and ponds, and in the **backwaters of slow-flowing streams and shallow stagnant water**. Eggs laid in a dense mass among emergent vegetation on water.	Least concern. Not threatened.	4
Natal dwarf puddle frog (*Phrynobatrachus natalensis*)	**A variety of vegetation types in the savannah and Grassland biome**. Shelter under rocks near breeding sites. Fairly deep water - slow-flowing streams. Temporary pans and pools, vleis and dams, and even small, slow-flowing streams. Breeding sites usually have vegetation or other types of cover along their banks. Eggs on water surface, hatch in 3-4 days; metamorphosis 4-5 weeks.	Least concern. Not threatened. Abundant and often near human habitation. Population trend: stable.	1
Family: Ptychadenidae			
Southern ornate frog (*Hildebrandtia ornata)*	Variety of bushveld vegetation types. *Deep sandy soils*. Breed – shallow temporary pans in dry open woodland, often with emergent grass. Also temporary pans, shallow pools in riverbeds, waterholes, and more permanent vleis.	Least concern. Not threatened	
Anchieta's ridged frog (*Ptychadena anchietae*)	Savannah biome. **Found sheltering amongst grass and plant and plant debris on edges of breeding sites. Adults occur in the grassy edges of rivers and streams**, escape into the water. Temporary pans, shallow pools in riverbeds, waterholes, and more permanent vleis.	Least concern. Does not appear to be at risk.	2

Sharp-nosed Grass Frog (*Ptychadena oxyrhynchus)*	**Moist open savannah and woodland.** Breeds in sedge pans, vleis, inundated grasslands, pools in rock outcrops and other temporary pools.	Least concern.	
Mozambique ridged frog (*Ptychadena mossambica)*	**Savannah species; bushveld vegetation types, open grassland. Conceal themselves in grass tussocks** near vleis, seepage areas and pans. Floodplains of rivers and inundated grassland. Dry season: deep cracks in dry mud of pans. Call from vegetation from water edge. Breeds in shallow water of vleis, pans, floodplains and inundated grasslands.	Least concern.	
Family: Xenopodinae			
Muller's platanna *(Xenopus muelleri)*	Breeding = non-breeding habitat. **Wide variety of permanent bodies of water**, including pans, lagoons and quiet regions of lowland rivers. Tolerant to high temperatures. Burrow into dry mud to aestivate when pools dry up.	Least concern.	1
African clawed frog (*Xenopus laevis)*	Most of the biomes. Restricted to aquatic habitats. Historically occurred in streams, rivers and their pools. **Currently in man-made water bodies**. Breeds in any more or less permanent bodies of water. Eutrophic waters seem to produce the highest densities. Burrow into dry mud to aestivate when pools dry up. Washed down during heavy rains into dry river courses. Breeds in remnant pools. Breeding and non-breeding habitats the same. Hatch in 2-3 days; metamorphosis within 2 months.	Least concern. Not threatened. Not threatened in any part of its range. Unprotected. Population trend: Increasing. Common and widespread.	
Family: Pyxicephalidae			
Delelande's river frog (*Amietia delalandii*)	Grassland and savannah biomes; grassland streams and forest fringes. Wide range of wetland habitats. **Adults occur in the grassy edges of rivers and streams, escape into the water**. Banks of slow flowing streams or other permanent bodies of water favoring those with aquatic vegetation. Edges of pools, dams, streams and slow-flowing rivers. Jump in water and hide in soft mud to escape. Spend day floating amongst vegetation or basking on rocks above water level. Call from floating vegetation or from shallow water at the edge. Breeds in both standing and flowing water: edges of pools, streams and slow-flowing rivers. Both standing water in flat areas and running water traversing slopes of more than 14 degrees. Tadpoles complete development in 9-12 months but take up to 2 years if food is in short supply or water is very cold.	Least concern. Not threatened. Widespread – found in all rivers, ponds, farm dams and other wetlands in its range. Not generally threatened. Population trend: stable.	2
Edible bullfrog (*Pyxicephalus edulis*)	Several bushveld vegetation types. Flat, low-lying areas in open *grassy woodland that become flooded after heavy rain or contain shallow seasonal pans*. Breeds in rain-filled pools.	Least concern. NEMA (Tops): Protected species.	
Marbled sand frog (*Tomopterna marmorata)*	Various habitats in subtropical savannah. **Breeds in quiet areas of rivers or streams with sandy substrates**.	Least concern. Not threatened	
Common sand frog (*Tomopterna cryptotis*)	**Variety of habitats in open savannah** and grassland, including arid areas. Open arid landscapes with sandy soils form the habitat of this species. The frogs spend most of the year buried in the soil; hibernate half a meter or more beneath the soil surface. Males call from exposed sites at the banks of streams, pools and puddles. They call at least partially from subterranean refuges, too. The frogs spawn in small temporary waters. They are usually nocturnal, but occasionally diurnal during periods of heavy rainfall. Breeds in temporary rain pools and vleis. The frogs spawn at night, reacting spontaneously to favorable environmental conditions but stopping their activities with similar promptitude. Rainfall plays a significant role as a trigger of reproductive activity. Eggs are deposited individually in shallow, usually rather turbid water. The tadpoles hatch 2–3 days later	Least concern. Not threatened. Unprotected. Widespread. Secure. Population trend: stable.	
Natal sand frog (*Tomopterna natalensis*)	**Variety of vegetation types in the Grassland and savannah biome**. Annual rainfall: 300-1000mm. Call from: exposed positions near water edge on bare rock, sand or mud. Breeds in shallow permanent streams, rivers, and other places where water flows slowly, but also in standing water: furrows or vleis in grassland. Eggs laid in running water. Metamorphosis within 2-3 weeks.	Least concern. Not threatened. This widespread species does not appear to require conservation action. Population trend: stable.	2

Family: Rhacophoridae			
Grey foam-net treefrog (*Chiromantis xerampelina)*	Savannah biome. Breeds over temporary pans, vleis and rivers in constructing foam nests. Found **around seasonal or permanent bodies of open** water in a variety of bushveld vegetation types in the savannah biome.	Least concern.	

Appendix 6: REPTILES: Available habitat, expected occurrence and observed presence of reptile species during surveys (Jacobsen, 1989; Interpreted distribution map - Branch, 1988; Atlas and Red List - Bates, et al 2014).

Reptiles expected to occur in the available natural habitats in the Nosilla project area are listed below. The words in **bold font** represent qualifying habitat (preferred habitat), and *underlined italics* disqualifying habitat (the reason why the species will not occur in the area). The shaded cells indicate the species likely to occur in the specific habitat, and the number inside a cell gives the number of individuals observed or definite signs of the species detected during surveys. Information also obtained from local inhabitants, especially of the larger snake species.

SPECIES	Total habitat	Status	
Family Pelomedusidae			
Marsh terrapin (*Pelomedusa subrufa)*	Grassland, Closed woodland, Rivers, Seasonal pools, Pans. **Slow-moving and still water, including natural temporary veld pans and pools (seasonal waters)** away from perennial rivers and dams (permanent water - crocodiles). Basking - at water's edge, exposed rock, and protruding log or mud bank; fresh or stagnant waterbodies (tolerates wide variation in water quality). Bury themselves up to 5 cm deep in soil, mud or debris to aestivate during winter. Lays eggs in moist soil above high-water mark; dig with hind feet.	Regional: Least Concern (2014). Secure, protected	
Serrated hinged terrapin *(Pelusios sinuatus)*	*Perennial rivers* and more permanent waterholes, pans and dams; upland Savanna and lowveld. Basking on sandbank protruding rock or submerged log or back of sleeping hippo and crocodiles. Lays eggs up to 500m from nearest water.	Regional: Least Concern (2014).	
Family Testudinidae (Land tortoises)			
Leopard tortoise (*Stigmochelys pardalis*)	Montane grassveld, fynbos, valley bushveld, arid and **mesic Savanna**. Level areas in open woodland and scrub or wooded grassland. A shelter in crevices in rock outcrops, under rocks or in burrows dug into old termitaria or earthen banks. Aestivates – in old termitaria or tightly fitting burrows, excavate under rocks, logs – scrape into earth embankments.	Protected. Widespread. Vulnerable but secure. Global: Least Concern (2014).	
Speke's hinged tortoise (*Kinixys spekii*)	**Tropical bushveld** (humid conditions) and Savanna. Low lying open woodland and scrub. Occur on flats but mostly associated with rocky hillsides. Shelters in crevices in rock outcrops, under rocks or in burrows, dug into old termitaria or earthen banks.	Regional: Least Concern (2014).	

Family: Crocodylidae			
Nile crocodile (*Crocodylus niloticus*)	*Larger rivers*, lakes and swamps. River mouths, estuaries and mangrove swamps. Young - dig burrow to shelter; spend lot of time out of water and eat small prey. Sub-adults prefer swamps and backwaters, eating fish, terrapins, birds and small mammals. Nest on sunny sand bank above floodwater level with good drainage and cover nearby.	**Regional: Vulnerable (2014). NEMBA TOPS (2015): Protected, suggested Vulnerable; SARCA (2014): Vulnerable. Zambia - Lower Risk – conservation dependant**	
Family:Gekkonidae			
Turner's giant gecko *(Chondrodactylus turneri)*	Terrestrial, **restricted to rock outcrops**. Semi-desert and arid Savanna, entering moist habitats. Large nocturnal and rupicolous gecko common in the western arid region and extending into savanna habitats. It inhabits rock outcrops and hollow trees. Eggs laid in small hole in sand or rock cracks.	Global: Least Concern (2014).	1
Common dwarf gecko *(Lygodactylus capensis capensis)*	**Well-wooded dry Savanna**: Open woodland and well-wooded dry Savanna country. Diurnal and arboreal gecko. Inhabiting trees with holes or loose bark, which provides shelter. Also shelters among rocks and dead vegetation. Marked preference for Baobab, Acacia and Mopane – plenty suitable rough bark as cover. Eggs are laid in rock cracks, crevices, under stones or under loose bark. Forage in low scrub and on dead trees. Observed clinging, head down, near base of tree waiting for prey.	Protected. Widespread, abundant. Under no threat.	3
Wahlberg's velvet gecko (*Homopholis wahlbergii*)	Land type varied - mesic and arid Savanna, Coastal bush. **Living in holes of old tree trunks, holes in dead trees and branches, under bark**, in holes in baobab trees, empty swallow nests in caves and rock overhangs, or amongst rocks and boulders – latter case prefer those lying in riverbeds near the water; rock fissures, particularly on overgrown koppies along river beds. Feeding both day and night but forage away from their retreat only at night. Eggs are laid in a rock cracks or/ crevices or beneath loose bark and in holes in trees.		
Common tropical house gecko (*Hemidactylus mabouia*)	Varied; arid and mesic Savanna, and coastal bush. Arboreal in wild and very territorial. Common under loose tree bark and in the hollows of trees (particularly baobab), in the crowns of palms, and in rock cracks and crevices. In fact, in **any dark convenient place on or above the ground (also piles of rubble).** In the wild the eggs are laid under a rock or in a crevice and sometimes in a communal depository. Mainly nocturnal.		2
Van Son's gecko (*Pachydactylus vansoni*)	Land type: Varied – karroid veld, grassland and mesic Savanna. Terrestrial; **inhabits rocky outcrops** and more frequently - tunnel under rotting rocks or logs on soil; disused termitaria, occasionally low rock cracks. Solitary, nocturnal. At night – emerge to forage, it moves about on the ground in search of food. Eggs laid in soil under rocks or stones, under bark; or logs; in old termitaria in summer.	Protected. Status is secure.	
Family Typhlopidae			
Bibron's blind snake *(Afrotyphlops bibronii)*	Highveld and coastal grassland. Under stones and in termitaria. **Underground**.	Partially protected. Widespread. Secure and out of danger.	

Family Leptotyphlopidae			
Long-tailed thread snake (*Myriopholis longicauda)*	Lowveld. Moist Savanna. **Subterranean habits, wide range of mesic soils**. Under decaying hardwood stumps and loose boulders. Under rocks on soil at altitudes of 200-1400m.	Least concern. Widespread and common.	
Incognito thread snake *(Leptotyphlops incognitus)*	Varied: grassland, coastal bush, **mesic and arid Savanna**. Burrow underground. Lives underground and only wriggle to surface after being flooded by heavy rains from their underground retreats. In or under rotting logs, among the roots of grass and small bushes. In particularly in or near termitaria where there is an abundance of termites.		
Peter's thread snake *(Leptotyphlops scutifrons scutifrons)*	Varied; grassland, coastal bushland, mesic and arid **Savanna**. Burrow underground. Usually taken under stones, under rocks on soil, under rotting logs, among grass roots.	Least concern. Partially protected. Secure.	
Distant's thread snake *(Leptotyphlops distanti)*	Varied, coastal bush, **grassland and Savanna**. Burrow underground. Usually taken under stones.	Least concern	
Family Boidae			
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, antbear 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.	**NEMBA TOPS (2015): Protected; SA Red Data (1988): Vulnerable. SARCA (2014): Least concern.**	Observed by farmer.
Family Colubridae			
Brown water snake *(Lycodonomorphus rufulus)*	**Small streams**, pans and vleis. Water-living and confined to rivers, streams and other permanent water or the immediate vicinity thereof. Under cover around water margins. Under rocks, debris, holes in the ground. Among swampy vegetation. Small streams, pans and vleis.	Partially protected. Widespread. Secure. Least concern.	
Brown house snake *(Boaedon capensis)*	Wide distribution: Highveld grassland and arid karroid regions. Terrestrial Nocturnal. Eggs being laid in decaying vegetable matter, termite hills or other suitable location. **Variety of habitats**: Moribund termitaria or any form of shelter. Tolerant of urban sprawl.	Partially protected. Widespread, adaptable. Under no threat.	Observed by farmer.
Cape wolf snake *(Lycophidion capense capense)*	Varied: Grassland and Savanna (open woodland), entering coastal bush and fynbos in Cape. Well-vegetated situations. Damp situations under stones and vegetable debris. Under rocks, logs, in moribund termitaria and under debris.	Partially protected. Widespread, considered secure.	Observed by farmer.
Common file snake (*Gonionotophis capensis capensis*)	**Open woodland**, mainly Savanna; entering coastal forest and arid regions. Shelters under large rocks, logs or other debris.		
Eastern bark snake (*Hemirhagerrhis nototaenia)*	Savanna or woodland-**Savanna areas up to 1550m**. Under rough bark of trees, often associated with Mopane bush.		
Sundevall's shovel-snout (*Prosymna sundevallii*)	**Open woodland**. Dry areas, including Savanna woodlands: burrow in loose soil. Nocturnal, partially fossorial. Under rocks, logs or even piles of bricks.		
East-African shovel-snout (*Prosymna stuhlmannii*)	**Savanna, extending into wooded hills**. Fossorial: Under stones, logs, or heaps of decaying vegetable matter. In termitaria and other similar locations.		

Striped grass snake *(Psammophylax tritaeniatus)*	**Open grassland and Savanna**. Highveld grassland to open bushveld and scrub veld (300-1600m). Holes in moribund termitaria, under rocks, piles of grass. Flee to nearest shrub or clump of grass or might flee into water – submerge to over 5min. Eggs laid under rock or other suitable cover.	Partially protected. Widespread, under no immediate threat.	
Western yellow-bellied sand snake (*Psammophis subtaeniatus*)	**Open woodland** and scrub in arid areas, open dry Savanna, thorn- or bushveld. Dry rocky hillsides in crevices between rocks, large termitaria, under loose bark or dead logs.	Partially protected. Widespread, under no immediate danger.	1
Olive grass snake (*Psammophis mossambicus*)	Coastal plains and upland Savanna. **Bush along streams and rivers** rather than the more open dry area. Mainly ground-living – in grass; may resort climbing on tops of bushes and shrubs in order to bask in sun. Pursued: quick moving, dash into thick cover where it lies still. Eggs are laid in piles of dead leaves or other similar location.		
Short-snouted grass snake *(Psammophis brevirostris brevirostris)*	Highveld & montane grassland. **Grassland, moist Savanna and lowland forest** in the east, and Karoo scrub and Namib desert in the west.	Partially protected. Common, under no immediate threat.	
Bibron's stiletto snake (*Atractaspis bibronii*)	Variable: **grassland, scrub and open woodland** to coastal forest in semi-arid to quite moist climates (sea level to 1700m), highveld grassland to semi desert. Occasionally found on surface on warm rainy nights in summer. Moribund termitaria. Rotting logs, under logs on soil, under stones, and crevices at ground level or under debris.	Partially protected. Considered secure.	
Black-headed centipede-eater *(Aparallactus capensis)*	Varied: Highveld and **montane grassland, open woodland**, open scrub veld, grassland and coastal bush. Open bush or Savanna country. Found in moribund termitaria, which offer shelter, warmth and food. Under stones, under logs, among roots of shrubs and grasses.	Partially protected. Common, not threatened or endangered. Adequately protected.	
Kwa-zulu Natal purple-glossed snake *(Amblyodipsas concolor)*	**Moist, well-wooded** or forested areas – sea level to 1500m. Semi-fossorial; solitary, often lying buried just below humic soil surface – head partly exposed. Under rocks and rotting logs.	**Endemic to South Africa.** Least concern.	
Common purple-glossed snake (*Amblyodipsas polylepis polylepis*)	**Open woodland** and scrub to coastal forest at altitudes from sea level to 1300m, Savanna, entering dry forest. Fossorial (burrowing snake) and slow moving. In burrows or piles of vegetation, not found under rocks or logs. Seen on surface after heavy rains has fallen and soil becomes water-logged.		
Spotted bush snake *(Philothamnus semivariegatus)*	Open woodland, scrub and coastal forest, open forest or Savanna: Open Forest or bush, even dry and far removed from water, however more frequently where water is – swims with ease. Coastal plain, along streams and rivers or along river courses. On rocky hillsides and mountains, shrubs and bushes on rocky ridges. Holes in trees or under loose bark. In crevices between or under rocks. In holes in large termitaria of Macrotermes. Take refuge to trees if disturbed.	Partially protected. Widespread, currently secure.	Observed by farmer
South-eastern green snake *(Philothamnus hoplogaster)*	Varied: Coastal plains (bush), fynbos to higher inland Savanna (Arid and mesic Savanna) and even montane forest. Home near water bodies where it hunts for frogs, **frequenting marshes, ponds, rivers, reedbeds**, pans, vleis and streams. Under logs, stones and under debris. Favour damp localities such as reed swamps, riverine thickets and flood plains of lakes and rivers.	Partially protected. Widespread, not common.	

Rhombic egg-eater *(Dasypeltis scabra)*	**Widespread in most veld types**: from sea level to an altitude of 2300m. Common in grassveld and bushveld. Absent only from true desert and closed-canopy forest. Mainly terrestrial but climb trees in search of birds' eggs. Any place where it can find shelter: Moribund termitaria, rock crevices, rock faces, heaps of rubble, rotting logs.	Partially protected. Widespread, common. Secure.	
Southern brown egg-eater *(Dasypeltis inornata)*	Montane grassland, woodland and grassland. *1200-1600m*. Rock on rock or soil, under grass tussocks.	**Endemic to South Africa.** Partially protected.	
Red-lipped snake *(Crotaphopeltis hotamboeia)*	Most habitats: **Savanna and open woodland**; Grassland to coastal forest but not in desert. Preference for damp localities. Marshy areas. Under virtually any available cover: Under rocks, in termitaria. Eggs laid in vegetable matter.	Partially protected. Occurs widely. Considered secure.	
Eastern tiger snake (*Telescopus semiannulatus semiannulatus*)	Savanna and sandveld: **Well-wooded areas** from sea level to 1600m. May be found in grassland. Terrestrial, old dead trees, under rocks, in crevices, in small shrubs and weavers' nests.	Partially protected. Uncommon, low densities. Secure.	
Southern twig snake (*Thelotornis capensis capensis*)	Savanna woodland: **Open or closed woodland** or coastal forest from sea level to 1200m. Almost exclusively arboreal: Live amongst the branches of trees. Entering holes in evergreen trees on slope during cold periods. May hibernate in hole in tree and even hole in ground.	Partially protected. Widespread, considered secure.	
Boomslang (*Dispholidus typus typus*)	Common in **most wooded regions** outside actual rainforests. From closed woodland through more open areas to scrub, from sea level to 1700m. Diurnal, mostly arboreal; move through branches of trees, shrubs and bushes. Mating takes place in trees and eggs are deposited in holes or hollows of trees, woodpeckers' nests or leaf litter on ground wherever suitable conditions exist. Take shelter in holes in trees and large termitaria and hibernate in holes in trees.	Partially protected. Widespread, secure.	Observed by farmer
Family:Elapidae			
Intermediate Shield Cobra (*Aspidelaps scutatus intermedius*)	**Open woodland and scrub** in stony or sandy areas at altitudes between 200m and 1400m. Fossorial: Stony or sandy areas, rodent burrows or buries itself in leaf litter and loose sand.		
Snouted cobra (*Naja annulifera*)	Savanna: Usually in drier regions – **bush- and lowveld**. Permanent or semi-permanent home or retreat. Animal or other hole in the ground or in a tree, in termite hills or under outcrops of rocks or boulders. Eggs laid in some suitable, sheltered hole or cavity in the ground or in trees.	Partially protected. Widespread, generally common. Secure.	
Mozambique spitting cobra (*Naja mossambica*)	**Savanna: Rocky outcrops and hillsides** in fairly closed woodland at altitudes from sea-level to 1750m along rivers or localities near water. Cleared areas in former forests. Holes in termitaria and other small animal burrows.	Partially protected. Widespread, common. Status is secure.	Observed by farmer
Black mamba (*Dendroaspis polylepis*)	**Savanna & open coastal bush below 1500m**: Lower lying, drier more open woodland and scrub to wooded grassland, moist Savanna and lowland forest (900m-1200m). Ground living snake, also at home in bush, shrubs or trees - in thickets, commonly on hillsides and outcrops, granite hillocks, termite mounds, hollow tree trunks. Female will find a good place to lay eggs, burrow must be damp but not wet, and warm, but not too hot (termite nests).	Partially protected. Widespread, mostly uncommon. In need of greater conservation effort.	Observed by farmer
Family:Viperidae			
Puff adder *(Bitis arietans arietans)*	Widespread: Fynbos, grassland, scrub and **woody Savannas**, from sea level to 1800m. Absent only from desert, dense forest and mountain tops. Any sort: rock on rock, rock on soil, logs, moribund grass.	Partially protected. Widespread, status is secure.	
Snouted night adder (*Causus defilippii*)	**Open to closed woodland** from sea level to an altitude of 1200m. Under rocks on soil or under rotting logs, often associated with rocky outcrops, burrowing.		

Family: Amphisbaenidae			
Van Dam's dwarf worm lizard *(Zygaspis vandami vandami)*	*Alluvial sands* with mesic Savanna. Usually found under stones on sandy or humic soils.		
Family: Scincidae			
Montane dwarf burrowing skink (*Scelotes mirus*)	**Rocky montane grassland**. Live in grass among rocks on upper mountain slopes and summits.	**Endemic to South Africa.** Least concern	
Mozambique dwarf burrowing skink (*Scelotes mossambicus*)	Prefers **rocky grassland** and alluvial sand. Found under stones on mountain slopes, or logs on alluvial sand or loamy soils.		
Giant legless skink (*Acontias plumbeus*)	**Lowveld in woodland** and alluvial sandy areas, forested areas. Fossorial: Usually found below soil surface in sandy soil admixed with vegetable matter, accumulated leaf litter and humic soils in damp situations. Under stones, logs and other rotting vegetation, termitaria and among roots of trees.	Least concern. Protected. Uncommon, widely distributed. Status currently secure.	
Rainbow rock skink (*Trachylepis margaritifer*)	**Rock-living form**: Confined to rocky outcrops and koppies in bushveld country: Sandstone, granite, rhyolite, dolerite and basalt, in vertical and horizontal crevices. Granite domes and other hard rock surfaces (paragneiss and some sandstone).	Protected. Status currently secure and under no threat.	4
Striped skink (*Trachylepis striata*)	**Variety of bushveld and Savanna types**, and a wide range of ecological conditions from sea level to high mountain tops, desert to tropical bush. Although mainly arboreal, they also inhabit rocky koppies and will cross open ground readily. Among rocks and boulders, on the ground and in trees.	Protected. Widespread, adaptable. Considered secure.	6
Variable skink (*Trachylepis varia)*	**Varied: Very adaptive, wide variety of habitats**: from sea level to high mountain slopes: Bushveld, open woodland and scrubby grasslands without rocks and grassland. Desert, karroid veld, montane grassland, Savanna, coastal bush, mesic thicket. Terrestrial and diurnal: Amongst rocks and stones at rocky or stony localities but avoids extensive rocky areas. Broken ground, rocks and tree bases. Also running on ground surface. Uses boles of trees, rocks or logs as vantage points to survey surroundings for prey. Forage among leaf litter under trees or shrubs or amongst grass tussocks, under grass tufts, tree trunks or in any convenient hole in the ground. At night: among stones, beneath bark of fallen logs, in holes in the ground or buried in leaf-litter. Small rocky outcrops, sheltering in burrows under rocks and logs, soil-filled rock cracks.	Protected. Widespread. Considered secure.	2
Sundevall's writhing skink (*Mochlus sundevallii sundevallii*)	Sandy Savanna and **open bushveld country**. A nocturnal fossorial to terrestrial species - lead largely a sub-terrestrial existence. In search of food, they often burrow to the surface of the ground. Shelter under stones, rotting logs, accumulations of dead leaves and other debris. Eggs laid in a suitable nook underground, particularly termitaria.	Protected. Widespread. Under no immediate threat.	
Wahlberg's snake-eyed skink (Panaspis *wahlbergi*)	Arid & **mesic Savanna**. From highveld grasslands and mountain tops through the bushveld and into the lowveld. Forage among grass and leaf-litter, seeking prey under fallen leaves. Shelter among grass tussocks, grass roots, under stones and rotting logs, in moribund termitaria and among leaf-litter in shady places under shrubs, in termite hills, and on broken ground. Eggs laid under a stone or log or sheltered, under stones and rotting logs or among fallen leaves and brushwood lying in shady places, lying on moist ground or among the roots of a tree or shrub, grassy spots, shrubs and trees. Rocky outcrops and rocky hillsides.	Protected. Widespread. Considered secure.	
Family: Lacertidae			
Common rough-scaled lizard *(Meroles squamulosus)*	Arid and mesic Savanna, found in both sand- and **bushveld country**. Open woodland, scrub and grassland, at altitudes of 250-1400. More common in areas with sandy substrates, sandy flat clearings. Particularly on sandy soils where there it shelters in holes in the ground or where it can burrow itself. Forage among grass tufts or edge of bushes.	Protected. Widespread. Currently secure.	

Spotted sandveld lizard (*Nucras intertexta*)	Arid Savanna – Kalahari sand: Open dry Savanna. Holes in the ground, **under rocks on soil, among grass tussocks and in leaf litter.**	Protected. Widespread. Secure.	
Bushveld lizard (*Heliobolus lugubris*)	Sandy, grass- or **bushveld country**, open woodland (300-1000m). Actively foraging terrestrial species: Sunny part of the day – darting between bushes, grass tussocks and shrubs in search of prey. When disturbed, shelters under grass or bushes in the shade, takes refuge in hole in ground if pursued.		
Family: Gerrhosauridae			
Yellow-throated plated lizard *(Gerrhosaurus flavigularis)*	**Wide range of habitat**: Scrub- or bush-covered flats near coast to high mountain slopes and plateau; including highveld, bushveld and lowveld. Bushveld, lowveld, grasslands (highveld) Savanna. On stony hillsides, sandy flats, woodland and grassland. Burrows of considerable lengths dug in ground under suitable sheltering bushes, shrubs, under boulders etc. Also shelters in rodent burrows, under rocks (lay half buried in soil), moribund termitaria. Escape to suitable refuge through low matted vegetation. Lays eggs in small chamber dug in leaf litter or on soil under a stone or rock in a hole which the female excavates, buried and left to incubate.	Protected. Status – secure.	1
Common Giant plated lizard *(Gerrhosaurus validus validus)*	Arid and **mesic Savanna**, open woodland (up to 1400m): Hills and outcrops in bushveld country. Terrestrial and rupicolous (rock-living); gregarious: confined to granitic and other boulder-strewn hills and outcrops. May forage several hundred meters from base of outcrop in which they live, quickly retreat back to suitable crevice or burrow in rocky retreats. Shelter in deep Crevices or Cracks between and under rocks on outcrops. Upper slopes of large granite koppies. Lays eggs in soil-filled rock crevices.		
Rough-scaled plated lizard (*Gerrhosaurus major major*)	Arid and **mesic Savanna**. Lowveld in open to fairly dense woodland – around rocky outcrops or isolated koppies in bushveld country. Rocky outcrops –crevices or hollows between rocks and boulders. Disused warrens of animals such as antbears, warthogs, small animal burrow - springhares, etc. old termitaria. Seldom found far from burrow – retreat at sign of danger. Cracks in small, well-vegetated rock outcrops and also in old termitaria. Lays eggs under log in moist soil, or in rock crack.		
Black-lined plated lizard (*Gerrhosaurus nigrolineatus*)	**Open Savanna woodland**, particularly gravelly soils, bushveld country. Deserted animal and other suitable holes, burrows of other animals, especially those of rodents. Disturbed: rush through vegetation back to burrow.		
Family: Cordylidae			
Jones' girdled lizard *(Cordylus jonesii)*	Bushveld or open woodland (300-1500m), dry Savanna: Under loose bark of dead trees or in the hollows or holes of living trees or dead stumps, in the dried leaves of aloes, in woodpiles and decaying logs. Under stones, dead logs and brushwood, where suitable trees are not available, amongst rocks at ground level.	Protected. Widespread in TVL. Secure.	
Common girdled lizard *(Cordylus vittifer)*	**Rock outcrops** in Grassland. In cracks in small rock outcrops.	Protected. Widespread, status is secure.	
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.	**Endemic to South Africa.** Least concern.	5
Family: Varanidae			
Rock monitor *(Varanus albigularis albigularis)*	Savanna and open bush or forest country, **open woodland, rocky hillsides**, ridges and outcrops. Moister Karroid areas. Terrestrial. Dig tunnel under rock overhangs. Cracks and fissures between or under rocks, or in disused animal burrows or in hollow trees or holes in trees. Expert climbers: tree and rocks. Great wanderers – even far from water. Eggs deposited in holes in suitable soil dug to 150-230 mm - cover and camouflage nest. Eggs in live termite nest, hollow tree, usually hole in soft moist sand.	Protected by Provincial legislation (CITES, Appendix 11). Widespread, status considered secure.	

Water monitor *(Varanus niloticus niloticus)*	Near water: rivers, dams, pans and major lakes. Major river valleys. Shelter in holes in banks, in animal burrows or in **crevices between rocks or under rocks, marginal vegetation**. Basking in sun on rocks, outcrops, tree stumps, branches of overhanging trees or amongst vegetation on banks - never far from water. Escape into water – swim swiftly. Forage in marginal vegetation. Hibernate in large rock crag on rocky cliff or koppie bordering river. Young – marginal reed beds. Eggs deposited in hole dug deep into a living termite nest or sandbank by female, roughly covered over – termites seal up securely.	Protected by Provincial legislation (CITES, Appendix 11). Widespread, status considered secure.	
Family: Agamidae			
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 other small animal burrows for shelter; burrows in termitaria; under stones and debris, partly buries in soil.	**Endemic to South Africa.** Least concern. Protected. Widespread in TVL. Sparsely distributed. Secure.	
Family: Chamaeleonidae			
Common flap-necked chameleon (*Chamaeleo dilepis dilepis*)	Various kinds of woodland: Savanna woodland; and wooded grassland, along streams. Wooded areas; branches of trees; branches of shrubs; **Open Forest and bush country**, Savanna woodland. Lays eggs in tunnel in damp soft soil at a sheltered spot. Diurnal, arboreal species, common in suitable habitat.	Protected. Widespread, out of danger.	

Appendix 7: BIRDS: Available habitat, expected occurrence and observed presence of bird species during surveys (Gibbons, 1997; Harrison et al, 1997; Hockey et al, 2005; latest name changes – Birdlife South Africa, 2020).

Birds expected to occur in the available natural habitats in the Nosilla project area, are listed below. The words in **bold font** represent qualifying habitat (preferred habitat), and *underlined italics* disqualifying habitat (the reason why the organism will not occur in the area). The shaded cells indicate the species likely to occur in the riverine habitat, and the number inside a cell gives the number of individuals or definite signs detected during surveys.

