APPENDIX 16

TERRESTRIAL ECOLOGY STUDY (2013)

FLORA AND FAUNA BASELINE ASSESSMENT FOR A FEASIBILITY STUDY FOR THE PROPOSED VENTERSBURG MINE

GOLD ONE AFRICA LIMITED

JUNE 2013

Digby Wells and Associates (South Africa) (Pty) Ltd (Subsidiary of Digby Wells & Associates (Pty) Ltd). Co. Reg. No. 2010/008577/07. Fern Isle, Section 10, 359 Pretoria Ave Randburg Private Bag X10046, Randburg, 2125, South Africa
Tel: +27 11 789 9495, Fax: +27 11 789 9498, info@digbywells.com, www.digbywells.com

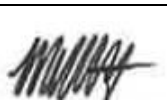
Directors: A Sing*, AR Wilke, LF Koeslag, PD Tanner (British)*, AJ Reynolds (Chairman) (British)*, J Leaver*, GE Trusler (C.E.O)
*Non-Executive

DIGBY WELLS ENVIRONMENTAL

This document has been prepared by **Digby Wells Environmental**.

Report Title: **FLORA AND FAUNA BASELINE ASSESSMENT FOR A FEASIBILITY STUDY FOR THE PROPOSED VENTERSBURG MINE**

Project Number: **GOL1675**

Name	Responsibility	Signature	Date
Rudi Greffrath	Report Writer		3/2/2013
Leigh-Ann de Wet, Pri.Sci.Nat. (400233/12)	Review		31/5/2013
Andrew Husted, Pri. Sci. Nat. (400213/11).	1st Review		4/2/2013
Danie Otto, Natural Scientist S.A (400096/02).	2nd Review		3/5/2013


Recycled Paper

EXECUTIVE SUMMARY

Digby Wells Environmental (Digby Wells) was contracted by Gold One Africa Limited (Gold One) to perform specialist studies for the Bankable Feasibility Study and various regulatory processes and studies for the proposed Gold One Ventersburg underground gold mine. This report presents the findings of the fauna and flora baseline assessment and the information gathered in this report will be used within the Bankable Feasability Study. The fauna and flora baseline assessment will provide a baseline condition of the study site, whereby an understanding of its current state will aid to facilitate the assessment of the needs of the potential changes the mine may create. This will help identify where changes to current mine plans are required and where additional expense may be required.

The objectives of this study were to characterise the fauna and flora environment from a desktop level assessment, and to supplement this information with a single field visit. Thereafter, to establish the significance of the impact of the construction and operation phases associated with the proposed mine and associated infrastructure on the fauna and flora in the area of interest and to investigate any potential threats to the proposed project.

The vegetation was found to be relatively uniform. Differing soil types due to topography and water accumulation (wetlands and drainange lines) appear to be the dominant factors in determining the vegetation variation. Land use has a major influence on the state of the vegetation. Natural vegetation has largely been removed for cultivation purposes. Over utilisation primarily in the form of grazing by domestic livestock will manifest itself in the occurrence of sparsely vegetated areas.

From the results of the desktop work it was concluded that the study area is situated within Central Free State grassland, Winburg Grassy Shrubland and the Vaal-Vet Sandy Grassland (Mucina & Rutherford 2006). The Vaal-Vet Sandy Grassland vegetation type is considered to be Endangered, the Central Free State grassland as Vulnerable and Winburg Grassy Shrubland as least concern. Nationally, all three vegetation types were altered primarily by cultivation historically and at present.

During the field visit, a brief screening of the habitat types were conducted in order to identify any animal species that might be present.The result of this was seven mammal species encountered in the game camp, and one species in the project area, not in the game camp. None of these species are officially protected.

In conclusion, the areas investigated were differentiated from one another primarily through management measures employed and presence of water, whereby seasonally wet areas were excluded from agricultural activities due to unsuitable soil. Through the construction of the mine and its associated infrastructure the management and water availability through change in land use will be affected to a large extent. However, following the prescribed guidelines and mitigation measures set forth in this document an attempt will be made to minimise the impacts. Recommendations include:

- Adherence to the mitigation measures as stipulated in the Impact Assessement;
- The wetland areas and drainage lines must be avoided during construction and operation.
- A specialist flora study to be conducted
- A specialist mammal study to be conducted;
- A specialist avifauna study to be conducted;
- A specialist reptile study to be conducted;
- A specialist amphibian study to be conducted;
- Rehabilitation of areas should occur concurrent to mining activity;
- A nursery is recommended which will serve to propagate indigenous species;
- The footprint of the mine should be limited as much as possible;
- Alien plants must be identified and removed throughout the construction, operation and decommissioning phases, design a specialist alien plant monitoring plan;

LIST OF ACRONYMS

BFS	Bankable-feasibility study
CARA	Conservation of Agricultural Resources Act (No 43 of 1983)
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DEAT	Department of Environmental Affairs and Tourism
ESIA	Environmental and Social Impact Assessment
EMP	Environmental Management Plans
GIS	Geographic Information System
Gold One	Gold One Africa Limited
IUCN	International Union for the Conservation of Nature
MBP	Mpumalanga Parks Board
NEMBA	National Environmental Management: Biodiversity Act (No 10 of 2004)
NSBA	National Spatial Biodiversity Assessment
PCD	Pollution Control Dam
POSA	Plants of South Africa
QDSG	Quarter Degree Square Grid
RDB	Red Data Books
Rob	Roberts Birds Reference
SABCA	South African Butterfly Conservation Assessment
SANBI	South African National Biodiversity Institute
SIBIS	Sanbi's Integrated Biodiversity Information System
UV	Ultra Violet
TSF	Tailings Storage Facility

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1 INTRODUCTION

Digby Wells was contracted by Gold One to perform specialist studies for the bankable feasibility study (BFS) and various regulatory processes and studies for the proposed Gold One Ventersburg underground gold mine. The proposed project will involve underground mining, including a shaft, a rock dump, a processing plant, and Tailings Storage Facility (TSF).

The aim of the study was to perform specialist biophysical studies for the Bankable Feasibility Study (BFS) and various regulatory processes for the proposed Gold One Ventersburg underground gold mine. To achieve this aim, various objectives must be met and environmental authorisation is one of them. This scoping level ecology report forms part of the authorisation process. The report conducts a desktop literature review of the flora and fauna that could be present within the relevant project area, accompanied by a short site visit description of the project area. With this report, the potential concerns that could become fatal flaws during this project is highlighted, of specific concern is the presence of protected and endangered flora or fauna species or landscapes.

2 TERMS OF REFERENCE

Digby Wells was contracted by Gold One to perform specialist studies for the Bankable Feasibility Study (BFS) and various regulatory processes and studies for the proposed Gold One Ventersburg underground gold mine. The proposed project will involve underground mining, including a shaft, a rock dump, a processing plant, and Tailings Storage Facility (TSF). The report will provide baseline flora and fauna conditions of the study site so as to enable an understanding of the current state and make recommendations as far as further studies are concerned.

This was accomplished by gathering available literature and information to characterise the natural environment present through lists of species that are likely to occur on and around the proposed Ventersburg Gold Mine. Furthermore**,** the presence of Red Data fauna and flora species that could occur in the area was investigated. Any potential concerns were also highlighted. The objectives, as per the proposal are as follows:

Flora:

- A desktop study regarding the general vegetation of the area according to Mucina *et. al.* (2006), Low & Rebelo (1996) and Acocks (1988) will be conducted as part of the scope of work;
- The conservation plans of the province and Parks Board/Authority, as well as the site specific findings associated with the broad results of the National Spatial Biodiversity Assessment will be reviewed, if avaialable;
- A detailed desktop study on all species recorded in the past, their red data status, ecological importance, red data and / or protected status (International level (IUCN), National level (Pops list) and Provincial level (Environmental Management Act lists), endemic species, medicinal species and declared Category 1, 2 & 3 invader species and / or exotic species. PRECIS List as obtained from SANBI needs to be included. The SANBI website namely http://bgis.sanbi.org/mapsearch.asp and

http://sibis.sanbi.org/faces/Mapping/Map.jsp?1=1 (species recorded according to SIBIS lists of the relevant Grids in which the mine is situated) needs to be consulted and included within the desktop study;

- List of all potential species that can possibly be present by conducting desktop studies and available PRECIS Lists;
- A site visit will be conducted by a senior ecologist to compare the information from the desktop study with the conditions on the ground.

Fauna:

- The SIBIS website will be consulted during desktop studies in order to compile detailed species lists of animal species recorded in the past and all protected and/or red data species recorded within the relevant grids must be identified and their red data status recorded.

3 STUDY AREA

The proposed project is located on the farms Tiepeie 752 portion R; Barbiena 398 on its portions 1, 3, 4 and R; Hans Verwacht 337 farm portions 4 and R; Flippie 738 portion R, La Rochelle 760; Vogells Rand 720 portion R; Klippan 77 portion R, 1 and 2; Overwacht342 Portion R; Ballyedikin 339 portion 1; IDA 62 portion 1; Bernards Deel 477 portion 1 and part of apportion R and Whites 747 portion R. The respective land tenure areas that the project area covered are represented in the Land Tenure Plan as indicated in the main BFS report.

The proposed project will be located between Welkom and Ventersburg and south of the town of Hennenman, in the Free State Province of South Africa. It is situated within the Grassland Biome (Figure 3-1).

Fig 3.1

Ventersburg Gold ESIA

Biome Setting

24°0'0"E 25°0'0"E 26°0'0"E 27°0'0"E 28°0'0"E

26°0'0"S 27°0'0"S 28°0'0"S 29°0'0"S 30°0'0"S

JOHANNESBURG
GAUTENG
POTCHEFSTROOM
KLERKSDORP
WELKOM
Ventersburg Project Area
KIMBERLEY
FREE STATE
BLOEMFONTEIN
NORTHERN CAPE
EASTERN CAPE
N14
N1
N12
N17
N3
N5
N8
N6
N10

Legend

- Project Area
- City
- National Roads
- Provincial Boundary

Biomes

- Grassland
- Nama Karoo
- Savanna

DIGBY WELLS ENVIRONMENTAL

www.digbywells.com

Projection: Geographic
Datum: WGS 84

Ref #: tdm.GOL1675.201210.103
Revision Number: 1
Date: 15/10/2012

N

0 15 30 60 90

Kilometres

1:2 000 000

The Grassland Biome is found mainly on the high central plateau of South Africa, and the inland areas of KwaZulu Natal and the Eastern Cape (Figure 3-1). The topography is mainly flat and rolling, but includes the escarpment itself. Grasslands are dominated by a single layer of grasses and the amount of cover depends on rainfall and the degree of grazing. Trees are absent, except in a few localised habitats and geophytes are often abundant (Low & Rebelo, 1996). These grasslands are maintained largely by the combination of relatively high summer rainfall and fires, frost and grazing, which preclude the presence of shrubs and trees.

Much of the grassland biome has been transformed by crop farming, afforestation, and dense human settlement. Sour grassland occurs in the high rainfall eastern grassland regions (average rainfall >625 mm/annum), on relatively acidic (leached) soils, and is characterized by being short and dense in structure, having a high fibre content and a tendency to withdraw its nutrients from its leaves to its roots during the winter, rendering it largely unpalatable to stock during this time. Sweet grassland is found in the relatively low rainfall western areas, is tall but fairly sparse in structure, has low fibre content and retains nutrients in its leaves during the winter. Mixed grassland represents a transition or combination of sour and sweet grassland types (Roberts 2003). The study area falls within the mixed grassveld.

4 METHODOLOGY

A study on available literature was conducted. It includes:

- Vegetation types of South Africa (Mucina and Rutherford, 2006); and Low & Rebelo (1998);
- Fauna distribution and identification books of South Africa (Friedman and Daily 2004), (Skinner and Chimimba 2005) (Bothma 2002) Friedman & Daly, Red Data Book of the Mammals of South Africa (2004);
- International level (IUCN), National level (Pops list) and Provincial level (Environmental Management Act lists);
- Frog and Frogging in Southern Africa. Struik, by Vincent Carruthers, 2009; and South African Frogs: A Complete Guide. By Carruthers & Passmore (1995);
- National Environmental Management Biodiversity Act 10 of 2004;
- The Field Guide to Snakes and Other Reptiles of Southern Africa, by Branch, B. 1998;
- Roberts' Multimedia Birds of Southern Africa version 7, by Roberts. 2012.
- South African National Bird Atlas 2
- Birdlife South Africa's IBA's

The review of the conservation plans for the province was not conducted as these do not exist.

4.1 Database review

Ecological databases include:

- South African National Biodiversity Institute (SANBI) Plants of South Africa (POSA) – For the proposed plant species that might occur on site. This is site specific (as far as QDSG) and according to the quarter degree square in which the project is located. It also indicates Red Data species within the project area.
- SANBI SIBIS (SANBI's Integrated Biodiversity Information System) – For the proposed fauna that might occur on site. It is also site specific based on the quarter degree square, but does not indicate Red Data species.

4.2 Maps and aerial photography review

Aerial photography, Google Earth and topographical maps have been studied to establish the habitat types and land use that occurs on the proposed project area. This is due to the fact that the probability of Red Data species occurring on site is based largely on the habitat requirements. This will also assist in the identification of sensitive or protected areas. Areas are protected or classified as sensitive if it supports a unique ecological system, contains keystone species or protected/Red Data species.

4.2.1 Legislation

Red Data Books or RDBs, are lists of threatened plants and animals specific to a certain region. They are a vital source of information in guiding conservation decisions. South Africa has produced 5 RDBs dealing with each of the following: birds, land mammals, fishes (fresh water and estuarine only), reptiles and amphibians, and butterflies.

The conservation status of a plant or animal species is described by the following terms (IUCN.org):

- EXTINCT: a species for which there is a historical record, but which no longer exists in the area under review.