BIRD	**All habitats**	**SA status**	
Grebes			
Little Grebe *(Tachybaptus ruficollis)*	More permanent waters: lakes, ephemeral pans and **dams**; emergent or overhanging vegetation, weedy shores. Backwaters in slow flowing rivers and streams. More permanent water. Infrequent: slow-flowing streams. Rarely in estuaries and sheltered bays. Nest - floating heap of water plants, either on open water or concealed in vegetation.	Common resident or nomad	
Cormorants			
White-breasted cormorant (*Phalacrocorax lucidus)*	Coastal and fresh waters: Dams and **impoundments**, streams and rivers. Mainly aquatic, in both salt and freshwater. Interior - streams and rivers. Colonial nester. Nest fixed to tree - islands, trees along rivers.	Common resident	
Reed cormorant (*Microcarbo africanus*)	Virtually all **freshwater habitats** except fast flowing streams. Prefers gently sloping shores. Also, estuaries, lagoons and sheltered coastal waters. Freshwater wetlands (any size) and water bodies: ephemeral habitats, major rivers and fast-flowing streams with pools, artificial wetlands: dams, sewage works. Nest in fork of tree over water or on an island. Also, in large reed bed or on ground or rocky outcrop on islands.	Common resident	
Darters			
African Darter (*Anhinga rufa*)	Freshwater wetlands, rivers and streams; avoids fast flowing and turbulent water; adapted to artificial wetlands. *Still and slow-moving freshwater bodies with open water*. Scarce on fast flowing rivers and in areas with dense floating vegetation. Prefers areas with dead trees, rocks or banks where it can rest after feeding. Nest built in tree fork, often over water or on an island; also, in large reedbed.	Common resident	
Egrets, herons and bitterns			
Grey heron (*Ardea cinerea*)	Bodies of shallow open water. **Wetlands – rivers, dams**, pans, marshes and estuaries – provided there is sufficient shallow water to feed in. Mountainous areas: keep to valleys. Tall trees, reed beds and cliffs for roosting. Also, marine intertidal zone, estuaries, lagoons. Rarely in dry grasslands. Tall trees, reed beds and cliffs for breeding and roosting. Nest placed in tree fork on bush or 1.5-2.0m above water in a reedbed.	Relatively uncommon; resident Breeding resident. Numbers augmented by Palearctic migrants Expansion in range – artificial water bodies. Common.	
Little egret (*Egretta garzetta*)	Open areas of shallow water: margins of lakes, dams, **rivers, marshes**, saltpans, estuaries and mangrove swamps. Breeds near water in trees or bushes. Edges of rivers and lakes, estuaries, pans, marshes, and saltpans. Also, mangroves, open coastal. Nest placed in tree or bush above water or reedbed.	Fairly common resident	
Intermediate egret (*Egretta intermedia*)	*Shallow water or wet grasslands*. Margins of lakes, rivers, saltpans and estuaries; especially seasonal waterbodies, marshes and flooded grasslands. Prefers shallow water, but also forages in dry grassland close to water. Breeds in reedbeds or trees.	Uncommon to locally common; local movements, possibly migratory in part	

Western Great Egret (*Egretta alba*)	**Shallow open water at lakes, rivers**, floodplains, flooded grasslands, marshes, saltpans and estuaries. Breeds in reedbeds or trees. Nest on platform 2-3m above water in reedbed or 1-5m up in a tree standing in water or island.	Uncommon resident	
Black-headed heron (*Ardea melanocephala*)	Open habitats, **preferring grasslands**. Pastures and field of stubble near wetlands. Tall trees for breeding and roosting.	Common resident	
Goliath heron (*Ardea goliath*)	Open water: lakes, dams, *large wide rivers* and estuaries with extensive shallows and where there are extensive reeds or papyrus. Nests on islands. Shallow margins of large water bodies. Nest in tall tree, but also on ground on islands, mats of trampled reeds, and in flooded bushes or trees.	Uncommon resident generally, but common and conspicuous on larger rivers.	
Purple heron (*Ardea purperea*)	Larger water bodies and wetlands: **Reedbeds, marshes**, reed-fringed rivers and lakes; flooded areas with tall grasses, rushes and sedges. Dense emergent vegetation, especially reed beds fringing shallow wetlands; also, mangroves. Nest in reedbeds on platform.	Uncommon to common resident	
Western Cattle egret (*Bubulcus ibis*)	Terrestrial; open **short grassland. Nests in trees** and reedbeds.	Very common resident	
Squacco heron (*Ardeola ralloides*)	Freshwater habitats: **dense emerging/fringing vegetation in the quiet backwaters** of ponds and the edges of slow-flowing rivers and streams. Adequate reed cover and a few bushes or trees are prerequisites. Flooded grasslands and ephemeral pans with emergent vegetation. Nest: A platform placed in bush or tree over water or in reed bed. <1m above water.	Uncommon to locally common resident	
Straited heron (*Butorides striata*)	**Densely vegetated rivers**, estuaries, streams, lakes, ponds, swamps and mangroves. Wooded areas around margins of rivers, streams, lakes, estuaries, mangroves reedbeds, and swamps where vegetation overhangs water. Occasional - mudflats, temporarily flooded grassland and seashore. Nest placed on lateral branch of tree or dense shrub, 0.3-7m above ground or water.	Uncommon resident	
Little bittern (*Ixobrychus minutus*)	Breeding birds confined to *Typha* and *Phragmites* **reedbeds in standing water**. Migrants in sedges or rank emergent vegetation in shallow water. At edges of wooded streams and rivers. Rank vegetation along ponds. Nest placed in live bulrushes or dense reeds above water.	Non-breeding Palaearctic migrant	
Storks			
Yellow-billed stork (*Mycteria ibis*)	Dams, large marshes, swamps, estuaries, *margins of lakes and rivers*, seasonal wetlands. Wetlands, including alkaline and freshwater lakes, rivers, pans, flood plains, flooded grasslands, small pools or streams. Nest placed on top of tree (Acacia, fig) 3-7m above ground or water.	**IUCN 2016 Status: Least concern. SA Red Data (Taylor 2015): Endangered.** Non-breeding infra-African migrant.	
African Openbill (*Anastomus lamelligerus)*	Various open aquatic habitats – *swamps, floodplains, ephemeral pans*, rice fields, river shallows and lake edges. Wetlands, including flood plains, temporarily flooded pans, marshes, swamps, ponds, river shallows, streams, lake edges, lagoons, intertidal flats. Breeds at sites with suitable water levels for feeding. Thin platforms of sticks and twigs lined with grasses, aquatic plants and sedges alongside other birds in branches of temporarily flooded trees, especially Acacias or reedbeds (0.3-10m above water).	**SA Red Data (Barnes 2000): Near-threatened.** Uncommon to locally common Intra-African trans-equatorial migrant.	
Black stork (*Ciconia nigra*)	*Shallow water: streams, rivers, marshes, floodplains*, coastal estuaries, flooded grassland; large and small dams; dry land. Shallows of rivers, pools in dry riverbeds. Uncommon in seasonal pans lacking fish. Nest up cliff above water: 10-100m.	**IUCN 2016 Status: Least concern. SA Red Data (Taylor 2015): Vulnerable, TOPS (2007): Vulnerable.** Uncommon to rare, nomadic.	

Abdim's stork (*Ciconia abdimii*)	**Grasslands, pastures** and cultivated fields.	**IUCN 2016 Status: Least concern. SA Red Data (Taylor 2015): Near-threatened.** Non-breeding intra-African migrant, very common.	
White stork (*Ciconia ciconia*)	**Open woodland, grassland, grassy** Karoo and wetland areas.	Non-breeding Palaeactric migrant	
Saddle-billed stork (*Ephippiorhynchus senegalensis*)	Larger inland waters: *large rivers in* open savannahs, freshwater wetlands and marshes: dams, pans, floodplains, swamps; usually in open or lightly wooded country. Freshwater and alkaline lake shores. Absent from forests. Breeds in marshes and other wetlands in tropical lowland and builds a large, deep stick nest on top of large tree (20-30m above ground).	**SA Red Data (Barnes 2000): Endangered. NEMBA (TOPS): Endangered. IUCN 2014 Status: Least concern.** Does not adapt well to alteration of its habitat, so is today restricted to large wilderness areas and wildlife reserves.	
Marabou Stork *(Leptoptilos crumeniferus)*	Both aquatic and terrestrial habitats, *preferring open and semi-arid areas*. Natural wetlands in woodland vegetation types.	**SA Red Data (2000): Near threatened.** Rare vagrant over most of southern Africa; elsewhere locally common.	
Ibis			
Hadeda Ibis (*Bostrychia hagedash*)	**Open moist grasslands & savannah**, along well-vegetated river courses; also marshes, flooded grasslands, edges of large wetlands, gardens.	Very common resident	
African Sacred ibis (*Threskiornis aethiopicus*)	Grassland habitats, associated with **freshwater habitats**: marshes, estuaries and dams.	Common to very common resident	
Hamerkop			
Hamerkop (*Scopus umbretta*)	Large perennial waterbodies (lakes, dams and rivers), **vleis and ephemeral wetlands**, perennial and seasonal rivers with pools. Edges and shallow waters of lakes, pans, swamps and marshes, rivers, streams and seasonally flooded ponds, including relatively small puddles. Nest in sturdy tree or on cliff ledge. Adjacent to or over water.	Common resident	
Ducks & geese			
White-faced whistling duck (*Dendrocygna viduata*)	Inland waters, mainly in savannah and grassland. Expanses of **shallow water with emergent vegetation**: backwaters of larger rivers, grassy floodplains, small ephemeral pans. Feeds in water - usually in shallows of permanent or seasonal wetlands, or flooded grasslands; on land - natural grasslands. Ephemeral wetlands. Dense grass or sedges - sometimes over water or island. Dense, long grass or sedges near water edge. Grassy island surrounded by shallow water.	Common resident. Nomadic when breeding. Not threatened.	
White-backed duck (*Thalassornis leuconotus*)	Quiet, clear inland waters with emergent of floating vegetation, natural pans, open vleis, floodplains and river backwaters. Diving to bottom muds in open water. Seasonal pans and floodplains. Ephemeral pans with stable water levels and isolated stands of sedges, rushes or reeds, and are well covered with aquatic grasses.	Uncommon resident or nomadic at times. Not threatened.	
Egyptian goose (*Alopochen aegyptiaca*)	Inland waters: **rivers, dams, lakes**, marshes, pans, and estuaries with some exposed shoreline; wetland edges. Rich aquatic plant growth. Naturally: Restricted to flood plains and large rivers with broad sandbanks. Currently: Crop fields and cereal fields. Nests usually on ground, typically in dense vegetation or among rocks; often on small islands in water bodies. Always near water. Also, old nests of other birds.	Very common resident	
Spur-winged goose (*Plectopterus gambensis*)	Inland waters / wetland: **larger bodies of water, floating vegetation; croplands**. Flightless moult: Dams and dense swamp. Breeding: smaller system or secluded bay, emerging fringing vegetation. Rivers - shallow areas in open. Nest: Shallow scrape in ground near water. Island, dense grass or reeds, sometimes in burrow.	Common to very common resident	

Knob-billed duck (*Sarkidiornis melanotos)*	Inland waters: seasonal flooded pans and vleis. **Rivers - shallow areas in open**. Nest in cavity of tree (dead, hollow), rotten palm stump, old hamerkop nests. 4-12m above ground.	Locally common; seasonal movements	
African black duck (*Anas sparsa*)	Rivers with running water, **pools with wooded banks**. Mainly perennial rivers and streams, from fast-flowing mountain streams to wide sandy river mouths, preferring shallow stony bottom streams with wooded banks. Moult: lodged branches undercut banks. Nest on ground in dense grass or other ground cover on riverbank, or in lodged flood debris, tangled roots or hollow stump.	Uncommon, localized resident.	
Yellow-billed duck (*Anas undulata*)	Inland waters: *Sluggish or still waters and still waters* of rivers and streams; mostly with marginal vegetation such as reeds. Avoid fast flow and saline/ acidic water bodies. Usually floats near emergent aquatic vegetation, occasionally on open water. Breeds on a variety of freshwater wetlands. Shallow seasonal waterbodies. Nest amongst rushes reeds, dense grass or sedges, often within dense patch of vegetation, screened from above. Close to water - within 20m.	Very common resident	
Red-billed teal (*Anas erythrorhyncha*)	Shallow, *permanent or temporary eutrophic fresh* water with grassy surroundings.	Common resident but nomadic	
Southern pochard (*Netta erythrophthalma*)	Deep, permanent or seasonal *freshwater pans*, vleis, clear water; emergent vegetation and seasonal floodplains.	Common to very common resident	
Finfoot			
African Finfoot *(Podica senegalensis)*	*Quiet wooded streams and rivers* flanked by thick riparian vegetation and overhanging trees. Forest and woodland areas: Streams and rivers lined with reeds, overhanging trees and shrubs. Avoids stagnant and fast flowing water. Perennial watercourses, clear water. Reclusive species that seldom ventures into open water. Climbs up and roosts in branches overhanging water. Forages close to water's edge and riverbanks, usually under overhanging vegetation. Nest: 1-2.5m above water on an overhanging branch, well concealed. Also, on flood debris and in rushes above water level.	**IUCN 2015: Least concern; SA Red Data (Taylor 2015): Vulnerable.** Uncommon resident; probably rare.	
Jacanas			
African Jacana *(Actophilornis africanus)*	Aquatic habitats: seasonal pans and floodplains; **along fringes of slow-flowing, meandering rivers** – emergent, floating hydrophytes to forage. Permanent, seasonal and ephemeral shallow, freshwater wetlands and margins of slow-flowing rivers with low emergent vegetation. Favours areas dominated by water lilies and pondweed. Walks on floating plants or swim when hydrophytes provide insufficient support. Nest: Platform of aquatic plants over still water, exposed or well-hidden when vegetation is available.	Common to abundant resident; local movements apparent	
Vultures			
Cape Vulture *(Gyps coprotheres)*	Both open country (grasslands) and woodland. Reliant on tall cliffs for breeding and roosting. **Wanders widely.**	**IUCN 2015 EN Endangered; SA Red Data (Taylor 2015): Endangered. NEMBA TOPS (2015): Endangered species;** Locally common.	
Secretary bird			
Secretary bird (*Sagittarius serpentarius*)	Open country: **Savanna, open woodland, grassland** and dwarf shrubland. Avoids mountain fynbos, forests, dense woodland and very rocky or hilly or mountainous areas.	**IUCN 2017 VU Vulnerable; SA Red Data (Taylor 2015): Vulnerable. NEMBA (TOPS 2007): Vulnerable species.**	
Hawks and eagles			
Western Osprey *(Pandion haliaetus)*	**Inland and coastal waters**. Widespread. Coastal along the seashore, and at estuaries and lagoons; inland on lakes and large rivers.	Mostly uncommon non-breeding Palaearctic migrant. Some may breed.	
African Cuckoo Hawk *(Aviceda cuculoides)*	**Forest and dense woodland**, indigenous or exotic.	Uncommon to fairly common resident. Probably rare.	

Black-winged Kite *(Elanus caeruleus)*	**Wide distribution:** Most abundant in grassland and fynbos with cultivated areas.	Common resident & nomad	
Yellow-billed Kite (*Milvus parasitus*)	**Great variety of habitats**: especially woodlands (higher rainfall areas)	Common breeding Palaearctic migrant	
African fish eagle (*Haliaeetus vocifer*)	Widespread. Coastal along the seashore, and at estuaries and lagoons; **inland on lakes and large rivers**. Usually associated with large water bodies, either flowing or still, including estuaries. Sometimes along open coastline. May remain on seasonally dry rivers once last pools dry up, subsisting on birds and scavenging carcasses. Absent from rivers that flow for only a few weeks a year. Nest in tall tree (including dead and drowned trees) or on cliff. 12-15m above ground.	Uncommon resident	1
Black-chested Snake-Eagle *(Circaetus pectoralis)*	Open country; **savannah woodlands**, dwarf shrublands, semi-desert.	Uncommon resident or local migrant	
Brown Snake Eagle (*Circaetus cinereus*)	**Arid woodland**. Breeds and roosts in trees.	Uncommon to fairly common resident.	
African Harrier-Hawk *(Polyboroides typus)*	Mainly in forests. **Dense woodland, tall riparian vegetation** and well-wooded ravines. Partial to stands of alien trees.	Locally common resident	
Lizard Buzzard *(Kaupifalco monogrammicus)*	savannah and **woodland,** especially mature broadleaved deciduous woodland.	Fairly common resident; somewhat nomadic	
Gabar Goshawk (*Micronisus gabar*)	**Open woodland**: *Acacia* parkland and Acacia-dominated riparian zone.	Common resident	
African Goshawk *(Accipiter tachiro)*	Mainly indigenous forest; also, **dense riverine woodland** and exotic plantations.	Common resident	
Shikra *(Accipiter badius)*	All **woodland types** – nests in open woodland.	Common resident	
Little Sparrowhawk *(Accipiter minullus)*	Forest and **woodland types**: Dense vegetation - forests, riparian bush and thickets.	Uncommon resident	
Black Sparrowhawk *(Accipiter melanoleucus)*	Forest, **wooded kloofs** and gorges, exotic plantations (especially Eucalyptus) in grassveld.	Uncommon to fairly common resident; numbers increasing - able to exploit exotic plantations	
Common Buzzard *(Buteo buteo)*	Open country: dwarf shrubland, grassland, **savannah, open woodland**, thornveld & fynbos. Also found in dense woodland.	Common non-breeding Palaeactric migrant	
Forest Buzzard *(Buteo trizonatus)*	**Edge of indigenous and exotic forest,** especially pine plantations; not in high mountains.	**South African endemic.** Uncommon, localized resident; probably a threatened species	
Jackal Buzzard *(Buteo rufofuscus)*	Mountainous and **hilly areas: grass and other short vegetation**. Nests on cliffs and in trees.	Locally common	
Wahlberg's Eagle *(Hieraaetus wahlbergi)*	**Woodland** – flat areas: river lines and riparian woodlands. Breeding in tall riparian trees in grassland and woodland	Common intra African breeding migrant	
African Hawk-Eagle *(Aquila spilogaster)*	**Woodlands**: breeds on hill slopes or along river courses in tall trees.	Uncommon to fairly common resident	
Ayres's Hawk-Eagle *(Hieraaetus ayresii)*	**Dense woodland**, forest edge, Eucalyptus groves in towns; avoids arid towns.	**IUCN 2015 Status: Least concern. SA Red Data (Taylor 2015): Peripheral species**. Scarce intra-African migrant	

Martial Eagle *(Polemaetus bellicosus)*	Open grassland and scrub. Large trees for nests. **Wide range of vegetation types**: deserts, densely wooded and forested areas.	**IUCN 2015 Status: Near-threatened; SA Red Data (Taylor 2015): Endangered; NEMBA TOPS (2015): Endangered species.** Fairly common to uncommon resident	
Long-crested Eagle *(Lophaetus occipitalis)*	Woodland; **exotic plantations, forest edge**, cultivated land with orchards, grassland and vlei.	Fairly common, but much reduced in southern parts of range; resident	1
Crowned Eagle *(Stephanoaetus coronatus)*	Dense indigenous forest, including **riverine gallery forest**; may range far from forest to hunt.	**IUCN 2015 Status: Near-threatened. SA Red Data (Taylor 2015): Vulnerable. NEMBA (TOPS 2007): Vulnerable species.** Common resident in suitable habitat, but numbers declining through deforestation	
Falcons, hobbies and kestrels			
Rock Kestrel *(Falco rupicolus)*	Wide variety of habitat types: arid to mesic conditions. Mountainous areas for breeding. **Montane grassveld with rocky outcrops.**	Common resident	
Amur Falcon *(Falco amurensis)*	Open and high-rainfall (sour) grasslands. Also, open areas in **woodland**.	Very common non-breeding Palaearctic migrant	
Eurasian Hobby *(Falco subbuteo)*	Mostly lightly **wooded country**; avoids arid zones and forests.	Uncommon non-breeding Palaearctic migrant	
Lanner Falcon *(Falco biarmicus)*	Open habitats. Most frequent in open grassland, open or **cleared woodland,** and agricultural areas. Cliff-nester, also in old nests in trees or electricity pylons and buildings.	IUCN 2017 Status: Least concern (Global). **SA Red Data (Taylor 2015): Vulnerable;** Fairly common resident	
Francolins and spurfowl			
Coqui Francolin *(Peliperdix coqui)*	**Savannah or well-grassed woodland**, sandy areas with good bush cover: grassy clearings and along edges of woodland.	Common resident	
Crested Francolin *(Dendroperdix sephaena)*	**Woodlands** with dense scrub component. Favours areas with bush encroachment in savannahs and tolerates poor grass cover.	Very common resident	
Shelley's Francolin *(Scleroptila shelleyi)*	Acacia **savannah** with good grass cover, edges of cultivated lands, often on stony ground.	Fairly common resident.	
Natal spurfowl (*Francolinus natalensis*)	Woodland types: **savannah** with scrub understorey, especially along water courses, to thickets and coastal forest. Dry riparian vegetation and wooded hills.	. Common resident	
Red-necked Spurfowl *(Pternistes afer)*	Wooded gorges, edges of upland evergreen forests, **riverine scrub**; feeds in clearings and cultivated lands.	Locally common resident; numbers declining because of habitat destruction.	
Swainson's Spurfowl *(Pternistes swainsonii)*	**Wide variety of habitats**. Tall grass in open country (grassland) or woodland. Adjacent to cultivation or close to water.	Very common resident	
Guineafowl			
Helmeted Guineafowl (*Numida meleagris*)	**Savannah mixed** with cultivation. Inhabiting most agricultural regions	Very common resident	
Quails			
Common Quail *(Coturnix coturnix)*	**Catholic use of habitats**: Prefer perennial grasslands, less than 0.5m in height, fallow weedy fields, and grassland regenerating after burning.	Common resident or migrating	

Harlequin Quail *(Coturnix delegorguei)*	Relatively short to medium-long, rank, open grass with **scattered bush cover**. Fallow lands and grassy clearings in woodlands, dry floodplains.	Locally common breeding migrant	
Kurrichane Buttonquail *(Turnix sylvatica)*	Open grassveld: neither very tall or very dense. **Savannah**. Fallow lands.	Uncommon resident	
Crake and rails			
Black crake (*Amaurornis flavirostris*)	**Rank grass, sedges, reedbeds**, bulrushes, papyrus, swampy thickets, bushes and other vegetation beside flowing, still or open fresh and estuarine waters. Occurs in tangled growth in which birds climb, roost and nest. In thin cover along very small streams in arid regions. Nest well-hidden and placed in vegetation just above water, sometimes on ground in grass tuft near water or floating among stiff grass stems.	Common resident	
Flufftails			
Buff-spotted Flufftail *(Sarothrura elegans)*	**Evergreen forest and adjoining thickets**, overgrown gardens.	Fairly common resident	
Red-chested flufftail (*Sarothrura rufa)*	Wide range of freshwater, **marshy habitats, from seasonally wet grassland** and sedge meadow to permanently flooded reedbeds. Wetland vegetation types, dense cover, firm ground or short vegetation. Marshy, boggy areas, reed-fringed pools, swamps, vleis, dambos, marshy vegetation fringing rivers, streams, lakes. Isolated wetland patches in grassland, woodland and forest. Requires permanent dense cover. Prefer moist to shallowly flooded ground with areas of mud, firm ground or short vegetation fo foraging. Also in deeply flooded wetlands, papyrus swamps, provided dense, matted emergent growth or flooded grass available to provide stable substratum. Habitat typically contains rich mosaic of plant species including grasses, sedges, reeds, rushes, forbs and even ferns; also pure stands of bulrushes or sedges - absent from pure reeds. Nest well hidden in or under clump of grass or herbs above ground or water surface. Often in damp to shallowly flooded grasses at edge of marshy areas.	Fairly common resident	
Coot, moorhens and gallinules			
Common Moorhen (*Gallinula chloropus*)	**Wetlands with emergent fringing vegetation**, including lakes, dams, ponds, pans, rivers, streams, canals, swamps and marshes. Flooded grassland. Temp ponds on floodplains. Sheltered sites with some open water, avoids very open situations. Nest usually well concealed in sedges, reeds or bulrushes, lower branches of tree, all above water level.	Common resident	
Red-knobbed coot (*Fulica cristata*)	**Open freshwater of lakes,** lagoons, ponds, pans and vleis, floodplains, reedy swamps. Occasionally on rivers and tidal lagoons. Favouring wetlands with emergent vegetation and pondweed. Spend much time swimming on open water. Nest on shallow (>1m) to deep water, out in the open or among emergent vegetation, sometimes on water lily leaves or mat of reeds.	Abundant resident, highly nomadic	
Korhaans and bustards			
Black-bellied Bustard *(Lissotis melanogaster)*	**Bushveld, savannah**, grassland, vleis, cultivated lands.	**SA Red Data (Barnes 2000): Near-threatened.** Uncommon resident; some local southward movement in winter	
Plovers and lapwings			
Three-banded plover (*Charadrius tricollaris*)	**Any freshwater habitat with** an open shoreline. Open shores of any freshwater habitat, favouring pools, streams and seeps. Also at tidal pools, estuaries and lagoons. Nest: Simple scrape in sand, dry mud or shingle, usually close to water.	Common resident, nomadic	
Blacksmith plover (*Vanellus armatus*)	**Moist short grasslands and mudflats on edges** of pans, lakes, rivers, and estuaries. Nest: typically, close to water or in seasonally inundated areas.	Common resident, nomadic	

African Wattled plover (*Vanellus senegallus*)	**Wet short grasslands and marshes near vleis**, streams and on river floodplains. Waterlogged grasslands at seeps, streams, edges of marshes and flood plains; exposed areas around lakes and pans. Nest: Usually on bare ground or open short or burnt grassland.	Locally common resident	
Crowned Lapwing *(Vanellus coronatus)*	Dry**, short and over-grazed or burnt grassveld**. Widespread in a number of grassland and woodland types. Absent from mountainous and desert areas.	Common resident, nomadic	
Sandpipers & other waders			
Wood sandpiper (*Tringa glareola*)	**Marshy shorelines**: ephemeral pans, vleis, marshes, streams, floodplains and upper reaches of estuaries. Muddy, sandy or gravel borders of dams and ponds, inundated short grassland, sandy and muddy riverbeds, natural pans, mixed rocky and sandy beaches, salt marshes, estuaries, tidal and non-tidal lagoons and mangroves. Marsh-like conditions favoured over open shorelines.	Common non-breeding Palaearctic migrant	
Common sandpiper (*Actitis hypoleucos*)	**Any aquatic habitat**, but favours streams and rivers shores with sandy, gravelly, stony or rocky substrata, estuaries, tidal creeks in salt marsh, mangroves. Open water edges: streams, rivers, marshes, vleis, coastal lagoons and upper reaches of tidal estuaries. Prefer wet conditions adjacent to water rather than wading in water.	Fairly common non-breeding Palaeartic migrant	
Dikkops or thick-knees			
Water Thick-knee *(Burhinus vermiculatus)*	Primarily **freshwater wetlands**, especially large rivers, lakes and dams. Also, mangrove swamps, estuaries and open beaches. Favours site with open sand banks; also, rocky areas, but avoids heavily vegetated wetland margins. Nest: Simple scrape in ground, close to water but fairly open position	Locally common resident.	
Spotted Thick-knee *(Burhinus capensis)*	Various **types of grasslands**; whole of SA highveld. Open grassland and savannah, edges of woodland, semi-desert with scrub, stony slopes of low hills, cultivated land. Sparse ground cover where it is stony.	Common resident	
Doves and pigeons			
Common pigeon (*Columba livia*)	Urban areas, less **often farmland**.	Abundant resident; introduced.	
Speckled Pigeon (*Columba guinea)*	Mountains, **cliffs, rocky gorges, boulder-strewn hills**. Inhabitant of cliffs and crags, fly out to forage on open ground. Artificial structures. Roosts on cliff ledges, in caves and sometimes on trees. Nests placed on ledge of cliff, in cave, gulley or rarely in trees.	Common to abundant resident, nomadic	
African Olive-Pigeon *(Columba arquatrix)*	Afromontane, lowland and coastal forests, **riverine forests**.	Locally common resident	
Lemon Dove *(Columba larvata)*	**Understory of evergreen forest and thickets**; also exotic plantations.	Common resident, but easily overlooked.	
Laughing dove (Spilopelia *senegalensis*)	**Open savannah**, Acacia thornveld and grassland; avoids natural high-altitude grasslands.	Very common resident	
Ring-necked Dove (*Streptopelia capicola*)	**Catholic choice of habitats**: all vegetation types, except forests.	Very common resident	
Red-eyed Dove (*Streptopelia semitorquata*)	**Tall trees in the vicinity of water**. Riparian woodland, forest verges and other well-wooded country.	Common resident	
Emerald-spotted Wood Dove (*Turtur chalcospilos*)	**Various deciduous woodland types** & moister thornveld; thickets or drainage lines and in valleys – taller denser growth.	Common resident	

Tambourine Dove (*Turtur tympanistria*)	Lowland evergreen forest, **riverine woodland**, dense thickets; less often on edges of montane forest.	Fairly common resident	
Namaqua Dove *(Oena capensis)*	Dry to semi-arid **open woodlands and savannahs**. More open habitat.	Common resident, nomad	
African Green-Pigeon (*Treron calva*)	**Well-wooded areas, along permanent rivers**. Fig trees for food. Nests in drier woodlands.	Common resident, nomad	
Parrots, lovebirds and parakeets			
Brown-headed Parrot (*Poicephalus cryptoxanthus*)	**Woodland and riverine forest**. Nests in hole in tree; up to 10m above ground. Gregarious in small groups in dead or leafy trees.	Common resident	
Louries & Turacos			
Knysna Turaco *(Tauraco corythaix)*	**Evergreen and riverine forest, dense thickets**.	**SA Endemic.** Fairly common resident	
Purple-crested Turaco (*Tauraco porphyreolophus*)	**Closed woodland, particularly riverine woodland**, secondary forest, patches where woodland intergrades with forest, coastal forest, dense scrub and thickets on termitaria. Riverine forest, evergreen thickets, woodland, dense thornveld, savannah, parks and gardens. Nest: Mid or upper canopy in densely branched, well-foliaged tree, commonly entwined with creepers, isolated tree 3-9m above ground in well-wooded habitats.	Fairly common resident	3
Grey go-away-bird (*Corythaixoides concolor*)	**Open woodland**, *Acacia* woodlands, near water.	Common resident	
Coucals			
Burchell's Coucal (*Centropus burchellii*)	**Rank and tangled growth**. Reedbeds, marshes, and thickets, coastal bush. Along drainage lines, edges of wetlands.	Common resident	
Cuckoos			
Jacobin Cuckoo *(Clamator jacobinus)*	Dry open savannahs, Acacia. **Dry to moist woodlands**.	Fairly common non-breeding Palaeartic and Indian migrant	
Levaillant's Cuckoo *(Clamator levaillantii)*	Dense, **closed humid woodland,** scrub and woody growth along streams. Well-developed woodland – Acacia & broadleaved.	Uncommon breeding intra African migrant	
Red-chested Cuckoo (*Cuculus solitarius*)	Forest and **well-wooded habitats**: riparian growth, thickets and evergreen forests. Trees around habitation.	Common intra African breeding migrant	
African Cuckoo (*Cuculus gularis*)	**Variety of woodlands** – broadleaved and *Acacia*.	Uncommon breeding intra African migrant	
Klaas's Cuckoo (*Chrysococcyx klaas*)	**Forest, moist woodland** and savannah. Trees around habitation.	Fairly common resident and intra African breeding migrant	
African Emerald Cuckoo *(Chrysococcyx cupreus)*	**Canopy of evergreen** and riverine forest	Fairly common breeding intra-African migrant	
Diederik Cuckoo (*Chrysococcyx caprius*)	**Variety of habitats: from forest edge** to semi desert. Not in forests and uncommon in mopane.	Very common intra African breeding summer visitor	
Black Cuckoo *(Cuculus clamosus)*	**Forest edges, woodland riverine bush** exotic plantations farmland, suburban areas. Acacia woodland, riparian thickets and mixed thornveld.	Fairly common intra African breeding migrant	

Owls			
Western Barn owl (*Tyto alba*)	**Wide range of vegetation types**. Northern woodlands. Needs large trees to roost. Nomadic owls moving in response to rodent population explosion.	Locally common resident	
African Scops-Owl *(Otus senegalensis)*	Range of **woodland types**; tall, scattered trees.	Common resident	
Spotted eagle-owl (*Bubo africanus)*	**Broad range of habitats**. Man-made structures. Rocky areas, woodland, forest edge savannah, semi desert. Towns.	Common resident	
African Wood Owl *(Strix woodfordii)*	Evergreen **and riverine forest**, dense woodland, coastal bush, pine plantations; seldom in savannah.	Locally fairly common resident	
Pearl-spotted Owlet *(Glaucidium perlatum)*	Relatively **open woodlands** (not tall dense woodlands) Sparse grass cover & trees for nests.	Common resident	
Marsh owl (*Asio capensis*)	Open grasslands, marshlands and **short scrub with high rodent populations** preferred.	Uncommon to rare. IUCN Least concern	
Nightjars			
Fiery-necked nightjar (*Caprimulgus pectoralis*)	**Dense broadleaved woodland**, savannah, coastal bush, fynbos and alien plantations. Ground, preferring areas where there is dense leaf litter.	Common partial migrant	
Swamp Nightjar *(Caprimulgus natalensis)*	**Open grassland**, often in damp areas, and palm savannah; roosts on ground.	IUCN 2020: Least Concern. SA Red Data (Taylor 2015): Vulnerable.	
Freckled nightjar (*Caprimulgus tristigma*)	Favours areas of **bare granite, Karoo sandstone, quartzite, mica-schist and weathered basalt substrata** on hills, escarpments, boulder-strewn hillsides, in ravines nd along dry, rocky riverbeds. Bare rocky outcrops and escarpments with well-wooded slopes. Requires some vegetation cover. By day roosts 0n exposed rock or among vegetation, in spite of ground temperatures sometimes reaching 60 degrees C. Nest: Natural hollow on bare rock where stone chips and wind-blown debris of plant material accumulated.	Locally common to very common resident	2
Square-tailed Nightjar *(Caprimulgus fossii)*	Scrub with open sandy **ground in savannah and riverine bush**. Eggs laid on bare ground among plant debris. Often under thorn bush.	Common resident in Lowveld.	
Swifts and spinetails			
African Palm-Swift (*Cypsiurus parvus*)	Governed by the distribution of the **flabelliform palms**, nests underside dead leaves.	Locally common resident	
Alpine Swift *(Tachymarptis melba)*	**Overall vegetation types**: Especially over Alpine grassland and Fynbos – breeding sites. Dry vertical cracks in overhanging cliffs.	Common breeding intra-African migrant	
African Black Swift *(Apus barbatus)*	Montane habitats: nesting – **horizontal cracks on cliffs or** in caves. Forage - open country.	Breeding intra-African migrant	
Little Swift *(Apus affinis)*	Overall vegetation types: prefers open grasslands and Karoo, not high-altitude alpine grasslands. Occur **over water** and nests under dry overhangs.	Very common partial migrant	
Horus Swift *(Apus horus)*	Anywhere: **common in more humid south** and east. Associated with high altitude grasslands. Nests in sandbanks.	Common breeding intra African migrant	
White-rumped Swift (*Apus caffer*)	Forage over open ground. Cliffs. Anywhere: **common in more humid south and east**.	Very common breeding intra African migrant	

Mousebirds			
Speckled mousebird *(Colius striatus)*	Forest, subtropical thicket and **mesic woodland**. Ecotones: Edges of forests and closed woodland, wooded drainage lines and gardens.	Common resident	
Red-faced Mousebird *(Urocolius indicus)*	**Savannah woodlands**, moist woodlands, shrubland. Avoiding forest and open grassland.	Very common resident	6
Trogons			
Narina Trogon *(Apaloderma narina)*	**Evergreen and riverine forests**, dense woodland, moist thornveld, coastal bush, valley bushveld, wattle plantations. Nests in natural hole in tree or dead stump. Forages by sallying from perch, catching prey of leaves, branches or from air.	Uncommon to common mostly resident; possibly breeding migrants from further north	
Hoopoe and woodhoopoes			
African Hoopoe *(Upupa africana)*	**Catholic use of habitats**. Tall savannah thornveld. Woodland. Bare ground and short grass.	Sparse to common resident	
Green Wood-Hoopoe (*Phoeniculus purpureus*)	Arboreal. **Most woodland types**. Edges of evergreen forests.	Common resident	
Common Scimitarbill (*Rhinopomastus cyanomelas*)	Tropical and subtropical arid **woodland**. Absent from closed canopy woodland.	Fairly common resident	
Kingfishers			
Half-collared Kingfisher *(Alcedo semitorquata)*	**Clear fast flowing perennial streams, rivers** and estuaries; clear water and well-wooded banks; often near rapids; narrow and secluded with dense marginal vegetation. Broken escarpment terrain. Well-vegetated lake shores and coastal lagoons. Breeds along perennial, clear-water streams and rivers that have wooded edges. Nests in low alluvial banks (1-1.5m high) along river edge. Face onto river or open pool and are screened or concealed to some extent by overhanging vegetation, roots or other growth. Riverbanks to excavate nest tunnels.	**IUCN 2017 Status: Least concern; SA Red Data (Taylor 2015): Near-threatened.** Uncommon resident.	
Malachite kingfisher (*Alcedo cristata*)	Strictly **aquatic environments** – availability of fish. River and stream banks – flanked by trees, shrubs and recumbent riverine grasses and weedy vegetation. Prefer well-vegetated, slow-flowing rivers and streams, but not with canopy closed over river. Sheltered shores, coastal lagoons, tidal estuaries, mangrove swamps. Perennial or seasonal wetlands. Small water courses in breeding season when steep banks required for nest tunnels. Burrow: Earthen bank - along stream, earth mound, soil around upturned roots of fallen tree, wall of aardvark burrow. Low (<1m high).	Common resident	
African Pygmy Kingfisher *(Ispidina picta)*	**Woodland habitats**; dry land and not necessarily near water. Coastal woodland and more open evergreen forest.	Locally fairly common breeding intra African migrant	
Woodland Kingfisher (*Halcyon senegalensis*)	**Well-developed woodland**; tall riverine *Acacia* stands & mopane; grass understorey heavily grazed.	Common breeding intra African migrant	
Brown-hooded Kingfisher (*Halcyon albiventris*)	Edges of evergreen forests, **woodland and riverine woodland**.	Common resident	
Striped Kingfisher (*Halcyon chelicuti*)	**Open woodlands**, broadleaved & *Acacia* mesic and arid conditions.	Common resident	
Giant kingfisher *(Megaceryle maxima*)	Any water body with sufficient food and overhanging branches to hunt from, - **streams, rivers**, estuaries, seashores. Perch under canopy in trees alongside streams or at edges of pools. Large rivers and small streams. Nests in hole made in high alluvial bank, usually one overhanging a flowing river. Seldom less than 2m in height, usually 3m, upper third of bank.	Fairly common resident	

Pied kingfisher (*Ceryle rudis*)	**Aquatic environments – availability of fish.** Any water body with small fish, including large rivers and perennial streams, estuaries, lakes, temporarily flooded areas, rocky coasts and intertidal zone of coast. Less common along well-wooded, fast flowing streams. Nest: Burrow in vertical alluvial sandbank being cut by flowing water, sometimes quite close to the water level. Usually positioned in the least accessible positions available: over water, in a high bank, and near the top of the bank.	Common resident	
Bee-eaters			
White-fronted bee-eater *(Merops bullockoides)*	**Associated with watercourses**. Typically associated with vertical sandy or lateritic riverbanks and watercourses - in woodlands (broadleaved and mixed woodland) and in wooded grassland. Also at eroded gullies, perennial rivers and seasonal streams with wooded banks. Need sandbanks for nesting. Sandy riverbanks or erosion gully clear of vegetation.	Locally abundant resident	
Little Bee-eater *(Merops pusillus)*	Semi-arid to high rainfall areas. Open spaces to forage **– low bushes** or reeds. savannah and light woodland.	Common resident	
European Bee-eater (*Merops apiaster*)	**Variety of woodland** and shrubby habitats avoids relatively mesic and arid conditions. Nest in riverbanks or erosion gullies.	Common non-breeding Palaearctic migrant & breeding migrant	
Southern Carmine Bee-eater *(Merops nubicoides)*	**Open woodland & savannahs**; floodplains & arid Acacia steppe; nests in freshly cut sand cliffs. Disperses to open grassy places in variety of woodland types.	Common to abundant non-breeding intra-African migrant	
Rollers			
European Roller (*Coracias garrulus*)	**Woodlands, bushveld** and grasslands. Open woodland.	IUCN 2018 Least concern; **SA Red Data (Taylor 2015): Near-threatened;** Fairly common non-breeding Palaearctic migrant. Population trend: decreasing.	
Lilac-breasted Roller *(Coracias caudatus)*	**Ecotone between light woodland and open grassy areas**. savannah and open woodland (broadleaved & Acacia)	Common resident	
Purple roller *(Coracias naevius)*	**Uniform bushveld and woodland** (broadleaved & *Acacia*).	Fairly common resident	
Hornbills			
Southern Red-billed Hornbill *(Tockus rufirostris)*	**Woodland** with sparse ground cover. Broadleaved and mixed woodlands, well-developed *Acacia* woodland.	Very common resident	
Southern Yellow-billed Hornbill *(Tockus leucomelas)*	Variety of dry, **open savannah woodlands** (broadleaved & Acacia)	Very common resident	
Crowned Hornbill *(Lophoceros alboterminatus)*	**Dense dry thorn thicket in lowland savannah**, dense woodland, forest edge. Primary and secondary forest and tall dense woodland; from patches of montane and coastal forests to linear strips of riverine and escarpment forests. Forages mainly in trees. Roosts communally on slender branches exposed from above; sheltered sites below canopy. Nest a hole in tree or rock face, 2-14m above ground.	Common resident	
African Grey Hornbill (*Lophoceros nasutus*)	**Taller woodland** (broadleaved & Acacia) in dry and humid savannahs. Bushveld.	Common resident	
Trumpeter Hornbill *(Bycanistes bucinator)*	Forest, **dense woodland with tall trees**, riverine bushveld. Patches of warm, coastal, lowland forests, especially along rivers. Lower altitudes - montane forests, in moist woodlands and mangroves, and along riparian forest strips in arid savannah. Mobile in search of fruit. Nesting in stand of large trees on hillside, along watercourses, in hills or in isolated stand of trees in dry savannah. Nest in natural cavity in tree trunk or large branch, 2-13m above ground.	Locally common resident; some local seasonal movements.	

Barbets & tinker barbets			
Yellow-rumped Tinkerbird *(Pogoniulus bilineatus)*	**Woodland: broad-leaved**. Forages like warbler in vegetation. Nests in hole excavated in dead trunk or underside of sloping branch of tree. Perches in high tree while calling.	Common resident	
Yellow-fronted Tinkerbird (*Pogoniulus chrysoconus*)	**Broad-leaved woodland**, moist woodland – mixed woodland and rocky hills.	Common resident	
Acacia Pied Barbet *(Tricholaema leucomelas)*	Arid savannahs, **soft-wooded trees (Acacia**) present, wooded drainage lines in grassland.	Common resident	
Black-collared Barbet (*Lybius torquatus*)	Miombo, **moist wooded areas**, along east facing slopes of the Transvaal escarpment, eastern coastal areas. Drier savannahs: restricted to riverine vegetation. Coastal bush, woodland, forest edge, riverine forest, parks, gardens.	Very common resident	
Crested Barbet (*Trachyphonus vaillantii*)	Savannah, **woodland and thickets** – broadleaved woodlands. Mixed woodland and Acacia habitats. Thornveld, thickets in woodland, riverine bushveld, exotic plantations, parks, gardens.	Common resident	
Honeyguides & honeybirds			
Scaly-throated Honeyguide *(Indicator variegatus)*	Canopy of evergreen and **taller riverine forest**, bushveld, thickly wooded valleys, exotic plantations.	Fairly common to uncommon local resident.	
Greater Honeyguide (*Indicator indicator*)	**Arid and moist woodland**: Wide range of woodland types.	Fairly common resident	
Lesser honeyguide *(Indicator minor)*	**Wide range of wooded habitats**: savannahs with scattered trees to forest fringes, riverine woodland; exotic plantations, gardens.	Locally common resident	1
Woodpeckers			
Golden-tailed Woodpecker (*Campethera abingoni*)	Wide spectrum of **woodland and savannah types**.	Fairly common resident	1
Cardinal Woodpecker (*Dendropicos fuscescens*)	Wide variety of **woodland and savannah**.	Common resident	
Bearded Woodpecker *(Dendropicos namaquus)*	More arid **savannah types. savannah and woodland**, tall trees in open park-like settings. Broadleaved woodland with tall trees and dead ones.	Fairly common resident	
Olive Woodpecker *(Dendropicos griseocephalus)*	Evergreen forest, dense coastal and **riverine bush;** also into fynbos when foraging.	Fairly common resident inland; scarce on coast.	
Wryneck			
Red-throated Wryneck *(Jynx ruficollis)*	Grassland biome: Sour and Mixed grasslands, not Alpine grasslands; needs trees for nesting. Only found in grassland where trees are present, even exotics. Forage on open ground, absent where trees are too dense or absent. **Thornveld, open bushveld, exotic plantations, farmyards, gardens**.	Locally fairly common; generally uncommon; migratory in south, resident in north.	
Larks			
Rufous-naped Lark (*Mirafra africana*)	Variety of habitats: bare patches, sparse grass cover, suitable perches. Open grassland with termitaria or **scattered bushes and bare patches,** open savannah woodland with sparse grass cover between trees, bare patches in fallow fields and cultivated lands.	Locally common resident. Common & conspicuous spp . No evidence of range contraction. Not threatened by habitat destruction.	
Flappet Lark (*Mirafra rufocinnamomea*)	**Open woodland, savanna** and grassland with scattered trees. Prefers rocky broad-leaved woodland. Woodlands: clearings or drainage lines.	Fairly common resident	

Sabota Lark *(Calendulauda sabota)*	**Wide range of savannah habitats**; arid open shrubland on rocks and sands, semi-arid Acacia savannahs on clays, calcrete and sands, on rocky slopes with tall shrubs, bushes and trees, on edges of wooded drainage lines, mixed woodlands on stony soils.	Common resident	
Swallows & martins			
Brown-throated Martin *(Riparia paludicola)*	Associated with water: Streams, large rivers, dams, estuaries and open wetlands. Forage over dryland habitats far from water. **Wetlands in fairly open habitats**. Extensive sandbanks along rivers support colonies with hundreds of widely spread burrows. Usually in sandy or friable soil in vertical sandbanks along rivers.	Common resident	
Grey-rumped Swallow *(Pseudhirundo griseopyga)*	Dry or burnt grassland, bare ground at edges of vleis, **clearings in woodland**, fallow lands, polo fields, golf courses.	Common resident or local migrant	
Barn Swallow (*Hirundo rustica*)	**All habitats**: more common in higher-rainfall eastern half: moister grassland, woodlands and fynbos.	Abundant non-breeding Palaearctic migrant	
White-throated Swallow *(Hirundo albigularis*)	**Vicinity of wetlands, especially rivers** and other expanses of open water where suitable nesting sites are available.	Common, but localized breeding intra-African migrant	
Wire-tailed Swallow *(Hirundo smithii)*	Always associated with water bodies, including large rivers, **streams, flood plains, adjacent open grassland**, open miombo, mopane woodlands, thornveld and forest edges. Rivers, streams and dams, usually in woodland and around buildings. Breeds widely in lower-lying mesic savannahs but is confined to the vicinity of permanent water, especially larger rivers. Nest: Usually close to overhang, 0.3-15.0m above ground or water. On low rock faces or the undersides of tree stumps in water.	Common resident; seasonal movements at higher elevations.	
Blue Swallow *(Hirundo atrocaerulea)*	Moist montane grassland, usually with **sinkholes, dongas and potholes**, often **close to evergreen mistbelt forest, usually with nearby stream.**	**NEMA (TOPS): Critically Endangered species; IUCN 2015: Vulnerable; SA Red Data (Taylor 2015): Critically endangered.** Uncommon to rare breeding intra-African migrant.	
Pearl-breasted Swallow *(Hirundo dimidiata)*	**Wide range of habitats**: broadleaved woodlands, avoiding Acacia woodlands. Wetland sites and open areas.	Breeding intra-African migrant	
Greater Striped Swallow *(Cecropis cucullata)*	Wide variety of **fairly open habitats**: semi-arid Karoo, fynbos, grassland and lightly wooded savannah.	Common breeding intra-African migrant	
Lesser Striped Swallow *(Cecropis abyssinica*)	Variety of woodland and **savannah habitats**.	Common breeding intra-African migrant	
Red-breasted Swallow *(Cecropis semirufa)*	**Open savannah**; sweet grassveld.	Scarce breeding intra-African migrant	
Rock Martin *(Ptyonoprogne fuligula)*	**Habitats with rock formations**: Rocky terrain. Rocky hills, cliffs, quarries. Nest attached to vertical surface of rock face supported by ledge below.	Common resident	
Common House-Martin *(Delichon urbicum)*	**Wide variety of habitats**: fynbos, grassland, savannah woodland and cultivated areas. Hilly open country.	Locally common non-breeding Palaearctic migrant	
Black Saw-wing (*Psalidoprocne pristoptera)*	Streams, **vleis and clearings in forest**, dense woodland and exotic plantations.	Breeding intra-African migrant, locally fairly common, resident in some areas.	
Cuckooshrikes			
Grey Cuckooshrike *(Coracina caesia)*	Afromontane forests, **lowland forests**, coastal forests and dense woodland areas near rivers. Foraging in pine and wattle plantations and trees in the trees of small towns.	Resident species but do undertake post-breeding movements during the dry season.	
Black Cuckooshrike (*Campephaga flava*)	Canopy of **moist woodlands**, both broadleaved and *Acacia* woodland. Moist, arid and riparian woodlands.	Uncommon resident	

Drongos			
Fork-tailed Drongo (*Dicrurus adsimilis*)	**Wide range of vegetation types**: Open bush and woodland; edges of forest patches; Highveld – alien trees.	Common resident	
Orioles			
Eurasian Golden Oriole *(Oriolus oriolus)*	Lush foliage in shady tree canopies. Broadleaved trees. **Riverine strips**.	Fairly common non-breeding Palaearctic migrant	
Black-headed Oriole (*Oriolus larvatus*)	**Moist woodland**; evergreen or lightly deciduous. Afromontane Forests. Overfly extensive unsuitable habitat – grassveld.	Common resident	
Bulbuls			
Dark-capped Bulbul (*Pycnonotus tricolor)*	**Wide range of habitats**: moister woodland and savannah, riverine bush, forest edge & regenerating forest (not inside) dense montane scrub, scrubby vegetation, alien plantations. Not in open grassland.	Very common resident	21
Sombre Greenbul *(Andropadus importunus)*	Forest, coastal and **riverine bush**, dense thicket.	Common resident.	3
Terrestrial Brownbul *(Phyllastrephus terrestris)*	Evergreen forest, mainly in lowlands, **riverine bush** and forest, dense thickets.	Sparse to fairly common resident.	
Tits			
Grey Penduline Tit *(Anthoscopus caroli)*	**Well-developed broadleaved woodland.**	Fairly common resident	
Southern Black Tit (*Parus niger*)	**Broadleaved woodlands.**	Common resident	
Babblers			
Arrow-marked Babbler (*Turdoides jardineii*)	Thickets or strips of **denser vegetation along seasonal drainage lines**. Broadleaved and mixed woodlands.	Very common resident	
Rock thrush			
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. Nest placed 3-20m above ground in crevices or on ledge on low cliff.	**South Africa endemic.** Locally common resident	
Thrushes			
Orange Ground Thrush *(Zoothera gurneyi)*	**Moist evergreen montane forest, especially along streams.**	IUCN 2010 Status: Least concern. SA Red Data (Taylor, 2015): Near-threatened. Locally scarce to fairly common resident; some seasonal altitudinal movement.	
Kurrichane Thrush (*Turdus libonyana*)	**Woodland and thickets**. Moist broadleaved and mixed woodland habitat.	Common resident	1
Groundscraper thrush *(Psophocichla litsitsirupa*)	Open parkland woodlands; **broad-leaved and Acacia woodland** – understorey poorly developed & patches of bare ground. Miombo, open overgrazed woodland, plantations.	Fairly common resident	
Olive Thrush *(Turdus olivaceus)*	**Riverine bush** and montane forest. Adapted to plantations. Well-shaded places with damp soil and moist litter.	Common resident	
Karoo thrush (*Turdus smithi*)	Mostly in **riparian woodland** in semi-arid Karoo and introduced woodland on the Highveld; common garden bird.	Locally common resident.	

Chats			
African Stonechat *(Saxicola torquata)*	Grassland biome: High altitude grasslands down to sea level, moist, **open country with rank growth of grass** and herbs.	Common resident and altitudinal migrant	1
Buff-streaked Chat *(Oenanthe bifasciata)*	Sour grasslands – **rocky habitat on** mountains, hills, ridges and escarpments (1500-1700). Avoids woodlands, including aliens.	Fairly common to uncommon resident. **SA endemic.**	
Mountain Wheatear *(Oenanthe monticola)*	**Rocky habitats** in mountains, hills, koppies, scarps and boulder strewn level ground. Scrub or grass. Rocky hills, slopes with boulders and bushes, small cliffs, old mine workings, rocky hillsides. Nest placed under hillside boulder, in hole in rock.	Locally common to fairly common resident.	
Familiar Chat *(Cercomela familiaris)*	Broad range of open vegetation types, **broken ground and rocky habitats**. Rocky mountain slopes, rocky hills and outcrops, valley slopes, eroded gullies, sparse woodland along drainage lines. Nest: Positioning highly opportunistic; in cavity in wall of erosion gully; on rock face, in old burrow or other burrowing-nesting species.	Common resident	
Mocking Cliff Chat (*Thamnolaea cinnamomeiventris*)	Vicinity of **rocky outcrops in wooded country**. Open well-faulted rock faces with scattered trees and shrubs. *Ficus* trees. Well-wooded rocky ravines, gullies, cliffs, boulder-strewn hillsides and along streams or rivers in valley bottoms where there are large boulders. Nest: Usually placed in nest of striped swallow under rock overhang or in cave.	Locally common resident	
Robins			
White-starred Robin *(Pogonocichla stellata)*	Breeding populations restricted to Afromontane **evergreen forest**. Avoids forests without tangles of undergrowth. Altitudinal migrants favour dense cover along drainage lines.		
Cape Robin-Chat *(Dessonornis caffra)*	Afromontane **forest fringe**: cover loving. Wide range of habitats utilized: coastal fynbos, farmstead woodlots, *Leucosidea* scrub, alpine grassland. Bracken-brair fringe of Afromontane forest.	Common resident	
White-throated Robin-Chat *(Cossypha humeralis)*	Thickets that line dry water courses in the bushveld and thornveld. **Open woodland** – closed thickets under large shade trees. Termite mounds & fire-free places on rocky hills.	Locally common resident	
White-browed robin-chat *(Cossypha heuglini)*	Dense riverine bush, **evergreen thickets**. Sing from low perch in tree or bush. Riverine forest with broken canopy and dense evergreen thickets, lakesides with shady trees and shrubs, Acacia woodland on flood plains. In dry areas restricted to evergreen thickets fringing river courses. Nests amongst dense shoots of coppicing bush or tree, hollow stump, tangled creepers, hollow in bank, cavity among tree roots on bank, up to 2m above ground.	Locally common resident	
Red-capped robin-chat (*Cossypha natalensis*)	Evergreen forests and **woodland, riparian growth**, deciduous thickets, riverine forests. Keeps to undergrowth of forests, forages on ground (dusk), moves seasonally to higher forest strata when fruit ripen. Sing from low perch. In general, favours linear habitats (e.g. along wet and dry watercourses). Nest in hollow stump, rock crevice, hanging creeper or ground.	Scarce to common. Mostly resident.	
Chorister Robin-Chat *(Cossypha dichroa)*	**Evergreen forest**, especially in mist belt.	**South African endemic.** Locally common resident; some seasonal altitudinal movement at higher elevations.	
Scrub-Robin			
White-browed Scrub Robin *(Erythropygia leucophrys)*	**Woodland and bushveld habitats**. Patches of dense undergrowth in thornveld and broadleaved woodland.	Common resident	
Warblers			
Papyrus yellow warbler (*Calamonastides gracilirostris*)	Found mainly in papyrus-swamps; occasionally in other marshy habitats, especially reeds.	Birdlife International (2020): Vulnerable.	

Little rush warbler *(Bradypterus baboecala)*	Associated with **tangled vegetation around wetlands**; not usually over open water.	Locally fairly common resident and nomad.	
Barratt's Warbler *(Bradypterus barratti)*	**Dense tangled vegetation along streams**, in kloofs, on forest edges; clumps of bush on coast; also montane scrub and heathlands.	Locally fairly common to very common resident; moves to lower altitudes in winter.	
Cape Grassbird *(Sphenoeacus afer)*	**Rank vegetation with long grasses**, restios or ferns, in tangled scrub, low sparse shrubland and in hilly grasslands with scattered bushes. Avoids areas in which the woody component becomes too high or dense.	Locally common resident	
Sedge warbler (*Acrocephalus schoenobaenus*)	Perennial and ephemeral wetlands with low emergent aquatic vegetation. In papyrus, reeds, elephant grass, **bulrushes, sedges, long grass and thickets** adjacent to water. Marshland: Reed-beds and long grass, low-growing rush beds. Grassland anthills close to water. Also in low wetland trees tangled with undergrowth.	Fairly common non-breeding Palaearctic migrant	
African reed-warbler (*Acrocephalus baeticatus*)	Usually in moist or wet areas, including edges of reeds, **bulrushes, sedges, tall herbs and forbs**, and tall grass and shrubs along river banks. Marshland: Outskirts of reed-beds where there is a mixture of grass, sedges, rushes and tall willow herbs. Nest bind to reeds, grass, sedges, well-hidden; 0.3-3.0m above dry or damp ground but usually over water.	Common breeding intra-African migrant	
Marsh Warbler *(Acrocephalus palustris)*	Thickets and marshland: **Fringes of reedbeds, waterside weeds**, woody thickets on anthills and leafy vegetation along rivers. Dense lush thickets with rank herbaceous undergrowth, usually away from water.	Uncommon to fairly common non-breeding Palaearctic migrant	
Great reed warbler (*Acrocephalus arundinaceus*)	Marshland: **Phragmites and tall grass**.	Locally common non-breeding Palaearctic migrant	
Lesser swamp warbler (*Acrocephalus gracilirostris*)	Marshland: Phragmites over water. Reeds and **bulrushes in standing water** in estuaries, lagoons, rivers, marshes. Nest on upright reed stems, sedge, bulrush, arum lily.	Locally common resident	
Willow Warbler *(Phylloscopus trochilus)*	Any **woodland: edges** of evergreen forests, savannahs, gardens, parks, exotic plantations. Anywhere with trees and bushes ie adequate tree cover; Adequate tree cover.	Fairly common non-breeding Palaearctic migrant	
Garden warbler (*Sylvia borin*)	**Dense thickets**: Inside thickets.	Fairly common non-breeding Palaearctic migrant	
Apalis			
Bar-throated Apalis *(Apalis thoracica)*	Adaptable, catholic: **Wooded habitats**. Interior of evergreen or semi-evergreen forests, forest fringes, woodland, Karoo scrub, grassveld – where suitable woodland or bush occurs, e.g., along drainage lines.	Common resident	
Yellow-breasted Apalis *(Apalis flavida)*	**Riverine forest, moist bushveld**, mixed woodland, mature thornveld, thickets, middle to lowland evergreen forest, regenerating scrub.	Locally fairly common resident.	2
Camaroptera			
Green-backed Camaroptera *(Camaroptera brachyura)*	Evergreen forests: lowland, riparian, montane and temperate forest. **Small patches of forest or dense secondary growth and thickets.** Forest edges tangled riverine bush; gardens, parks. Forages low down in undergrowth, even on ground, hopping restlessly around. Rather secretive. Nests in low herbs, bush or leafy tree, from ground level to 1.3m above ground.	Common resident	
Crombec			
Long-billed Crombec (*Sylvietta rufescens*)	Woodland; scrubland. **Catholic in use of different woodland** – not found in unwooded grassland and forest interiors.	Common resident	

Cisticolas			
Red-faced Cisticola (*Cisticola erythrops*)	**Tall rank vegetation** in marshes, along streams and rivers and bordering reedbeds in lowveld. Sometimes in weeds, rank growth and edges of cane fields away from water. Skulks in dense undergrowth. Nests sewn into broad leaves of herb or shrub up to 50cm above ground.	Locally common to fairly common resident	
Lazy Cisticola *(Cisticola aberrans)*	**Rocky slopes with grass**, dense scrub and occasional trees and thickets. Valley bottoms and in gullies. Rank grass, shrubs and bracken on damp ground, edges of forests.	Locally common resident	
Rattling Cisticola (*Cisticola chiniana*)	**Tree savannah –** Acacia woodland where grassland interspersed with trees & thickets or shrub. Fringes of dense woodland and in coastal scrub patches.	Very common resident	
Levaillant's cisticola (*Cisticola tinniens*)	Marshland: Streamside where there is short grass, sedges and **rushes with clumps of taller growth**. Marshy areas along rivers and streams, edges of reedbeds, moist grassland, and seasonally flooded endorheic ponds. Nest: Bond with spider web between leaves and stems of forbs and herbs. 0.1-1.0m above ground or water.	Very common resident	
Croaking Cisticola (*Cisticola natalensis*)	**Rank open moist grassland**, edges of vleis, usually with scattered bushes or trees; also in clearings and edges of forest and regenerating secondary growth.	Common resident or local migrant	
Neddicky (*Cisticola fulvicapilla*)	Dune scrub, in **scrub and rank grass on hill slopes**, on the edges of woodlands and plantations, in secondary growth and in thornveld savannah. Understorey of woodlands. Tolerant of alien vegetation. Avoid dense grassland – cannot feed on ground level. Especially Valley Bushveld.	Very common resident	
Zitting Cisticola *(Cisticola juncidis)*	Natural grasslands and weedy areas, edges of vleis, dams, pans, and salt marshes. *Eragrostis* grass pastures, cereal cropland, edges of cultivation, fallow lands, and any open areas with rank grass. **Associated with wetlands.**	Common resident	
Wing-snapping Cisticola (*Cisticola ayresii)*	Short moist and **relatively dense grassland on well-drained soils** – Alpine, Sour and Mixed Grasslands.	Common resident	
Prinias			
Tawny-flanked prinia (*Prinia subflava*)	Marshland: In **reeds and sedges in vleis**. Relatively tall and dense patches of vegetation: rank grass on edges of roads or farmlands, drainage lines and edges of dams and rivers, scrubby patches within woodland savannahs, secondary thickets, reeds and sedges in wetlands, ecotones between grassland and dense, tall woodlands and forests. Suburban and rural gardens.	Very common resident. Readily adapts to modified habitats. Distribution not changed.	3
Karoo Prinia *(Prinia maculosa)*	**Scrub and rank growth** along drainage lines. Karoo and fynbos shrubland and mixture of grassland and scrub. Fallow land and edges of forests and alien plantations.	Common resident	
Drakensberg Prinia *(Prinia hypoxantha)*	Montane scrub, **rank grass and thickets** along streams and edges of forests, woodland and exotic plantations, tall weeds in fallow lands and on roadsides, gardens.	Common resident	
Flycatchers			
Blue-mantled Crested Flycatcher *(Trochocercus cyanomelas)*	Middle to lower layers of coastal, lowland and mid-altitude evergreen forest (even **small forest patches**; also, thickets in riverine forest.)	Uncommon and local resident; may have seasonal movements.	
African Paradise Flycatcher (*Terpsiphone viridis*)	Woodlands: evergreen forests and broadleaved woodlands. **Riverine strips, riparian vegetation**.	Common breeding intra-African migrant	
Southern Black Flycatcher (*Melaenornis pammelaina*)	**Woodlands** near surface water; taller vegetation, not necessarily clumped, open space at ground level.	Common resident	2
Fiscal Flycatcher *(Sigelus silens)*	Fairly open vegetation with trees or **intermittent scrub**.	Common resident	

Spotted Flycatcher *(Muscicapa striata)*	**Open woodland**; habitat where bare branches alternate with open space. Open habitat with less well-structured middle and lower stratum.	Common non-breeding Palaearctic migrant	
African Dusky Flycatcher (*Muscicapa adusta*)	**Evergreen and riverine forest**, patches of forest in dense woodland; exotic plantations, well wooded gardens.	Locally common; some populations resident, most locally migratory	
Ashy flycatcher *(Muscicapa caerulescens)*	**Edges of lowland evergreen forests**, upper strata of riverine woodland, thickets in drier woodland, moister savannah, wooded gorges.	Locally common resident	
Grey Tit-Flycatcher *(Myioparus plumbeus)*	**Dense vegetation**, upper strata. Riverine strips. Holes in trees for nests.	Uncommon resident	
Batis			
Cape Batis *(Batis capensis)*	Afromontane forests. **Lower levels of evergreen forests**, isolated forest fragments: undergrowth tangles and canopy. Densely wooded gorges and exotic plantations in summer; in winter may spread to more open woodland and savannah.	Common resident; some seasonal altitudinal movement.	1
Chinspot Batis *(Batis molitor)*	**Major woodland types**. Acacia spp. Valley bushveld, thornveld and karroid broken veld.	Common resident	
Wagtails			
African pied wagtail (*Motacilla aguimp*)	Along margins, rocky patches and sandbanks of large rivers, pans and dams. Usually near water, preferring wide rivers and **open water bodies with sandy banks or exposed rocks** and boulders. In drier areas restricted to perennial rivers. Nest usually built close to water, on ground, in grass tussock, reeds or other vegetation, including flood debris and tree stump over water, in crevices or on rock ledge or cliff.	Common to scarce; mostly resident; non-breeding migrant to much of Transvaal in winter.	
Cape wagtail *(Motacilla capensis)*	**Almost anywhere where there is water** with open ground nearby. Wide range of natural environments: require merest trickle of water; open streams in forest habitats, rivers and waterfalls. Nest concealed in vegetation on ground, often in recess in a steep bank or donga, or in bush or tree.	Common resident	
Mountain wagtail (*Motacilla clara)*	Largely restricted to **small streams and rivers** in hilly, forested country, preferring stretches with emergent rock and where water flows over flat rocks. Especially fond of waterfalls. Also, along rivers through woodland and dense thicket, including valley bushveld. Fast-flowing well-wooded rocky streams and rivers, larger forested rivers; sometimes also smaller quiet tributaries, or streams in forest with pools and waterfalls. Forced to move if rivers dry up completely. Nest built 1-5m above water in a niche in stream bank, rock face, boulder among flotsam on branch over water of a tree. Often near deep pool or behind waterfall.	Sparse resident on permanent streams and rivers; nomadic on seasonal tributaries.	
Longclaws			
Yellow-throated Longclaw (*Macronyx croceus*)	Rank grass, edges of vleis, swampy drainage lines, with **scattered trees and bushes** or in savannah or light woodland.	Locally common resident; some irregular local movement away from breeding areas in winter.	
Pipits			
Striped Pipit *(Anthus lineiventris)*	**Broadleaved woodland; rocky outcrops** and gorge like situations; alongside small woodland streams. Deeply incised drainage lines. Rock faces.	Locally fairly common resident	
African Pipit *(Anthus cinnamomeus)*	Grasslands: open stretches fringing pans, **lightly wooded savannah**, dry floodplains with short vegetation and recently burnt open veld. Avoids dense rank growth. Fallow fields.	Common resident	
Shrikes			
Red-backed Shrike *(Lanius collurio)*	**Medium dense thornveld**. Open habitats with fewer smaller trees for males; females – skulk in taller woodland. Fallow land with coppicing Acacia bushes, pockets of scrub.	Fairly common non-breeding Palaearctic migrant	
Common Fiscal *(Lanius collaris)*	**Open spaces with exposed perches**, short or sparse ground cover and trees for nesting. Scarce in Arid Woodland, Marula and Knobthorn savannah, Alpine Grassland.	Common resident	1

Southern White-crowned Shrike *(Eurocephalus anguitimens)*	**Woodland and savannah**, often with baobab trees. Forages by watching from perch and dropping to ground for prey. Nests on horizontal branch or fork several meters above ground. Some local or nomadic movements.	Fairly common to common resident	
Brubru *(Nilaus afer)*	**Savannah woodlands**. Acacia and broadleaved woodland. From tall, well-developed, mixed woodlands, forest edges, scattered scrubby areas.	Common resident	
Black-backed puffback (*Dryoscopus cubla*)	**Indigenous woodland** and forest. Dense woodland.	Common resident	2
Black-crowned Tchagra (*Tchagra senegala*)	Scrub and **woodland habitats**. Mesic broadleaved woodlands.	Common resident	
Brown-crowned Tchagra *(Tchagra australis)*	**Woodland and scrub** – restricted to undergrowth. Acacia-, mopane- and broadleaved woodland.	Common resident	
Southern Boubou *(Laniarius ferrugineus)*	Dense tangled **undergrowth, thickets along watercourses** in wide range of woodland types; all woodlands and forest types. Forests and exotic plantations. Grasslands - thickets along watercourses.	Common resident.	3
Orange-breasted Bushshrike *(Chlorophoneus sulfureopectus)*	Woodland. **Mixed riparian woodland**.	Very common resident	
Gorgeous Bushshrike *(Chlorophoneus quadricolor*)	**Dense thickets at edges of lowland to mid-altitude evergreen forest** and fairly dry woodland; dune forest; riverine bush, tangles of secondary growth. Forages low down in undergrowth and on ground, creeps into densest vegetation when disturbed. Nest 0.6-1.5m (usually 1m) above ground in tangled creeper or dense bush, well hidden.	Locally common to fairly common resident	1
Grey-headed Bushshrike *(Malaconotus blanchoti)*	**Woodland of medium density.**	Uncommon resident	1
White-crested Helmet-Shrike *(Prionops plumatus)*	Deciduous broadleaved woodland – breeding. Otherwise – Acacia savannah.	Common resident	5
Retz's Helmet-Shrike *(Prionops retzii)*	**Deciduous woodlands** when breeding. Non-breeding: disperses into Acacia savannah and other dry woodland types. Forages mainly on larger branches and on trunks of trees. Nests 3-20m above ground on stout horizontal branch of large tree (especially Pterocarpus rotundifolia).	Fairly common to common resident or nomad	
Starlings			
Red-winged Starling *(Onychognathus morio)*	**Cliffs and rocky areas**. Common in highland areas; less common on plains. Rocky outcrops and gorges in highland grassland, visits forests to feed on fruit. Nest: Typically, on rock ledge.	Common resident	
Cape Starling *(Lamprotornis nitens)*	**Wide range of vegetation types**: Not a grassland or forest bird. Depends on trees or tall vegetation for nests. Woodland species.	Common resident	
Violet-backed Starling (*Cinnyricinclus leucogaster*)	**Open woodlands**; mixed broadleaved woodlands.	Fairly common to scarce breeding intra-African migrant	
Wattled Starling *(Creatophora cinerea)*	Dry grasslands and **dry open country**; nests in thorn trees.	Locally abundant nomad	
Oxpeckers			
Red-billed Oxpecker (*Buphagus erythrorhynchus*)	**Variety of woodlands**; needs holes in trees for nesting. Food supply on game and cattle.	SA Red Data: Least concern (Taylor, 2015). Merit monitoring.	
Sunbirds			

Amethyst Sunbird *(Chalcomitra amethystina)*	**Broadleaved woodland types**. Gardens and stands of alien trees.	Common resident	1
Scarlet-chested Sunbird *(Chalcomitra senegalensis)*	**Woodland, savannah**, riverine bush, gardens.	Common resident; some seasonal fluctuations in some areas.	
Malachite Sunbird *(Nectarinia famosa)*	Fynbos, grassland, Karoo and **open savannah**: Scrubby hillsides and forest edge. Alpine Grassland, Karoo and Fynbos vegetation types. Abundance determined by food plants and their flowering phenology.	Common; resident in lower-lying areas; seasonal migrant from higher regions in winter.	
Collared Sunbird (*Hedydipna collaris*)	**Riverine and lowland evergreen forest**; coastal bush, especially with tangled creepers. Nest suspended to drooping branch of leafy tree or shrub at edge of forest.	Locally common resident	
Southern double-collared sunbird (*Cinnyris chalybeus*)	**Evergreen forest and bush**, Eucalyptus plantations, gardens.	Locally common to fairly common resident.	1
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.	Common resident. **South African endemic**.	
White-bellied Sunbird *(Cinnyris* *talatala*)	**Wide range of woodland** and bush types – moist woodlands. Open savannah.	Common resident	
White-eyes			
Cape white-eye *(Zosterops capensis)*	Catholic choice of habitat: **Evergreen and coastal forests**, fynbos, riverine bush, thickets. Drainage lines. Wooded areas in grassland and alien plantations.	Very common resident and local migrant	6
Sparrows			
House Sparrow *(Passer domesticus)*	**Human dwellings.**	Very common resident, introduced	
Cape Sparrow *(Passer melanurus)*	Arid Karoo and grassland biomes: **Woody vegetation along drainage lines**. Gardens, farms, parks.	Very common resident	
Southern Grey-headed Sparrow *(Passer diffusus)*	**Various woodland types**: broadleaved and *Acacia*. Alien tree populations.	Common to abundant resident and nomad	
Northern Grey-headed Sparrow *(Passer griseus)*	Diversity of **fairly open habitats** up to 2500m; commensal with man.		
Yellow-throated petronia *(Gymnoris* *superciliaris*)	Broadleaved **woodland and savannah**.	Mostly common resident	
Weavers			
Lesser Masked Weaver *(Ploceus intermedius)*	Acacia savannah, bushveld, dry **woodland, riverine trees**, usually near water. Forages mostly in canopies of trees and by probing flowers. Nests suspended from branch on inside or outside of tree, often over water up to 18m above ground. Sometimes also in reeds or low bushes. In small colonies of 10-20 nests.	Locally common resident	
Spectacled Weaver (*Ploceus ocularis*)	Tall woodland or other **tall vegetation, edge of forest patches** and in riverine woodland and thickets.	Fairly common resident.	
Cape weaver (*Ploceus capensis*)	Nests in reeds and **bulrushes along rivers** and dams.	Common resident	
Holub's Golden Weaver *(Ploceus xanthops)*	**Rank vegetation**, reeds and bushes along streams and rivers, forest edge.	Uncommon resident; possibly altitudinal migrant in Mozambique highlands.	