- ENDANGERED a species in danger of extinction, and whose survival is unlikely if the factors causing its decline continue.

- VULNERABLE a species which it is believed will move into the endangered category if the factors causing its decline continue.

- RARE a species with small populations, which are not yet vulnerable or endangered, but which are at risk.

The term **THREATENED** is commonly used as a collective description for species which are endangered vulnerable or rare.

Some species are **ENDEMIC,** i.e. they are restricted to one region and occur nowhere else. A threatened endemic is a conservation priority.

Of special concern was protected plant and animal species. Listed species of flora and fauna are regarded as species whose representation in the wild, has declined to such an extent

that drastic action is needed to ensure their survival. Under anthropogenic pressure the number of these species has reached levels where preservation management is needed, and conservation management will no longer be effective. The listing of these species under either IUCN or CITES, is regarded as a valuable starting point to initiate legally sanctioned management practices to bring the numbers of these species back to within acceptable numbers.

4.2.1.1 IUCN

The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on plants and animals that have been globally evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those plants and animals that are facing a higher risk of global extinction (i.e. those listed as Critically Endangered, Endangered and Vulnerable). The IUCN Red List also includes information on plants and animals that are categorized as Extinct or Extinct in the Wild; on taxa that cannot be evaluated because of insufficient information (i.e., are Data Deficient); and on plants and animals that are either close to meeting the threatened thresholds or that would be threatened were it not for an on-going taxon-specific conservation programme (i.e., are Near Threatened).

Plants and animals that have been evaluated to have a low risk of extinction are classified as Least Concern (IUCN.org) (Figure 4-1).

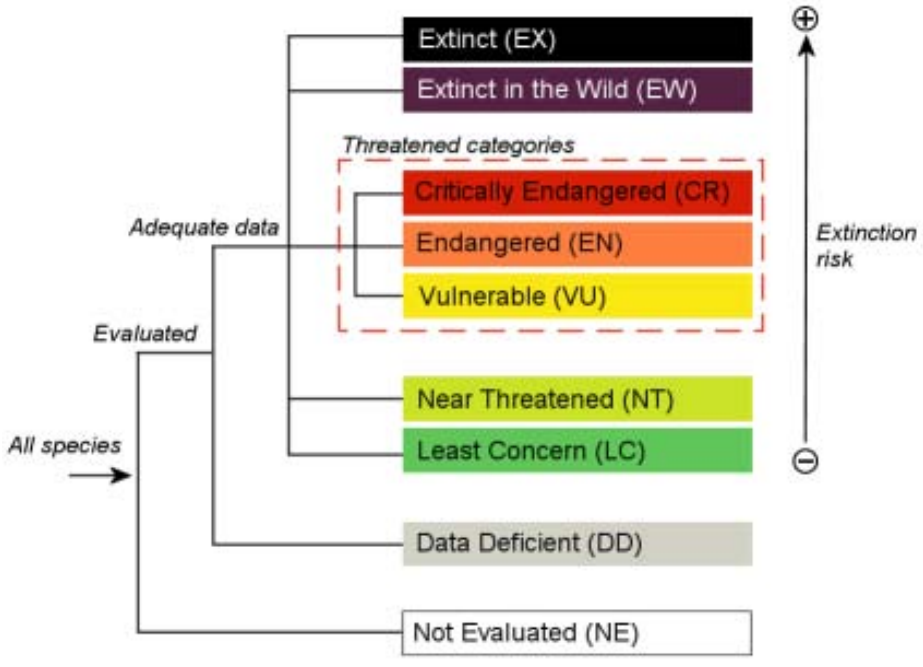


Figure 4-1: IUCN categories (IUCN.com)

4.2.1.2 CITES

CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival (CITES.org).

CITES works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction from the sea of species covered by the Convention has to be authorized through a licensing system. Each Party to the Convention must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species (CITES.org). Specimens are divided into the following appendices according to the restriction on trade.

Appendices I, II and III

- Appendix I include species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances.
- Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.
- Appendix III contains species that are protected in at least one country, which has asked other, CITES Parties for assistance in controlling the trade. Changes to Appendix III follow a distinct procedure from changes to Appendices I and II, as each Party's is entitled to make unilateral amendments to it.

4.2.2 Impact assessment

4.2.2.1 Methodology

Table 4-1: Severity, Spatial Scale, Duration and Probability Categories

Rating	Severity	Spatial scale	Duration	Probability
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or eco system. Persistent severe damage.	International The effect will occur across international borders	Permanent: No Mitigation No mitigation measures of natural process will reduce the impact after implementation.	Certain/ Definite. The impact will occur regardless of the implementation of any preventative or corrective actions.

Rating	Severity	Spatial scale	Duration	Probability
6	Significant impact on highly valued species, habitat or ecosystem.	National Will affect the entire country	Permanent: Mitigation Mitigation measures of natural process will reduce the impact.	Almost certain/Highly probable It is most likely that the impact will occur.
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate	Province/ Region Will affect the entire province or region	Project Life The impact will cease after the operational life span of the project.	Likely The impact may occur.
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year	Municipal Area Will affect the whole municipal area	Long term 6-15 years	Probable Has occurred here or elsewhere and could therefore occur.
3	Moderate, short-term effects but not affecting ecosystem function. Rehabilitation requires intervention of external specialists and can be done in less than a month.	Local Local extending only as far as the development site area	Medium term 1-5 years	Unlikely Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants.	Limited Limited to the site and its immediate surroundings	Short term Less than 1 year	Rare/ improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures

Rating	Severity	Spatial scale	Duration	Probability
1	Limited damage to minimal area of low significance, (eg ad hoc spills within plant area). Will have no impact on the environment.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month	Highly unlikely/None Expected never to happen.

Significance

Probability / Likelihood	Consequence (severity + scale + duration)								
	1	3	5	7	9	11	15	18	21
1	1	3	5	7	9	11	15	18	21
2	2	6	10	14	18	22	30	36	42
3	3	9	15	21	27	33	45	54	63
4	4	12	20	28	36	44	60	72	84
5	5	15	25	35	45	55	75	90	105
6	6	18	30	42	54	66	90	108	126
7	7	21	35	49	63	77	105	126	147

Significance		
High (Major)	108- 147	
Medium-High (Moderate)	73 - 107	
Medium-Low (Minor)	36 - 72	
Low (Negligible)	0 - 35	

5 EXPERTISE OF THE SPECIALISTS

Rudi Greffrath achieved a National Diploma in Nature Conservation, followed by a B. tech degree in Biodiversity Conservation at the Nelson Mandela Metropolitan University; and is an environmental consultant specialising in both terrestrial ecology and environmental management. Experience includes ecology field work such as flora and fauna surveys, biodiversity assessments, Biodiversity Action Plans, species relocation and environmental rehabilitation. Furthermore experience has been acquired in environmental Rehabilitation monitoring, Rehabilitation action plans, EIAs and Environmental Management Plans (EMP).

Project experience includes various countries such as Botswana, Sierra Leone, Mali, Mozambique, Ghana, Democratic Republic of the Congo, and Namibia and throughout South Africa. Refer to Appendix A.

Leigh-Ann de Wet achieved a Bachelor of Science and Honours, followed by a Master of Science degree in Botany at Rhodes University, is registered as a Professional Natural Scientist (ecology) through SACNASP, and is an environmental consultant specialising in vegetation assessments, fauna assessments and monitoring plans. Experience includes ecological impact assessments, baseline vegetation assessments, monitoring plans, Biodiversity Action Plans and rehabilitation plans in the renewable energy, mining and palm oil sectors, amongst others. Project experience includes various countries such Mozambique, Malawi, Zambia, Madagascar and Liberia and throughout South Africa.

Andrew Husted is manager of the Biophysical Department which includes the terrestrial and aquatic ecosystem specialists as well as soil scientists. Andrew has his MSc. (Aquatic Health) and is recognised by the South African regulatory authorities to be competent in the application of the national River Health Programme, a programme used to assess and monitor freshwater ecosystems. In addition to this, he is an accredited SASS5 practitioner. Andrew is also registered with the South African Council for Natural Scientific Professions, a professional aquatic ecologist. He was been trained by the Department of Water and Environmental Affairs in wetland systems and has training and on site experience with the WET-Management Series. His interaction and exposure to other biophysical specialist disciplines has afforded Andrew a holistic understanding of the natural environment. This has resulted in the development of biodiversity and land management strategies in order to prescribe realistic management for systems and areas, based on individual specialist components as well as considering the relationships of these components on each other.

Andrew has worked with internationally recognised methodologies which have been successfully applied abroad in countries such as Botswana, Ivory Coast, Senegal, Ghana, Sierra Leone and the Democratic Republic of the Congo as well as Armenia.

Additional areas of interest include toxicology and bioaccumulation studies which have been conducted on numerous projects. In addition to this, Andrew also has experience in community health assessments, fish health studies, telemetry, instream flow requirements and parasitology. Refer to Appendix A.

6 RESULTS AND DISCUSSIONS

The description of the specific vegetation type has been adapted from Mucina and Rutherford (2006), and Low and Rebello (1996).

6.1 Flora

6.1.1 National Spatial Biodiversity Assessment

South Africa's first National Spatial Biodiversity Assessment (NSBA) was commissioned by the Department of Environmental Affairs and Tourism (DEAT), and led by the South African National Biodiversity Institute (SANBI). The NSBA is the first ever comprehensive spatial

assessment of biodiversity throughout the country. It has four components dealing with the terrestrial, freshwater, estuarine and marine environments

In order to explain the need for spatial biodiversity assessments the SANBI biodiversity planning unit describes biodiversity as something that is not evenly distributed across the landscape or seascape. Rather, it occurs varied concentrations, concentrated in some areas and less in others. Therefore a spatial biodiversity assessment is needed to take these geographic variations into account by mapping information about biodiversity features (such as species, habitats and ecological processes), protected areas, and current and future patterns of land and resource use. This mapped information is then analysed using tools linked to a Geographic Information System (GIS), to help determine geographic priority areas for action.

Spatial assessments or analysis can take place at different spatial scales, from global to local. A national biodiversity assessment is intended to be broad. It provides a national context for assessments at the sub-national scale, and points to broad priority areas where further investigation, planning and action are warranted.

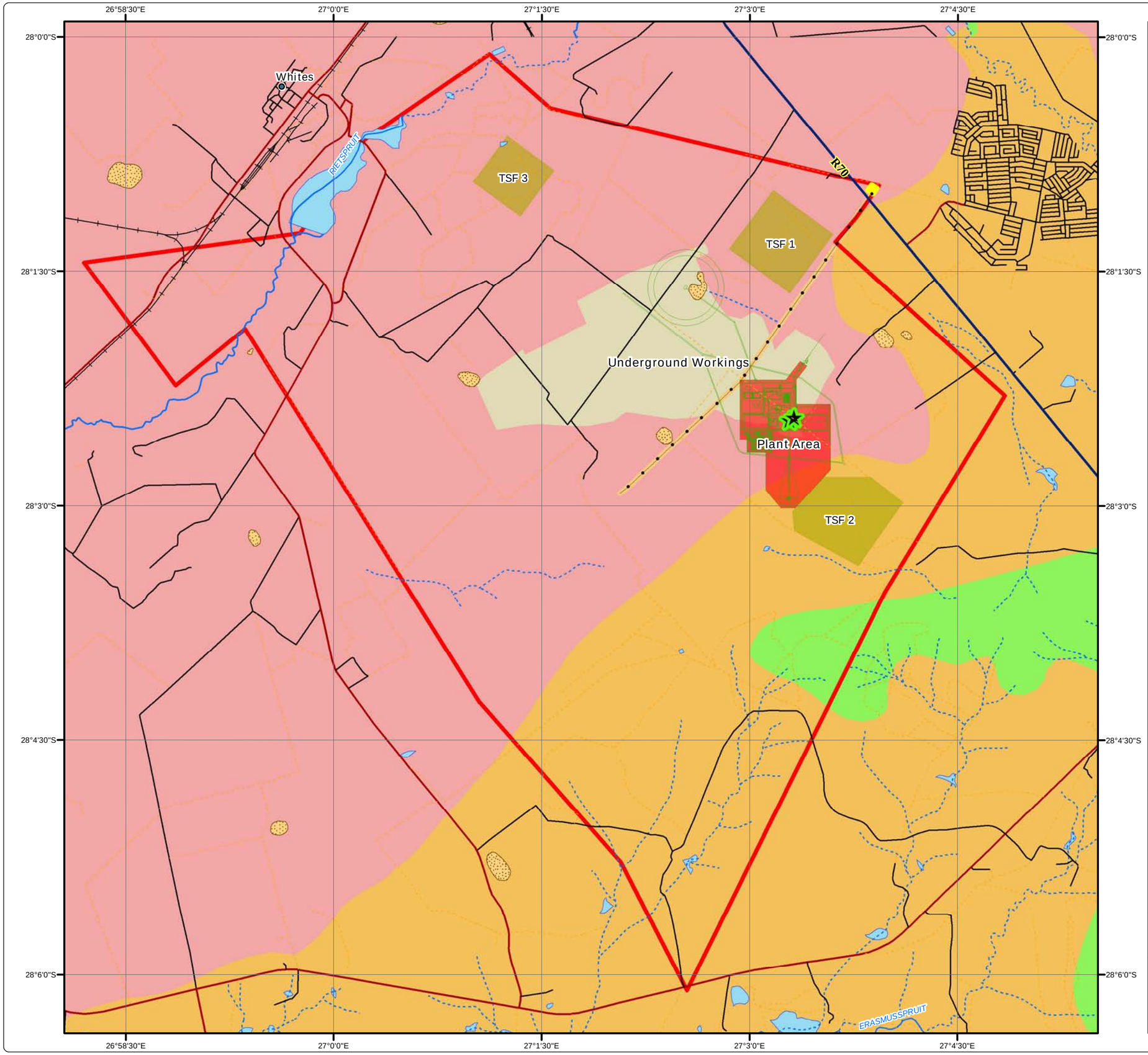
The approach used most often in South Africa, including in the NSBA, is systematic biodiversity planning. It is based on three key principles:

- The need to conserve a **representative sample** of biodiversity pattern, such as species and habitats (the principle of representation).
- The need to conserve **ecological and evolutionary processes** that allow biodiversity to persist over time (the principal of persistence).
- The need to set quantitative **biodiversity targets** that tell us how much of each biodiversity feature should be conserved in order to maintain functioning landscapes and seascapes.