Southern Masked weaver (*Ploceus velatus*)	Nests in reeds, bushes and **trees along watercourses**. Also, in trees near homesteads and in other vegetation away from water.	Common resident	
Village weaver *(Ploceus cucullatus)*	Near water; **different woodland vegetation types** along river valleys. Open thornveld, but not in forests and treeless grasslands. Edges of riverine forests, usually near water. Wide range of woodland types along river valleys. Breeds in mesic savannah especially along rivers. Nesting colonies usually in large trees, 3-10m above ground, commonly overhanging water.	Very common resident	
Red-headed Weaver *(Anaplectes melanotis)*	**Woodland, bushveld, savannah**, usually not far from water. Forages off foliage. Nest attached to branch of tree, usually several meters from the ground.	Common to fairly common resident, summer breeding visitor to some areas	
Thick-billed weaver *(Amblyospiza albifrons)*	Forest types: **riparian forest,** reeds or bulrushes near forests. In breeding season at marshes, rivers, with rank grass, reedbeds and papyrus. Nest between two or more upright stems of bulrush, reeds or papyrus.	Resident but disperse widely after breeding	
Quelea			
Red-billed Quelea (*Quelea quelea*)	Most vegetation types. **Woodlands and grasslands**. Annual grasses and surface water.	Abundant nomad. Expanded range and increased in numbers.	
Widows			
Fan-tailed Widowbird *(Euplectes axillaris)*	Open moist grassland, edges of vleis, **rank grassy hillsides**, marshes, edges of sugarcane fields.	Common resident; nomadic in winter	
White-winged Widowbird *(Euplectes albonotatus)*	Woodland and grassland: **rank growth on the margins** of open grassy areas, usually near water. Overgrown edges of cultivated areas. Seasonally inundated floodplains and tall grasslands.	Locally fairly common resident and nomad	
Red-collared Widowbird *(Euplectes ardens)*	**Mosaic of grass and bush**: typical of grassland with scattered trees or bushes.	Locally common resident and nomad	
Bishops			
Yellow bishop (*Euplectes capensis*)	Fynbos and Alpine Grassland: scrubby fringes of Afromontane forest. Rank grass or marshy places on steep slopes or in valley bottoms in mountainous or hilly country, usually with **scattered trees and bushes**, often at edge of woodland or patch of forest; also edges of sugarcane and cotton. Damp grassy areas and heathlands.	Locally common resident; nomadic in winter.	
Southern red bishop (*Euplectes orix*)	**Primarily grassland birds**: Nests in reedbeds. Rarely found far from water; strikingly absent from areas without permanent surface water. Found in areas cleared for cultivation. Typically, where there is access to perennial water. Nests in reeds, sedges, or bulrushes standing in water, usually 1-2.5m above water.	Very common resident and nomad. Artificial wetlands increased numbers. Common to abundant.	
Twinspots			
Green Twinspot *(Mandingoa nitidula)*	**Mature evergreen forest**, secondary growth around cultivation, gardens near dune forests, exotic plantations.	Locally fairly common resident.	
Mannikin			
Bronze Mannikin *(Lonchura cucullata)*	Edge habitats; dependent on water. **Moist wooded areas**.	Very common resident	
Red-backed Mannikin *(Lonchura nigriceps)*	**Riverine forest**, moist thickets, edges of coastal, lowland to midland evergreen forest, sometimes with tall grass.	Locally fairly common to common	
Firefinches & bluebills			
Red-billed Firefinch *(Lagonosticta senegala)*	Woodland, savannah, **riverine and thicket vegetation** – near water.	Common resident and nomad	

African Firefinch (*Lagonosticta rubricata*)	**Moist, wooded habitats**. Forest margins and bracken-briar. Riverine forest, bush and thickets.	Common resident	3
Jameson's Firefinch *(Lagonosticta rhodopareia)*	Broadleaved woodlands – open grassy areas **with thickets; watercourses**. Rank grass, edges of thickets, secondary growth, cultivated lands, edges of riverine forest, bushy gullies and rocky hillsides.	Common resident.	
Waxbills			
Common Waxbill (*Estrilda astrild*)	Rank grasslands, reedbeds, croplands, coastal estuaries, inland wetlands and dams, along **ephemeral and permanent rivers.**	Common resident	
Blue Waxbill (*Uraeginthus angolensis*)	**Arid thorn savannahs**. Reliable on availability of surface water.	Common resident. No changes from past distribution; common	
Swee Waxbill *(Estrilda melanotis)*	**Edges of evergreen forests**, exotic plantations, gardens, bushy hillsides, farmyards, thick streamside bush.	Common resident; some seasonal altitudinal movement.	
Orange-breasted waxbill *(Amandava subflava)*	**Tall-grass savannah** at forest edge, secondary growth, villages and plantations.		
Indigobirds			
Village Indigobird *(Vidua chalybeata)*	Thorn savannah, edges of broadleaved woodland, **riverine scrub and woodland**.	Common nomad	
Dusky Indigobird *(Vidua funerea)*	Edge habitats. savannah & open woodland. Edges of montane and **riverine forests**. Moist areas with forest.	Locally common nomad	
Whydahs			
Pin-tailed Whydah (*Vidua macroura*)	Wide range of open mesic habitats. Edge habitats with man. Wetlands.	Very common resident and nomad	8
Canaries			
Cape Canary *(Serinus canicollis)*	**Broad spectrum of vegetation types**: Grassland, fynbos, Karoo, woodland. Frequents “waste” and “disturbed” ground. Fallow fields. Require trees or shrubs for breeding.	Very common resident and nomad	
Forest Canary *(Crithagra scotops)*	Evergreen forest and **adjacent exotic plantations**, fynbos, rank secondary growth and well-wooded gardens.	Locally fairly common resident.	
Yellow-fronted Canary *(Crithagra mozambicus*)	Wide variety of **woodland habitats**: lightly wooded thornveld, moist broadleaved woodlands, along river courses. Avoid *Acacia* woodlands. Alien plantations.	Common resident	8
Streaky-headed Seedeater *(Crithagra gularis)*	Vegetation associated with mountains and **hilly topography**: Fynbos, wooded valleys. Well-wooded areas; drier deciduous woodland and miombo. Avoids open grassland, arid *Acacia* woodland. Edges of evergreen forests and scrub on mountain slopes.	Fairly common resident and nomad	1
Buntings			
Cinnamon-breasted Bunting *(Emberiza tahapisi)*	**Rocky ridges and hillsides**, eroding stony slopes and gullies, bare stony areas. Mountain sides, granite and dolerite outcrops with scattered bushes or trees, almost bare rocky and stony patches in woodlands on hills and plains, eroding stony slopes and gullies, dry watercourses. Nest placed in shallow scrape in ground at base of grass tuft, against rock or clod on rocky slope, on earth bank, in crevice in small rock face, on open stony ground, or among scattered rocks in a hollow.	Locally common resident	
Golden-breasted Bunting (*Emberiza flaviventris*)	Open **broadleaved and mixed woodlands** and savannah.	Common resident	

Appendix 8: MAMMALS: Available habitat, expected occurrence and observed presence of mammal species during surveys (Friedman & Daly 2004; Child MF, et al 2016). Mammals expected to occur in the available natural habitats of in the Nosilla project area are listed below. The words in **bold font** represent qualifying habitat (preferred habitat), and *underlined italics* disqualifying habitat (the reason why the organism will not occur in the area). The shaded cells indicate the species likely to occur in the riverine habitat, and the number inside a cell gives the number of individuals or definite signs detected during surveys.

MAMMAL	**HABITAT**	**Status (SA) Year assessed.**	
Order: Insectivora			
Family: Soricidae			
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.	**SA Red Data (2016): Vulnerable.** IUCN 2016: Least concern. TOPS: None.	
Forest shrew (*Myosorex varius*)	Highveld: In moist, **densely vegetated habitat**; burrows under rocks and uses rodent/molerat burrows. Dense grass along the banks of streams.	Least concern.	
Greater dwarf shrew (*Suncus lixus*)	Very little known of this species	Data deficient	
Least dwarf shrew (*Suncus infinitesimus*)	Commonly associated with **termitaria. Terrestrial**.	Intermediate	
Lesser dwarf shrew (*Suncus varilla*)	Reliant on **termite mounds.**	Data deficient	
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.	**SA Red Data (2016): Near-threatened**. IUCN 2016: Least concern. TOPS: None.	
Tiny musk shrew (*Crocidura fuscomurina)*	All latitudes, wide tolerance. **Terrestrial. Cover such as debris**, fallen trees, wood piles or dense grass clumps.	Data deficient	
Makwassie musk (*Crocidura maquassiensis)*	Subtropical/tropical dry. **Temperate, montane, grassland**, **rocky areas**, coastal forests.	Vulnerable	
Reddish-grey musk shrew (*Crocidura cyanea*)	Dry terrain: **Among rocks, in dense scrub and grass**. Grassland and thick shrub bordering streams. Wet vleis with good grass cover.	Data deficient	
Greater red musk shrew (*Crocidura flavescens*)	Broken country with a dense cover of vegetation, areas of decaying leaf litter in damp places, **thick undergrowth in vleis or along the banks of streams.**	Least concern. Population trend: Unknown	
Lesser grey-brown musk shrew (*Crocidura silacea*)	**Catholic in habitat requirements**; damp places.	Data deficient	
Lesser red musk shrew (*Crocidura hirta*)	In **damp situations along rivers and streams**. Low bushes, dense undergrowth, piles of debris and fallen logs.	Data deficient	

Family: Pteropodidae			
Wahlberg'sepauletted fruit bat (*Epomophorus wahlbergi*)	Tropical forests, penetrate up river valleys carrying **evergreen riverine forests**, mangrove forests, may be largely absent from densely forested areas,	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007).	
Peters's epauletted fruit bat (*Epomophorus crypturus*)	Evergreen forests in higher rainfall areas; **evergreen riverine forests** and forest edges in dryer savanna areas or in moist woodland where there are fruit-bearing trees.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007):	
Egyptian rousette (*Rousettus aegyptiacus*)	**Almost all habitats**. Totally dependent on the presence of caves. Roosts gregariously in caves. Distribution is influenced more by the availability of suitable roosting sites than vegetation associations. Rely on fruiting trees. Nomadic.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007):	
Family: Hipposideridae			
Percival's short-eared trident bat *(Cloeotis percivali)*	Savanna woodland. **Rest in caves**. Sufficient cover in the form of caves and mine tunnels for day roosting. Roost in narrow crevices. A clutter forager (in vegetation).	IUCN (2016): Least concern. **SA Red Data (Child, 2016): Endangered.** Very sensitive to disturbance.	
Sundevall's leaf-nosed bat (*Hipposideros caffer*)	**Savanna woodland**: Wide range of caves, sink holes and subterranean habitats (cavities); athropogenic roosts: mines and culverts. Colonies - dozen to hundreds. Riparian locations. Forage in and around thickets and well-developed undergrowth vegetation, avoiding open areas. Fly slowly through cluttered environment.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None. Population trend: Unknown.	
Family: Rhinolophidae			
Hildebrandt's horseshoe bat (*Rhinolophus hildebrandti*)	**Savanna woodland**; roost in caves, mines, disused buildings, cavities in rocks or large hollow trees	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None. Population trend: Unknown.	
Darling's horseshoe bat (*Rhinolophus darlingi*)	**Woodland savanna**: Caves, and amongst piles of loose boulders. It roosts in caves and subterranean habitats (mine adits) in medium-sized colonies. Also roosts in mine adits, medium-sized colonies, culverts.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None. Population trend: Unknown.	
Ruppels horseshoe bat (*Rhinolophus fumigatus*)	**Open savanna woodland**; fringes of forests. Absent from forests, desert and semi-deserts. Roosts in caves, mine adits road culverts.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None. Population trend: Unknown.	
Geoffroy's horseshoe bat (*Rhinolophus clivosus*)	**Savanna woodland**: Forest fringes. Mountainous areas: Caves, rock crevices. Riparian forests and savanna woodlands. Temperate species. Riverine conditions and with well-watered terrain. Cave dweller. It roosts in caves and subterranean habitats (mine adits) in large colonies.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None. Population trend: Unknown.	
Lander's horseshoe bat (*Rhinolophus landeri*)	Forests and **savanna woodlands**. Riverine conditions and with well-watered terrain. Cave dweller. Roost in caves, mine adits, and large hollow trees. Roost in small groups.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None. Population trend: Unknown.	
Bushveld horseshoe bat (*Rhinolophus simulator*)	**Savanna woodland**; riparian forest and along wooded drainage lines. Dependent on substantial shelter in form of caves, small caverns in rocky outcrops, road culverts and mine adits. Roost in large groups.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None. Population trend: Unknown.	

Family: Nycteridae			
Egyptian slit-faced bat (*Nycteris thebaica*)	**Open savannah woodland**; karoo; avoids open grassland (plateau grasslands). Roosts during day: caves, hollow large trees or holes in the ground. Caves (not deep) and subterranean habitats (aardvark burrows); temperate savanna and shrubland. Man-made structures: culverts under roads. Forages low above ground - susceptible to predation by owls, thus need tree cover.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None.	
Family: Molossidae			
Little free-tailed bat *(Chaerephon pumilus)*	**Wide range of habitats. Lowveld** and coastal areas, rarely above 1000m. Savanna, mountainous and arid areas. Rocky environment with an abundance of crevices. Narrow cracks in rocks and trees. Roosts: Crevices in trees, rocks or roofs. Gregarious.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None.	
Midas free-tailed bat *(Mops midas*)	**Hot, low-lying river valleys and** permanent water bodies. Woodland. Narrow cracks in rock, especially on cliff faces; Cracks in tree trunks and hollow trees.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None.	
Angola free-tailed bat *(Mops condylurus*)	**Catholic in habitat requirements**. Narrow crevices in rock faces and caves; hollows in trees.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None.	
Egyptian free-tailed bat (*Tadarida aegyptiaca*)	Open grassland: Roosts during day in rock crevices, **exfoliating rocks, caves, hollow trees**, behind loose bark of trees. Fly well above the canopy of the vegetation. Vegetation no influence but avoid forests. Desert, semi-arid scrub, savanna, grassland and agricultural land. Areas with permanent water bodies. Roosting in buildings, roofs of houses.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None.	
Family: Vespertilionidae			
Welwitsch's myotis (*Myotis welwitschii*)	**Savanna woodland**; Mountains covered with woodland or woodland forest, sparsely distributed. Furled banana leaves hanging in bushes.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None.	
Temminck's myotis (*Myotis tricolor*)	**Savannah woodland**, dry and moist savanna; mountainous areas: Gregariously cave dweller- availability govern distribution. Mediterranean-type shrubby vegetation. Possible also in tropical moist forest. The species roosts in caves and abandoned mines. It appears to prefer larger caves that are relatively undisturbed, usually ones that contain large pools of water.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None. This is a common species with colonies often consisting of thousands of animals.	
Kuhl's bat (*Pipistrellus kuhlii*) = Dusky pipistrelle (Pipistrellus hesperidus)	**Diverse habitats: well-watered terrain**. Streams and rivers. Vertical narrow cracks in rocks.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None.	
Rusty pipistrelle (*Pipistrellus rusticus*)	**Savanna woodland: riverine associations** and open water bodies; mopane woodland with rocky habitat. Crevices and hollows in trees.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None.	
Yellow-bellied house bat (*Scotophilus dinganii*)	**Savanna woodland** & mixed bushland; coastal forests; lower altitudes: Narrow crevices, holes and in hollow trees. Tied to presence of trees. Avoid open habitat - grassland and karoo scrub.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None. There appear to be no major threats to this species.	
Green house bat (*Scotophilus viridis*)	**Low-lying, hot savannas and woodland**; bushveld habitats; both dry and moist wooded savanna habitats. Avoid open habitats (grassland - lack of roost sites). Riverine conditions - tall riparian woodland. Various shelters - holes in trees, small colonies in hollow trees, roofs of houses.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None. There appear to be no major threats to this species.	
Cape serotine *(Neoromicia capensis*)	**Very broad habitat tolerance**, from forest to desert. Abundant in low-lying hot savannas; from arid semi-desert to montane grasslands, forests: Under bark of trees, base of aloe leaves. Crevices in rocks. Suburban situations - under roofs of houses.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None.	

Banana bat *(Neoromicia nana)*	**Forest and woodland** savanna; well-wooded habitats - riparian vegetation; forest patches in proximity of water: Near bananas or Strelitzia trees, rolled-up terminal leaves of banana plants; Also, other leaves.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None.	
Schlieffen's twilight bat (*Nycticeinops schlieffeni*)	**Low-lying savannah woodland**: well-wooded places such as riparian vegetation along rivers and drainage lines; not in forests. Roosts in crevices in trees.	IUCN (2016): LC Least concern. SA Red Data (Child 2016): Least concern. NEMBA TOPS (2007): None.	
Family: Lorisidae			
Thick-tailed bush baby (*Otolemur crassicaudatus*)	Forests, thickets and **well-developed woodland**. Penetrate into dry terrain in riverine forests and woodland. During the day - in the thick foliage of trees.	Least concern	Observed by farmer
Southern lesser bushbaby (*Galago moholi*)	**Woodland: Nocturnal; arboreal** – holes in trees, thick foliage, disused bird nests. Degraded open forest	Least cocern	Observed by farmer
Family: Cercopithecidae			
Chacma baboon (*Papio ursinus*)	Widespread, diurnal: At night - **Cliffs & high trees**	Least concern	2
Vervet monkey (*Cercopithecus aethiops*)	Woodland, diurnal: At night – **Heavy foliage in high trees**, rocky cliffs	Least concern	4
Family: Protelidae			
Aardwolf (*Proteles cristatus*)	**Savannah woodland** and in scrub, grassland. Open country, nocturnal, and solitary. Rests in hole in ground. Independent on water. Dependant on availability of termites.	Least concern	
Family: Hyaenidae			
Brown hyaena *(Parahyaena brunnea*)	Semi-desert, open scrub and **open woodland savanna**. Nocturnal, holes in ground.	**IUCN 2015: Near threatened; SA Red Data (Child 2016): Near threatened; NEMBA (TOPS 2007): Protected species.** Population trend: Decreasing.	
Family: Felidae			
Leopard (*Panthera pardus*)	Widespread. **Broken country or forests**. Nocturnal & solitary.	**IUCN (2016): Vulnerable. SA Red Data (Child 2016) Vulnerable. NEMBA (TOPS 2015): Protected species.** Population trend: Decreasing.	
Lion (*Panthera leo*)	*Availability of prey.*	**IUCN (2012): VU Vulnerable. NEMBA (TOPS 2015): Vulnerable species**	
Caracal (*Felis caracal*)	**Widespread – open scrub & woodland**, open vleis and open grassland. Nocturnal & solitary. Litters born in holes in ground.	Least concern	Observed by farmer
African wild cat (*Felis silvestris cafra)*	Widespread – **Wide habitat tolerance. Rocky hillsides**, underbush, reedbeds, stands of tall grass. Litters born dense underbrush or other substantial cover.	Least concern	
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.	**IUCN (2016) Least concern. SA Red Data (Child 2016): Near threatened; NEMBA (TOPS 2015): Protected species.** Population trend: Stable.	Observed by farmer
Family: Canidae			
Wild dog (*Lycaon pictus*)	Resident prey and permanent water	**NEMBA (TOPS 2015): Endangered species; IUCN 2012: EN Endangered**	**Present for a short while**
Black-backed jackal (*Canis mesomelas*)	**Widespread. Wide habitat tolerance**. Open terrain. Litters born in holes in ground.	Least concern	

Family: Mustelidae			
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.	**IUCN (2016): NT Near-threatened; SA Red Data (Child 2016): Near-threatened; NEMBA (TOPS 2007): Protected species;** Population trend: Stable.	Observed by farmer
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 riverbanks, in rock crevices or in dense reed.	**IUCN (2016): NT Near-threatened; SA Red Data (Child 2016): Vulnerable; NEMBA (TOPS 2007): Protected species;** Population trend: Decreasing.	
African striped weasel (*Poecilogale albinucha*)	**Savannah**: Moist grassland. Litters born in burrows.	**SA Red Data 2016: Near threatened;** NEMBA (TOPS) 2016: None. IUCN, 2016: Least concern.	
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.	**NEMBA (TOPS) 2007: Protected species.** IUCN (2014) Least concern. SA Red Data (Child 2016): Least concern. Population trend: Decreasing.	Observed by farmer
Family: Viverridae			
Small-spotted genet (*Genetta genetta*)	Widespread. Open arid: **Woodland, open scrub** and dry grassland or dry vlei areas. Trees. Nocturnal – nests in holes in the ground or in hollow trees.	Least concern	Observed by farmer
Large-spotted genet (*Genetta tigrina*)	Better watered parts: Woodland, **open scrub and dry grassland** or dry vlei areas. Trees. Nocturnal – nests in holes in the ground or in hollow trees.	Least concern	
African civet (*Civettictis civetta*)	Widely distributed – forest and **woodland where water is available**. Nocturnal & solitary. Litters born in holes or dense underbrush.	Least concern	Observed by farmer
Slender mongoose (*Galerella sanguinea*)	**Widespread. Open areas**. Underbrush or holes in the ground, holes in termitaria.	Least concern	
White-tailed mongoose (*Ichneumia albicauda*)	Savannah woodland: Well-watered areas. Not in desert, semi-desert or forest.	Least concern	Observed by farmer
Water mongoose (*Atilax paludinosus*)	**Well-watered terrain: Rivers, streams**, marshes, swamps, wet vleis, dams and tidal estuaries - adequate cover of reed beds or dense stands of semi-aquatic grasses. Coastally in mangrove swamps in brackish water.	Least concern	1
Selous' mongoose (*Paracynictis selousi*)	**Open country**, frequenting vleis, floodplain and grasslands.	Data deficient	
Large grey mongoose e (Herpestes ichneumon)	On fringes of rivers, swamps, lakes and dams. **Riverine underbrush** or reed beds.	Least concern	
Banded mongoose (*Mungos mungo*)	Wide habitat tolerance. Essential habitat requirement: woodland, underbrush, substrate detritus such as fallen logs and other vegetable debris. Acacia woodland.	Least concern	Observed by farmer
Dwarf mongoose (*Helogale parvula*)	Widespread. Dry open woodland and on grassland where there is substrate litter and termitaria. Lives in permanent holes – termitaria, burrows deeply.	Least concern	Observed by farmer

Family: Elephantidae			
African elephant (*Loxodonta africana*)	All vegetation types. Open forests.	**IUCN (2010): Vulnerable. NEMBA (TOPS 2015): Protected species;** SA Red Data: Least concern	
Family: Equidae			
Plains zebra (*Equus quagga)*	Open plains to heavily wooded savannas	**IUCN (2014) Near-threatened;** SA Red List 2016: Least concern; NEMBA (TOPS 2007): None.	
Family: Orycteropodidae			
Aardvark (*Orycteropus afer*)	Widespread. Wide habitat tolerance. **Open woodland, scrub and grassland**. Nocturnal. Lives in extensive burrows.	IUCN (2014) Least concern; SA Red List 2016: Least concern; NEMBA (TOPS 2015): None.	
Family: Procaviidae			
Yellow-spotted dassie (*Dendrohyrax brucei*)	**Rocky hills and krantzes or among piles of boulders.**		
Rock dassie (*Procavia capensis*)	Widespread where there is rocky habitat. **Outcrops of rock** – rocky crevices. Krantzes, rocky koppies, hillsides, piles of loose boulders – accompanied with bushes and trees to provide browse. Crannies and crevices provide shelter. Granite formations with piles of huge boulders, from which overlying soil has been washed away. Sandstone krantzes with loose, rocky, overhanging slabs. Erosion gulleys.	Least concern	
Family: Suidae			
Bushpig (*Potamochoerus larvatus)*	**Forests, thickets, riparian underbrush, reed beds or stands of tall grass** where there is water. Nests of grass in secluded places. Linear forest (DRC).	Least concern	1
Warthog (*Phacochoerus africanus)*	**Open areas of grassland**, floodplain, vleis and around waterholes and pans. Deserted antbear holes. Linear forest.	Least concern	
Family: Hippopotamidae			
Hippopotamus (*Hippopotamus amphibius*)	*Suitable deep, open, permanent water* (deep enough to allow it to submerge totally) with gently sloping sandbanks must be available and adjacent food supplies. Open stretches of permanent water. Temporary resting places during flooding in oxbows or up in tributaries of major rivers.	**IUCN (2014): VU Vulnerable.**	
Family: Giraffidae			
Giraffe (*Giraffa camelopardalis*)	Most savanna habitats.		
Family: Bovidae			
Blue wildebeest (*Connochaetes taurinus*)	Open short grass plains or lightly wooded open savanna habitats.	IUCN (2014) Least concern; SA Red List 2016: Least concern; NEMBA (TOPS 2007): None.	
Tsessebe (*Damaliscus lunatus*)	Ecotone of woodland and grassland where water is available	**NEMBA (TOPS 2015): Protected species.** IUCN (2014): Least concern	
Red duiker *(Cephalophus natalensis)*	Forest, **dense thickets, thickly wooded ravines** and dense coastal bush where there is surface water.	**IUCN Least concern**	Observed by farmer

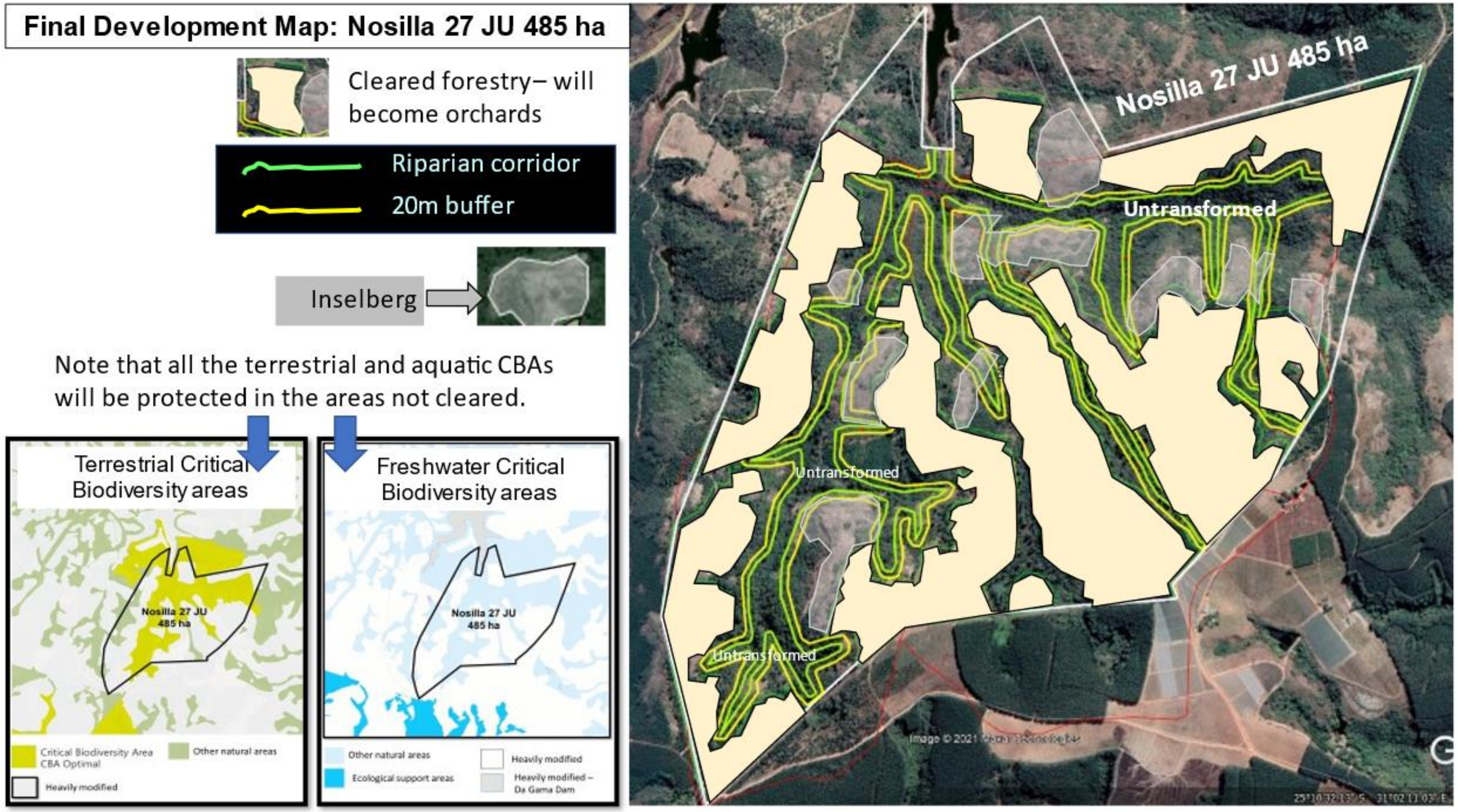
Cape common duiker (*Sylvicapra grimmia grimmia*)	Widespread. Presence of bush. **Woodland with ample underbush**, grassland of medium and tall grass. Rest in bushes or tall grass.	Least concern	3
Klipspringer (*Oreotragus oreotragus*)	**Restricted to rocky areas.** Mountainous areas with krantzes, rocky hills or outcrops, extensive areas of rocky koppies, gorges with rocky sides. Rocky shelter and steep rock faces. Boulder-strewn riverbeds.	Least concern	
Steenbok (*Raphicerus campestris)*	**Widespread. Open country**: Open grassland with stands of tall grass, scattered bushes or scrub and forbs. Avoid densely wooded areas.	Least concern	
Sharpe's grysbok (*Raphicerus sharpei)*	Open forest. Thick woodland, riverine forest, thick bush and **broken country with bush cover**.	**NEMBA (TOPS 2015): Protected species; IUCN Least Concern**	
Impala (*Aepyceros melampus*)	Woodland savanna: Widespread in light open woodland – surface water.	Least concern	
Sable antelope (*Hippotragus niger niger*)	Open woodland. Areas with a well-developed field layer. Dependent on the availability of water.	**NEMBA (TOPS 2015): Vulnerable species**	
Cape buffalo (*Syncerus caffer*)	All habitats with a plentiful supply of grass, shade and water.	Least concern	
Kudu (T*ragelaphus strepsiceros*)	**Widespread in savanna woodland**. Areas of broken, rocky terrain with woodland cover & open water.	Least concern	
Nyala (*Tragelaphus angasii*)	Dry savanna woodland with mosaic of open ground, thickets and woodland.	Least concern	
Bushbuck (T*ragelaphus scriptus*)	**Riverine and thickets near water.**	Least concern	1
Eland (*Taurotragus oryx*)	Arid semi-desert areas as well as better-water environments, montane situations and in various types of woodland. Avoid forests and open grasslands	Least concern	
Grey rhebok (*Pelea capreolus*)	Rocky hills, rocky mountain slopes and mountain plateau with good grass cover.	Least concern	
Reedbuck (*Redunca arundinum*)	Open water with cover; stands of tall grass or reed beds	TOPS NEMBA (2007): Protected.	
Mountain reedbuck (*Redunca fulvorufula*)	Dry, grass-covered, stony slopes of hills and mountains; some form of trees and bushes	Least concern	
Waterbuck (*Kobus ellipsiprymnus*)	Savanna habitats with medium and tall grass in the close proximity of water.	Least concern	
Order: Manidae **Family: Pholidota**			
Temminck's ground Pangolin (*Smutsia temminckii*)	**Wide habitat tolerance**, absent from forests. Day – piles of leaves or other vegetable debris, holes in the ground	**IUCN (2016) Vulnerable. SA Red Data (Child 2016): Vulnerable. NEMBA (TOPS 2015): Vulnerable species.** Population trend: Decreasing.	
Order: Rodentia			
Family: Hystricidae			
Cape Porcupine *(Hystrix africaeaustralis)*	Widespread: **All types of country** apart from swampy areas, very moist forests and barren desert areas. Nocturnal. Shelter - resting in caves, rock cavities, holes in ground. Absent from forest. Use abandoned antbear and other types of holes in the ground or lie up under the roots of trees exposed by erosion.	Least concern	2
Family: Sciuridae			
Tree squirrel (*Paraxerus cepapi*)	**Widespread in woodland**: Savanna woodland including a wide variety of woodland types. Trees with suitable nest holes are favoured. Diurnal – resting in holes in trees.	Least concern	1

Family: Thryonomyidae			
Greater Canerat *(Thryonomys swinderianus)*	Forest belts and open woodland wherever there is tall and matted grass or reeds growing in damp or wet places. Reedbeds or areas of dense tall grass with thick reed or cane-like stems. In vicinity of rivers, lakes and swamps - **never found far from water**. Resting place densest part of reed bed. Cover - matted tussock grasses, holes in stream banks, under root systems of trees adjacent to grass and reeds. Use existing holes or simply use matted vegetation.	Least concern	
Family: Bathyergidae			
Common Molerat *(Cryptomys hottentotus)*	**Loose sandy soils to stony soils and hills to montane and escarpment conditions**. Tendency to loose sandy soil - especially alluvial soils along major rivers and streams. Karroid veld types, coastal rhenosterbushveld, coastal forests, thornveld, mopaneveld, savanna and pure grassveld, as well as temperate and transitional forests, scrub and bushveld.	Least concern	6
Family: Cricrtidae			
Bushveld gerbil (Gerbilliscus leucogaster)	Widespread – **Survives regardless of vegetation type** or degree of cover present, having been recorded in open grasslands, Acacia woodland or scrub, and mopane woodland. Commonly encountered on old, cultivated lands.	Data deficient	
Vlei Rat *(Otomys irroratus)*	Temperate low-altitude swamps and grassland, and subtropical and tropical high-altitude grassland, swamps, and plantations. It is a terrestrial species that lives above ground in an open, bowl-shaped nest made of shredded grass near **marshy areas with a lot of vegetation**.	Least concern	
Angoni Vlei Rat *(Otomys angoniensis)*	**Savanna woodlands and grasslands** – in drier areas in wet vleis, swamps and swampy areas along rivers. Fringes of rivers with reed beds, sedges and semi-aquatic grasses. Nests in tussock grass near permanent water; above water level on raised ground.	Least concern	
Laminate Vlei Rat *(Otomys laminatus)*	Tied to moist habitats - *grasslands in submontane and coastal areas*.	**SA Red Data (2016): Near threatened. Endemic.**	
Family: Muridae			
Mesic four-striped mouse (*Rhabdomys dilectus*)	**Widespread – grass cover**: Diurnal – burrows under grass. Wide variety of habitat types (broad niche species). Prefers grassland, habitat includes bushy and semi-dry vlei country as well as dry riverbeds, high grassveld areas, the edges of forests and the bases of hills.	Least concern	
African marsh 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.	IUCN 2016: Least concern. **SA Red Data (Child 2016): Near threatened;** Population trend: Unknown.	
Pouched mouse (*Saccostomus campestris*)	**Widespread and catholic**, wide habitat tolerance: In burrows, sandy soil or sandy alluvium, open short grass fringes of pans, rocky koppies, fringes of lowland forests. Exclusively terrestrial, predominantly solitary and nocturnal.	Least concern	
Grey climbing mouse (*Dendromus melanotis*)	**Grassland with high grass**.		
Chestnut climbing mouse (*Dendromus mystacalis*)	**Grassland with high grass.**		
Brant's climbing mouse (*Dendromus mesomelas*)	**Tall grass or rank vegetation near water.**	Least concern	
Fat mouse (*Steatomys pratensis*)	**Grassland and savannas** over sandy soils or sandy alluvium. On sandy ground in scrub or in sandy alluvium on the fringes of swamps, streams and rivers. Open woodland and abandoned cultivated lands.	Least concern	

White-tailed mouse (*Mystromys albicaudatus*)	*Highveld and montane grassland*. Nocturnal – lives in burrows or cracks in the ground. Sandy soil with good cover.	**IUCN (2008): EN Endangered; SA Red Data (Child 2016): Vulnerable. NEMBA (TOPS 2007): None.** Population trend: Decreasing.	
Tete Veld Rat *(Aethomys ineptus)*	Widespread – Grassland with open shrub association, **open woodland**, fringes of pans. Temperate grassland and savanna: Rocky crevices and piles of boulders. Sandy ground or sandy alluvium, or hard ground – holes or rock crevices and piles of boulders. Associated with cover: rocky crevices, piles of debris, clumps of grass or fallen trees.	Least concern	
Bushveld Namaqua rockmouse *(Micaelamys namaquensis subsp. alborarius)*	Widespread – where there are **rocky koppies, outcrops** or boulder-strewn hillsides - preferred areas. Cracks and rock crevices of rocky koppies or outcrops (prefers crevices and does not burrow), or on piles of stones in the veld, low lying ridges and stony country and is often plentiful in old ruins. In the absence of outcrops, may nest in holes or forks in trees or under bushes. Piles plant debris over the entrances to its shelters. Calcareous outcrops. Nocturnal, terrestrial and communal.	Least concern	
Acacia rat *(Thallomys paedulcus)*	**Acacia woodland**: Living in crevices in the trunks, under loose strips of bark or in holes in the ground between the roots of the tree (Especially Acacia). Nocturnal.	Least concern	
Single-striped Mouse *(Lemniscomys rosalia)*	**Savanna woodland** to dry open scrub. Common factor: Grassland - excavates burrows under the cover of matted grass.	Data deficient	
Southern multimammate mouse (*Mastomys coucha*)	**Wide habitat tolerance** (pioneer species - drought, burn, ploughing), fond of grassland where there is some cover of low scrub. In dry watercourses or fringes of swamps. In riverine associations running westwards into arid country. Frequents the fringes of pans where there are calcareous outcrops nearby. Partial to sandy ground, overgrown with scrub and grass. Under fallen logs, crevices between rocks, cavities inside pile of stones or debris or even holes in termite mounds. Nocturnal.		
Multimammate mouse *(Mastomys natalensis)*	**Wide habitat tolerance** (pioneer species - drought, burn, ploughing), from sea level to high-lying ground, absent from arid areas: Fond of grassland where there is some cover of low scrub. Households; fringes of agricultural land; In riverine associations running westwards into arid country. Degraded forests, fields. Often occurs in high numbers. Communal, terrestrial and nocturnal. Constructs its own burrows but often uses existing burrows of other rodents.		
Woodland mouse (*Grammomys dolichurus*)	Predominantly arboreal: in forests and **thickets**, usually in damp places; constructs nests of grass or leaves in dense underbrush	Least concern	
Pygmy Mouse *(Mus minutoides)*	In **all types of vegetation**. Wide variety of habitats. Nocturnal and terrestrial, not communal. Fairly damp country where there is high grass, bush or other cover. Makes its own burrows in soft ground. Normally finds shelter under piles of debris, fallen tree trunks/logs and similar type of cover, also boulders or holes in termite mounds.	Least concern	
Family: Gliridae			
Rock Dormouse *(Graphiurus platyops)*	**Rocky terrain**. A rock-frequenting dormouse. Near or on rocky outcrops. In association with dassies. Also, dry scrub thickets or dry riverbeds, frequenting trees when no rocks available. Live in rock crevices, under exfoliation of granite bosses and in piles of boulders.	Data deficient	
Woodland Dormouse *(Graphiurus murinus)*	Widespread in **woodland**. Wooded areas. Large trees provide holes for shelter. Live in holes in trees or under loose bark.	Least concern	
Family: Leporidae			
African savanna hare (*Lepus victoriae*)	**Savannah woodland** and in scrub, tall grass. Absent from forest, desert and open grass. Open forest, savanna.	Least concern	
Hewitt's red rock rabbit (*Pronolagus saundersiae*)	**Top of rocky outcrops**	Least concern	
Natal red rock rabbit *(Pronolagus crassicaudatus)*	**Rocky habitat**: Rocky terrain or boulder-strewn areas – rest deep in rock crevices	Least concern	

Family: Macroscelididae			
Rock elephant shrew (*Elephantulus myurus*)	**Rocky areas**: Rocky koppies or piles of boulders – sufficient holes crannies and crevices in rocks for shelter. Absent on granite domes. Needs broken and exfoliated granite. Prefer rocky habitat with overhanging ledges or vegetation. Cover from aerial predation. Keep to shady cover of overhanging rocks or bushes/trees.	Least concern	

Appendix 9: Final Development Map: Sensitive Areas (Riparian and Buffer Zones included)



APPENDIX 4.4.4.
HERITAGE SPECIALIST REPORT

SPECIALIST REPORT

PHASE 1 ARCHAEOLOGICAL/HERITAGE IMPACT ASSESSMENT FOR A PROPOSED BULK WATER INFRASTRUCTURE (DAMS & WEIRS) ON THE FARM NOSILLA 27JU, WHITE RIVER/HAZYVIEW, MPUMALANGA PROVINCE

REPORT COMPILED FOR

RHENGU ENVIRONMENTAL SERVICES

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MAY 2021

ADANSONIA HERITAGE CONSULTANTS

ASSOCIATION OF SOUTHERN AFRICAN PROFESSIONAL ARCHAEOLOGISTS

REGISTERED WITH SAHRA

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EXECUTIVE SUMMARY

A Phase 1 Heritage Impact Assessment (HIA) regarding archaeological and other cultural heritage resources was conducted on the footprint of *the farm NOSILLA 27JU,* between White River and Hazyview. The study area is situated on topographical map 1:50 000, 2531AA, which is in the Mpumalanga Province. This area falls under the jurisdiction of the Ehlanzeni District Municipality, and Mbombela Local Municipality.

The National Heritage Resources Act, no 25 (1999) (NHRA), protects all heritage resources, which are classified as national estate. The NHRA stipulates that any person who intends to undertake a development, is subjected to the provisions of the Act.

The applicant, Mr. Pieter Du Preez, in co-operation with *RHENGU ENVIRONMENTAL SERVICES*, is proposing to establish a bulk water supply infrastructure (dams, weirs and a pipeline), as well as connecting to an existing ESKOM line, to provide an adequate water supply for their agricultural activities. NOSILLA farm is currently a commercial Timber property which is being converted to farm macadamias, blueberries and ginger. The entire property is highly disturbed with existing timber plantations, except for small sections of natural vegetation within drainage lines.

The three proposed dams will be situated within existing disturbed plantation areas and the two weirs within the natural drainage line, from where the water will be pumped to the dams. Existing roads was used to access the proposed areas.

No archaeological or heritage features were observed during the site survey which took place over two days, and no graves were observed. The owner, Mr. Du Preez, as well as the farm manager, Mr. Ferreira were also not aware of any graves on the property. No land claim has been lodged against the property.

It is recommended that the applicant be made aware that distinct archaeological material or human remains may only be revealed during the development phase. Such sub-surface finds must be assessed by a qualified archaeologist after which an assessment can be made. Based on the survey and the findings in this report, Adansonia Heritage Consultants state that there are no compelling reasons which may prevent the proposed agricultural development, within the study area, to continue.

Disclaimer: *Although all possible care is taken to identify all sites of cultural significance during the investigation, it is possible that hidden or sub-surface sites could be overlooked during the study. Christine Rowe trading as Adansonia Heritage Consultants will not be held liable for such oversights or for costs incurred by the client as a result.*

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1) *The results of the project;*
2) *The technology described in any report;*
3) *Recommendations delivered to the Client.*

……………………
C. Rowe

MAY 2021

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PHASE 1 ARCHAEOLOGICAL / HERITAGE IMPACT ASSESSMENT FOR A PROPOSED BULK WATER INFRASTRUCTURE (DAMS & WEIRS) ON THE FARM NOSILLA 27JU, WHITE RIVER / HAZYVIEW, MPUMALANGA PROVINCE

A. BACKGROUND INFORMATION TO THE PROJECT

Mr. Pieter du Preez, in co-operation with *RHENGU Environmental Services,* is requesting the establishment of a bulk water supply infrastructure in the form of weirs and off-channel storage facilities (dams & pipeline), as well as a powerline connecting to the existing ESKOM lines, on the farm NOSILLA 27JU*,* in the White River district of Mpumalanga. [1]

The entire farm NOSILLA is currently a commercial Timber property. The owner is planning to remove 218.3ha of forestry to establish macadamia, blueberries and ginger to expand the current existing enterprise of the neighboring property (St Cloud farm). [2] The removal of the timber will increase the water runoff which can either be abstracted directly or stored in off-channel storage dams. The aim is to reduce the risk of water supply which is key to the production of quality produce in a sustainable manner. The availability of irrigation water is seen to be the most important factor for successful and sustainable production on this enterprise. [3] Two small weirs will be constructed from which water will be pumped to the three storage dams. This will ensure that the additional water can be harnessed and utilized for irrigation purposes. [4] The pipelines which will connect the dams and weirs, and a connection to the existing power lines will follow existing roads or disturbed (plantation) areas on the farm.

The proposed site for the development is situated between White River and Hazyview in the Lowveld region. The site is accessed off the R40 provincial road, approximately 12km north of the town of White River. The entire property is highly disturbed with existing timber plantations, except for small pockets of natural vegetation within the drainage lines.

The owner, Mr. Du Preez, as well as the farm Manager, Mr. Ferreira, were interviewed during the two site visits. None of them were aware of any graves or any heritage features on the

[1] Needs & Desirability Report: Mr. Ralf Kalwa, e-mail access: 2021-04-25.
[2] Provisional development Plan Table, 2021-01-18, p.1.
[3] MBB Consulting Services: Nosilla 27JU Engineering Planning Report, p. 1.
[4] IWR Water Resources, Water Resources Analysis of a Forestry to irrigation conversion on the property Nosilla 27JU, Mpumalanga, p. 1.

NOSILLA property. [5] [6] Rock art sites occur within the wider area as well as on the Legogote hill directly to the east, [7] but none was observed on the NOSILLA farm.

Google images and topographical maps were studied which indicated that the farm was mainly used for timber since at least 1971 (see map 8 - 10). Several drainage lines are sloping towards the Dagama dam in the north. The farm NOSILLA 27JU is located in the X31H-2 quinary catchment on a tributary of the White Waters River, which is a tributary of the Sabie River. [8] A few granite outcrops occur on the farm in the form low hills (fig. 11). These are natural and undisturbed with indigenous vegetation cover and are not developed with timber or agriculture and will be left undisturbed.

Adansonia Heritage Consultants were appointed by *RHENGU Environmental Services*, to conduct a Phase 1 heritage impact assessment (HIA) on archaeological and other heritage resources. A literature study, relevant to the study area as well as a foot survey was done, to determine that no archaeological or heritage resources will be impacted upon by the proposed development (see map 8: topographical map 1:50 000, 2531AA KIEPERSOL).

The aims of this report are to source all relevant information on archaeological and heritage resources in the study area, and to advise the client on sensitive heritage areas as well as where it is viable for the development to take place in terms of the specifications as set out in the National Heritage Resources Act no., 25 of 1999 (NHRA). Recommendations for maximum conservation measures for any heritage resources will also be made. The study area is indicated in maps 3 & 8 - 10, & Appendices 1 & 2.

- This study forms part of an EIA, Consultant: *RHENGU Environmental Services*, Mr. Ralf Kalwa, P.O. Box 1046, Malelane, 1320, Cell: 0824147088 / Fax: 0866858003 / e-mail: rhengu@mweb.co.za [9]
- Type of development: Establishment of bulk water supply infrastructure on the farm NOSILLA 27JU, White River, Mpumalanga Province.
- The study area consists entirely of disturbed land (commercial timber plantations), [10] with small pockets of indigenous vegetation cover within the natural drainage lines.
- The area is zoned as agricultural and no rezoning will take place.

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5 Personal communication: Mr. P. Du Preez (Owner), 2021-04-15.
6 Personal communication: Mr. H. Ferreira (Farm Manager), 2021-04-27.
7 Personal communication: Mr. Solomon, (PEEBLES Farm), 2019-10-19.
8 IWR Water Resources, Water Resources Analysis of a Forestry to irrigation conversion on the property Nosilla 27JU, Mpumalanga, p. 4.
9 Needs & Desirability Report: Mr. Ralf Kalwa, e-mail access: 2021-04-25.
10 Needs & Desirability Report: Mr. Ralf Kalwa, e-mail access: 2021-04-25.

- Location of Province, Magisterial district / Local Authority and Property (farms): The area falls within the Mpumalanga Province under the jurisdiction of the Ehlanzeni District Municipality and the City of Mbombela Local Municipality.
- Landowner & applicant: Mr. Pieter du Preez, St Cloud Farm, White River, 1240, Cell: 0844511601. [11]

Terms of reference: As specified by section 38 (3) of the NHRA, the following information is provided in this report.

a) The identification and mapping of heritage resources where applicable;
b) Assessment of the significance of the heritage resources;
c) Alternatives given to affected heritage resources by the development;
d) Plans for measures of mitigation.

Legal requirements:

The legal context of the report is grounded within the National Heritage Resources Act no. 25, 1999, as well as the National Environmental Management Act (Act No. 107 of 1998) (NEMA as amended).

- **Section 38 of the NHRA**

This report constitutes a heritage impact assessment investigation linked to the environmental impact assessment required for the development. The proposed development is a listed activity in terms of Section 38 (1) of the NHRA. Section 38 (2) of the NHRA requires the submission of an HIA report for authorisation purposes to the responsible heritage resources agency, (SAHRA).

Heritage conservation and management in South Africa is governed by the NHRA and falls under the overall jurisdiction of the South African Heritage Resources Agency (SAHRA) and its provincial offices and counterparts.

Section 38 of the NHRA requires a Heritage Impact Assessment (HIA) to be conducted by an independent heritage management consultant, for the following development categories:

- The construction of a road, wall, powerline, pipeline, canal or similar form of linear development or barrier exceeding 300m in length;
- Any development or other activity which will change the character of a site: exceeding 5000m² in extent;
- the rezoning of a site exceeding 10 000m² in extent;

[11] Personal communication: Mr. P. du Preez (Owner), 2020-04-15.

In addition, the new EIA regulation promulgated in terms of NEMA, determines that any environmental report will include cultural (heritage) issues.

The end purpose of this report is to alert RHENGU Environmental Services, the applicant, as well as interested and affected parties about existing heritage resources that may be affected by the proposed development, and to recommend mitigation measures aimed at reducing the risks of any adverse impacts on these heritage resources. Such measures could include the recording of any heritage buildings or structures older than 60 years prior to demolition, in terms of section 34 of the NHRA and also other sections of this act dealing with archaeological sites, buildings and graves.

The NHRA section 2 (xvi) states that a “heritage resource” means any place or object of cultural significance, and in section 2 (vi) that “cultural significance” means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. Apart from a heritage report assisting a client to make informed development decisions, it also serves to provide the relevant heritage resources authority with the necessary data to perform their statutory duties under the NHRA. After evaluating the heritage scoping report, the heritage resources authority will decide on the status of the resource, whether the development may proceed as proposed or whether mitigation is acceptable, and whether the heritage resources require formal protection such as Grade I, II or III, with relevant parties having to comply with all aspects pertaining to such a grading.

- **Section 35 of the NHRA**

Section 35 (4) of the NHRA stipulates that no person may, without a permit issued by SAHRA, destroy, damage, excavate, alter or remove from its original position, or collect, any archaeological material or object. This section may apply to any significant archaeological sites that may be discovered. In the case of such chance finds, the heritage practitioner will assist in investigating the extent and significance of the finds and consult with an archaeologist about further action. This may entail removal of material after documenting the find or mapping of larger sections before destruction. No archaeological material was observed during the survey.

- **Section 36 of the NHRA**

Section 36 of the NHRA stipulates that no person may, without a permit issued by SAHRA, destroy, damage, alter, exhume or remove from its original position or otherwise disturb any grave or burial ground older than 60 years, which is situated outside a formal cemetery administered by a local authority. It is possible that chance burials might be discovered during development of road infrastructure or agricultural activities. No graves were observed on the study area.

- **Section 34 of the NHRA**

Section 34 of the NHRA stipulates that no person may alter, damage, destroy, relocate etc., any building or structure older than 60 years without a permit issued by SAHRA or a provincial heritage resources authority. No historical structures / buildings were observed during the survey.

- **Section 37 of the NHRA**

This section deals with public monuments and memorials but does not apply in this report.

- **NEMA**

The regulations in terms of Chapter 5 of the National Environmental Management Act, (107/1998), provides for an assessment of development impacts on the cultural (heritage) and social environment and for specialist studies in this regard. In terms of the Environmental Impact Assessment (EIA) regulations (under the NEMA Act, as amended), the proposed development constitutes listed activities which requires environmental authorisations prior to commencement with the proposed activities.

B BACKGROUND TO ARCHAEOLOGY AND HISTORY OF THE STUDY AREA

- **Literature review, museum databases & previous relevant impact assessments**

The study area on the farm NOSILLA 27JU, is located approximately 12km north of White River, with access from the R40 provincial road, towards Hazyview.

The wider area is rich in archaeological history and the first evidence of ancient mining occurred between 46 000 and 28 500 years ago during the Middle Stone Age. Hematite or red ochre was mined at Dumaneni (near Malelane, approximately 45km south-east of the study area) and is regarded as one of the oldest mines in the world. Iron ore was also mined in the area, and a furnace as well as iron slag was documented. [12]

Bushman (or San) presence is evident in the area as research by rock art enthusiasts revealed 109 sites in the Kruger National Park, [13] and over 100 rock art sites at Bongani Mountain Lodge and its immediate surrounds [14] (south-east of the study area), as well as many sites in the Nelspruit, Rocky's Drift and White River areas. A rock art site on Legogote

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12 Bornman, H., *The Pioneers of the Lowveld*, p. 1.

13 English, M. Die Rotskuns van die Boesmans in die NKW, *in De Vos Pienaar, U., Neem uit die Verlede*, p. 18-24.

14 Hampson, et al., The rock art of Bongani Mountain Lodge, SA Archaeological Bullitin 57: p. 15.

hill, directly east of the study area, was visited by the author in the 1980's. Another rock art site was mentioned by Mr. Solomon (security guard who was interviewed during a previous survey on the Peebles farm to the east). This rock art site is also situated towards the east of the NOSILLA property and was vandalized by people who excavate the site for possible treasure. [15] Thirty- one rock art sites were recorded by the author on the Mpumalanga Drakensberg Escarpment. Rock art sites were also recorded in Swaziland. [16] [17] The Bushman painters most probably obtained the ochre, which was used as a pigment in the paintings, from the Dumaneni ochre mine.[18] [19]

Primary and secondary sources were consulted to place the surrounding area in an archaeological context. Ethnographical and linguistic studies by early researchers such as Ziervogel and Van Warmelo shed light on the cultural groups living in the area since ca 1600. Historic and academic sources by Meyer, Voight, Bergh, De Jongh, Evers, Myburgh, Thackeray and Van der Ryst were consulted, as well as historic sources by Makhura and Webb.

Primary sources were consulted from the Pilgrim's Rest Museum Archives for a background on the pre-history and history of the study area. Several circular stone-walled complexes and terraces as well as graves have been recorded in the vicinities of Hazyview [20], Bushbuckridge, Graskop and Sabie. Clay potsherds and upper as well as lower grinders, are scattered at most of the sites.[21] Many of these occur in caves as a result of the Swazi attacks during the 1900's on smaller groups. The 1911 topographical map (Degree Sheet 22) of Komatipoort revealed no historic black settlements in the immediate area the farm (see map 2).[22]

The author was also involved in desktop studies and surveys in the area, such as:

- *Study for the Proposed Eskom Powerlines, Hazyview – Dwarsloop* (2008);
- *Inspection of Umbhaba Stone-walled settlement, Hazyview,* (2001);
- A *Phase 1 Archaeological and Heritage Impact Assessment for 132Kv Powerlines from Kiepersol substation (Hazyview), to the Nwarele substation Dwarsloop (2002);*
- A *Phase 1 Archaeological and Heritage Impact Assessment for a proposed traffic*

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15 Personal communication: Mr. Solomon (Peebles farm), 2019-10-09.
16 Rowe, C. 2009. Heritage Management of Archaeological, Historical and Industrial resources on the Blyde River Canyon Nature Reserve, MA dissertation. Pretoria: UP.
17 Masson, J. 2008. Views from a Swaziland Cave. The Digging Stick, Vol. 25 no 1: 1-3.
18 Bornman, H. The Pioneers of the Lowveld, p. 1.
19 Masson, J. 2008. Views from a Swaziland Cave. *The Digging Stick,* Vol. 25 no 1: 1-3.
20 PRMA: Information file 9/2.
21 D. Ziervogel, *The Eastern Sotho, A Tribal, Historical and Linguistic Survey,* p. 3.
22 Map: 1911 Topographical Map: KOMATIPOORT Degree Sheet no. 22.

training academy, Calcutta, Mkhuhlu, Bushbuckridge (2013*);*

- Phase 1 Archaeological and Heritage Impact Assessment for the proposed *Nkambeni* cemetery in Numbi, Hazyview *(2013);*
- Phase 1 Archaeological and Heritage Impact Assessment for a *Development on the farm Agricultural Holding no 56 JU,* White River (2013) was done in the wider area;
- Phase 1 Archaeological and Heritage Impact Assessment for proposed *agricultural development on the farm SIERAAD,* Komatipoort area, (2013) revealed one possible Late Stone Age borer which was identified in a soil sample, one meter below the surface;
- Phase 1 AIA / HIA for *proposed debushing of natural land for agricultural use: Portion 10 of the farm Thankerton 175JU, Hectorspruit,* Mpumalanga Province (2013); revealed some Later Stone Age artifacts which were all out of context and a burial site;
- Phase 1 AIA / HIA for the *proposed residential township, Tekwane extension 2, portion 7 of the farm Tekwane 537 JU.* No archaeological material of significance was identified.
- Report on Grave site found at *portion 7 of the farm Tekwane 537 JU, in way of amended Bulk Sewer Pipeline, Kanyamazane, Mpumalanga Province (2017)* – Large graveyard identified.
- Phase 1 AIA / HIA *for the proposed construction of a 0.75ML/D water treatment plant and bulk line on government land at Makoko Village (near White River) Kabokweni, Mpumalanga Province (2017) residential township, Tekwane extension 2, portion 7 of the farm* – no significant archaeological sites were observed;
- Letter of recommendation for the exemption from a Phase 1 AIA / HIA *for the proposed new position for the Gutshwa substation, Gutshwa (near White River) (2016);*
- Phase 1 AIA / HIA for the *proposed 2ha development of the Msogwaba Youth Development Centre on a portion of the farm Nyamasaan 647JU, Msogwaba, Mpumalanga province* - no significant archaeological sites were observed (2018).
- Phase 1 AIA / HIA for a *proposed agricultural development on the farm Krokodilspruit 248JT, White River, Mpumalanga Province (2019)* – some archaeological features as well as graves were observed.
- Phase 1 AIA / HIA for a *proposed establishment of macadamia plantations on portion 1 of the farm Peebles 31JU, White River, Mpumalanga Province* – some archaeological features were observed.
- Phase 1 AIA / HIA for a *proposed clearing of 30ha of indigenous vegetation for*

cultivation of indigenous vegetation on portions 6, 21 & R/14 of the farm Nooitgedacht 62JU, White River, Mpumalanga Province (2020); A historic house foundation was documented and proposed to be demolished.

The SAHRA database for archaeological and historical impact assessments was consulted and revealed other recent Archaeological Impact assessment reports in the wider area:

- J. Van Schalkwyk: *Proposed new Lebombo Port of Entry and upgrade of Komatipoort railway station between Mpumalanga (SA) and Mozambique (2008)* – Some historic buildings were identified but no archaeological remains were identified;
- A. Van Vollenhoven: *Report on a cultural Heritage Impact Assessment for the proposed Kangwane Antracite Mine, Komatipoort (2012)* – An archaeological site with Middle and Late Stone Age tools were identified as well as some Iron Age artifacts and decorated pottery. Mitigation measures were recommended by exclusion from the development or a Phase 2 study;
- JP Celliers: *Report on Phase 1 Archaeological Impact assessment on erven at Komatipoort 182 JU Extension 4, Komatipoort (2012)* **–** Revealed two pieces of undecorated sherds of pottery which was of low significance. It was recommended that any earthmoving activities be monitored by a qualified archaeologist.
- A. Van Vollenhoven: *Archaeological Impact Assessment for Border site at Komatipoort (2012)* – Revealed historic remains linked to the Steinaeker's Horse regiment during the South African War.
- A. Van Vollenhoven: *A Report on a basic assessment relating to cultural heritage resources for the proposed ESKOM Tekwane North line and substations, Mpumalanga Province (2013)* – revealed historic remains of low significance and a cemetery.

Very little contemporary research has been done on prehistoric African settlements in the study area. Later Stone Age sites in the Kruger National Park date to the last 2500 years and are associated with pottery and microlith stone tools. [23] The only professionally excavated Early Iron Age site near the area, besides those in the Kruger National Park, was the Plaston site east of White River, dating ca 900 AD. [24] No other archaeological excavations have been conducted to date within the study area, which have been confirmed by academic institutions and specialists in the field. [25] [26] Several stone walled settlements

[23] J.S. Bergh (red)., *Geskiedenis Atlas van Suid Afrika: Die vier Noordelike Provinsies,* p. 95.
[24] M.M. Van der Ryst., Die Ystertydperk, *in J.S. Bergh (red.), Geskiedenis Atlas van Suid Afrika: Die vier Noordelike Provinsies.* p. 97.
[25] Personal information: Dr. J. Pistorius, Pretoria, 2008-04-17.
[26] Personal information: Dr. MS. Schoeman, University of Pretoria, 2008-03-27.

with terracing were recorded in the area close to Hazyview, [27] as well as several which were documented in the southern parts of the Kruger National Park. [28] The southern Kruger Park and Nelspruit / Bongani Nature Reserve areas have an abundance of San rock art sites, [29] as mentioned above, but none was identified, or known on *the farm NOSILLA 27JU.*

Several early ethnographical and linguistic studies by early researchers such as D. Ziervogel and N.J. Van Warmelo, revealed that the study area was mainly inhabited by the Sotho groups (Pulana & Pai) and Swazi from before the 18th century. [30] [31] (See map 1: 1935: Map of Van Warmelo). When concentrating on ethnographical history, it is important to include a slightly wider geographical area for it to make sense. Van Warmelo based his 1935 survey of Bantu Tribes of South Africa on the number of taxpayers in an area. The survey does not include the extended households of each taxpayer, so it was impossible to reliably indicate how many people were living in one area. [32]

The whole district is divided in two, with the Drakensberg Escarpment in the west, and the Low Veld (in which the study area is situated) towards the east. Today, we found that the boundaries of groups are intersected and overlapping. [33] Languages such as Zulu, Xhosa, Swazi, Nhlanganu, Nkuna, sePedi, hiPau and seRôka, are commonly spoken throughout this area. [34]

During the middle of the 18th century some Sotho and Swazi groups combined under a fighting chief Simkulu. The tribe so formed became known as the BakaNgomane. The principal settlement of Simkulu was in the vicinity of the confluence of the Crocodile and Komati Rivers. It is believed that the BakaNgomane chiefs were also buried there. [35]

The Swazi under Mswati II (1845), commenced on a career of largescale raids, on the prosperous tribal lands to the north of Swaziland. His regiments such as the Nyatsi and the Malelane brought terror to African homes as far afield as Mozambique. [36] During their northern expansion they forced the local inhabitants out of Swaziland or absorbed them. [37] There is evidence of resistance, but the Eastern Sotho groups who lived in the northern parts

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[27] C. Van Wyk, *Inspection of Umbhaba Stone-walled settlement, Hazyview,* pp. 1-2.
[28] Eloff J.F., Verslag oor Argeologiese Navorsing in die Krugerwildtuin, June / July, 1982.
[29] Hampson, J., et al., The rock art of Bongani Mountain Lodge and its environs, *South African Archaeological Bulletin* 57: pp. 17-28.
[30] N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa.* pp. 90-92 & 111.
[31] H. S. Webb, The Native Inhabitants of the Southern Lowveld, *in Lowveld Regional Development Association, The South-Eastern Transvaal Lowveld.* p.16.
[32] N.J. van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, p.9.
[33] N.J. van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, p. 51.
[34] M. De Jongh (ed)., *Swatini,* p. 21.
[35] Bornman H., *The Pioneers of the Lowveld* pp. 10-11.
[36] Bornman H., *The Pioneers of the Lowveld* p 11.
[37] A.C. Myburgh, *The Tribes of Barberton District*, p. 10.

of Swaziland, moved mainly northwards. [38] This appears to have taken place towards the end of the 18th century, [39] when these groups fled from Swaziland to areas such as Nelspruit, White River, Bushbuckridge, Klaserie, Blyde River and Komatipoort. [40]

Mswati II built a line of military outposts from west to east of the upper Komati River and the Mlambongwane (Kaap River). At each outpost, he stationed regiments to watch and stop the BaPedi returning to their old haunts. [41] Shaka in the course of his military actions, came into conflict with Zwide Mkhatshwa (1819). Notwithstanding Zwide's numerical superiority, Shaka defeated him. The remnants of Zwide's tribe fled into the Eastern Transvaal where they settled. They ultimately found a new kingdom in Gaza land, which extended from just north of the current Maputo, up the east coast as far as the Zambezi River. [42]

Soshangane was a very powerful chief of the Gaza people, even though he was under the rule of Zwide. Soshangane decided to leave and was given full passage through Swaziland. He passed on his way through the Komati gorge, today known as Komatipoort, taking with him a great booty of cattle and women. Meanwhile more Shangane arrived and by 1896 some 2000 refugees settled between Bushbuckridge and Acornhoek where they are still living today. With the establishment of the Sabie Game Reserve (later known as the Kruger National Park), the BakaNgomane, their Shangaan protégés and Swazis who lived within its borders, were evicted in 1902, and went westward into Klaserie and Bushbuckridge areas, or south of the Crocodile River and established themselves in the Tenbosch and Coal Mine (Strijdom Block) areas, west and south of Komatipoort. The Swazi of Khandzalive moved to Mjejane or Emjejane, the current name for Hectorspruit [43] (see also: Map 1: 1935 Van Warmelo).

Swazi

The Swazi people descended from the southern Bantu (Nguni) who migrated from central Africa in the 15th and 16th centuries. [44] The differences between the Swazi and the Natal Nguni were probably never great, their culture as far as is known from the comparatively little research being carried out, does not show striking differences. Their language is a 'Tekeza' variation of Zulu, but through having escaped being drawn into the mainstream of the Zulus

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38 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa.* p. 111.
39 H. S. Webb, The Native Inhabitants of the Southern Lowveld, *in Lowveld Regional Development Association, The South-Eastern Transvaal Lowveld.* p. 14
40 *Ibid.,* p. 16.
41 Bornman H., *The Pioneers of the Lowveld* p. 12.
42 Bornman, H., *The Pioneers of the Lowveld*, p.17.
43 Bornman, H., *The Pioneers of the Lowveld*, p.19.
44 Swaziland: http://en.wikipedia.org/wiki/Swaziland p.1.

of the *Shaka* period, they became independent and their claim to be grouped apart as a culture is now well founded. [45]

Eastern Sotho group: The Pai

Van Warmelo identified the groups in northern Swaziland and the Pilgrim's Rest district before 1886 (including Sabie, Hazyview and White River), as Eastern Sotho (Pulana, Pai and Kutswe). According to Von Wielligh, the **Pai** occupied the area as far south as the Komati River (umLumati). Most of the younger generation has adopted the Swazi language. [46]
The Swazi constantly attacked the Eastern Sotho groups during the nineteenth century. The Pai fled to the caves in the mountains near MacMac (between Sabie and Pilgrim's Rest), while some of them (which were subjugated by a Swazi leader) fled from Mswazi in about 1853 to Sekukuniland (Steelpoort area) but decided to turn back towards their country along the Sabie River (1882). By this time, Europeans had already settled in this area when gold was discovered in 1873. [47]

Eastern Sotho group: The Pulana

The history of the **Pulana** goes back to the Barberton area from where they trekked via Krokodilpoort (Nelspruit district) to settle north-east of Pretoriuskop (near Hazyview). When the Swazi invaded them, they moved on and split up under several chieftainships, [48] of who chief Kobêng (after which Kowyns' Pass was named), is well-known in the area's history.

The Pulana roughly lived in the following areas: north of the Crocodile River, west of the western boundary of the Kruger National Park as far north as its crossing the Sabie River, south of the Sabie river until its cutting through the main road from Pretoriuskop (including Hazyview and close to White River), to Bushbuckridge, west of this road as far as Klaserie, south of a line drawn from Klaserie to the confluence of the Blyde and Orighstad rivers, and east of the Blyde River. This large area is divided in two by the main road from Pilgrim's Rest to Bushbuckridge. This road was since ancient times the only connection between the Low Veld and Escarpment and became known as "Kowyns' Pass". [49] The majority of Pulana lived to the north of this line, while south of this line the Pulana are scattered in groups into which are wedged Pai groups on both sides of the Sabie River, and Swazi peoples in the south, and south-eastern portions.[50] [51]

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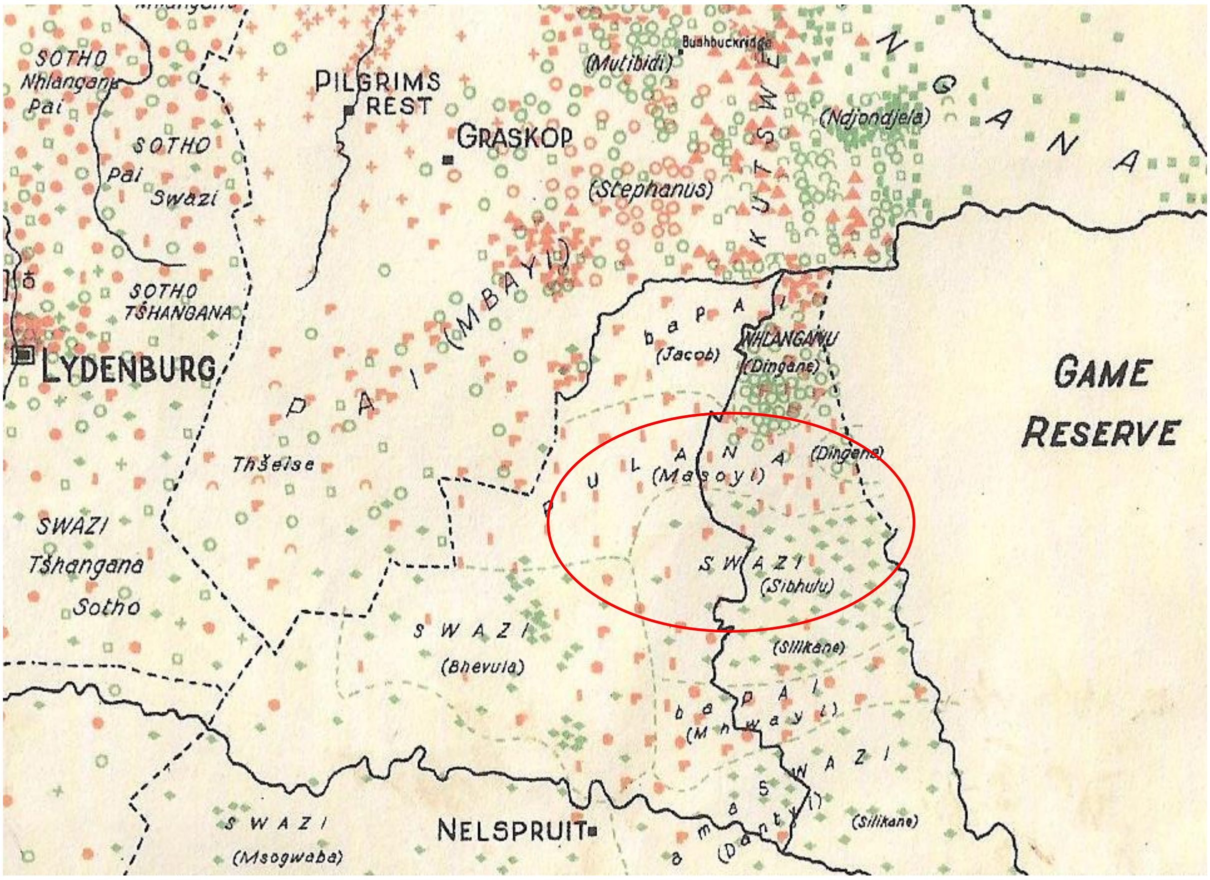
45 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, p. 83.
46 D. Ziervogel, *The Eastern Sotho, A Tribal, Historical and Linguistic Survey,* pp. 3-5.
47 D. Ziervogel, *The Eastern Sotho, A Tribal, Historical and Linguistic Survey,* p. 11.
48 *Ibid.,* p. 108.
49 M. De Jongh, (ed)., *Swatini,* p. 21.
50 D. Ziervogel, *The Eastern Sotho, A Tribal, Historical and Linguistic Survey,* p. 107.
51 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa.* p. 111.