Fig 6.1

Ventersburg Gold ESIA

Terrestrial Ecosystems Status



Legend

- Project Area
- Arterial / National Route
- Main Road
- Minor Road
- Tracks
- Power Line
- Perennial Stream
- Non-Perennial Stream
- Dam / Lake
- Non-Perennial Pan
- Perennial Pan

Surface Infrastructure

- Shafts
- Site Layout
- Plant Area
- Tailings
- Underground Workings
- Powerline Servitude
- Substation

Terrestrial Ecosystems Status

- Endangered
- Vulnerable
- Least Concern

DIGBY WELLS ENVIRONMENTAL

www.digbywells.com

Projection: Transverse Mercator
Datum: Hartebeeshoek 1984
Central Meridian: 27°E

Ref #:tdm.GOL1675.201210.104
Revision Number: 1
Date: 15/10/2012

N

0 0.5 1 2

Kilometres

1:45 000

The area of interest is devided into the project mining right boundary and the area affected by infrastructure. The project mining rights boundary coincides with two areas that have a terrestrial ecosystems status of Endangered and Vulnerable and one area of least concern (Figure 6-1). The area affected by infrastructure coincides with the two areas with terrestrial ecosystems status of Endangered and Vulnerable and not with the area of least concern.

This delineation differs from the preliminary field work results of the dry season. As the area indicated as Endangered was in actual fact agricultural arable land, and the Vulnerable category was found to be semi natural, but under grazing pressure. The vegetation encountered on site was not representative of the desktop assessment, this was because of large scale alteration of the natural environment, specifically due to agriculture.

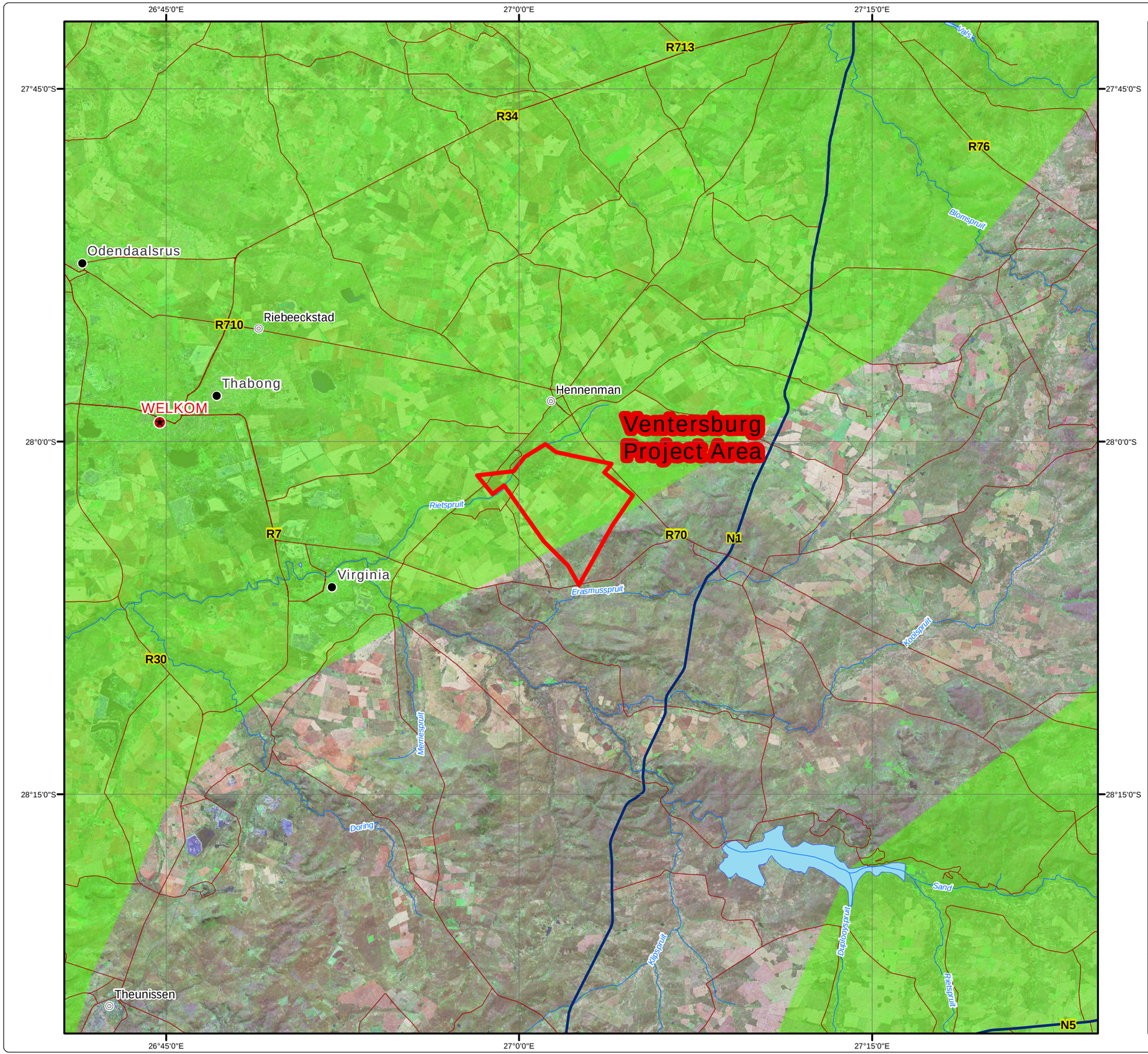
The project area falls within the Central Grasslands terrestrial priority conservation area, as can be seen in Figure 6-2.

The main aim of the NSBA is the management and conservation of biodiversity in production landscapes. In the case of the study area's location, it does fall within a Priority Conservation area, therefore the conservation of natural areas within the mine boundary, and areas surrounding the mine, that could be affected by the mine and accompanying infrastructure, is of importance.

Fig 6.2

Ventersburg Gold ESIA

Terrestrial Priority Conservation Areas



Legend

- Project Area
- City
- Major Town
- Secondary Town
- Main Road
- Arterial / National Route
- Perennial River
- Dams

Priority Conservation Areas

- Central Grasslands

DIGBY WELLS ENVIRONMENTAL

www.digbywells.com

Projection: Geographic
Datum: WGS 1984

Ref #: tdm.GOL1675.201210.106
Revision Number: 1
Date: 15/10/2012

N

0 4 8 16

Kilometres

1:300 000

6.1.2 Description of vegetation type

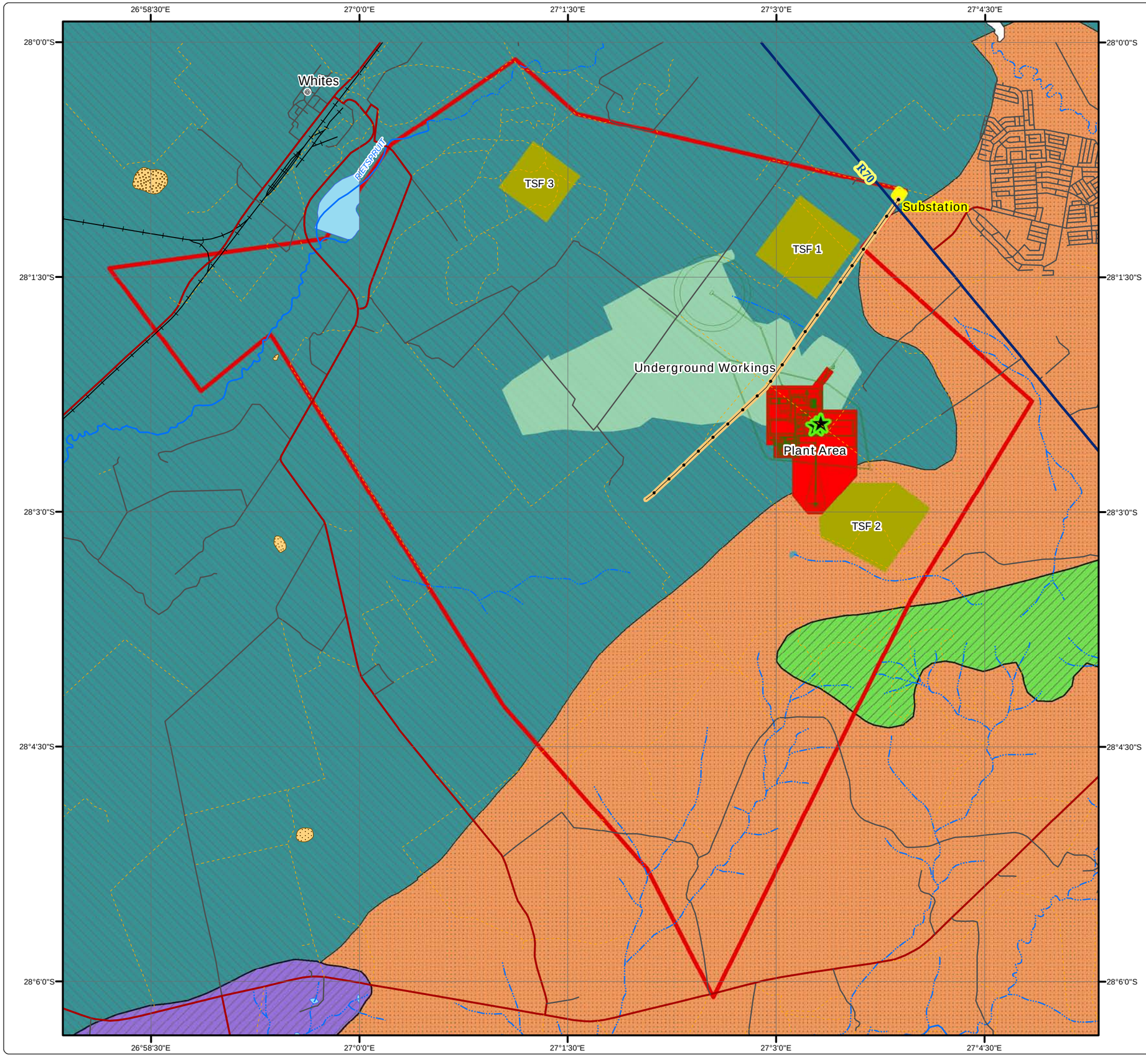
The study area is situated within three areas vegetated by the Moist Cool Highveld Grassland, the Sandy Highveld Grassland and the Dry Sandy Higheld Grassland according to Low & Rebelo (1998), with the most recent vegetation classification, classifying it as Central Free state grassland, Winburg Grassy Shrubland and the Vaal-Vet Sandy Grassland (Mucina & Rutherford 2006). The vegetation type is considered to be Endangered Vulnerable and least concern nationally, altered primarily by cultivation. The distribution of the three vegetation types in relation to the proposed infrastructure in displayed in Figure 6-3.

Following a site investigation in which the extent of the natural occurring, or expected vegetation types were assessed, the following was concluded. The majority of the study area has been altered by anthropogenic activities, specifically cultivation and grazing of livestock. The three vegetation types that occur in the study area according to Mucina and Rutherford (2006) could still be represented by isolated pockets of natural areas. These areas are depicted in Figure 6-4. Within these remaining natural areas, one could expect the plant species of the original vegetation type, with variations of species composition and richness most probably occurring due to current and historical impacts.