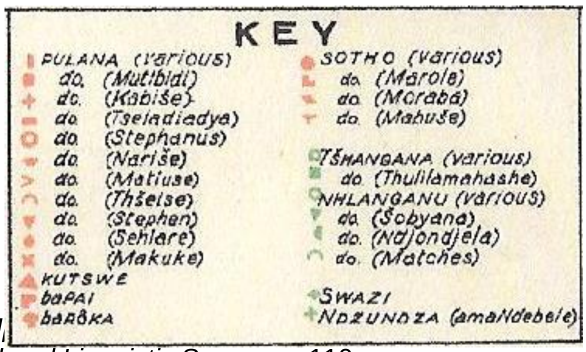
Eastern Sotho group: The Kutswe

The **Kutswe** trekked from the northern parts of Swaziland northwards as a result of pressure from the Swazi in the south. [52] The Kutswe settled north-east of the present Nelspruit at a river called Kutswe (Gutshwa) [53] from where they got their present name. From here they moved on and settled at various places, and ruins of their kraals are scattered from Pretoriuskop, Hazyview (Phabeni) as well as on the farms Welgevonden 364, Lothian 258, Boschhoek 47, Sandford 46, Culcutta 51 and Oakley 262.[54] They occupied additional areas between **White River and Sabie**, and had sufficient influence amongst the Pai during the early 20th century, to establish authority over more than 2000 individuals living on farms on both sides of the Sabie River from the town of Sabie as far as the main road from **White River / Hazyview to Bushbuckridge.** [55]



MAP 1: Van Warmelo: 1935:

The study area is indicated within the red oval.



52 *Ibid.,* p. 110.

53 T. Makhura, Early Inhabitants, *in Delius, P. (ed)., M*

54 D. Ziervogel, *The Eastern Sotho, A Tribal, Historical and Linguistic Survey,* p. 110.

55 *Ibid.,* pp. 4-10.

The historical background of the study area confirmed that it was occupied since the 17th century by mainly Swazi and to a lesser extent, Sotho groups (Pulana). These groups have intermarried extensively or were absorbed by other groups in time. [56]

MAP 2: 1911 Topographical map (Degree Sheet: Komatipoort No 22). NOSILLA is situated directly west of LEGOGOT. No features of interest were indicated on this map.

- **History of White River**

Early white settlers reported that there were relatively few black people in the district at the turn of the century, due to a combination of malaria, tsetse fly and the marauding Swazi impi's. There were however isolated kraals from the present Drum Rock Hotel near White River to Bushbuckridge (south-east of the study area). [57]

Just after the Anglo-Boer War, the High Commissioner of South Africa, Lord Alfred Milner, was investigating areas with favorable and healthy climates, fertile soil and lots of water,

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56 M. De Jongh (ed)., *Swatini,* p. 40.
57 Nevill C., White River Remembered, p. 68.

for farming. The ideal area that was identified was White River (or the White River Valley as it was then known). [58] Many ex-servicemen settled in the area, but conditions were harsh and by 1911 only a Scot named Macdonald successfully farmed with citrus. [59]

Today, citrus from this area is one of the main forms of agriculture in the Province. [60] Massive timber plantations were planted around White River and one of the biggest timber mills with the latest technology was built in 1982 in the town. [61]

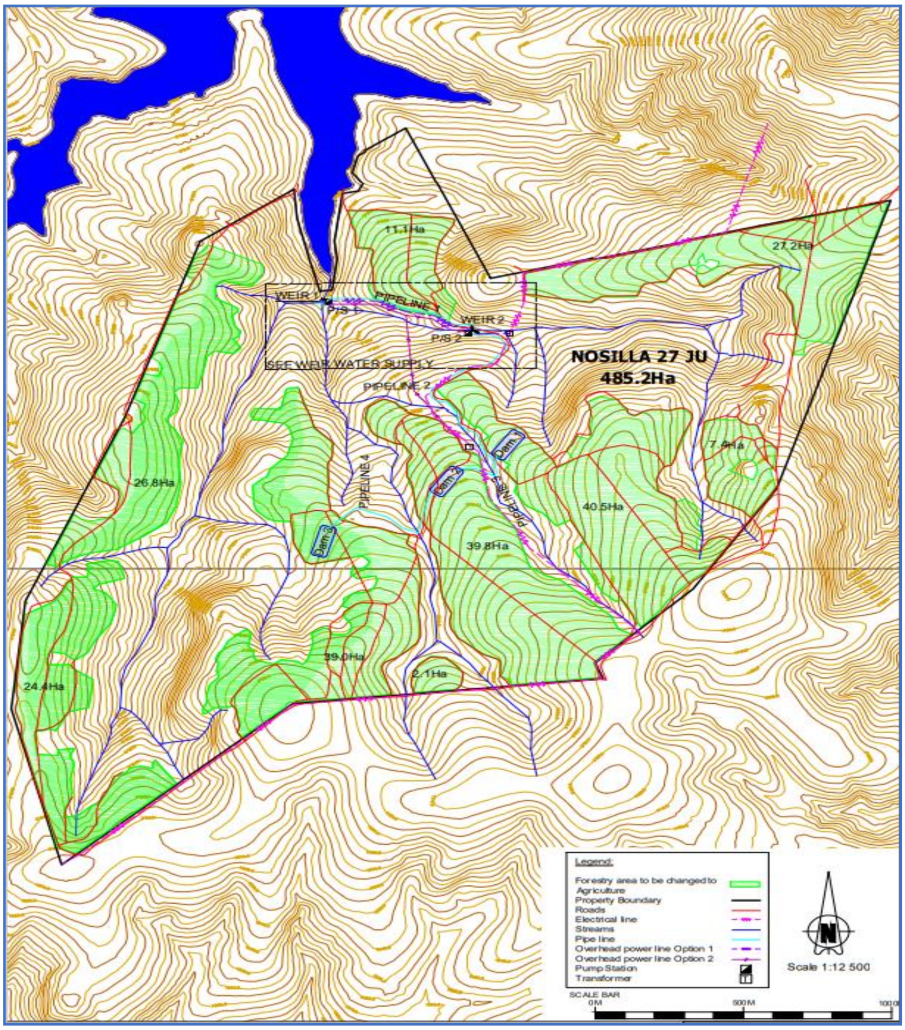
Fig. a: White River in 1905, consisted of a hotel, a general dealer and the managers' house. Photocopied from: Baanbrekers van die Laeveld, p. 39: Photo by Shirley Swanepoel.

C. DESCRIPTION OF THE AREA TO BE AFFECTED BY THE PROPOSED DEVELOPMENT

The applicant, Mr. Pieter du Preez, in co-operation with RHENGU Environmental Services, is requesting a bulk water supply infrastructure for agricultural use to harvest water for irrigation purposes (see maps 4 – 7). The entire study area consists of commercial Timber plantations which is in the process of being converted to macadamia, blueberry and ginger crops (see maps 3 & 8). Only small sections of natural vegetation are situated within the drainage lines and on the granite rocky outcrops, but these will be left undisturbed. No archaeological or historical features were observed on the property and the owner and farm manager confirmed that they have never encountered any graves or burial sites on the farm. [62] [63] The 1971 topographical map show that the entire farm was used for afforestation since at least

[58] Bornman, H., *Baanbrekers van die Laeveld*, p. 39.
[59] Nevill, C., *White River Remembered*, p. 3.
[60] Delius, P. & Hay, M., *Mpumalanga, an illustrated history*, p. 156.
[61] *Ibid*. p. 162.
[62] Personal communication: Mr. P. du Preez (Owner), 2020-04-15.
[63] Personal communication: Mr. H. Ferreira (Farm Manager), 2021-04-27.

this date (map 8), and the 1911 topographical does not indicate any settlement on the farm during that time (map 2). The proposed bulk water supply infrastructure will be situated on previously disturbed land and pipelines will follow the existing road network (see maps 4 & 8). The power line will connect with the existing ESKOM line and will also be established on disturbed plantation areas or road network. The two weirs (and pump stations) will be situated within the natural drainage lines where no archaeological or historical remains were observed. [64] (see maps 3 – 7 & figs. 1 - 11).



MAP 3: Study area (NOSILLA farm). The proposed bulk water supply infrastructure and other features are indicated in the map. (Map from MBB Consulting Engineers).

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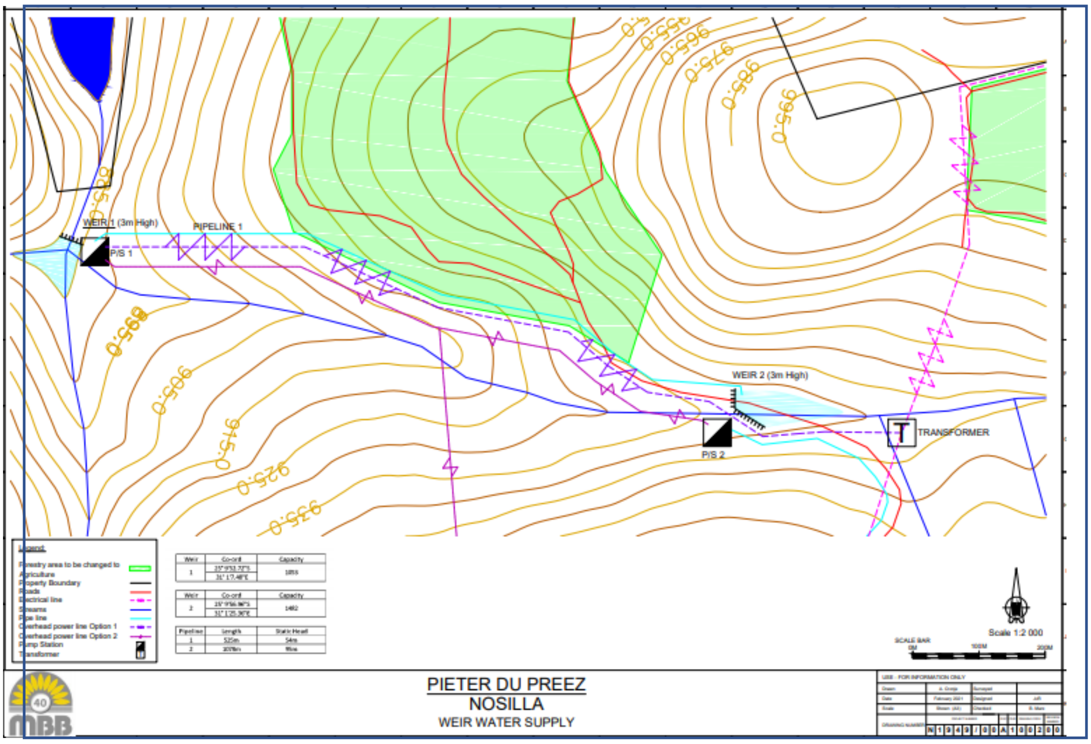
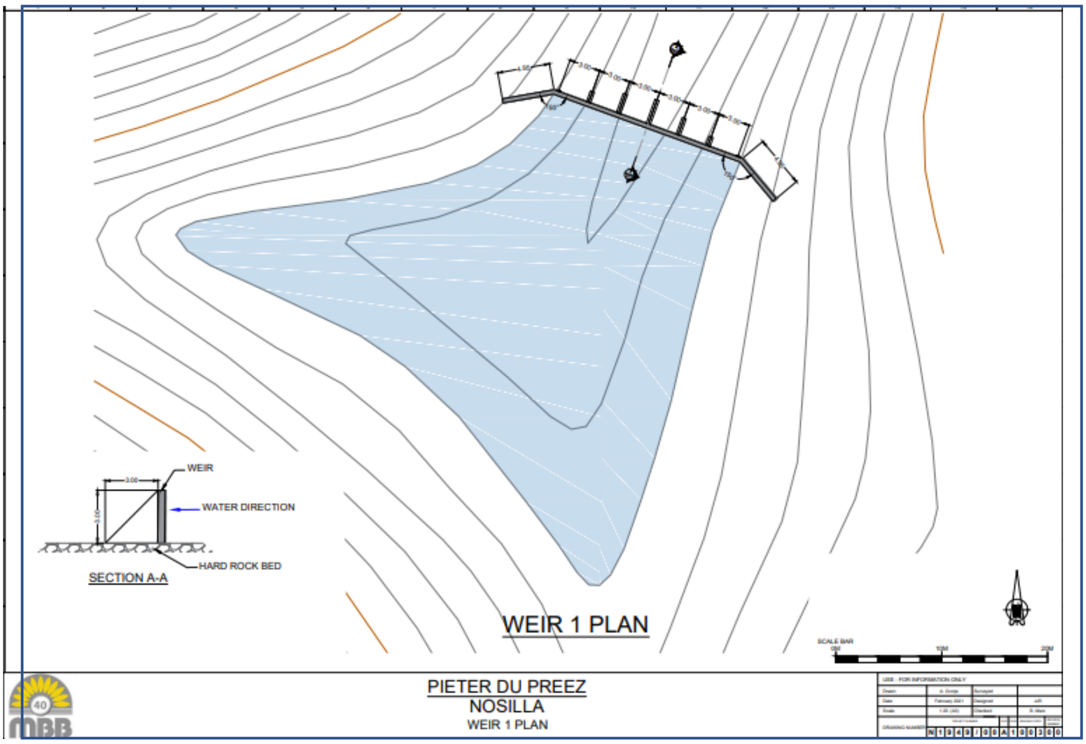
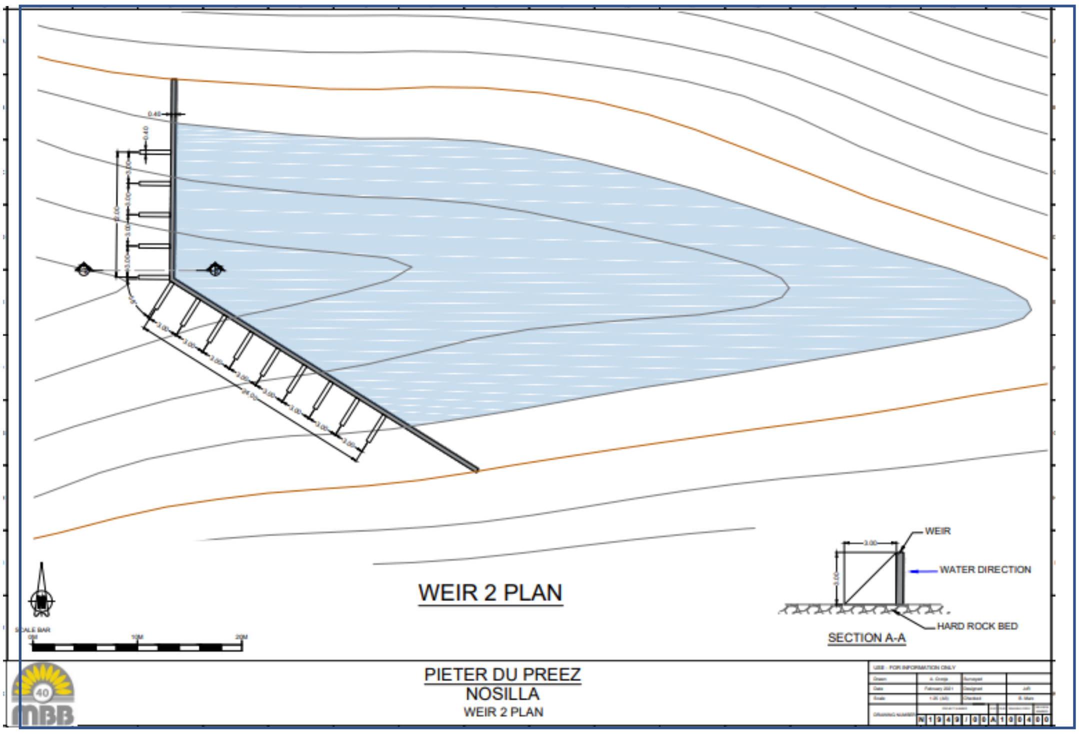
64 Needs & Desirability Report: Mr. Ralf Kalwa, e-mail access: 2021-04-25.



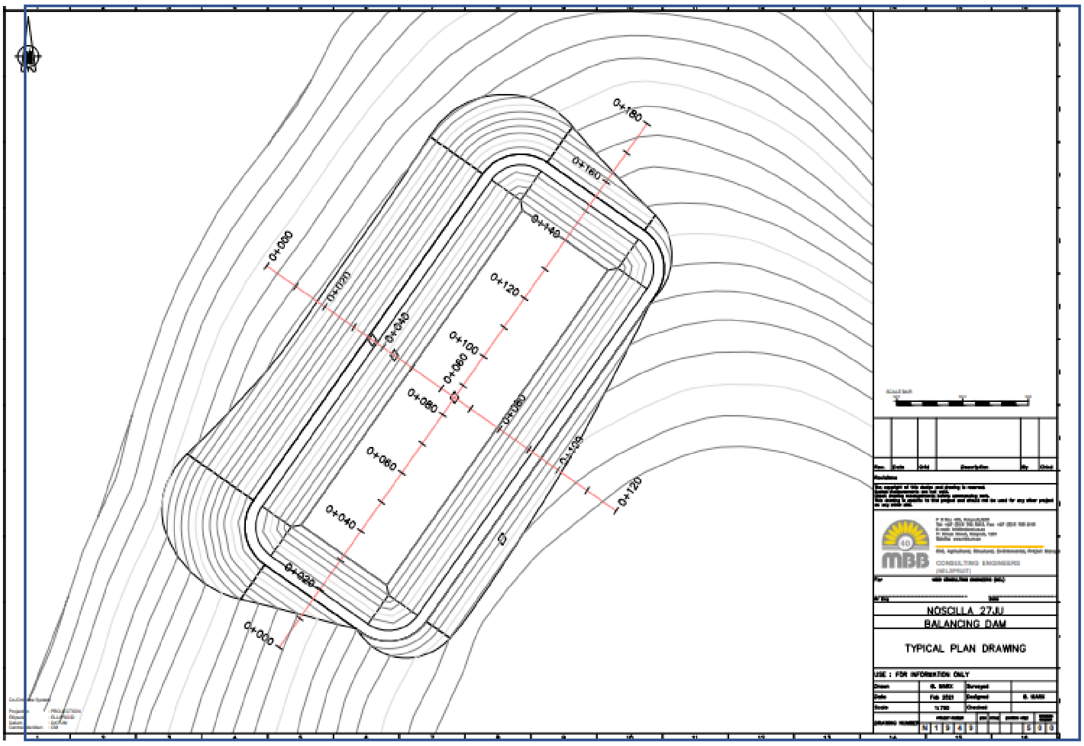
MAP 4: Detail of weir water supply indicating the pump stations, options for overhead powerlines and pipelines. (Map from MBB Consulting Engineers).



MAP 5: Plan of Weir 1. (Map from MBB Consulting Engineers).



MAP 6: Plan of Weir 2. (Map from MBB Consulting Engineers).



MAP 7: Typical plan drawing of the balancing dams. (Map from MBB Consulting Engineers).

The farm has a few natural and undisturbed granite outcrops with indigenous vegetation (fig. 11). Several drainage lines feed through the valley and into the Dagama dam to the north (8 & 9). The typical granite and dolerite plains have sandy soils and clayey soils in the lower areas. Most of the area is underlain by gneiss and migmatite of the Nelspruit Suite. Soils are of Mispah, Glenrosa and Hutton forms, shallow to deep, sandy or gravelly and well drained. [65] [66] [67]

The site is situated north of White River in the Lowveld region of Mpumalanga. The Lowveld is subtropical, due to its proximity to the warm Indian Ocean and latitude. The proposed development falls within the lower eastern slopes and hills of the north-eastern escarpment. Technically the ecozone representing this area is referred to Lowveld Sour Bushveld veld type according to Acocks (1988), or *Sour Lowveld Bushveld* according to Low & Rebelo 1998), and Schmidt et al (2002). [68]

D. LOCALITY

The proposed site for the development is situated between White River and Hazyview in the Lowveld region. The site is accessed off the R40 provincial road, approximately 12km north of the town of White River. The entire property is highly disturbed with existing timber plantations, except for small pockets of natural vegetation within the drainage lines. The farm is west of the Legogote Hill, a prominent landmark in the area, where a rock art site is also known. [69] The farm NOSILLA 27JU is located within the X31H-2 quinary catchment on a tributary of the White Waters River, which is a tributary of the Sabie River. [70] The site falls within the Ehlanzeni District Municipality, and the City of Mbombela Local Municipal in the Mpumalanga Province (maps 1 - 10 & Appendix 2 figs. 1 – 11 for the study area).

Description of methodology:

The 1971 topographical map, (2531AA KIEPERSOL, map 8), a 1911 map (Degree Sheet 22, KOMATIPOORT), as well as Google images were intensively studied to assess the current and historically disturbed areas and infrastructure on the farm NOSILLA 27JU (maps 2 & 3, 9 - 10).

In order to reach a comprehensive conclusion regarding the cultural heritage resources in the study area, the following methods were used:

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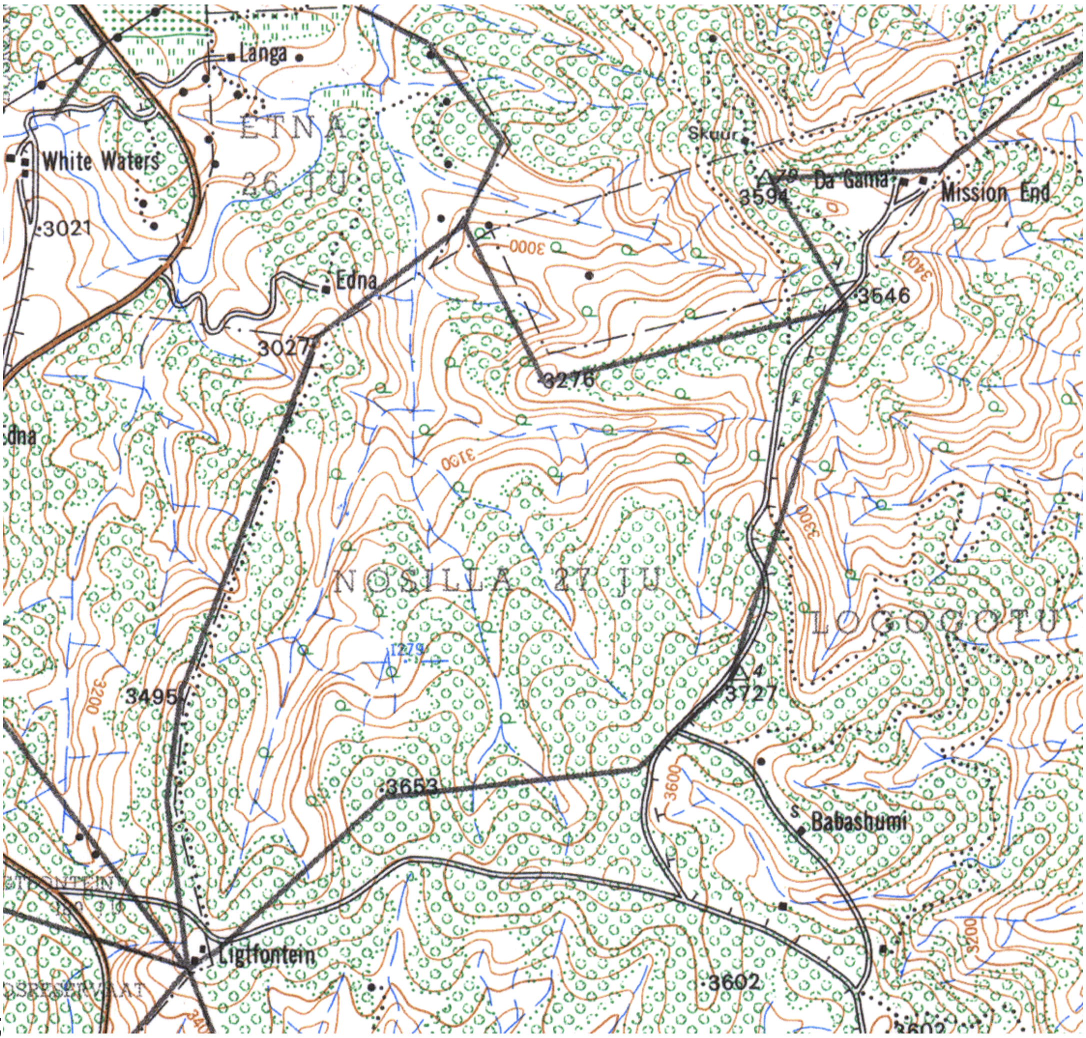
65 SANPARKS, Visitors Guide to the Kruger National Park, p. 2.
66 Van Wyk, B., & Van Wyk P., Field Guide to Trees of Southern Africa, 1997, p. 500.
67 Personal Communication: Dr. Andrew Deacon (for White River area), 2018-11-22.
68 Personal Communication: Dr. Andrew Deacon (for White River area), 2018-11-22.
69 Bornman, H., *Baanbrekers van die Laeveld*, p. 1.
70 IWR Water Resources, Water Resources Analysis of a Forestry to irrigation conversion on the property Nosilla 27JU, Mpumalanga, p. 4.

- The desktop study consisted mainly of archival sources studied on distribution patterns of early African groups who settled in the area since the 17th century, and which have been observed in past and present ethnographical research and studies.
- Literary sources, books and government publications, which were available on the subject, have been consulted, in order to establish relevant information.
- Specialists currently working in the field of anthropology and archaeology have also been consulted on the subject.

-Literary sources: A list of books and government publications about prehistory and history of the area were cited, and revealed some information;



;

MAP 8: Topographical Map 1:50 000 (1971), 2531AA KIEPERSOL. Nosilla 27JU was already an established timber farm since at least 1971.

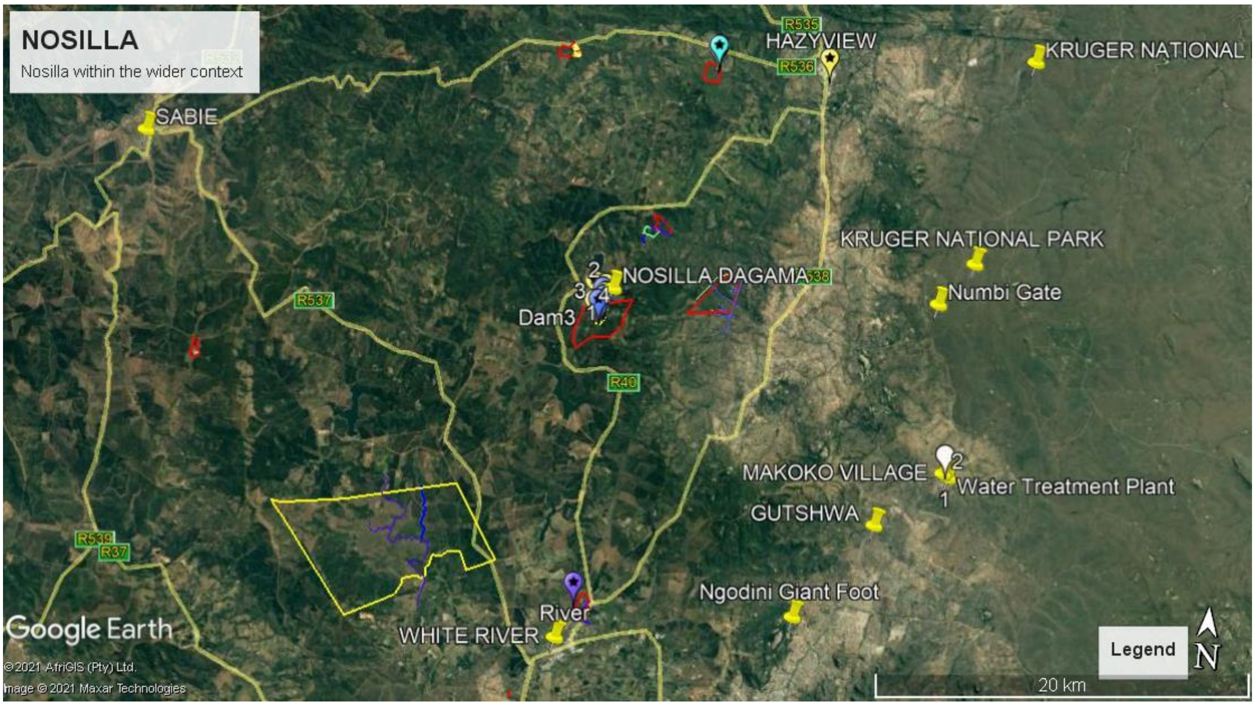
-The archaeological database of SAHRA as well as the National Cultural History Museum were consulted. Heritage Impact Assessment reports of specialists who worked in the area were studied and are quoted in section B.

- The fieldwork and survey were conducted extensively by three people on foot and per vehicle. Existing tracks and paths were also used to access sections (see Appendix 1).

- Large sections of previous timber plantations are being converted into agricultural land, which made visibility excellent. The sections which are still covered with commercial plantations, were already disturbed since at least 1971. An existing road network was used to access the sites (Appendix 1). Weir 1 was situated in the valley where three drainage lines meet (figs. 6 - 9). Weir 2 was situated next to an existing access road, near a natural stream (figs. 10 & 11). The proposed dams are all within existing plantations or recently cleared plantation areas (figs. 2 – 5). The pipeline and powerlines will be constructed within existing roads or within disturbed plantation areas.
- The relevant data was located with a GPS instrument (Garmin Oregon 750) datum WGS 84 and plotted. Co-ordinates were within 3 meters of identified sites.
- Evaluation of the resources which might be impacted upon by the footprint, was done within the framework provided by the National Heritage Resources Act, no. 25 (1999);
- Personal communication with environmental practitioner Mr. Ralf Kalwa, the owner Mr. Du Preez, [71] as well as the farm manager, Mr. Ferreira, [72] were held.
- GPS co-ordinates were used to locate the perimeters and any heritage features within the study area. Co-ordinates: see project maps 3 & 4.

GPS CO-ORDINATES			
Location	**South**	**East**	**Elevation**
WEIR 1	S 25° 09' 51.56"	E 31° 01' 06.01"	906m
WEIR 2	S 25° 09' 55.60"	E 31° 01' 27.60"	957m
DAM 1	S 25° 10' 10.80"	E 31° 01' 27.90"	1019m
DAM 2	S 25° 10' 18.05"	E 31° 01' 22.21"	1041m
DAM 3	S 25° 10' 25.00"	E 31° 01' 06.58"	1042m

[71] Personal communication: Mr. P. du Preez (Owner), 2020-04-15.
[72] Personal communication: Mr. H. Ferreira (Farm Manager), 2021-04-27.



MAP 9: Google image of the study area, as seen in a wider context.

E. DESCRIPTION OF IDENTIFIED SITES

Mr. Pieter du Preez, in co-operation with *RHENGU Environmental Services,* is requesting the establishment of a bulk water supply infrastructure in the form of weirs and off-channel storage facilities (dams, pipeline and pumpstations), as well as a powerline connecting to the existing ESKOM lines, on the farm NOSILLA 27JU*,* in the White River district of Mpumalanga. [73]

The entire farm NOSILLA is currently a commercial Timber property (highly disturbed area) (maps 8 & 9). The owner is planning to remove 218.3ha forestry to establish macadamia, blueberries and ginger to expand the current existing enterprise of the neighboring property (St Cloud farm). [74] The terrain was accessible throughout the survey (see Appendix 2).

The historical and topographical maps do not indicate any historical or pre-historical settlements directly in, or close to the study area (maps 2 & 8). The 1971 topographical map (map 8) indicates that the entire farm was already an established commercial timber farm from at least this date. No archaeological or historical structures / features, or any burial sites or graves were observed during the survey.
Photographs in Appendix 2 show the general view of the study area, as well as the locations for the weirs and dams (figs. 1 - 11).

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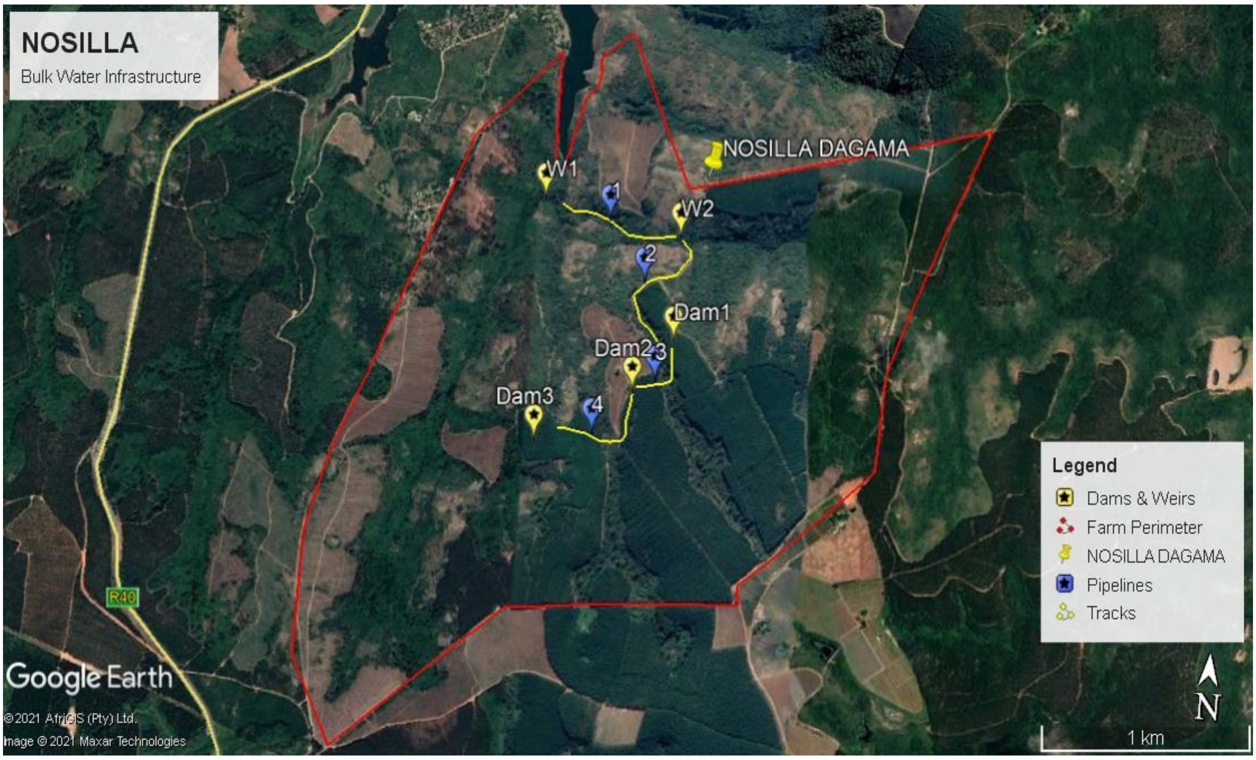
[73] Needs & Desirability Report: Mr. Ralf Kalwa, e-mail access: 2021-04-25.
[74] Provisional development Plan Table, 2021-01-18, p.1.



MAP 10: The map is indicating the footprint of the proposed bulk water infrastructure on the farm Nosilla.

F. DISCUSSION ON THE FOOTPRINT OF THE PROPOSED DEVELOPMENT

ACT	*COMPO-NENT*	*IMPLICATION*	*RELEVANCE*	*COMPLIANCE*
NHRA	S 34	Impact on buildings and structures older than 60 years	None	None
NHRA	S35	Impacts on archaeological heritage resources	None	None
NHRA	S36	Impact on graves	No graves within the study area	None
NHRA	S37	Impact on public monuments	None present	None
NHRA	S38	Developments requiring an HIA	Development is a listed activity	HIA done
NEMA	EIA regulation	Activities requiring an EIA	Development is subject to an EIA	HIA is part of EIA

- **Summarised identification and cultural significance assessment of affected heritage resources: General issues of site and context:**

Context		
Urban environmental context	No	NA
Rural environmental context	No	NA
Natural environmental context	No	NA
Formal protection (NHRA)		
(S. 28) Is the property part of a protected area?	No	NA
(S. 31) Is the property part of a heritage area?	No	NA
Other		
Is the property near to or visible from any protected heritage sites	No	NA
Is the property part of a conservation area of special areas in terms of the Zoning scheme?	No	NA
Does the site form part of a historical settlement or townscape?	No	NA
Does the site form part of a rural cultural landscape?	No	NA
Does the site form part of a natural landscape of cultural significance?	No	NA
Is the site adjacent to a scenic route?	No	NA
Is the property within or adjacent to any other area which has special environmental or heritage protection?	No	NA

Context		
Does the general context or any adjoining properties have cultural significance?	No	NA

Property features and characteristics		
Have there been any previous development impacts on the property?	Yes	Commercial Timber property
Are there any significant landscape features on the property?	No	NA
Are there any sites or features of geological significance on the property?	No	NA
Does the property have any rocky outcrops on it?	Yes	Rocky outcrops occur
Does the property have any fresh water sources (springs, streams, rivers) on or alongside it?	Yes	Drainage lines.

Heritage resources on the property		
Formal protection (NHRA)		
National heritage sites (S. 27)	No	NA
Provincial heritage sites (S. 27)	No	NA
Provincial protection (S. 29)	No	NA
Place listed in heritage register (S. 30)	No	NA
General protection (NHRA)		
Structures older than 60 years (S. 34)	No	NA
Archaeological site or material (S. 35)	No	NA

Heritage resources on the property		
Palaeontological site or material (S. 35)	No	NA
Graves or burial grounds (S. 36)	No	NA
Public monuments or memorials (S. 37)	No	NA
Other		
Any heritage resource identified in a heritage survey (author / date / grading)	No	NA
Any other heritage resources (describe)	No	NA

NHRA	***ELEMENTS***	***INDICATORS OF HERITAGE SIGNIFICANCE***										***RISK***
S (3)2 ***Heritage resource category***		Historical	Rare	Scientific	Typical	Technological	Aesthetic	Person or community	Landmark	Material condition	Sustainability	
Buildings / structures of cultural significance	No	No	No	No	No	No	No	No	No	No	No	-
Areas attached to oral traditions / intangible heritage	No	No	No	No	No	No	No	No	No	No	No	-
Historical settlement/ townscapes	No	-	-	-	-	-	-	-	-	-	-	-
Landscape of cultural significance	No	-	-	-	-	-	-	-	-	-	-	-
Geological site of scientific/ cultural importance	No	-	-	-	-	-	-	-	-	-	-	-
Archaeological / palaeontological sites	No	-	-	-	-	-	-	-	-	-	-	-
Grave / burial grounds	No	-	-	-	-	-	-	-	-	-	-	-
Areas of significance related to labour history	No	-	-	-	-	-	-	-	-	-	-	-
Movable objects	No	-	-	-	-	-	-	-	-	-	-	-

- **Summarised recommended impact management interventions**

NHRA S (3)2 Heritage resource category	***SITE***	***IMPACT SIGNIFICANCE Cultural significance rating***		***Impact management***	***Motivation***
		Cultural significance	***Impact significance***		
Buildings / structures of cultural significance	No	No	None	None	-
Areas attached to oral traditions / intangible heritage	No	None	None	-	-
Historical settlement/ townscape	No	None	None	-	-
Landscape of cultural significance	No	None	None	-	-
Geological site of scientific/ cultural importance	No	None	None	-	-
Archaeological / palaeontological sites	No	None	None	No impact	-
Grave / burial grounds	No	No	None	-	-
Areas of significance related to labour history	No	None	None	-	-
Movable objects	No	None	None	-	-

ACT	***COMPO-NENT***	***IMPLICATION***	***RELEVANCE***	***COMPLIANCE***
NHRA	S 34	Impact on buildings and structures older than 60 years	NA	None
NHRA	S35	Impacts on archaeological and palaeontological heritage resources	NA	None
NHRA	S36	Impact on graves	NA	None
NHRA	S37	Impact on public monuments	None present	None
NHRA	S38	Development requiring an HIA	Development is a listed activity	Full HIA
NEMA	EIA regulation	Activities requiring an EIA	Development is subject to an EIA	HIA is part of EIA

G. STATEMENT OF SIGNIFICANCE & EVALUATION OF HERITAGE RESOURCES

Section 38 of the NHRA, rates all heritage resources into National, Provincial or Local significance, and proposals in terms of the above are made for all identified heritage features.

- **Evaluation methods**

Site significance is important to establish the measure of mitigation and / or management of the resources. Sites are evaluated as *HIGH (National importance), MEDIUM (Provincial importance) or LOW, (local importance),* as specified in the NHRA. It is explained as follows:

- **National Heritage Resources Act**

The National Heritage Resources Act no. 25, 1999 (NHRA) aims to promote good management of the national estate, and to enable and encourage communities to conserve their legacy so that it may be bequeathed to future generations. Heritage is unique and it cannot be renewed and contributes to redressing past inequities.[75] It promotes previously neglected research areas.

All archaeological and other cultural heritage resources are evaluated according to the NHRA, section 3(3). A place or object is considered to be part of the national estate if it has cultural significance or other special value in terms of:

(a) its importance in the community, or pattern of South Africa's history;

(c) its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;

(g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;

(h) its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.[76]

Please note that no archaeological or cultural heritage features or graves were observed during the field investigation.

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75 National Heritage Resources Act, no. 25 of 1999. p. 2.

76 National Heritage Resources Act, no. 25 of 1999. pp. 12-14

H. CONCLUSION

Archaeological material or graves are not always visible during a field survey and therefore some significant material may only be revealed during the construction of the bulk water supply infrastructure development. Based on the survey and the findings in this report, Adansonia Heritage Consultants state that there are no compelling reasons which may prevent the proposed development to continue in the study area. It is recommended that an assessment and recommendation be done by a qualified archaeologist, should any other archaeological material be found during development activities.

Adansonia Heritage Consultants cannot be held responsible for any archaeological material or graves which were not located during the survey.

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- http://en.wikipedia.org/wiki/Swaziland, Access: 2013-06-13.

PERSONAL INFORMATION

- Personal communication: Dr. A. Deacon, (areas around White River), 2018-11-22.
- Personal communication: Mr. R. Kalwa, Rhengu Environmental Services, 2021-04-25.
- Personal communication: Mr. P. Du Preez, Owner, Cell: 0844511601.
- Personal communication: Mr. H. Ferreira, Cell: 082626869.
- Personal communication: Mr. Solomon, (PEEBLES Farm), 2019-10-19.

MISCELLANEOUS

- Map: 1911 Topographical Map: Komatipoort Degree Sheet no. 22.
- IWR Water Resources, Water Resources Analysis of a Forestry to irrigation conversion on the property Nosilla 27JU, Mpumalanga, January 2021.
- MBB Consulting Services: Nosilla 27JU Engineering Planning Report, February 2021.
- Needs & Desirability Report: Mr. Ralf Kalwa, e-mail access: 2021-04-25.
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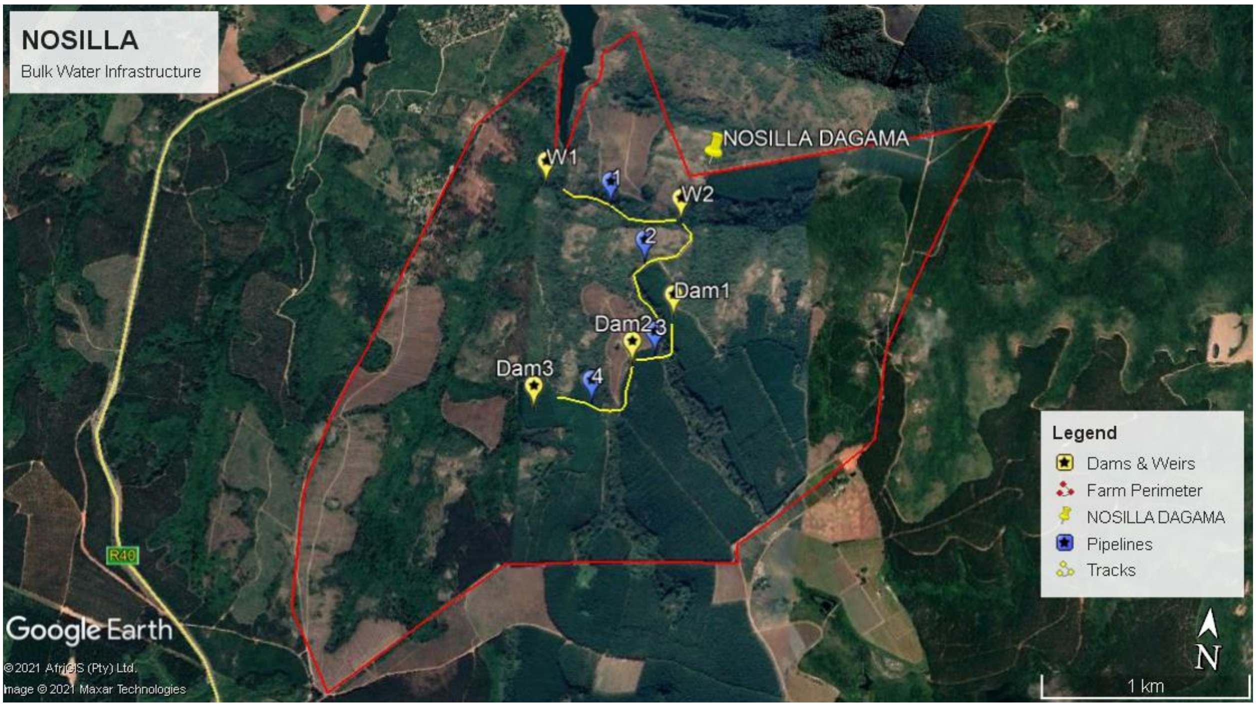
APPENDIX 1

Tracks and Paths used to access the study area



Tracks and paths which were used during the survey.

APPENDIX 2: PHOTOGRAPHIC DOCUMENTATION OF NOSILLA

Fig. 1: A panoramic view of the study area. The arrows indicate roughly where the three dams will be located. The Weirs will be constructed in the valley below.

Fig. 2: The area for Dam 1 was previously a timber plantation which has been cleared of vegetation. The view faces north.

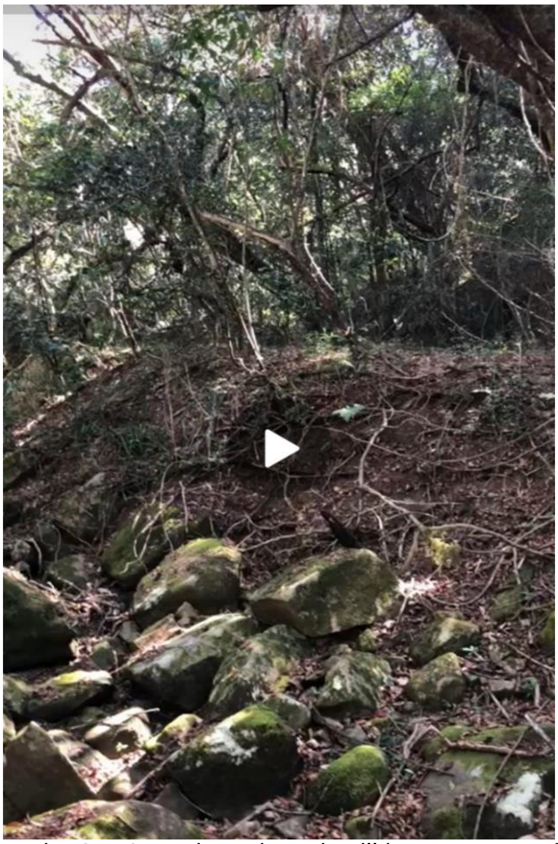
Fig. 3: Another view of the area where Dam 1 will be located. The Dagama Dam is visible in the north.

Fig. 4: A general view of the area where Dam 2 will be located. The area is still part of the timber plantation, with young trees.

Fig. 5: A general view of the location for Dam 3. The area is entirely within the timber plantation.

Fig. 6: Weir 1 will be located in the drainage line between the two hills. The arrow indicates the area.

Fig. 7: A closer view of the area where Weir 1 will be located (see arrows).



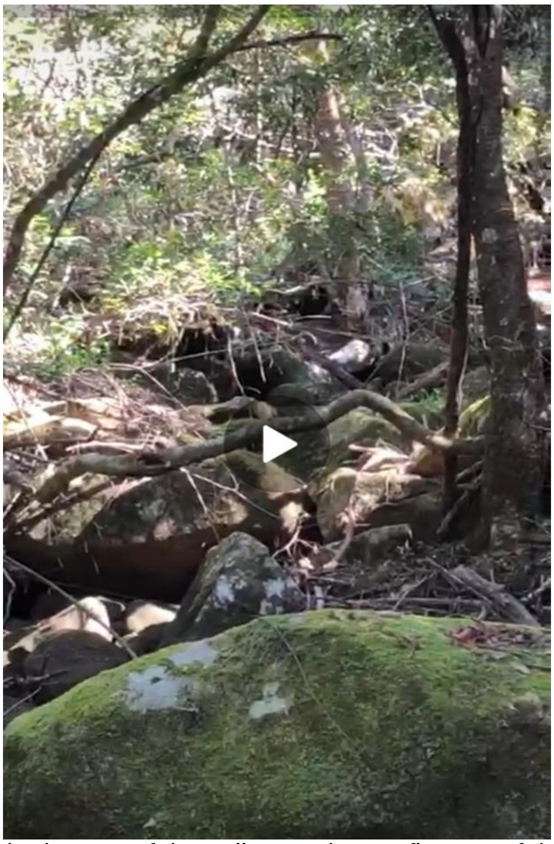


Fig. 8 & 9: Weir 1 where it will be constructed at the bottom of the valley, at the confluence of three drainage lines. The drainage lines are currently dry.

Fig. 10: Weir 2 will be constructed from the low outcrop to the left (see arrow), to incorporate the stream which flows under the gravel road (see arrow).

Fig. 11: The rocky outcrop to the left of the area where Weir 2 will be constructed.

APPENDIX 5:

ENVIRONMENTAL MANAGEMENT PROGRAMME

1. ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPr): DEVELOPMENT ACTIVITIES

1.1. The environmental management programme will address the development phase of the proposed activity. This will include the construction of the two weirs and pump houses. Furthermore, it will include the preparation of the orchards and the installation of services (irrigation pipelines).

1.2. The EMPr will primarily be used by the applicant/blue gum clearing/construction teams under the guidance of the ECO. For this purpose, the EMPr must serve a number of functions. These are:

- Instructions and conditions included in the EMPr must be written in a clear, down to earth language.
- All aspects of the EMPr must be practical and unambiguous.
- Instructions and conditions must be concise and to the point.
- Aspects of the EMPr must reflect the recommendations and mitigation measures listed in the Environmental Impact Assessment Report/s.
- Aspects of the EMPr must reflect the recommendations and mitigation measures listed in the Specialist Studies and the comments by Interested and Affected Parties/Government Departments. See **Appendix 2** in the EIR.
- The EMPr must be used to monitor compliance to the conditions stipulated in the Authorisation of the Project as issued by DARDLEA.
- Aspects of the EMPr can be referred to in an Operational Management Programme (OMPr) during future Environmental Audit Assessments.
- The EMPr must ensure the protection of the natural environment and cover all aspects of rehabilitation/sustainable preparation of the impacted sites.
- The EMPr will guide the process from initiation until sign off the project.
- **Note:** The EMPr will remain a dynamic document which can be updated with the approval by DARDLEA.

1.3. The implementation of the EMPr will be guided by an Environmental Control Officer (ECO).

- The applicant/developer is responsible for the appointment of the ECO.
- The name and contact details of the ECO must be submitted to DARDLEA once the project commences.
- All Interested and Affected Parties (I&AP's) must be informed of the name and contact details of the ECO.

1.4. Monitoring and Auditing

The Environmental Control Officer (ECO) will ensure that all the **conditions** as set out in the **Environmental Authorisation (EA**) **and any other requirements as issued by DARDLEA or any other applicable Department, e.g., DWS**, are met and implemented as stipulated.

The ECO must submit to DARDLEA, a **quarterly audit report** on the activities of the development. Quarterly audit reports will be made available to I&AP's on request.

The role of the ECO and independent audit teams are well defined within the framework of Integrated Environmental Management (IEM). The developer, together with the ECO will ensure **compliance** in terms of this process**.**

1.5. Initial Role-players: Contact Details:

1. Developer/Applicant/Representative: Pieter du Preez	Cell: 083 679 9366
2. ECO: To be appointed	Cell: To be confirmed.
3. EAP: Ralf Kalwa	Cell: 082 414 7088

2. DEVELOPMENT PHASE: ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPr)

This programme must be read in conjunction with the **Contract Documents** for the project. This environmental management programme will address the development/preparation phase of the proposed development as described in Environmental Impact Assessment Report.

KEY ISSUES: EMPr

This programme is designed for the entire development period and includes the rehabilitation of areas where development/storage activities took place.
The Contractor/Applicant, together with the Environmental Control Officer (ECO) will be responsible to ensure that all construction workers, sub-contractors, suppliers and relevant personnel associated with the development:

- Understand the contents of the Environmental Management Programme (EMPr).
- Ensure that all the construction/farm personnel are fully aware of all environmental issues relating to the development activities.
- Adhere to all the precautionary and mitigating measures described in the EMPr.
- Ensure that all the construction personnel understand the implications and stipulations of the Environmental Rules and Regulations described in the Development Contract.
- The ECO shall instruct the Applicant/Developer to suspend the works if the Contractor and/or any Sub-Contractors do not comply with the contents of the EMP.
- The ECO will submit quarterly audit reports to DARDLEA, the Contractor and the Developer.
- The EMPr describes the responsibilities of all the staff during the development phase.
- The ECO will oversee the operations and ensure compliance with the EMPr.

Non-Compliance: The Contractor/Applicant is deemed NOT to have complied with the EMPr, the Environmental Authorisation and the EIA if:

- Within the boundaries of the site, site extensions and haul/access roads there is evidence of contravention of the Specifications of the EMPr;
- Environmental damage ensues due to negligence;
- The Contractor fails to comply with corrective or other instructions issued by the ECO within a specific time;
- The Contractor fails to respond adequately to complaints from the public;

Prior to construction: The Contractor/Applicant, in liaison with the ECO will submit a final layout plan of the development site indicating all of the following: storage areas, hazardous substances storage area (if applicable), different stockpile areas, material stores, waste disposal areas, on site offices, workshops, ablutions, access roads, no go areas etc. This construction site layout plan must be submitted to DARDLEA and the ECO prior to site establishment. Once the layout is approved by the ECO the Contractor will be required to sign acceptance of the EMPr and commence with the development. **Note:** Contractor = Construction of the weirs and pump houses and Installation of Irrigation Systems etc.

2. DEVELOPMENT PHASE: ENVIRONMENTAL MANAGEMENT PROGRAMME: The ECO will monitor compliance of this EMPr		
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
1. Site Establishment and Logistics.	**<u>1. Site Office and Logistics</u>**: Establish a site office for the development. The Farmer's Office can serve this purpose. The following procedures and equipment must be made available at the office: • Copies of the EIA and the EMPr. • Copy of the Environmental Authorisation. • Copies of the Development/Site Layout Plan (Weirs). • A Complaints Register. • A Corrective Actions and Site Instruction Register. • An Emergency/Evacuation Procedure. • A Monitoring- and Audit Register. • Emergency Contact Numbers including but not limited to telephone contact details for medical doctors; hospitals; emergency helicopters; emergency fire management; the ECO and Project/Site Manager. • Fire Extinguishers. • First Aid Kit. • A register of all applicable Standard Operational Procedures and Method Statements (e.g., handling of hazardous materials) of materials and equipment that are used and stored on site.	**Contractor and the ECO**
	<u>2. Final Walk Inspection (Pre-Construction)</u>: A final walk through the site with the ECO to point out the presence sensitive areas, e.g., Special Plants/Habitat/Drainage Line, or any other aspect which requires protection has to be undertaken prior to site establishment.	
	• All staff must be trained to respect the importance of rare/conservation significant plants and artefacts. This is specifically applicable to the no-go area around the drainage lines, any rocky outcrops and buffer areas.	
	• Special features (rocky outcrops; large indigenous trees; rivers; wetland; buffer zone etc.) must be indicated on the development map and demarcated on site prior to construction. Damage to such features must be rehabilitated to the satisfaction of the ECO and the developer. • Implement the 20m buffer zone delineation. • Refer to the **Final Development Map attached to this EMPr**.	
	• All drainage lines must be demarcated to ensure that all machinery is kept out of these zones.	
	• **<u>Timing</u>**: All development should take place in the period April-October.	

	3. Demarcation: Demarcate the boundaries of the total development site (weir sites) for management purposes using steel droppers/standards spaced at regular intervals with a combination of nylon rope/barrier tape between the droppers. **This will be required in the vicinity of the riparian zones, rocky outcrops and sites with special plants of concern.**	
	• The Contractor shall maintain the demarcation line and ensure that materials used for construction on site do not blow on or move outside the site or pose a threat to any neighbours or adjoining property owners.	
	• Where applicable, structures must be located in such a manner as to reduce visual intrusion and minimal disturbance to neighbouring properties. Make use of coloured netting or corrugated cladding to hide unsightly features.	
	• Construction activities are restricted within these boundaries, thus all construction equipment, materials and personnel will remain within this demarcated area at all times.	
	• Ensure that access to the site including related infra-structure and machinery is restricted to authorised personnel only.	
	4. Site Control: Limit the construction/development site to existing infrastructure and or to disturbed areas.	
	• Ensure that only approved workers and Sub-Contractors are accommodated and allowed access to the site.	
	5. Site Facilities: The construction site and storage areas must be safeguarded against fire. • Ensure that the Contractors Site/Farm Maintenance Yard is fully functional in terms of water- and sewerage supply (temporary toilets) prior to the contractors coming on site.	
	• Contractor to be held responsible for providing construction-, drinking- and washing water for all the activities on site.	
	6. Access Routes and Control: No temporary access routes and haul roads are required for this activity. • No vehicle movement outside demarcated areas/routes/existing roads is permitted without authorisation from the ECO.	
	• Dust control measures, i.e., dampening access routes with water, must be implemented where necessary.	
	• Damage to any existing roads as a result of construction activities will be repaired to the satisfaction of the ECO and the Developer/Applicant.	

	7. Storage- and Material Laydown Areas: The need for laydown/storage areas will be minimal however irrigation piping, pumps, cement, re-inforcing etc. will require a site when these materials are delivered and until these items are installed/used.	
	• All equipment, materials; pipelines etc. must be stored at the farm maintenance centre.	
	8. Site Closure: Once the development period e.g., weir sites, are completed the following conditions will apply:	
	• The Contractor shall ensure that all temporary structures/facilities, equipment, materials and waste used for construction activities are removed after completion of development.	
	• The contractor shall clear and clean the construction site to the satisfaction of the ECO and the developer upon completion of the development.	
	• Remove all components of demarcation when the development phase is completed.	
	• Rehabilitate disturbed areas. This will include but not be limited to: • Break up any hardened soil surfaces allowing seeds and rainwater an opportunity to penetrate the soil surface. • Brush pack/landscape bare areas and reduce the potential run-off of water. • Shape/level off any unnatural areas to fit in with the surrounding landscape.	
	Site Closure: Should the site be closed for a period of more than one week, a report on compliance will be lodged with the ECO, and the following will be confirmed: • Stores will be left at as low a volume as practically possible with no leaks. • The store area will be secure and locked. • Fire extinguishers will be serviced and accessible. • The area will be secure from accidental damages. • Emergency- and contact numbers will be available and prominently displayed. • Temporary toilets will be empty and secured. • Refuse bins will be empty and secured. • Access to the site must be limited to authorised personnel only. • Security staff will patrol and guard the site.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
2. Site Biodiversity Management. (The ECO must be consulted at all times during this process).	**<u>1. Vegetation Management</u>**: Vegetation clearing will be limited. Where applicable it must be undertaken in a judicious and responsible manner. The following approach will apply:	**Contractor and ECO where applicable.**
	• Six weeks prior to the vegetation being cleared all Protected Tree Species (where applicable) must be clearly marked by the ECO and DAFF/MTPA Permits must be obtained to ensure permitted removals and translocations.	
	• **<u>Vegetation Clearing</u>:** During the clearing of vegetation in the project area most vertebrates will move away from the project site. During this activity the project team may encounter slow moving reptiles and smaller mammals. These animals should be allowed to move away unharmed or be assisted and relocated to the natural areas/ecological corridors on the farm.	
	• **<u>Riparian Corridor and Buffer Zone</u>:** All drainage lines and riparian zones as identified by the Project Ecologist will be kept intact. The riparian zones will act as a corridor for migrating fauna.	
	<u>2. Alien Invader Plants</u>: Control of alien invasive species will be undertaken on the development footprint in line with the requirements of the Conservation of Agricultural Resources Act. The ECO will identify plants (where applicable) which require removal and management. The applicant has commenced with this process as part of his Best Practice philosophy.	
	• Alien invasive plant material will be preferentially removed through mechanical means (e.g., chainsaw, hand-pulling of smaller specimens).	
	• Chemical control is only required as a last resort or as a support mechanism to control coppicing and sprouting.	
	• All exotic plants must be identified and earmarked for removal. The ECO will assist with identifications (where applicable).	
	• A number of workers must be used to remove the vegetation i.e., 4/6 workers. ECO to monitor.	
	• If during the establishment period, any noxious or excessive weed growth occurs, such vegetation will be removed by the contractor.	
	<u>3. Fauna and Flora Management</u>: Collection of firewood/seeds/fruit/plants/animals or any biological material (where applicable) is strictly prohibited.	
	• No animals including snakes should be killed or injured by workers during the construction- and or the operational phases of the project.	
	• No poaching will be allowed on site.	
	• The Contractor is not allowed to deface, paint or mark and/or damage natural features/vegetation on the site.	

	<u>4. Topsoil Protection</u>: Topsoil will have to be removed/moved from all areas where pipelines/pump houses are to be installed.	
	• Topsoil to be handled twice only; once to strip and stockpile (in low heaps of 1m) in the Right of Way (ROW) next to the trench, and secondly to replace along the contour, level, shape and scarify.	
	• The topsoil must be replaced as soon as possible.	
	• Topsoil may not be compacted, nor should any object be stored or stockpiled upon it.	
	• No vehicle traffic will be allowed on the topsoil.	
	• The Contractor shall prevent pollution incidents on the topsoil. ECO to monitor.	
	<u>5. Biodiversity Protection</u>: **<u>See Appendix 4.4.3. Refer to applicable maps.</u>** • **<u>Activity 1: The construction of two weirs in the non-perennial stream</u>.** • **<u>Impact 1.1:</u>** Clearing of the weir basin and manipulate the soil. • **<u>Nature of Impact</u>:** Removing indigenous vegetation from the weir basin will impact adversely on the riparian corridor and riverine habitats. Clearing will also disturb the soils of the basin and the bare soil will be prone to erosion. • **<u>Mitigation of Impact 1.1</u>:** The impact of the dammed areas in relation to the extent of the catchment is marginal and therefore the impact on the system is classified as low. • Clearing for the weir site should take place during the dry period or when the stream is not flowing. However, as high rainfall can occur in any month of the year, all measures should be taken to prevent exposed soils from being washed downstream. • Obtain permission from the ECO to proceed with the clearing of vegetation. Only clear specified areas. • Levelling and landscaping of the site should follow natural drainage patterns as far as possible. Retain natural trees, shrubbery and grass species wherever possible. The remaining peripheral riparian woodland in the weir basin should be left intact in order to still maintain the denser riparian corridor. • Adequate erosion and sedimentation control measures must be put in place once the clearing of the basin is completed. This will prevent siltation in the downstream habitat. • Following the completion of any works, the water user must ensure that all disturbed areas are: • cleared of construction debris and other blockages; • reshaped to free-draining and non-erosive contours, and • re-vegetated with indigenous and endemic vegetation suitable to the area. • Disturbed riparian areas must be rehabilitated immediately after construction of the weir and pipeline abstraction point, with indigenous species as required. Riparian habitat restoration will ensure that the integrity of a wildlife corridor is retained and links between habitat types are enhanced.	

	• **Impact 1.2:** Construction of the weirs and coffer dams. • **Nature of impact:** Construction of the weir has the potential to impact on the environment. The following activities can result in erosion and siltation: • All clearing of vegetation (for dams, pumps and pipelines, roads and all watercourse crossings), • Construction and operation of coffer dams and diversion pipes, • Construction of dam/weir walls and spillways, • Installation of pumps and pipelines. • Sedimentation in the stream due to disturbing soil layers during construction activities, will result in siltation of the downstream aquatic habitat. • **Mitigation of Impact 1.2:** It is generally specified that work in watercourses is carried out during periods of low average rainfall (May-September). This reduces the risks inherent in their construction. • Furthermore, the lower stream flows reduce the risks of scour and disturbance of sediment in the riverbed during construction. • The cofferdam construction must be properly managed and maintained. • Adequate erosion and sedimentation control measures (hessian/bidum curtains, hay bales etc.) must be put in place to prevent downstream impacts.	
	• **Impact 1.3:** Rehabilitation of coffer dams. • **Nature of Impact:** This impact involves the sedimentation and siltation during removal and rehabilitation of the coffer walls. It must be kept in mind that water that accumulated in the coffer dam could deteriorate. Sudden release of sediment or polluted water can be disastrous for some aquatic biota. • **Mitigation of Impact 1.3:** Ensure that pump outfalls and outfalls from any temporary treatment do not cause or generate erosion of land, banks or beds. This can be achieved by using baffles or other energy dissipating devices and scour protection. • Coffer dams must not be left in place for longer than 30 days. The coffer dam can serve to trap any sediments which may wash towards the downstream channel. Any such sediments must be physically removed from the channel before the coffer dam is removed. • In the event that submersible pumps are used for dewatering, they must be placed in sumps that isolate them from the base of the excavation in order to avoid the mobilisation of silt into suspension through turbulence. • Removal of the coffer dam should be planned and executed with the same degree of care as its installation, on a stage-by-stage basis.	

	• **<u>Impact 1.4:</u>** Pollution due to construction activities and human presence at the site. • **<u>Nature of Impact</u>:** Poor water quality or presence of contaminants impacting on aquatic biota at the site and in the downstream reach. • Hazardous substances associated with construction activities include hydrocarbons (oil, diesel) from construction machinery and toxic materials used in dam/weir construction such as cement, shutter releasing fluid, paints, etc. In addition, washing soap, faeces, etc. from workers using the rivers and riparian zones for ablutions could pollute rivers. • Pollutants could be harmful to aquatic biota, particularly during low flows when dilution is reduced and could pose a health risk to locals using the river water for domestic purposes. Lime-containing (high pH) construction materials such as concrete, cement, grouts, etc., are highly toxic and can be lethal to fish and other aquatic biota. • If dry cement powder or wet uncured concrete is exposed to surface run-off or river water, these compounds can elevate the pH to lethal levels. Thus, extreme care should be taken when these hazardous compounds are used near water. • **<u>Mitigation of Impact 1.4</u>:** Carefully control all on-site operations that involve the use of cement and concrete. • Limit cement and concrete mixing to single sites where possible. • Use plastic trays or liners when mixing cement and concrete: Do not mix cement and concrete directly on the ground. • Dispose of all visible remains of excess cement and concrete after the completion of tasks. Dispose of in the approved manner (solid waste concrete may be treated as inert construction rubble, but wet cement and liquid slurry, as well as cement powder must be treated as hazardous waste). Engage the services of an accredited hazardous waste service provider. • Contain water and slurry from cement and concrete mixing operations as well as from batching area wash bays. Direct such wastewater into a settlement pond or sludge dam for later disposal via the service provider. • Do not allow the washing of trucks delivering concrete anywhere but within designated wash bays equipped with runoff containment. Direct such wastewater into a settlement pond or sludge dam for later disposal. • Spills: Immediately clean any accidental oil or fuel spills or leakages. • Do not hose oil or fuel spills into a storm water drain or sewer, or into the surrounding natural environment. • Make use of absorption blankets and spill kits. • Ensure that the contaminated soils are managed and handled by an accredited service provider.	

	• **<u>Activity 2. Two small pump stations will be constructed to house the electrical/irrigation equipment required for the project</u>**. • **<u>Impact 2.1:</u>** Clearing of vegetation on footprint and construction activities. • **<u>Nature of Impact</u>:** Construction impacts on the immediate environment, including removing indigenous vegetation. • **<u>Mitigation of Impact 2.1</u>:** Infrastructure establishment should preferably not take place during high rainfall periods and erosion protection measures should be put in place in case heavy rainfall occurs e.g., placement of stop-boards, covering with bidum or other suitable material. • Prior to work commencing, the contractor must supply the ECO with a layout plan demarcating the location and physical extent of the construction weir works. • Identify and demarcate the extent of the site and maintain site demarcations as indicated on the approved plan using danger tape with steel droppers. • Do not paint or mark any natural feature. Marking for surveying and other purposes must be undertaken using pegs, beacons or rope and droppers. • All areas that were cleared or disturbed during construction activities must be rehabilitated to a natural vegetated state. Care must be taken to ensure that these rehabilitated areas blend in with the lie of the land. • Clear and completely remove from site all construction plant, equipment, storage containers, temporary fencing, temporary services, fixtures and any other temporary works. • Due to their high efficiency at low flows, submersible pumps will be used. These will be placed in the weirs at suitable positions.	