Fig 6.3

Ventersburg Gold ESIA

Mine Plan & Vegetation Types



Legend

- Project Area
- Arterial / National Route
- Main Road
- Minor Road
- Tracks
- Power Line
- Perennial Stream
- Non-Perennial Stream
- Dam

Mine Plan

- Shafts
- Site Layout
- Plant Area
- Underground Workings
- Tailings
- Substation
- Powerline Servitude

Vegetation Type

- Central Free State Grassland
- Highveld Alluvial Vegetation
- Vaal-Vet Sandy Grassland
- Winburg Grassy Shrubland

Conservation Status

- Endangered
- Least threatened
- Vulnerable

Mucina & Rutherford, 2006

DIGBY WELLS ENVIRONMENTAL

www.digbywells.com

Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 27°E

Ref #:mpl.GOL1675.2012302.041
Revision Number: 1
Date: 14/02/2013

N

0 0.5 1 2

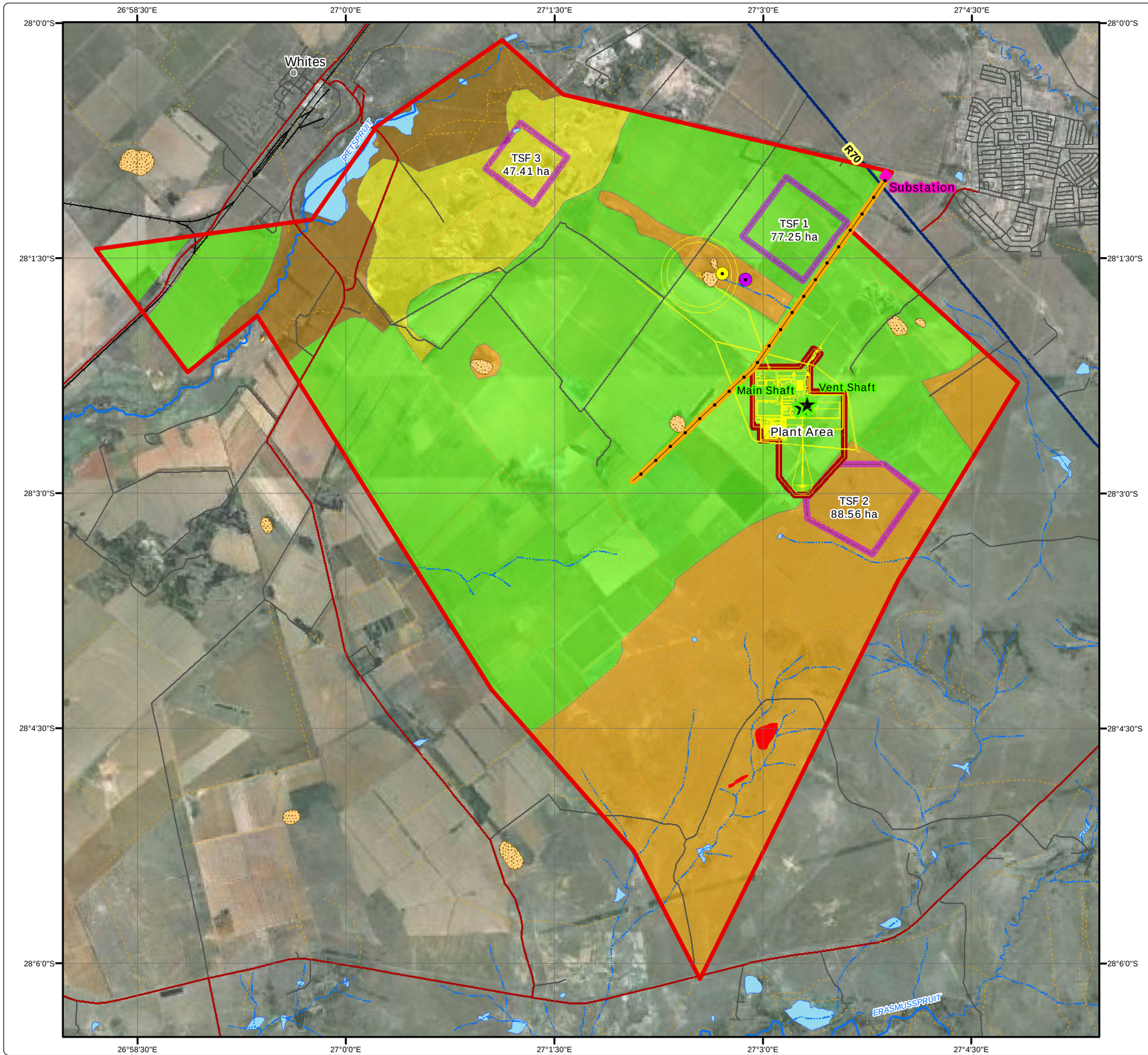
Kilometres

1:45 000

Fig 6.4

Ventersburg Gold ESIA

Mine Plan & Existing Vegetation



Legend

- Project Area
- Arterial / National Route
- Main Road
- Minor Road
- Tracks
- Railway Line
- Power Line
- Perennial Stream
- Non-Perennial Stream
- Dam / Lake
- Non-Perennial Pan
- Perennial Pan

Avifauna SSC

- Avifauna SSC 1
- Avifauna SSC 2

Infrastructure

- Shafts
- Site Layout
- Plant Area
- Tailings
- Powerline Servitude
- Substation

Existing Vegetation

- Cultivation
- Semi Natural
- Semi Natural (Grazed)
- Not Rehabilitated
- Ridges

DIGBY WELLS ENVIRONMENTAL

www.digbywells.com

Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 27°E

Ref #: mpl.GOL1675.201302.047
Revision Number: 1
Date: 25/09/2012

N

0 0.5 1 2

Kilometres

1:45 000

As discussed earlier the conservation status of these vegetation types are very poor, with large parts that are either currently cultivated or have been previously ploughed, and the remaining untransformed vegetation that occurs as patchy remnants that are often heavily grazed. A more detailed description of the three vegetation types is given below. The most important aspects of these vegetation types, from a desktop assessment point of view are:

- Vegetation and Landscape features;
- Important taxa, (Graminoids, Herbs, Geophytic Herbs, Succulent herbs and Low shrubs), that could possibly occur; and
- Conservation status.

6.1.3 Central Free State Grassland

Transitional Cymbopogon-Themeda Veld (Acocks 1953)

Moist Cool Highveld Grassland (Low and Rebello 1996)

6.1.3.1 Vegetation and Landscape features

Undulating plains supporting short grassland, in natural condition dominated by *Themeda triandra* and *E. chloromelas* became dominant in degraded habitats. Dwarf karoo bushes establish in severely degraded clayey bottomlands. Overgrazed and trampled low lying areas with heavy clayey soils are prone to *Acacia karoo* encroachment.

6.1.3.2 Important taxa Graminoids

Aristida adscensionis, A congesta, Cynodin dactylon, Eragrostis chloromelas, E curvula, E. plana, Panicum coloratum, Setaria sphacelata, Themeda triandra, Tragus koelerioides, Agrostis lacnantha, Andropogon appendiculatus, Aristida bipartita, A. canescens, Cymbopogon pospischilii, Cynodon transvaalensis, Digitaria argyrograpta, Elionorus muticus Eragrostis lehmaniana, E. micrantha, E. obtuse, E. racemosa, E. trichophora, Heteropogon contortus, Microchloa caffra, Setaria incrassate, Sporobolus discosporus

6.1.3.2.1 Herbs

Berkheya onopordifolia var. onopordifolia, Chamaesyce inaequilatera, Conyza pinnata, Crabbea acaulis, Geigeria aspera var. aspera, Hermannia depressa, Hibiscus pusillus, Pseudognaphalium luteo-album, Salvia stenophylla, Selago densiflora, Sonchus dregeanus.

6.1.3.2.2 Geophytic Herbs

Oxalis depressa, Raphionacme dyeri.

6.1.3.2.3 Succulent herb

Tripteris aghillana var. integrifolia.

6.1.3.2.4 Low shrubs

Felecia muricata, Anthospermum rigidum subs pumilum. Helichrysum dregeanum, Melolobium candicans, Pentzia globosa.

6.1.3.3 Conservation

Vulnerable, Target 24%. Only small portions enjoy statutory conservation (Willem Pretorius, Rustfontein and Koppies dam nature reserves, as well as in some nature reserves. Almost a quarter of the area has been transformed, either for cultivation or building of dams (Allemanskraal, Erfenis, Groothoek, Koppies, Kroonstd). No serious infestation by alien flora has been observed, but encroachment of dwarf karoo shrubs becomes a problem in the degraded southern parts of the vegetation type).

6.1.4 Winburg Grassy Shrubland

Cybopogon- Themeda veld (Acocks 1953)

Dry Sandy Highveld Grassland (Low & Rebello 2002)

6.1.4.1 Distribution

Free State province: Series of larger patches between Trompsburg through Bloemfontein and Winburg to Ventersburg. Altitude 1300 – 1660m mainly 1360-1440m.

6.1.4.2 Vegetation and Landscape features

Solitary hills, slopes and escarpments of mesas creating a mosaic of habitats ranging from open grassland to shrubland. Tall shrubs and sometimes small trees are sheltered between frequent periods of frost during winter months and regular veld fires in late winter to early spring. The medium height evergreen shrubland are dominated by a combination of Olea *europaea subs. Africana, Eulcea crispa subs. Crispa, Gymnosporia buxifolia, Diospyros lycioides, Rhus burchelli, R. ciliate, R. erosa* (mainly in the south), *Clutia pulchella* and *Grewia occidentalis*. Trees such as *R. lancea, Celtis Africana* and *Ziziphus mucronata* are found in more deeply incised drainage lines.

6.1.4.2.1 Small trees

Acacia karoo, Celtis Africana, Cussomia paniculata, Pittosporum viridiflorum, Rhus lancea, Scolopia zeyheri, Ziziphus mucronata.

6.1.4.2.2 Tall shrubs

Buddleja saligna, Euclea crispa subs ovate, Gymnosporia polycantha, Olea europaea, subs Africana, Rhus burchelli, Rhus erosa, Diospyros lycioides subs lycioides, Grewia occidentalis, Gymnosporia buxifolia, Tarchonanthus camphoratus.

6.1.4.2.3 Low shrubs

Helichrysum dregeanum, Pentzia globosa, Anthospermum rigidum subs pumilum, Asparagus cooperi, Asparagus laricinus, Berkheya annectens, Chrysocoma cilliata, Clutia pulchella, Euryops empetrifolius, Felecia filifolia susp filifolia, Felecia muricata, Nenax microphylla, Osyris lanceolata, Rosenia humulis, Salago saxatalis, Solanum tomentosum var coccineum.

6.1.4.2.4 Graminoids

Aristida adscencionis, A. congesta, A. diffusa, Cymbopogon pospischilii, Cynodon datylon, C. incompletus, Eragrosstis chloromelas, E. lehmanniana, E.micrantha, E. obtuse, E. trichophora, Eustchys paspaloides, Hetropogon contortus, Panicum stapfianum, Setaria lindenbergiana, Setaria sphacelata, Sporobolus fimbriatus, Themeda triandra, Tragus koelerioides, Digitaria argyrograpta, Elionorus muticus, Enneopogon scoparius, Eragrostis plana, Eragrostis superba, Tragus berteronianus, Tragus racemosus, Triraphis andropogonoides.

6.1.4.2.5 Herbs

Berkheya onopordifolia, Hermania coccocarpa, Indigofera alternans, Mohria cafrorum, Pupalia lappacea, Salvia repens.

6.1.4.2.6 Geophytic herbs

Oxalis corniculata, Oxalis depressa.

6.1.4.2.7 Succulent her

Crassula lanceolata.

6.1.4.3 Consevation

Least threatened. Target 28%, almost 2% statutory conserved in the Willem Pretorius Nature Reserve. More than 10% transformed for cultivation and Urban sprawl. Erosion low (57%), very low (24%)

6.1.5 Vaal-Vet Sandy Grassland

6.1.5.1 Distribution

North west and Free state provinces. South of Lichtenburg and Ventersdorp, stretching south wards to Klerksdorp, Leeudoringstas, Bothaville and to the Brandfort area. Altitude 1260- 1560, generally 1260m- 1360m.

6.1.5.2 Vegetation and Landscape features

Plains dominated landscape, with some scattered, irregular undulating plains and hills. Mainly low tussock grassland with an abundant karroid element. Dominance of *Themeda*

triandra is an important feature of this vegetation unit. Locally low cover of *T. triandra* and the associated increase in *Elionurus muticus, Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall.

6.1.5.2.1 Graminoids

Antephora pubescens, Aristida congesta, Chloris virgate, Cymbopogon caesius, Cynodon dactylon, Digitaria argyrograpta, Elionurus muticus, Eragrostis chloromelas, E. lehmaniana, E. Plana, Heteropogon contortus, Panicum gilvum, Setaria sphacelata, Themeda triandra, Tragus berteronianus, Brachiaria serrate, Cymbopogon pospischilii, Digitaria erianthra, Eragrostis curvula, E. obtuse, E. superba, Panicum coloratum, Pogonarthria squarrosa, Trichoneura grandiglumis, Triraphis andrpogonoides.

6.1.5.2.2 Herbs

Stachys spathulata, Barleria macrostegia, Berkheya onopordifolia, var. onopordipholia, Chamaesyce inaequilatera, Geigeria asperata var. aspera, Helichrysum caespititium, Hermania depressa, Hibiscus pusilus, Monsonia burkeana, Rhynchosia adenodes, Selago densiflora, Vernonia oligocephala.

6.1.5.2.3 Geophytic herbs

Bulbine narcissifolia, Ledebouria marginata.

6.1.5.2.4 Succulent herb

Tripteris aghillana var. integrifolia.

6.1.5.2.5 Low Shrubs

Felecia muricata, Pentzia globosa, Anthospermum rigidum subs. Pumilum, Helichrysum dregeanum, H paronychioides, Ziziphus zeyheriana.

6.1.5.2.6 Endemic: Herb

Lessertia phillipsiana.

6.1.5.3 Conservation

Endangered, Target 24%, Only 0.3% statutorily conserved in the Bloemhof dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit an Soetdoring Nature reserves. More than 64% transformed by cultivation (ploughed and commercial crops) and the rest under strong grazing pressure from cattle and sheep Erosion very low.

6.1.6 Plants of Conservation significance that could occur in the area

The POSA website list was obtained from the SANBI website, it lists all the Red Data plant species officially recorded by SANBI for Quarter degree square grid (2727CC, 2826BB and 2827AA) (Table 6-1). In order for a plant species to be included in this list, a specimen

collected in this grid must be supplied to SANBI. This list is therefore not a comprehensive list representing only those species that may occur in these grids, but rather a guideline as to what is likely to occur here. The sites sampled are also only a very small portion of the whole grid and habitats suitable for certain species in these POSA lists may not be present at the sites sampled. It is therefore not unusual for species in the POSA list to be absent from the sampling sites.

The plant species list obtained from the SANBI website (Table 6-1) indicated three species (classified as declining), that might occur within the project area that have been recorded in the relevant grid reference. These species are displayed in Table 6-1.

It is recommended that further studies with regards to flora be conducted, the motivation for this is the high and medium probability of occurrence of protected plant species. Furthermore, the presence of sensitive landscapes such as ridges and wetlands on the project site must be seen as habitat that must be further investigated from a floral perspective.

Table 6-1: Protected plant species

Family Name	Species Name	Common Name	IUCN	P.o.O.
AMARYLLIDACEAE	*Boophone disticha*	Bushman Poison Bulb	Declining	Medium
FABACEAE	*Acacia erioloba*	Black-Barked Camel thorn	Declining	High
HYPOXIDACEAE	*Hypoxis hemerocallidea*	Star-flower	Declining	Medium

6.2 Fauna

Fauna expected to occur on site include assemblages within terrestrial ecosystems, they are mammals, birds, reptiles and amphibians. Each of these species occurs within unique habitats, the ecological state of these habitats directly relates to the number of species found within them. According to Carruthers (2007), the main habitats occurring in the region are grassland plains, rivers and pans, with little altitudinal variation. The study area can be described as varying between arable and grazing to wilderness and wetland. It is therefore expected that agriculturally disturbed areas do exist on site, which would have a negative effect on the available natural habitat for natural occurring animal species. The general habitat condition encountered during the brief site visit was found to be modified to such an extent that the number of animal species one is likely to encounter is far less than what the desktop studies have suggested.

6.2.1 Mammals

Mammal species that have historically and could potentially occur in the area of interest include 96 species, of which 11 are listed on the South African Red Data list (Table 6-2).

The relative similarity and presence of disturbances of vegetation types occurring in the area of interest ensures a relatively poor ecological assemblage of plant species. This in turn appears to support a relatively poor selection of mammal species. Mammals that could occur

on site under pre-disturbance (farming) conditions are listed in Appendix C. The potential of a mammal species to occur in the project area have been evaluated through the presence of threats, prefered habitat and food availability. With a species scoring high if threats are not present, preferred habitat is present and food supply is present. A medium score will mean threats are not present, and preferred habitat and food supply is both or only one present. A low score indicates that threats are present, there is no preffered habitat and no food resource.

Current available habitats are heavily grazed remnant Central Free State grassland, which could present habitat for smaller mammals such as rodents, however larger grazers are not expected. The Winburg Grassy Shrubland, of which a very small portion is expected on site, and which also suffers under the same grazing pressure as Central Free State grassland. Thridly the Vaal-Vet Sandy Grassland of which very little remains and is not expected to harbour any but the hardiest of small mammal species.

Table 6-2: Listed Mammal Species

Common Name	*Scientific name*	Nemba Status	Potential to occur
African Clawless Otter	*Aonyx capensis*	Protected	Low
South African Hedgehog	*Atelerix frontalis*	Protected	Low
Black Wildebeest	*Connochaetes gnou*	Protected	Medium
Black-footed Cat	*Felis nigripes*	Protected	Low
Small Spotted Cat	*Felis nigripes*	Protected	Low
Brown Hyaena	*Hyaena brunnea*	Protected	Low
Serval	*Leptailurus serval*	Protected	High
Spotted-necked Otter	*Lutra maculicollis*	Protected	Low
Oribi	*Ourebia ourebi*	Endangered	Very Low
Leopard	*Panthera pardus*	Vulnerable	Low
Cape Fox	*Vulpes chama*	Protected	Low

It is recommended that a specialist mammal study be conducted for this project site. Although the habitat present in the study area cannot be described as pristine condition for mammal species, it still has the potential to support protected species, such as the Serval, which havs a high probability of occurring in the project area.

6.2.2 Birds (Avifaina)

Birds have been viewed as good ecological indicators, since their presence or absence tends to represent conditions pertaining to the proper functioning of an ecosystem. Bird communities and ecological condition are linked to land cover. As the land cover of an area changes, so do the types of birds in that area (The Bird Community Index, 2007). Land

cover is directly linked to habitats within the study area. The diversity of these habitats should give rise to many different species. During field work two protected bird species were positively identified, *Eupodotis caerulescens* (Blue Korhaan) (Avifauna SSC1 in Figure 6-4) and *Tyto Capensis* (African Grass Owl) (Avifauna SSC2 in Figure 6-4) which are regarded as near threatened and vulnerable respectively (Roberts 2009).

The potential of a bird species to occur in the project area have been evaluated through the presence of threats, prefered habitat and food availability. With a species scoring high if threats are not present, preferred habitat is present and food supply is present. A medium score will mean threats are not present, and preferred habitat and food supply is both or only one present. A low score indicates that threats are present, there is no preffered habitat and no food resource.

The South African Bird Atlas Project 2 (SABAP2), was used to determine the species that could be expected in the project area, this list is displayed under Appendix B, 107 bird species have recently been observed in the project area.

According to Roberts (2006), approximately 305 species of birds have been identified in the area. All birds that could be present within QDS 2727CC, 2826BB and 2827AA, according to Roberts, are listed in Appendix B. General and protected species as listed by SIBIS, for the relevant grid squares and are listed below. Of these species, 19 have been assigned a protected status (Table 6-3), according to the IUCN, and nine according to NEMBA. Due to the transient nature of the listed bird species that have been recorded in the area of interest and beyond previously, it is assumed that if preferred habitat is present, within or outside the project area boundaries that these species could occur on site.

The Important Bird Areas (IBA) Programme was also consulted, this is one of BirdLife International's most important conservation initiatives. The IBA Programme identifies and works to conserve a network of sites critical for the long-term survival of bird species that:

- are globally threatened;
- have a restricted range;
- are restricted to specific biomes/vegetation types.

The study area does not fall within an IBA. Current available habitats are as mentioned previously, heavily grazed Central Free State grassland, which could present habitat for seed eating, fruit eating and insect eating birds. No permanent open water bodies were encountered in this vegetation type. Which indicates that riparian or water birds will not be found, except if they are moving through the area.

The Winburg Grassy Shrubland once again, of which a very small portion is expected on site, and which also suffers under the same grazing pressure as Central Free State grassland.

Finally the Vaal-Vet Sandy Grassland of which little remains, after agricultural activities have transformed large areas of the project site. Seed eating fruit eating and insect eating birds could be present in these areas. The small seepage zones encounterd could create

temporary habitat for wading birds or riparian birds. In general a very limited range of habitats were encountered on site, and some of the habitats encountered were degraded, therefore little preferred habitat is available for bird species. That said, this was the vegetation type where both the protected bird species were encountered.

Table 6-3: Red Data bird species that could be present in the area

Common Name	*Scientific name*	Nemba Status	P.o.O.	IUCN
Blue Crane#	*Anthropoides paradiseus*	Endangered	Medium	VU
Yellowbreasted Pipit#	*Anthus chloris*	Not listed	Low	VU
Kori Bustard	*Ardeotis kori*	Vulnerable	Low	VU
Grey Crowned Crane	*Balearica regulorum*	Endangered	Medium	VU
Eurasian Bittern	*Botaurus stellaris*	Not listed	Low	CR
Redbilled Oxpecker	*Buphagus erythrorhynchus*	Not listed	Low	NT
Shortclawed Lark#	*Certhilauda chuana*	Not listed	Low	NT
Black Harrier#	*Circus maurus*	Not listed	Low	NT
African Marsh Harrier	*Circus ranivorus*	Protected	Medium	VU
Blue Korhaan	*Eupodotis caerulescens*	Vulnerable	**Confirmed**	NT
Whitebellied Korhaan	*Eupodotis senegalensis*	Not listed	Medium	VU
Whitebacked Night Heron	*Gorsachius leuconotus*	Not listed	Low	VU
Bearded Vulture	*Gypaetus barbatus*	Endangered	Low	EN
Cape Vulture#	*Gyps coprotheres*	Endangered	Low	VU
Meloduis Lark#	*Mirafra cheniana*	Not listed	High	NT
Ludwig's Bustard#	*Neotis ludwigii*	Vulnerable	Low	VU
Martial Eagle	*Polemaetus bellicosus*	Vulnerable	High	VU
Botha's Lark#	*Spizocorys fringillaris*	Not listed	High	EN
Caspian Tern	*Sterna caspia Pallas*	Not listed	Low	NT
African Grass-Owl	*Tyto capensis*	Vulnerable	**Confirmed**	VU

#- endemic

Of possible concern, apart from confirmed protected birds, are the Meloduis Lark, Martial Eagle and Botha's Lark, these three species scored high as a result of the presence of their preffered habitat, their preffered prey, and no direct threats, apart from possibly the Marshall Eagle, which could face certain threats depending on their proximity to settlements and roads. The possible presence of these birds of concern, and definite presence of the Blue

Korhaan and Grass Owl, substantiates the need for a speciealist Avifauna study within the study area.

6.2.3 Reptiles

Reptiles are ectothermic (cold-blooded) meaning they are organisms that control body temperature through external means. As a result reptiles are dependent on environmental heat sources (Savage, 2005). Due to this many reptiles regulate their body temperature by basking in the sun, or in warmer areas. According to Carruthers (2007) substrate is an important factor determining which habitats are suitable for which species of reptile. The presence of and limited availability of rocky out crops within the study area may indicate that only a few reptile species are present. . The potential of a reptile species to occur in the project area have been evaluated through the presence of threats, prefered habitat and food availability. With a species scoring high if threats are not present, preferred habitat is present and food supply is present. A medium score will mean threats are not present, and preferred habitat and food supply is both or only one present. A low score indicates that threats are present, there is no preffered habitat and no food resource. The Giant Girdled Lizard has a high probability of occurrence due to all three criteria being met.

Reptiles expected to occur on site are listed in Appendix C. Of these species, one has been assigned a Red Data status; and this species are listed in Table 6-4. The Giant Girdled Lizard (Table 6-4), are the reptile species of conservation concern that may occur in the area of interest.

Table 6-4: Red Data Reptile Species that could occur in project area

Genus	Species	Common name	Red list category	P.o.O
Smaug	*giganteus*	Giant Girdled Lizard	Vulnerable	Low

According to Branch (1998) the giant girdled lizards live in self-excavated burrows in the silty soil of the *Themeda* grassland in South Africa. Furthermore, they are insectivores, however they will at times eat small vertebrates (Branch, 1998). The decline in numbers is a result of habitat destruction (conversion of the grassland to farmland) and illegal collecting for the pet and traditional medicine trade.

From data obtained from the site visit, it was determined that isolated pockets of T*hemeda spp.* grassland do exist on the Central Free state grassland, and the remaining Vaal-Vet Sandy Grassland areas, it is therefore suggested that a reptile specialist study be undertaken to gain a further understanding of the study area, in general, and the possibility of these reptiles occuring on site.

6.2.4 Amphibians

Amphibians are viewed to be good indicators of changes to the whole ecosystem because they are sensitive to changes in the aquatic and terrestrial environments (Waddle, 2006). Most species of amphibians are dependent on the aquatic environment for reproduction (Duellman and Trueb 1986). Additionally, amphibians are sensitive to water quality and UV

radiation because of their permeable skin (Gerlanc and Kaufman 2005, Taylor et al. 2005). Activities such as feeding and dispersal are spent in terrestrial environments (Waddle, 2006). According to Carruthers (2001), a number of factors influence the distribution of amphibians, but because amphibians have porous skin they generally prosper in warm and damp habitats. The presence of suitable habitat within the study area could provide habitat to a number of different species of amphibians, this can however not be confirmed during this study.

According to Carruthers (2001), frogs occur throughout southern Africa. A number of factors influence their distribution, and they are generally restricted to the habitat type they prefer, especially in their choice of breeding site. The choices available of these habitats coincide with different biomes, these biomes in turn, are distinguished by means of biotic and abiotic features prevalent within them. Therefore a collection of amphibians associated with the Grassland biome will all choose to breed under the prevailing biotic and abiotic features present. Within the biome further niche differentiation is encountered by means of geographic location within the biome, this differentiation includes, banks of pans, open water, inundated grasses, reed beds, trees, rivers and open ground, some of which are present within the area of interest. No Red Data Amphibian species are expected to occur on site.

Table 6-5: Amphibian species

Genus	Species	Common name	Red list category	P.o.O
Amietophrynus	*gutturalis*	Guttural toad	Least Concern	High
Amietophrynus	*poweri*	Western Olive toad	Least Concern	High
Amietophrynus	*rangeri*	Raucus toad	Least Concern	High
Kassina	*senegalensis*	Bubbling Kassina	Least Concern	High
Amietia	*angolensis*	Angola River Frog	Least Concern	Medium
Amietia	*fuscigula*	Cape River Frog	Least Concern	Medium
Cacosternum	*boettgeri*	Boetgers Caco	Least Concern	High
Tomopterna	*cryptotis*	Tremelo Sand frog	Least Concern	High

Seasonal water sources were encounterd within isolated pockets of the Vaal-Vet Sandy grassland (Figure 6-4), these areas are highly likely to harbour any number of the above mentioned amphibian species, and further specialist studies are recommended in this regard.

6.2.5 Invertebrates

Invertebrates discussed in this section is from a high level desktop assessment only as no surveys were undertaken to identify invertebrates on site during the site visit. During the site visit it was found that habitat for the below mentioned orders do occur. As all of them are generalists in habitat requirements it is expected that assemblages of these do occur in the project area.

6.2.5.1 Lepidoptera

The lepidoptera desktop study conducted by accessing the SABCA (South African Butterlfy Conservation Assessment), found that no protected species are expected to occur on the project site. The species that have been recorded within the general area are listed in Appendix D.

6.2.5.2 Arachnida (adapted from South African National Survey of Arachnida)

Spiders do not occur on any many official protected lists, however this does not mean they are not threatened by human activity, such as mining that is responsible for habitat destruction in general. Spiders are wingless animals and frequently have a high bio-indicative value as they are usually more strongly associated with a biotope than flying insects.

Conservation status: Spiders of the suborder Mygalomorphae, and especially the larger baboon spiders of the family Theraphosidae, are classified as Commercially Threathened in terms of the IUCN system, this is because of their demand as pets. In South Africa the larger Theraphosidae genera were added to Schedule VII of the Transvaal Provincial Nature Conservation Ordinance of 1983 as Protected Invertebrate Animals.