	• **<u>Activity 3. Four bulk water supply pipelines will be installed in phases on the property.</u>** • **<u>Impact 3.1:</u>** Pipeline activities: Trenching, excavation and rehabilitation. • **<u>Nature of Impact</u>:** Trenching impacts on the immediate environment, especially when it involves the clearing of indigenous vegetation. • These actions can result in erosion and siltation of the cleared area and disturbed soils. Inadequate erosion control along pipeline trenches could result in sediment or sediment-laden water entering the watercourses. • Laying of the pipelines • **<u>Mitigation of Impact 3.1</u>:** The pipelines will follow existing roads, minimising disturbance to the natural environment. For pipelines, a servitude width of 15m is permitted for machine excavation and 6m for manual excavation, unless otherwise specified by the ECO. This working servitude must accommodate all construction related activities, including materials storage, access routes etc. • Laying of the pipelines will require soil to be stockpiled. This must be adequately protected (e.g., by covers or regular spraying with water) to prevent sedimentation of watercourses. Soil stockpiles should not be stored for extended periods i.e., pipeline laying should occur in stages. • Laying of the pipeline near watercourse crossings should be scheduled for average low rainfall periods (winter months). However, erosion protection measures should be put in place in case heavy rainfall occurs e.g., placement of bidum/hay bales or other suitable material.	
	• **<u>Activity 4. Three 40 000m^3 HDPE lined off-channels balancing dams will be constructed on the property</u>**. • **<u>Impact 4.1:</u>** Balancing dams: Clearing the footprint. • **<u>Nature of Impact</u>:** Removing all vegetation and associated habitats. • **<u>Mitigation of Impact 4.1</u>:** The dams will be constructed on cleared forestry blocks. • The areas earmarked for the dams have deep red soils, suitable for the construction of dams. • The dams will be designed to use the onsite material. • No imported material will be required.	

	• **<u>Activity 5. Two weirs completed in the unnamed tributary.</u>** • **<u>Impact 5.1:</u>** Inundating riparian habitats due to damming. • **<u>Nature of Impact</u>:** The integrity of a riparian corridor will be compromised by the inundation of the riverbank with the dammed water. The movement of mammals, herpetofauna and birds along a dense riparian corridor could be lost and replaced by an open aquatic habitat i.e., the dammed water. • **<u>Mitigation of Impact 5.1</u>:** During the clearing phase of the weir basin, the remaining peripheral riparian woodland around the basin should be left intact to maintain the denser riparian corridor. • Disturbed riparian areas must be rehabilitated immediately after construction of the weirs. • The weir sites are both surrounded with dense valley bush and the small weir footprints will not have a detrimental impact on the riparian corridor. • The areas surrounding these weirs will also have a protective buffer which will safeguard these sites from further development and impacts.	
	• **<u>Impact 5.2</u>:** Abstraction of water from the weirs • **<u>Nature of Impact</u>:** Dry spells during crucial months make irrigation essential for successful macadamia farming. Irrigation is therefore critical during the months of August, September and October, when flowering and fruit set occurs (highest irrigation demand and lowest rainfall). The months of July and August have the lowest rainfall (7mm and 12mm respectively). This rainfall is very low, indicating the need to irrigate during these times. • Storing or diverting water into weirs, alters the natural distribution and timing of stream flow. Changes in temporal and spatial characteristics of flow can have an impact on downstream habitat attributes such as an increase in duration of low flow season (or none-flow events), resulting in low availability of certain habitat types or availability of water at the start of the breeding, flowering or growing season of the riverine biota (aquatic and riparian). • **<u>Mitigation of Impact 5.2</u>:** The removal of approximately 187 ha of commercial forestry will increase the runoff on the Farm Nosilla by an estimated 187 000 m^3 /annum. • The intention is the pump this water during the high flow months of November through to the end of May into off-channel dams. Due to the negative environmental impact of in-stream storage, off-channel storage of 120 000 m^3 will be constructed on the farm to store the water. • Pumping of water freed up by the removal of exotic plantations, will only be allowed during the high flow months so as not to reduce the low flow in the system. • A low flow analysis shows that the removal of forestry and transferring the increase flow to the off-channel dams could result in a small decrease in the low flow, even though the EWR will still be met. The conversion from Streamflow Reduction (SFR) to irrigation will benefit downstream users by 25 900 m^3 /annum. • As an additional safeguard to secure the low flow, it is recommended that the condition of the water use licence be that a minimum flow of 11 l/s must always flow out of the lower weir (when there is flow in the system) and this must be metered.	

	• **Impact 5.3:** The dam wall as a migration barrier to aquatic animals. • **Nature of Impact:** Fish and other aquatic species could be prevented from migrating upstream. • Dams and weirs disrupt riverine migration routes. Preventing the free passage of aquatic animals and fish. • This disruption of migratory routes affects the lifecycle of anadromous species. Dam barriers prevent brood stock from reaching their spawning grounds during the breeding season, resulting in a failure of recruitment and eventual extinction of the stock above the dam. • **Mitigation of Impact 5.3:** During the ecological studies of the stream system, no fish were sampled in the small seasonal system. • Fishways are devised specifically to create passage for aquatic fauna to overcome migration barriers, such as man-made dams and weirs. The reason for the lack of fish in the system could be the fact that this system is seasonal and there are a number of small waterfalls and cascades in the narrow stream, rendering the system a challenging environment to overcome. • With no fish or other organisms that will need to migrate up the small stream, providing a fishway in the weir will not be unnecessary.	

	Activity 6. Farm Operations. - Different aspects which could impact on the riverine system can include roads, traffic, cleared surfaces, human activity, applying pesticides and herbicides, fertilisers, etc. - These aspects can lead to threats such as: - Increases in sedimentation and turbidity. - Increased nutrient inputs. - Increased inputs of toxic organic and heavy metal contaminants. - Pathogen inputs. Aspects of these threats have been sorted into three groups under the heading: Operational activities impacting on the riverine system. - Trampling in the riparian zone. - Erosion of the cleared lands and siltation of the non-perennial streams. - Irrigation return-flows containing fertilisers and pesticides seeping towards the drainage line. - All of these threats have one shared mitigation measure and that is to establish **buffer zones** to protect the water course. - 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. - 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. - Using a site-based tool exercise the buffer zone requirements for the Nosilla drainage system were defined. According to this initial buffer requirement, it becomes apparent that, to protect the unnamed drainage line in its current condition from degradation, a **buffer of 20 m wide** on both sides of the drainage line is required. - Additionally, most of the drainage system and its ecological buffer around the riparian corridor, are also protected by a buffer of natural woodland which will increase the integrity of the acquired buffer. - Minimal impact should be permitted in riparian zones and buffer areas as these serve to contain water quality impacts. The riparian ecological buffers (or relevant buffers monitored by on-site supervision during fencing) should be adhered to. **Impact 6.1:** Operational activities. **Nature of Impact:** Roads **Mitigation of Impact 6.1:** Make use of existing roads and tracks where feasible, rather than creating new routes. Ensure that only authorised roads and access routes are used. - Any additional routes and turning areas required by the contractor must be approved by the ECO. Vehicles may not leave the designated roads and tracks and turnaround points will be limited to specific sites. Ensure that adequate vehicle turning areas are allowed for. - No off-road driving is permitted, unless authorised by the ECO. Do not permit vehicular or pedestrian access into natural areas beyond the demarcated boundary of the work area.	

	• Avoid routes through drainage lines and riparian zones wherever possible. Where access through drainage lines and riparian zones is unavoidable, only one road is permitted, constructed perpendicular to the drainage line. • Routes should not traverse slopes with gradients more than 8%. Where this is unavoidable, stabilise the road surface. • In general, construction routes should not be wider that 3m in sensitive areas, with passing bays where two-way traffic is required. Clear up any gravel or cement spillage on roads. • Ensure that all access roads utilised during construction (which are not earmarked for closure and rehabilitation) are returned to a usable state and/or a state no worse than prior to construction. • Implement the buffer zone of 20 m.	
	• **Impact 6.2:** Clearing of plantations for orchards. • **Nature of Impact:** Inadequate stormwater management and erosion control in the newly established fields could result in sediment or sediment-laden water entering the watercourses. • **Mitigation of Impact 6.2:** Maintaining strips of natural vegetation between orchards is encouraged, if and where feasible, to assist with run-off control. Natural indigenous vegetation should also support insects required for pollination or pest control. The unnamed drainage lines are surrounded with dense valley bush which forms an additional protective buffer which will safeguard these systems from sedimentation.	
	• **Impact 6.3:** Farming activities and irrigation of the orchards. • **Nature of Impact:** During the operational or farming phase, chemical (inorganic) fertilisers and pesticides are likely to be used. The key pollutants associated with fertilisers are phosphates and nitrogen. • Although pesticides are likely to be sprayed, rather than placed *in-situ*, during high rainfall periods, the pesticides can leach into the soil. Toxic pesticides or herbicides may negatively impact on riparian species. • **Mitigation of Impact 6.3:** Maintaining strips of natural vegetation between orchards is encouraged, if and where feasible, to assist with run-off control. • Natural indigenous vegetation should also support local insects required for pollination or pest control. • Only use environmentally friendly pesticides and herbicides. • The unnamed drainage lines are surrounded with dense valley bush which forms an additional protective buffer which will also safeguard these systems from sedimentation.	

- **Biodiversity Monitoring Requirements**:
- **Monitoring Programme**: A monitoring programme for the biodiversity associated with the project, would be to record the reaction of the biota to changes in the environment due to the impacts of the project.
- **Aspects 1: EWR:** Very little monitoring will be necessary during the operational phase of the project. Most of the mitigatory aspects, will be assessed by the ECO during construction. The only impact require monitoring during the operational phases of the project, is to ensure that the **flow releases from the weirs** will meet the requirements stipulated for the Environmental Water Requirement releases.

Ecological Water Requirement per month in m³

Month	Weir 2	Weir 1
Jan	6000	19 011
Feb	6967	21 134
Mar	7071	21 936
Apr	6843	21 228
May	6642	20 474
Jun	6013	18 398
Jul	5571	17 549
Aug	5143	16 086
Sep	4769	14 152
Oct	4500	13 893
Nov	4769	14 152
Dec	5143	16 086

- **Aspect 2: Abstraction of water from the river system**: Pumping of water freed up by the removal of exotic plantations, will only be allowed during the high flow months so as not to reduce the low flow in the system.
- As an additional safeguard to secure the low flow, it is recommended that the condition of the water use licence be that a minimum flow of 11 l/s must always flow out of the lower weir (when there is flow in the system) and this must be metered.
- **Aspect 2: Measuring the flow**: Whatever system will be in place to release and measure flow releases must be monitored regularly in order to ensure the 11 l/s is released and be confirmed using the metering system.
- The weirs must be inspected frequently to maintain the system and ensure that the outlets are not blocked or not functioning properly. The results of the metering of flows should be made available to the relevant authority or Irrigation Board on request.

	• **<u>Aspect 3</u>**: **<u>The buffer zone and riparian corridor</u>**: The implementation of the buffer area should be monitored throughout the duration of construction activities to ensure that the effectiveness of the final buffer zone areas are maintained and that management measures are implemented appropriately. Regular inspections during the operational phase should also be undertaken to ensure that functions are not undermined by inappropriate activities.	
	• **<u>Aspect 4</u>**: **<u>Exotic and alien invasive plants</u>**: To anticipate and evaluate imminent or potential risks to the project area regarding exotic- and alien invasive plants, as well as pathways of invasion, a monitoring programme should be developed in order to create effective mechanisms to manage or mitigate these. Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge. It is important to evaluate the effectiveness of control methods and to monitor the cleared areas on a regular basis to identify emergent seedlings and to remove those immediately.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
3. Project Specifics and Excavation Management: Trenching; Backfilling and Levelling.	**<u>1. Excavation</u>**: During excavation topsoil has to be stockpiled as specified in low 1m heaps next to the trench in the ROW. • Excavation of soil to solid ground to be done carefully and to ensure proper drainage.	**Contractor and ECO where applicable.**
	• Remove soil/sand and debris and expose all rocky material.	
	• Excess (spoil) excavated rocky material (rock and boulders) to be used for erosion control/cladding where applicable or for purposes of landscaping.	
	<u>2. Backfilling</u>: The Contractor shall backfill according to the requirements of progressive reinstatement, i.e., reinstatement of disturbed areas to topsoil profile on an ongoing basis, immediately after selected construction activities are completed, which will allow for passive rehabilitation.	
	• All soils must be returned into the trench in the sequence in which they were excavated.	
	<u>3. Levelling</u>: Excess sand/soil (after construction) must be filled in and landscaped into natural sandbanks blending in with the topography of the surroundings.	
	• Excess stockpiled building material must be removed completely and all areas levelled.	
	• Excess sand and soil resulting from levelling activities of the work area to be stored in low heaps on the access road/or already disturbed areas.	
	• Excess topsoil to be spread evenly over the area in a manner that blends in with the natural topography.	
	• When the bulk of material stockpiles have been cleared, the disturbed areas are to be levelled and cleared of any unnatural foreign material manually using shovels and rakes.	
	<u>4. Trenching</u>: This activity is limited to the pipeline installations to the new orchards. • Trenching will be minimised through the use of single trenches.	
	• Planning and selection of trench routes along existing roads will be indicated on the Site Development Plan.	
	• Trench routes with permitted working areas will be clearly defined and marked with painted stakes prior to excavation.	
	• All trenches must be clearly marked (Flags; coloured posts; reflective banners; lights) in order to alert people to the potential hazard thereof.	
	• All open trenches must be patrolled on a minimum of a daily basis to ensure that animals, e.g., lizards, small rodents, have not become trapped. Such animals will be removed and released. A log must be placed at strategic spots each afternoon to allow any animal that accidentally falls into the trench an opportunity to escape.	

	• Stripping and separation of topsoil will occur as stipulated in the EMPr above.	
	• Soil will be excavated and used for re-filling trenches using the **rollover method**, i.e., progressive re-instatement: This entails the following approach: • Soil from the first trench section will be stockpiled. • Soil excavated from subsequent trench lengths will be used to backfill once the pipelines have been laid on an ongoing basis. • The final trench length will be re-filled using the originally stockpiled soil.	
	• Trench lengths will be kept as short as practically possible.	
	• Trenches will be re-filled to the same level as, or slightly higher to allow for settlement of the surrounding land surface to minimise erosion. Excess soil will be stockpiled in an appropriate manner.	
	• Immediately after refilling, the disturbed areas will be stabilised.	
	• The Contractor will not pollute any eco-system as a result of construction activities. All cement mixing activities must take place on an impermeable layer, e.g., metal sheet or plastic. **No mixing of cement may take place directly on the soil surface.**	
	5.Irrigation Methods/Equipment: • The efficient use of water and the implementation of a site-specific irrigation system will go a long way towards the sustainable use of irrigation water on the new orchards.	
	• It is therefore essential that a cost-effective system is used which optimises the use of water and prevents run-off and erosion. For this reason, the **Low Flow Irrigation System (LFIS)** must be implemented:	
	Advantages of the LFIS: • **Broader water distribution:** As water enters the ground at a slow pace, it spreads around the sides of the plant rather than seeping downward. • **Better nutrient utilisation:** Since water stays closer to the area where the roots are most active, more nutrients are available to the plant with fewer ground pollutants. • **Larger and enhanced yields:** Since the in-ground air-water ratio at any given moment is higher, crop yields are larger and of a better quality. • **Lower nutrient usage:** As all the fertiliser is distributed at the active root-zone level, the plant receives a high percentage of the amount distributed, leading to lower quantities of applied fertiliser. • **Water saving:** Irrigation is placed underneath the agricultural fabric; the low flow drip ensures no over irrigation. Drip emitters have an ultra-low flow of 0.7 lt/hr each, spaced 1m apart.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
4. Waste Management: Solid Waste.	**<u>1. Litter and Builders Waste</u>**: All waste to be disposed of off-site **at an approved landfill site in White River**. • Contractor not to dispose of any waste and/or construction debris through burning or by burying.	**Contractor**
	• Contractor to supply tamper proof waste bins throughout the site at locations where construction workers are working.	
	• Tamper-proof refuse bins to be emptied on a daily basis. Refuse bins not to be used for any other purpose.	
	• Contractor has to designate specific areas for staff to enjoy their lunches and tea and he must provide for access to adequate refuse bins at these sites.	
	• All litter must be removed off site daily and deposited at the designated waste collection point near the Farm Maintenance Yard.	
	• Waste includes cigarette boxes, cigarette butts, paper, plastic bags, tin, glass, wires, cable ties and organic waste e.g., peels and bones.	
	• Under no circumstances will **cigarette butts** be discarded anywhere on the development site.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
5. Waste Management: Liquid Waste.	**<u>1. Construction Water</u>**: Construction water refers to all water affected by construction activities. • No River/Stream/Natural Drainage Line must be used for cleaning of tools and equipment. This includes the washing of clothes and bathing/recreational purposes.	**Contractor**
	• All washing of equipment to be undertaken at the designated facilities in the Farm Site Yard.	
	• Water from any other cleaning operations in the Farm Site Yard to be collected in a “conservancy” tank removed from site and disposed of in the agreed manner.	
	• Water and slurry to be contained to prevent the pollution of the ground surrounding the mixing and/or disposal points.	
	• No spills to be channelled into natural environment. Contractor to take reasonable precautions to prevent pollution of the ground- and water resources.	
	• Contractor to ensure that no fuels (petrol/diesel), oils, lubricants and/or other chemicals are discarded onto the ground. Use drip trays in all potentially risky situations, e.g., refuelling a mobile generator.	
	<u>2. Sewerage Management</u>: Adequate temporary (e.g., Enviro-loos) ablution facilities to be put in place on sites located near to working areas. • 1 Enviro-loo per 10 workers.	
	• Toilet paper must be provided by the contractor.	

	• All toilets must be checked daily and serviced accordingly **by an accredited service provider**. • No spillages into the surrounding environment will be allowed. • The entrances to the toilets must be adequately screened from public view.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
6. Waste Management: Hazardous Waste (The use of hazardous materials are not envisaged during the development phase, however unforeseen events may occur which are not known to the EAP at this stage of the process. This aspect is therefore included as a precautionary measure).	**<u>1. Hazardous Waste Process</u>**: The EAP has not been made aware of any hazardous substances that may be used during the development construction process. To ensure that the EMPr maximises the implications of the precautionary approach the following conditions are included in the event that substances such as fuel (mobile generator); paints; varnishes; chemicals for alien plant control etc. are used at any stage of the development. • A Contractor staff member must be designated to manage this process. • Contractor to comply to all national, regional, and local legislation with regards to the storage, transport, use and disposal of petroleum, chemicals, harmful and hazardous materials and substances. • Contractor to provide the ECO with a list of all petroleum, chemical, harmful and hazardous materials and substances on site, together with all the storage, handling and disposal procedures for these materials. A register must be kept at the site office containing all the written/prescribed handling procedures. • Contractor to be responsible for training and education of workers that will be working with these materials. Training to include the proper use, handling and disposal of the substances. • Storage of chemicals to be safe, tamper proof (locked in a store) and under strict control. • Storage and handling of fuels, lubricants, chemicals and other hazardous substances to be protected by placing an impermeable liner, e.g., bund beneath the above ground storage containers in order to prevent accidental contamination of the soil. • The contractor will ensure that there is a supply of absorbent material (or absorption blankets) readily available on site to absorb, break down and where possible control any petrol/diesel spillages that may occur. The amount and type of absorbent material must be appropriate to the volumes of hazardous liquids on site. • Any accidental chemical/fuel spills to be addressed and reported immediately to the ECO. The ECO will inform the applicable authorities and initiate a containment- and control programme as applicable. • Contractor to be responsible for establishing an emergency procedure for dealing with spills/releases of fuels, chemicals, hazardous substances and medical emergencies. All spills/accidents to be recorded (in the Incident Register) and reported to the ECO. The clean-up of spills and any damage caused shall be for the Contractor’s account.	**Contractor**

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
7. Access Roads.	**<u>1. Existing Roads</u>**: The farm is well serviced with all-weather farm roads to the various sections and facilities on the property. The proposed project and all deliveries will make use of these access routes.	**Contractor**
	• Adhere to the local speed limit on the farm (40km/h) at all times.	
	• Contractors to limit the number of deliveries to the weir sites where possible through appropriate advance planning.	
	• Contractors will be required to submit a delivery timetable to the ECO.	
	• Construction personnel should only use authorised paths and roads.	
	• Any damage caused by the construction activities to any access or public roads must be rehabilitated thoroughly upon completion of the construction.	
	<u>2. New Roads to Orchards (Less than 3.5m wide)</u>: Note: No new roads are envisaged, however if this becomes necessary then the following conditions will apply. • All orchard roads created for the purposes of the development must be designed and planned in advance with the ECO. • Access will be required to each orchard. Orchard roads must be designed to incorporate adequate drainage and water attenuation structures.	
	• Where applicable the road must be stabilised with all-weather gravel (patch gravelling).	
	• Where applicable, a **designated roads contractor** must oversee this aspect of the development process.	
	• **<u>Stabilise/All Weather Access</u>**: Although these farm roads will not carry significant loads of traffic on a daily basis access to the orchards will be required during the harvesting process. The road surfaces must thus be stabilised for all weather use.	
	• **<u>Prevention of Erosion</u>**: Erosion problems on roads must be addressed immediately as and when these occur. This must be done by installing humps across the roads at regular intervals, in order to redirect the water away from the road or track.	
	• **<u>Humps</u>** must be large enough to withstand storm water events. They must be constructed across the entire width of the road (from side to side and into the adjoining vegetation). The humps must be at least 50cm higher than the surrounding ground level. This will ensure that run-off of water is directed out of the road and not down the road.	
	• **<u>Mitre Drain</u>**: All water run-off from the roads must be channelled into mitre drains. These drains must be kept open (free of vegetation and blockages). All drains must be opened by end of September annually.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
8. Construction Staff	**1. Staff Management**: The Code of Conduct for Contractors as described in the Tender Document will apply to all Construction Staff. • The EMPr will be included as a condition of the Tender Document.	**Contractor**
	• Contractor must adhere to all conditions of the Occupational Health and Safety Act.	
	• A Safety Plan must be submitted to the ECO prior to the commencement of construction.	
	• No contractor staff will be housed on the development site.	
	• All contractor staff will abide with the Rules and Regulations of the Nosilla Farm. This includes all aspects to gain entrance and to exit the property.	
	• All staff must use the water- and sewerage facilities judiciously and keep these facilities neat and clean.	
	• All staff must remain within the development footprint and behind the demarcated boundaries.	
	• No open fires will be allowed for cooking and or heating purposes.	
	• Staff must supply their own lunches and refreshments. No cooking will be allowed on site.	
	• Staff must respect the surrounding environment and prevent all littering and damage to fauna and flora.	
	• **Site Specifics: Induction Courses**: All staff will undergo an intensive induction course on worker safety and safety procedures for the various sections of the site.	
	• **EMPr**: The conditions of the Environmental Management Programme must be explained to all workers and staff on site.	
	• All staff on site must sign an acceptance of understanding the EMPr form prior to being allowed on site.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
9. Fire.	**<u>1. Fire Management</u>**: Contractor to take all the necessary precautions to ensure that no fires are caused as a result of activities on site. • A Contractor staff member must be designated to manage this process.	**Contractor**
	• Contractor to supply all facilities, site offices, workshop areas, storage areas, with approved fire-fighting equipment.	
	• All staff on site will be made aware of general fire prevention and control methods and the name of the responsible person to alert to the presence of a fire.	
	• The Contractor will advise the relevant authority/applicant of a fire outside of a demarcated area as soon as it starts and will not wait until he can no longer control it.	
	• All fire-fighting equipment to be maintained in good operating order.	
	• No open fires for heating or cooking are allowed on site.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
10. Accidents.	**<u>1. Staff Safety</u>**: Contractor to comply with the Occupational Health and Safety Act (OHASA) and any other labour regulations with regard to safety on site.	**Contractor**
	• Contractor to provide an Occupational Health and Safety Management Plan to the ECO for approval prior to the commencement of works in terms of the Construction Regulations.	
	• A Contractor staff member must be designated to manage this process.	
	• Fencing and barriers will be in place in accordance with the Occupational Health and Safety Act (Act No. 85 of 1993).	
	• Applicable notice boards and hazard warning notices will be put in place and secured. Night hazards, e.g., open trenches, will be suitably indicated (e.g., reflectors, lighting, and traffic signage).	
	• No unauthorised firearms or weapons of any kind will be permitted on the site.	
	• Contractor to ensure that all staff are familiar with all the emergency procedures.	
	• All staff must undergo a basic First Aid Course.	
	• Contractor to ensure that lists of all emergency telephone numbers/contact people are available and are posted at relevant locations, e.g., site office, at all times and that they are updated regularly.	
	• Contractor to be responsible for establishing an emergency procedure for dealing with medical emergencies. All incidents to be recorded (in the Incident Register) and reported to the ECO.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
11. Adverse Weather Conditions and Erosion Protection.	**1. Wet Weather: Overflows and Erosion Protection**: Development on this project will preferably take place during the period April-October.	**Contractor**
	• Contractor to set up a procedure for rapidly emptying any collection points to prevent them filling with rainwater.	
	• Contractor to ensure that no sumps (where applicable) are emptied unnecessarily. Special care to be taken during rainy periods/adverse weather conditions to prevent contents from overflowing.	
	• Contractor to ensure that a procedure is established for dealing with potentially polluted rainwater. Procedures/method statements must be filed in the register in the site office.	
	• Stockpiles of fine material such as sand, topsoil, etc. to be protected from rain run-off and wind.	
	• During construction, Contractor to protect all areas susceptible to erosion by installing all the necessary temporary and permanent drainage works ASAP. Contractor must also prevent water scouring of the slopes, embankments (where applicable) and any other areas.	
	• Correct any cause of erosion at the onset thereof through the most appropriate mechanism. Discuss any remedial actions with the resident ECO.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
12. Noise, Visual and Dust Impacts.	**1. Noise Impacts**: Contractor to use the equipment that is appropriate to the task in order to minimise the extent of damage to the environment and minimise the noise levels.	**Contractor**
	• The provisions of SABS 1200A will apply to all areas within audible distance of the site.	
	• Noise levels to be kept within acceptable limits for an agricultural area and not to be of such a nature as to detract from the experience of persons in the area.	
	• No amplified music will be allowed.	
	• Construction activities generating output levels of 85dB or more will be confined to the hours 07h00 to 16h30 Mondays to Fridays.	
	2. Dust: Dust to be controlled on site at all times.	
	• Dust emissions may occur during the clearing of vegetation and delivery of equipment and supplies on the farm roads to the project area.	
	• Contractor must control dust emissions using a water tanker as and when the impact arises.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
13. Cultural Artefacts.	**<u>1. Handling of Unexpected Cultural Finds</u>**: The proposed project does not traverse, impact and or influence aspects of historical value, however the following conditions are listed in the event that an unexpected find or artefact is unearthed. • An accredited archaeologist must oversee the clearing process (weir sites).	**Contractor**
	• Sensitise the Contractor/labourers to be aware of the importance of cultural artefacts/fossils and implement the recommended procedure below in the event that such a discovery is made accidentally during construction.	
	• Should any artefact, historical site or fossil be discovered during excavations for irrigation trenches as well as in future, all works must cease with immediate effect. • **A buffer of 30m must be established around the find.**	
	• The find must be reported to the ECO and the Project Manager/Applicant for the project. • These representatives will initiate an Action Plan in conjunction with an accredited archaeologist/palaeontologist (Contact SAHRA) to address the management and handling of the find.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
14. Site Clean Up and Closure.	**<u>1. Removal and Clearance</u>**: Contractor to ensure that all temporary structures, materials, water and waste facilities used for construction activities are removed upon completion of the project.	**Contractor and the ECO.**
	• All signs of disturbance and contractor activity must be rehabilitated to a state as on day of site handover.	
	• All toilets must be removed.	
	• All left over stock and bits and pieces of materials must be removed.	
	• All waste bags must be deposited at the waste management facility (site yard).	
	<u>2.Rehabilitation</u>: It is not envisaged that major rehabilitation efforts will be required, however applying the precautionary approach the following conditions are placed on record:	
	• All re-seeding activities will be undertaken at the end of the dry season to ensure optimal conditions for germination and rapid vegetation establishment.	
	• When ripping for rehabilitation the contractor will rip to refusal or a minimum of 300 mm.	
	• The rehabilitated and seeded areas must be harrowed after spreading the topsoil and fertiliser uniformly.	
	• Inspect rehabilitated area at three monthly intervals during the first and second growing season to determine the efficacy of rehabilitation measures.	

	• Take appropriate remedial action where vegetation establishment has not been successful or erosion is evident.	
	• Only indigenous vegetation (as approved by the ECO) commensurate with the Nosilla landscape is to be used in any landscaping/reseeding which may be undertaken.	
	3. Project Sign Off: The ECO must sign off the works and the site during a Final Audit Assessment. The Final Audit Report will be submitted to DARDLEA for approval and verification.	

PROTECTION OF THE ENVIRONMENT:
DECLARATION OF UNDERSTANDING: CONTRACTOR TO SIGN:

The Contractor will not be given right of access to the Site until this form has been signed.

I / we, ____ {Contractor} record as follows:

I / we, the undersigned, do hereby declare that I / we am / are aware of the increasing requirement by society that construction activities shall be carried out with due regard to their impact on the environment.

In view of this requirement of society and a corresponding requirement by the Employer with regard to this Contract, I / we will, in addition to complying with the letter of the terms of the Contract dealing with protection of the environment, also take into consideration the spirit of such requirements and will, in selecting appropriate employees, plant, materials and methods of construction, in-so-far as I / we have the choice, include in the analysis not only the technical and economic (both financial and with regard to time) aspects but also the impact on the environment of the options.

In this regard, I / we recognize and accept the need to abide by the "precautionary principle" which aims to ensure the protection of the environment by the adoption of the most environmentally sensitive construction approach in the face of uncertainty with regard to the environmental implications of construction.

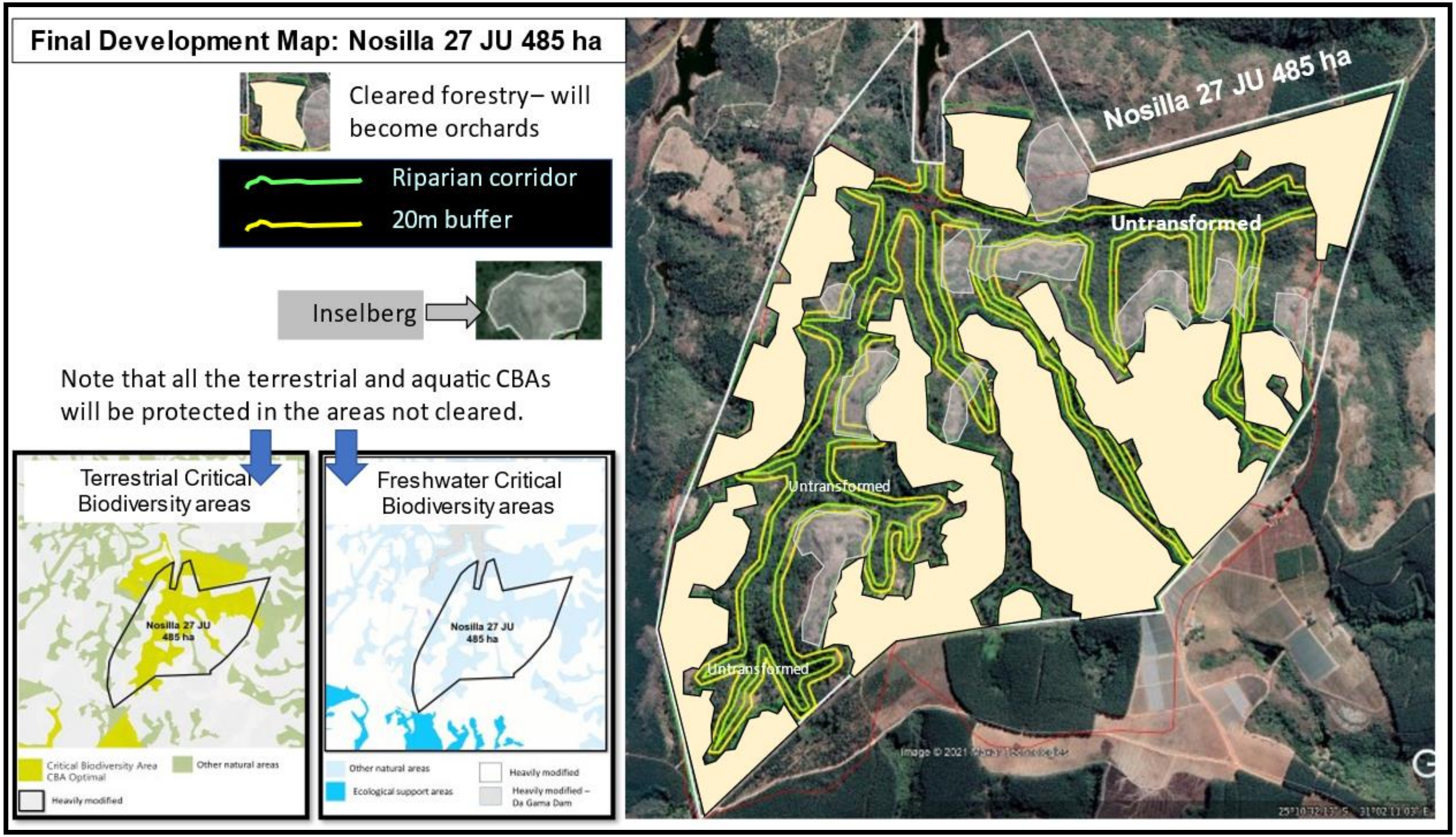
I / we have signed the Declaration of Understanding with respect to the Environmental Management Programme.

I / we acknowledge and accept the right of the Employer to deduct, should they so wish, from any amounts due to me / us, such amounts (hereinafter referred to as fines) as the Construction Manager shall certify as being warranted in view of my / our failure to comply with the terms of the Contract dealing with protection of the environment, subject to the following:

The Project Manager, in determining the amount of such fine, shall take into account inter alia, the nature of the offence, the seriousness of its impact on the environment, the degree of prior compliance / non-compliance, the extent of the Contractor's overall compliance with environmental protection requirements and, in particular, the extent to which he/she considers it necessary to impose a sanction in order to eliminate / reduce future occurrences.
The Construction Manager shall, with respect to any fine imposed, provide me / us with a written statement giving details of the offence, the facts on which the Construction Manager has based their assessment and the terms of the Contract (by reference to the specific clause) which has been contravened.

Signed _______________________________
Date _________________________

FINAL DEVELOPMENT MAP: NOSILLA 27 JU



RHENGU ENVIRONMENTAL SERVICES
P O Box 1046 Cell: 082 414 7088
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1320 E–mail: rhengu@mweb.co.za

ACCEPTANCE OF EMPr:
Nosilla 27 JU Weir Project:

DECLARATION

I/We, the undersigned as the proponent/s/person/s responsible for the above-proposed activity undertake to abide by the above-designated EMP and associated conditions.

CONTRACTOR

Name: ____________________

Signature: ____________________

Date: ____________________

APPLICANT

Name: ____________________

Signature: ____________________

Date: ____________________

CHECKED BY ENVIRONMENTAL CONTROL OFFICER

Name: ____________________

Signature: ____________________

Date: ____________________