6.2.5.3 Scorpions (adapted from South African National Survey of Arachnida)

South Africa has a rich fauna represented by three families: Buthidae, Liochelidae and Scorpionidae and more than hundred species.
Scorpions are predators and the South African scorpions can be divided into three ecological categories according to their choice of habitat, viz. burrowing scorpions, rock-dwelling or arboreal species. They are fairly well collected and research shows that most regions contain at least one endemic species. Hotspots of rare species showed a concentration in the western third of Southern Africa and they occur in regions of rugged topography, complex geology, or varied strata.

Conservation status: No scorpions are presently protected in South Africa. Scorpions are not too difficult to collect and therefore might be endangered by collectors. They can also be endangered by pollution and habitat destruction.

6.2.5.4 Solifugau (adapted from South African National Survey of Arachnida)

South Africa has a rich fauna of Solifugae represented by 146 species in six families. Of these species 107 (71 %) are endemic to South Africa. The South African fauna represents 16 % of the world's fauna.

Solifugids tend to be more common in the warm and arid regions of the country and twice as many species are found in the western and northern half of Southern Africa than in the east. The highest number of species has been recorded from the Northern Cape (81), Western Cape (41) and Eastern Cape and Northern Province each with 28. Mpumalanga and KwaZulu-Natal each have 15 species, Gauteng 10, North West Province seven and the Free State five.

Conservation status: No sun spiders are protected. They are difficult to keep in captivity and are therefore not popular in the pet trade. They might however be endangered by pollution and habitat destruction. At present 24 species are known to occur in the National Parks.

6.2.5.5 Mites and ticks (adapted from South African National Survey of Arachnida)

The order Acari, includes the mites and ticks and many of them are very small. Most groups are of economic importance to man's environment, health and agriculture. Although many mite species are pests, some are beneficial to man and are used in the biological control of invasive plants or crop pests.

Acari are distributed worldwide and form a major component of every ecosystem whether aquatic, terrestrial, arboreal or parasitic. They have a wide distribution throughout South Africa.

Conservation status: No Acari species are on the IUCN red list and little is known about their conservation status. Numerous mite and tick species are associated with a specific plant or animal species. With this type of association the Acari will receive indirect protection when the host is protected.

6.3 Sensitive Ecological areas

As discussed previously, the study area has undergone modification to a large extent through current land use, this means that the natural vegetation and subsequent habitat types present in the study area is not of good quantity or quality. Sensitive habitats that are usually found within the grassland vegetation type include, rocky outcrops, wetlands seepages (hillside, valey bottom) and pristine grassland with excellent species richness. Of these the only sensitive habitat encountered was the wetlands and accompanying drainage lines and very limiterd ridges, the specific designation and description of the wetlands which are contained in the specialist wetland report compiled by Digby Wells (Figure 6-4). The Ridges encountered are not affected by the infrastructure placement.

7 PRELIMINARY DRY SEASON SITE VISIT RESULTS

The two most prominent influences on the vegetation in the study area are:

- A soil moisture gradient which separated different areas into communities from the first community on shallow, sandy soils which seldom becomes saturated occurring to the south east of the project area, to the last community on deep, sandy clay loam soils which are permanently or regularly inundated with water; and

- Human influence through management, from the moderately utilised climax grassland to the severely disturbed and degraded communities along the slopes and drainage lines.

From the results obtained during the preliminary dry season site visit, it was clear that the natural vegetation of the study area experiences impacts from periodic and unplanned fires as well as grazing. Areas of excessive grazing pressure were also periodically accompanied by erosion due to bare soil.

From the expected three vegetation types, that make up the natural vegetation, according to Mucina and Rutherford (2006) the central Free State grassland is the least impacted on by agricultural activities, this vegetation type is nationally classified as vulnerable. This vegetation type is located to the south and east of the study area, and will be disturbed by the current location of TSF 2 and part of the rock dump.

The Winburg grassy shrubland only occurs in a small pocket in the south eastern corner of the study site, it is designated as least threatened, and will not be disturbed during construction activities according the the latest (February 2013) mine plan.

The Vaal-vet sandy grassland occupies approximately 70% of the project area, the entire central and north western parts. It is nationally designated as Endangered. This vegetation type is almost completely transformed by cultivated fields apart from small isolated drainage lines that were untouched by agriculture at the time of the field visit (Figure 6-4). These remaining areas of this vegetation type will not be directly affected by the placement of TSF 1 and 3. The underground mining will also be taking place underneath this vegetation type.

Prominent plant species encountered during this site visit included *Heteropogon contortus, Tricholeana monachne, Eragrostis gummiflua, Eragrostis capensis, Eragrostis racemosa, Helichrysum aureonitens, Monocymbium ceresiiforme, Aristida congesta congesta, Bidens bipinnata, Cynodon dactylon, Cyperus esculentus, Digitaria eriantha, Elionurus muticus, Imperata cylindrica*. These plant species were found in the grazed Central free-state grassland, and isolated drainage lines, in the Vaal-vet sandy grassland (Figure 6-4).

The tree component was scarce and *Acacia Karoo* was found to dominate the drainage lines to the south central area. With *Eucalyptus camaldulensis* (Red River gum), an invasive species alien invasive category 2, dominating areas close to farm houses and roads, this species is commonly used for wind breaks by farmers. *Conyza bonariensis, Cosmos bipinnatus, Bidens pilosa* and *Tragus berteronianus* were also found around homesteads.

Periodic fires in the grasslands of South Africa are one of the main factors that maintain grassland structure, and all species of plant and animal (specifically plants) have adapted to survive these fires. However the frequency, intensity and season these fires occur ultimately decide the composition and structure of grassland plant communities. The main reasons why burning is important though is that it removes moribund material. Moribund material hampers the spring growth by way of excessive shading and limiting available space.

Evidence of previous burning was encountered during the site visit. When burning is applied to frequently in an area, certain species of plants will be removed from the system, specifically the seed bearing plants as these will not have enough time to set seed.

Geophytes are also disadvantaged due to their life cycle, requiring above ground appendages to surive at certain stages.

Mammal species encountered during this dry season site visit, was concentrated in the game camp area to the north of the project site Table 7-1. Steenbuck was encountered to the south of the project site.

Table 7-1: Mammals encountered

Species	Scientific name	Area found	Protected
Blesbuck	*Damaliscus pygargus phillipsi*	Game Camp	Not listed
Cape Ground Squirrel	*Xerus inauris*	Game Camp	Not listed
Giraffe	*Giraffa camelopardalis*	Game Camp	Not listed
Lechwe	*Kobus leche*	Game Camp	Not listed
Springbuck	*Antidorcas marsupialis*	Game Camp	Not listed
Kudu	*Tragelaphus strepsiceros*	Game Camp	Not listed
Steenbuck	*Raphicerus campestris*	General area	Not listed
White-tailed Mongoose	*Ichneumia albicauda*	Game Camp	Not listed

The three options for the location of the TSF's were located to the north of the study area (TSF3), to the east (TSF1), and the south (TSF2). Only TSF 2 will be placed in un-cultivated land, where grazing is currently taking place (Figure 6-3). TSF 1 is located to the side of a drainage line area within Vaal-vet sandy grassland, and the placement will have no direct affects on the surrounding vegetation. Poor management of this TSF could have indirect negative effect on the fauna possibly present here through seepage, specifically amphibians that depend on the permanently wet area. Furthermore TSF 1 is located within a buffer zone for the wetland area, which must be avoided, this effectively cancels this option. TSF 2 is located within Central free-state grassland, away from water courses, but within the remaining semi-natural vegetation that was heavily overgrazed. TSF 3 is located within a heavily disturbed area, where no natural vegetation remains, however this option is very close to a water course, and buffer zones might be applicable, and not allow placement. From a flora and fauna point of view the placement of option 3 will potentially have the least negative effect on the natural flora and fauna in the study area, followed by option 2 where no natural vegetation is at present, with option 1 not being seen as an option.

8 IMPACT ASSESSMENT

8.1 Proposed Activities

The following Table, Table 8-1 describes the various activities associated with the phases of mining proposed for the Gold One Ventersburg Mine. Associated with these activities are several impacts, which are described in the section below.

Table 8-1: Mining Activities Proposed for Gold One Ventersburg

Phase		Activity
Construction	1	Site Clearing: Removal of topsoil & vegetation
	2	Construction of any surface infrastructure e.g. internal roads, pipes, storm water diversion berms, conveyors (including transportation of materials & stockpiling)
	3	Drilling, blasting and development of infrastructure and shaft for mining (incl. stockpiling from initial cuts).
	4	Temporary storage of hazardous product (fuel, explosives) and waste or sewage.
	5	Waste rock dump for shaft material
Operation	6	Use and maintenance of haul roads
	7	Removal of certain ore (mining process) and Stockpiling
	8	Water use & storage on site (incl. stormwater, PCD, domestic waste water)
	9	Storage, handling and treatment of hazardous products (fuel, explosives, oil) and waste activities (waste, sewage, PCD)
	10	Revegetation of stockpiles (where applicable)
Decommissioning	11	Demolition & Removal of certain infrastructure (incl. transportation off site)
	12	Rehabilitation (spreading of soil, re-vegetation & profiling/contouring)
	13	Environmental monitoring of decommissioning activities
	14	Storage, handling and treatment of hazardous products (fuel, explosives, oil) and waste activities (waste, sewage, discard)
Post-closure phase	15	Post-closure monitoring and rehabilitation

8.2 Issues and Impacts

The following section describes the Flora and Fauna Issues and Impacts for;

- Proposed Ventersburg Mining Development.

8.2.1 Impacts of the Proposed Mining Activities

8.2.1.1 Issue 1: Loss of Vegetation Communities

This Issue and the associated impacts will occur as a result of Activities 1 and 5 in the Construction phase. The removal of vegetation for the proposed mining activity and associated infrastructure will result in the loss of vegetation. The destruction of the

vegetation will result in the permanent reduction of natural habitat of reptiles, birds, frogs, insects and mammals present within the areas. The birds, reptiles, frogs, insects and mammals that currently inhabit this area will be directly affected.

- Impact 1: Loss of Remnant Central Free state Grassland
  - This impact is minor for this project as very few of the mining infrastructure occurs within this vegetation type. Only Option 2 for the TSF, could have an impact (Figure 6-3).

8.2.1.1.1 Mitigation and Management

The mining infrastructure, (including roads and conveyors) have allready been moved into areas of low sensitivity (disturbed or degraded land) such as cultivated and grazed areas, rather than being built within remnant natural vegetation types. Rehabilitation of areas should occur concurrent to mining activity, and should concentrate on introducing naturally occurring plant species. A nursery is recommended which will serve to propagate indigenous species in order that they can restore disturbed areas, immediately after activity has ceased.

Issue 1	**Loss of vegetation Communities**				
Parameters	***Severity***	***Spatial scale***	***Duration***	***Probability***	***Significance***
Impact 1	**Loss of Central Free State Grassland**				
Pre- Mitigation	Minor (2)	Limited (2)	Project Life (5)	Likely (5)	Medium-low (45)

8.2.1.2 Issue 2: Loss of biodiversity

Some loss of biodiversity will occur in the construction phase of the development as a result of clearing of the vegetation (TSF2 only).

- Impact 1: Loss of Biodiversity (General)
- Impact 2: Loss of Biodiversity (Sensitive Ecological areas, such as ridges and wetlands).

8.2.1.2.1 Mitigation and Management

Adhere to designated mining areas. Avoid all natural areas, including sensitive landscapes.

Parameters	*Severity*	*Spatial scale*	*Duration*	*Probability*	*Significance*
Impact 1	**Loss of Biodiversity (general)**				
Construction Phase					
Pre- Mitigation	Minor (2)	Limited (2)	Project Life (5)	Likely (5)	Medium-low (45)
Post- Mitigation	Minor (2)	Limited (2)	Project Life (5)	Likely (5)	Medium-low (45)
Operational Phase					
Pre- Mitigation	Minor (2)	Limited (2)	Project Life (5)	Likely (5)	Medium-low (45)
Post- Mitigation	Minor (2)	Limited (2)	Project Life (5)	Likely (5)	Medium-low (45)
Impact 2	**Loss of Biodiversity (Sensitive Landscapes)**				
Construction Phase					
Pre- Mitigation	Moderate (3)	Local (3)	Project Life (5)	Likely (5)	Medium-low (55)
Post- Mitigation	Minor (2)	Limited (2)	Project Life (5)	Likely (5)	Medium-low (45)
Operational Phase					
Pre- Mitigation	Moderate (3)	Local (3)	Project Life (5)	Likely (5)	Medium-low (55)
Post- Mitigation	Minor (2)	Limited (2)	Project Life (5)	Likely (5)	Medium-low (45)

8.2.1.3 Issue 3: Loss of ecosystem function

The general functioning and provision of ecosystem services in the greater area ecosystem will be reduced and impaired. The introduction of alien species will occur, but if managed properly, can be adequately controlled.

- Impact 3: Influx of alien invasive plants

8.2.1.3.1 Mitigation and Management

The footprint of the mine should be as small as possible. Alien plants must be identified and removed throughout the construction, operation and decommissioning phases.

Issue 3	**Loss of Ecosystem Function**				
Parameters	***Severity***	***Spatial scale***	***Duration***	***Probability***	***Significance***
Impact 9	**Influx of alien invasives**				
Construction Phase					
Pre- Mitigation	Serious (4)	Local (3)	Medium term (3)	Almost certain (6)	Medium-low (60)
Post-Mitigation	Minor (2)	Local (3)	Medium term (3)	Probable (4)	Low (32)
Operational Phase					
Pre- Mitigation	Significant (6)	Local (3)	Permanent (6)	Almost certain (6)	Medium-high (90)
Post-Mitigation	Minor (2)	Local (3)	Permanent (6)	Probable (4)	Medium Low (44)
Decommissioning Phase					
Pre- Mitigation	Significant (6)	Local (3)	Permanent (6)	Almost certain (6)	Medium-high (90)
Post-Mitigation	Minor (2)	Local (3)	Permanent (6)	Probable (4)	Medium Low (44)

9 CONCLUSION

The preliminary field scan was completed during the dry season of the area of concern, and as a result the presence of seasonal plant and animal species were not confirmed. The area of concern has been impacted on by the current and historical land use, to such an extent that very few natural areas remain. Maize cultivation is the current and major land use, with grazing of natural areas being the secondary land use. The majority of the animal species encountered were all within the game camp to the north of the study area, it was found that this area is artificially stocked, with animal species that are not expected in the Free State grasslands, such as Giraffe. Two protected bird species were encountered in the remaining natural grassland during this site visit.

The general infrastructure placement or mine plan supplied to Digby Wells indicates the mining infrastructure will be placed in the cultivated lands, or remnance of the Vaal-vet sandy grassland (apart from TSF 2), which has been transformed for cultivation and, as discussed earlier, is not a good representation of the vegetation type as described by Mucina and Rutherford (2006).

Impacts to the remaining natural vegetation from the infrastructure footprint will have a small impact on the remaining natural vegetation in the area (TSF2).

10 RECOMMENDATIONS

The study area presently consists of semi-natural areas with medium low biodiversity conservation value. Based on the scope and findings of this assessment the following broad management units can be identified:

- Remnant Grassland;
- Current cultivation;
- Alien trees;
- Pastures, semi-natural areas that are grazed;
- Ridges
- Drainage lines/Riparian.

The biodiversity management actions of the proposed mine should be focussed on these vegetation units. These recommended management actions inlcude.

- Adherence to the mitigation measures as stipulated in the Impact Assessement;
- The wetland areas and drainage lines must be avoided during construction and operation.
- A specialist flora study to be conducted;
- A specialist mammal study to be conducted;
- A specialist avifauna study to be conducted;
- A specialist reptile study to be conducted;
- A specialist amphibian study to be conducted;
- Rehabilitation of areas should occur concurrent to mining activity;
- A nursery is recommended which will serve to propagate indigenous species;
- The footprint of the mine should be as small as possible;

- Alien plants must be identified and removed throughout the construction, operation and decommissioning phases, design a specialist alien plant monitoring plan;
- Design and implement a fire management plan;

11 REFERENCES

ACOCKS, J.H.P, 1988. Veld types of South Africa. 3rd edn. Memoirs of the Botanical Survey of South Africa 57: 1-147

SOUTH AFRICAN NATIONAL SURVEY OF ARACHNIDA: http://www.arc.agric.za/home.asp?pid=3297, accessed on the 20/05/2013.

BARNES K. N. (ed) 2000. The Eskom Red data Book of Birds of South Africa, Lesotho & Swaziland. Birdlife South Africa, Johannesburg

BEZEUIDENHOUDT, H.& BREDENKAMP, J.G. 1990, A reconnaissance survey of the vegetation of the dolomite region in the Potchefstroom-Ventersdorp-Randfontein area, South Africa. Phytocoenologia 18: 387-403

BRANCH, B. 2001. Snakes and Other Reptiles of Southern Africa. Struik Publishers, South Africa.

BREDENKAMP, J.G. 1982. 'n Plantekologiese studie van die ManyeletinWildtuin. D.Sc. thesis, University of Pretoria, Pretoria.

BOTHMA, J.DU.P. (ed). 2002. *Game Ranch Management (4th Edition).* Van Schaik Publishers, Pretoria

BROMILOW, C. 2010. Problem Plants of South Africa. Briza Publications, Pretoria.

CARRUTHERS, V. & PASSMORE, NI. 1995. *South African Frogs: A Complete Guide.* Witwatersrand University Press, South Africa

DU PLESSIS, F. 2001. A phytosociological synthesis of Mopaneveld. M.Sc. thesis, University of Pretoria, Pretoria.).

DU PREEZ, L. & CARUTHERS, V. 2009. A Complete guide to the frogs of South Africa. Struik Nature, South Africa.

DRIVER, A., MAZE, K., LOMBARD A.T., NEL, J., ROUGET, M., TURPIE, J.K., COWLING, R.M., DESMET, P., GOODMAN, P., HARRIS, J., JONAS, Z., REYERS, B., SINK, K. & STRAUSS, T. 2004. South African National Spatial Biodiversity Assessment 2004: Summary Report. South African National Biodiversity Institute, Pretoria.

ELZINGA, R.J. 2000. Fundamentals of Entomology. Prentice Hall, Upper Saddle River, New Jersey.

FERRAR, A. F. and LOTTER, M. C. Mpumalanga Biodiversity: Conservation Plan handbook. Mpumalanga Tourism an Park Agency, Scientific services. Mpumalanga Provincial Government, Nelspruit. 2007

FRIEDMAN, Y. AND DALY, B. 2004 Red Data Book of the Mammals of South Africa: A Conservation Assessment. CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust. South Africa.

LOW, A.B. & REBELO, A.G. 1996. Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

MUCINA, L, RUTHERFORD, M.C. & POWRIE, L. 2006. Vegetation Map of South Africa, Lesotho & Swaziland. SANBI, Pretoria.

MUELLER-DOMBOIS, D. & ELLENBERG, H. 1974. Aims and methods of vegetation ecology. John Wiley & Sons, New York

PASSMORE N.I., & CARRUTHERS, V.C. 1995. South African Frogs: A complete Guide. Southern Book Publishers, Witwatersrand University Press, South Africa

POOLEY, E.S. 1998. A Field Guide to Wildflowers Kwazulu-Natal and the eastern region.Natal Flora Publishers Trust: Durban, South Africa.

ROBERTS 2010. Roberts' Multimedia Birds of Southern Africa.

SKINNER J.D. & CHIMIMBA C.T. 2005. The Mammals of the Southern African Subregion (3rd Ed.). Cambridge University Press, Cape Town. CSIR, 2006.

SoER: http://soer.deat.gov.za/dm_documents/TOR_Specialist_Studies_1qWDC.pdf

TAINTON, N.M. 1999. Veld Management in South Africa. Univ. Natal Press, Pietermaritzburg.

VAN OUTSHOORN, F. 1999. Guide to grasses of Southern Africa. Briza Publications, Pretoria, South Africa.

PICKER, M., GRIFFITHS, C & WEAVING, A. 2002. *Field Guide to Insects of South Africa.* Struik Publishers, Cape Town

Appendix A: Expertise of Specialists

Mr Rudi Greffrath

Environmental Scientist

Biophysical Department

Digby Wells Environmental

EDUCATION

2001-2004 Diploma in Nature Conservation, UPE Saasveld Campus

2005 B-tech Degree in Nature Conservation, UPE Saasveld Campus

EMPLOYMENT

2006- present: Employed at Digby Wells Environmental, as an Environmental Consultant.

2002 -2003: As part of course work I completed 1 year experiential training at Shamwari private game reserve. I was involved with all daily tasks of the conservation department of the reserve, including anti-poaching patrols, fence monitoring, alien vegetation control, erosion control, animal husbandry, also the yearly game capture and game relocation. Furthermore I also worked at the born free cat sanctuary located on Shamwari, this included feeding and care of all big cats. Annual ecological monitoring of vegetation condition was conducted as part of the reserves annual monitoring programs. Annual monitoring of game numbers and general condition. These tasks were performed on Shamwari (Eastern Cape), Sawubona (Western Cape), and Bushman Sands (Eastern Cape) Game reserves.

1999-2001 I was employed by a geotechnical instrumentation company called Kop-Kop, during which time I worked on the Lesotho highlands water project specifically the Mohale dam. I was charged with installing and maintaining the Mohale instruments, as well as taking daily readings, and training personnel before hand over to local authorities. I also worked on the Maguga Dam in Swaziland, where my duties were essentially the same.

EXPERIENCE

- Environmental Impact Assessments (EIAs), Basic Assessments and Environmental Management Plans (EMPs) for environmental authorisations in terms of the South African National Environmental Management Act (NEMA), 1998 (Act 107 of 1998);
- Environmental pre-feasibility studies for various projects;
- Public Participation Processes and Public Consultation and Disclosure Plans;
- Biodiversity Assessments including Flora, Mammalia, Avifauna, Herpetofauna and Arthropoda;

- Impact assessments based on the terrestrial environment;
- Biodiversity Action Plans (BAP), rehabilitation and monitoring methods;
- Environmental auditing;
- Rehabilitation monitoring;
- Rehabilitation design;
- Project management of ecological specialist studies.

PROJECT EXPERIENCE

Botswana

Mmamabula Energy Project (MEP). Including:

- MEP Railway siding;
- MEP Strip mining operation;
- MEP Calcrete mine;
- MEP Transmission lines;
- MEP Wellfields;
- MEP Serorome mine;
- Zoetfontein and Parr's halt.

Namibia

- Valencia Uranium Project, conducted Fauna and Flora baseline studies.

Sierra Leone

- Koidu Holdings, Sierra Leone: Fauna and Flora and impact assessment for the expansion of kimberlite mine.

Ghana

- Anglo Gold Ashanti, Ghana: Fauna and Flora assessment on and rehabilitation monitoring.

Democratic Republic of Congo

- Randgold Kibali Gold Mine, Fauna and Flora and impact assessment;
- Randgold Nzoro, Hydrostations, Fauna and Flora and impact assessment;
- Randgold, Budana Hydroelectric power station and transmission lines, Fauna and Flora and impact assessment.

Mali

- Randgold Loulo Gold mine, Rehabilitation monitoring, Alien invasive plant eradication program initiation.

South Africa

Grassland

- BHP Billiton, Naudesbank mineral optimisation study, Mpumalanga grasslands;
- BHP Billiton Vaalbank, baseline studies, Mpumalanga grasslands;
- Xstrata Mpunzi division biodiversity studies, Mpumalanga grasslands;
- Kangala, injula baseline studies, Mpumalanga grasslands;
- Xstrata Impunzi Biodiversity monitoring and Biodiversity Action Plan.

Savannah biomes

- Chomdek, Waterberg south, Limpopo river valley;
- Chomdek, Waterberg main, Limpopo river valley;
- MEP, Botswana studies, Botswana;
- Temo Coal, Waterberg Limpopo: Fauna and Flora Assessment and an impact assessment based on the development of an opencast coal mine;
- Harmony Gold, Virginia shaft, Rehabilitation action plan;
- Galaxy Gold, Barberton, Tailings dam expansion Fauna and Flora assessment.

PROFESSIONAL AFFILIATIONS

IAIA, International Association for Impact assessments.

Botanical Society of South Africa

Ms Leigh-Ann de Wet (Pri.Sci.Nat.)

Flora and Fauna Specialist

Biophysical Department

Digby Wells Environmental

EDUCATION

2006 – 2007:	MSc in Botany – Rhodes University
2005 – 2006:	BSc Honours in Botany – Rhodes University
2001 – 2004:	Undergraduate BSc (Botany and Entomology) – Rhodes university
1995 – 2000:	Maris Stella School, Durban, South Africa

EMPLOYMENT

2012 -	Present: Digby Wells Environmental – Flora Fauna Specialist
2012	Coastal and Environmental Services – Senior Environmental Consultant and Ecological Specialist
2009 - 2012	Coastal and Environmental Services – Environmental Consultant and Ecological Specialist
2007 - 2009	March 2009: Rhodes University (South Africa) and Sheffield University (England) - NERC research Assistant

EXPERIENCE

Current Work at Digby Wells (October 2012 – to date)

Leigh-Ann is a Flora and Fauna Specialist in the biophysical department and has been appointed to conduct Ecological Specialist Studies. In addition she is responsible for the management of Biodiversity Action Plans (BAP).

Prior to joining Digby Wells Environmental (September 2007 – September 2012)

Prior to this appointment, she gained experience as a research assistant working on and international common or garden experiment to determine the role climate change has on grassland composition. In 2009, she was appointed at Coastal and Environmental Services where she was responsible for conducting Ecological Impact Assessments (EcIA), Ecological Baseline Assessments, Vegetation Impact Assessments, Rehabilitation Plans and Ground-truthing studies and permit applications for removal or transplantation of Species of Special Concern (SSC). She has worked in several African countries in West Africa, Southern Africa and Madagascar, and extensively within South Africa. In 2012 at Coastal and Environmental Services she was promoted to Senior Environmental Consultant and Ecological Specialist and her role expanded to include management of specialist work.

PROJECT EXPERIENCE

Project Involvement

Current: BAP for Anglo Coal, South Africa

Project Involvement prior to joining Digby Wells Environmental

- Ecological Impact Assessment for Equatorial Palm Oil (palm oil plantation), Liberia
- Vegetation Impact Assessment for Toliara Sands (mineral sands mine), Madagascar
- Ecological Impact Assessments for various wind energy facility developments in the Eastern Cape, Western Cape, Mpumalanga and KwaZulu Natal
- Vegetation and Flora Impact Assessment for First Quantum Minerals (copper mine), Zambia
- Ecological Impact Assessment for GS Cimentos (cement mine), Mozambique
- Ecological Impact Assessment and Rehabilitation Plan for Lynas (Monazite mine), Malawi
- Ecological Impact Assessments for various developments (managanese smelters, housing developments, bamboo plantations) in South Africa
- Rehabilitation Plans for various developments in South Africa
- Biodiversity Monitoring Plans for various developments in South Africa

SHORT COURSES

2009: EIA Short course – Rhodes University and Coastal and Environmental Services

2011: Land Degradation Short Course – Rhodes University

PROFESSIONAL REGISTRATION

2012: Registered as a Professional Natural Scientist (Ecology) with the South African Council for Natural Scientific Professions (400233/12)

2012: Registered as a High Conservation Value Assessor (plants) with the Round Table of Sustainable Biofuels.

SOCIETY REGISTRATION

2013: Wildlife and Environment Society of South Africa

2013: Botanical Society of South Africa

AWARDS

2004: Putterill Prize for conservation in the Eastern Cape

2005: Best Young Botanist second prize for a presentation entitled: “Population biology and effects of harvesting on *Pelargonoium reniforme* (Geraniaceae) in Grahamstown and surrounding areas” at the SAAB conference

PRESENTATIONS

2011: LR de Wet - Finding Ecological Benefits of Windfarms – Thicket Forum, Grahamstown

2010: Lubke, RA, N Davenport, LR de Wet and C Fordham – The ecology and distribution of endorheic pans in the subtropical thicket vegetation near Port Elizabeth, Eastern Cape, South Africa – International Association for Vegetation Science, 53rd Annual Symposium, Ensenada, Mexico.

2006: LR de Wet – Pollinator-mediated selection in *Pelargonium reniforme* as described by Inter Simple Sequence Repeat markers. – South African Association of Botanists (SAAB) conference.

2006: LR de Wet – Pollinator-mediated selection of *Pelargonium reniforme* and two floral morphs described by inter simple sequence repeat markers – Southern African Society for Systematic Biology (SASSB) conference.

2005: LR de Wet – Population biology and effects of harvesting on *Pelargonium reniforme* (Geraniaceae) in Grahamstown and surrounding areas, Eastern Cape, South Africa – South African Association of Botanists (SAAB) conference.

2005: LR de Wet – Harvesting of *Pelargonium reniforme* in Grahamstown; what are the implications for populations of the plant? – Thicket Forum

2005: LR de Wet – Harvesting of *Pelargonium reniforme* in Grahamstown; what are the implications fotr populations of the plant? – Annual general meeting. Botanical Society of South Africa, Albany Branch.

2004: LR de Wet – Population biology of *Pelargonium reniforme* – Annual general meeting. Botanical Society of South Africa, Albany Branch.

PUBLICATIONS

Ripley BS, de Wet, L and Hill MP (2008). Herbivory-induced reduction in photosynthetic productivity of water hyacinth, *Eichhornia crassipes* (Martius) Solms-Laubach (Pontederiaceae), is not directly related to reduction in photosynthetic leaf area. African Entomology 16(1): 140-142.

de Wet LR, Barker NP and Peter CI (2008). The long and the short of gene flow and reproductive isolation: Inter-Simple Sequence Repeat (ISSR) markers support the recognition of two floral forms in *Pelargonium reniforme* (Geraniaceae). Biochemical Systematics and Ecology 36: 684-690.

de Wet L, NP Barker and CI Peter (2006). Beetles and Bobartia: an interesting herbivore-plant relationship. Veld & flora. September: 150 – 151.

de Wet LR and Botha CEJ (2007). Resistance or tolerance: An examination of aphid (*Sitobion yakini*) phloem feeding on Betta and Betta-Dn wheat (*Triticum aestivum* L.). South African Journal of Botany 73(1): 35-39.

de Wet L (2005). Is *Pelargonium reniforme* in danger? The effects of harvesting on *Pelargonium reniforme*. Veld & Flora. December: 182-184.

Mr. Andrew Husted

Ecologist/GIS Specialist

Biophysical Department

Digby Wells Environmental

Pri. Sci. Nat. (400213/11)

Education

- 2006 – 2007: BSc Masters in Aquatic Health – University of Johannesburg (UJ)
- 2005 – 2006: BSc Hons. Zoology – Aquatic Health – Rand Afrikaans University (RAU)
- 2003 – 2005: BSc Natural Science – Zoology & Botany (RAU)

Employment

- August 2007 – Present: Digby Wells Environmental, as an aquatic ecologist
- January 2006 – June 2007: Econ@UJ, as an aquatic ecologist

Experience

Andrew is the manager of the biophysical department which consists of the ecological and rehabilitation units. He is responsible for the management and co-ordination of the relevant specialists in order to fulfil the departmental and company objectives as well as to oversee implementation of the required strategies. Additional managerial responsibilities include the preparation of project proposals for a variety of specialist studies, general project management as well as office administration. He also provides input into specialist reporting as well as conducts reviews of the relevant studies. Andrew is an aquatic ecologist and has obtained a wealth of experience due to the exposure to a variety of projects, within different systems throughout Africa and in selected parts of Europe.

Aquatic ecology

The River Health Programme (RHP) is a national programme in which Andrew has had extensive training on both a provincial and national level. He is a registered and recognised user of the programme. In addition to this, he has been involved in the formulation of the programme on an on-going basis. Through this, he has a good understanding of the benefits and uses of such a programme, as well as the limitations offered by it. Andrew is also an accredited South African Scoring System version 5 (SASS5) practitioner, a requirement of the RHP. Experience for this study area includes the following:

- Aquatic state assessments: Ghana, Mali, DRC, Botswana, Ivory Coast, Sierra Leone, Armenia and South Africa
- Biomonitoring assessments: DRC and South Africa
- Fish community state assessments; Botswana and South Africa
- Instream flow requirements: DRC

Aquatic hydropower assessments

Owing to the growing demand to find alternative energy sources, Andrew has been exposed to hydropower generation projects as a result. These studies assess the potential of the project to affect the structure and function of the surface aquatic ecosystems. These include the reduction in flows below the abstraction point, and the establishment of a barrier that may affect the access of species to the upper reaches of the system. Local fish communities are used as indicators of ecological health to evaluate the potential effects of reduced flows and the establishment of a barrier in the system. A habitat type modelling approach with additional information obtained from hydraulic modelling is used to assess the response of fish communities to changes in habitat types due to a reduction in flows. Information collated from these sources is then used to prescribe the instream flow requirements for the system. Experience for this study area includes the following:

- Instream flow requirements: DRC

Wetland assessments

Andrew was part of the first group of consultants to be trained by the Department of Water Affairs and Forestry (DWAF) during a yearlong training programme (2008). Due to this training, he is recognised by the Mondi Wetlands Programme as a competent wetland delineator. The programme not only allowed for wetland areas to be delineated but also for ecological services offered by the wetlands to be identified and described as well as for the integrity (health) of the wetland units to be assessed. Andrew also received a certificate of competence from Rhodes University for tools which are considered for wetland delineations as well as the WET-Management series. Owing to complexity of wetlands and the demands and stresses placed on these systems, he was trained in the soil classification of wetlands as well as the rehabilitation methods and techniques widely adopted to better understand this specialist area. Experience for this study area includes the following:

- Wetland delineations: Senegal, Sierra Leone and South Africa
- Riparian delineations: Botswana and South Africa
- Wetland functional assessments: Botswana, Senegal, Sierra Leone and South Africa
- Wetland integrity assessments: Botswana, Senegal, Sierra Leone and South Africa
- Wetland offset strategy: South Africa
- Wetland rehabilitation: South Africa

Toxicity and metal analysis

Andrew completed a master's degree in the bioaccumulation of selected metals in selected fish populations in South Africa. Owing to the growing need to assess and monitor the state of the available water resources, Andrew also developed an interest in toxicity testing. The results for the respective components are compared to the relevant guidelines and management measures prescribed accordingly. In addition to these two components, Andrew has also analysed for metals in sediment samples. Experience for this study area includes the following:

- Toxicity: Ghana, Mali, Armenia and South Africa

- Metal analysis: DRC, Ghana, Mali, Armenia and South Africa
- Sediment analysis: Ghana, Mali and South Africa

Telemetry

Andrew has obtained training and experience with the application of telemetry to Tigerfish (*Hydrocynus vittatus*) both in Botswana and the Limpopo province of South Africa. This included the capture of the species, as well as the sedation, transport, tagging and stocking of the species into a different system. In addition to this, the training required the monitoring of tagged individuals throughout the year which included 24 hour surveys. The aim of such a component was to conduct an assessment of the behaviour of the tagged populations. Andrew was co-author for a paper submitted on this project to the African Journal of Aquatic Sciences. Experience for this study area includes the following:

- Fish telemetry: Botswana and South Africa

Professional registration

South African Council for Natural Scientific Professions (Ecological Science): 400213/11

Training

- Wetland and Riparian Delineation Course for Consultants (Certificate of Competence) – DWAF
- The threats and impacts posed on wetlands by infrastructure and development: Mitigation and rehabilitation thereof – Gauteng Wetland Forum
- Ecological State Assessment of Lentic Systems using Fish Population Dynamics – University of Johannesburg/Rivers of Life
- Soil Classification and Wetland Delineation – Terra Soil Science
- Wetland Rehabilitation Methods and Techniques - Gauteng Wetland Forum
- Application of the Fish Response Assessment Index (FRAI) and Macroinvertebrate Response Assessment Index (MIRAI) for the River Health Programme
- Tools for a Wetland Assessment (Certificate of Competence) – Rhodes University

Presentations

- Zoology postgraduate colloquiums 2005, 2006 and 2007.
- Department of Water Affairs and Forestry (Bronkhorstspruit). Findings of a wetland assessment and aquatic assessment conducted for a project for Xstrata Coal South Africa, November 2008.
- Department of Water Affairs and Forestry (Pretoria). Findings of two case studies conducted for accreditation and recognition by DWAF as a competent wetland specialist, November 2008.
- Harress Pickel Consult AG (Selebi Phikwe, Botswana). Environmental study to establish the baseline biological and physical conditions of the Letsibogo Dam near Selebi Phikwe, Botswana. (Programme “Economic Diversification of the Mining Sector”, 8 ACP BT 13). October 2009.

- Xstrata Coal South Africa (Oogies). Formulation of a Biodiversity and Land Management Plan, November 2009, April 2010.
- Exxaro Coal Pty (Ltd) (Belfast area). EIA Feedback meeting for the Public Participation Process. Findings of the integrated wetland assessment and the formulated wetland offset strategy for the project, April 2010
- BHP Biliton Energy Coal South Africa (Johannesburg). Findings of the aquatic assessments and wetland assessments conducted for the respective project area, May 2010.
- Xstrata Coal South Africa (Oogies). Submission of a Biodiversity and Land Management Plan, July 2010.
- The International Society of Limnology conference (Cape Town). Use of bio-telemtry to evaluate the advantages and disadvantages of using Tigerfish (*Hydrocynis vittatus*) as a management option for the control of alien species in souther African impoundments. Case study: Letsibogo Dam, Botswana, August 2010.
- The International Association of Impact Assessments South Africa conference (Pretoria). The management of biodiversity in areas associated with mining through the application of a GIS based, integrated Biodiversity Land Management Plan (BLMP), August 2010.

Publications

Husted, A. (2009). Aspects of the the biology of the Bushveld Smallscale Yellowfish (*Labeobarbus polylepis*): Feeding biology and metal bioaccumulation in five populations.

O'Brien, G.C., Bulfin, J.B., Husted, A. and Smit, N.J. (2012). Comparative behavioural assessment of an established and new Tigerfish (*Hydrocynus vittatus*) population in two manmade lakes in the Limpopo catchment, southern Africa. (for review)

In an endeavour to continue to improve my skills and specialist knowledge of my areas of interest, continuous training is required. Also considering the environment we live in today and demand for goods and services from our natural systems, there is a growing need to better understand our ecosystems so that we can better manage these systems for future generations.

Appendix B: Expected Bird List

Rob	English Family	Scientific	General Status
1	Ostrich Common	*Struthio camelus*	R-C
6	Grebe Great Crested	*Podiceps cristatus*	R(n)-U
7	Grebe Black-necked	*Podiceps nigricollis*	R(n)-U
8	Grebe Little	*Tachybaptus ruficollis*	R-C
49	Pelican Great White	*Pelecanus onocrotalus*	R-LC
55	Cormorant White-breasted	*Phalacrocorax lucidus*	R-C
58	Cormorant Reed	*Microcarbo africanus*	R-C
60	Darter African	*Anhinga rufa*	R-C
62	Heron Grey	*Ardea cinerea*	R-C
63	Heron Black-headed	*Ardea melanocephala*	R-C
64	Heron Goliath	*Ardea goliath*	R-U
65	Heron Purple	*Ardea purpurea*	R-U
66	Egret Great	*Ardea alba*	R-C
67	Egret Little	*Egretta garzetta*	R-C
68	Egret Yellow-billed	*Egretta intermedia*	R-U
69	Heron Black	*Egretta ardesiaca*	R-LC
71	Egret Cattle	*Bubulcus ibis*	R-C
72	Heron Squacco	*Ardeola ralloides*	R/NBM-U
74	Heron Green-backed	*Butorides striata*	R-U
76	Heron Black-crowned Night-	*Nycticorax nycticorax*	R-C
80	Bittern Eurasian	*Botaurus stellaris*	R-R
81	Hamerkop	*Scopus umbretta*	R-C
83	Stork White	*Ciconia ciconia*	NBM-C
84	Stork Black	*Ciconia nigra*	R-U
85	Stork Abdim's	*Ciconia abdimii*	NBM-C
89	Stork Marabou	*Leptoptilos crumeniferus*	R-R/LC
90	Stork Yellow-billed	*Mycteria ibis*	NBM/R-LC
91	Ibis African Sacred	*Threskiornis aethiopicus*	R-C
93	Ibis Glossy	*Plegadis falcinellus*	R-U
94	Ibis Hadeda	*Bostrychia hagedash*	R-A
95	Spoonbill African	*Platalea alba*	R(n)-C
96	Flamingo Greater	*Phoenicopterus roseus*	R(n)-LA
97	Flamingo Lesser	*Phoeniconaias minor*	R(n)-LA
99	Duck White-faced	*Dendrocygna viduata*	R-C
100	Duck Fulvous	*Dendrocygna bicolor*	R-C
101	Duck White-backed	*Thalassornis leuconotus*	R-U
102	Goose Egyptian	*Alopochen aegyptiaca*	R-A
103	Shelduck South African	*Tadorna cana*	**E**-C

Rob	English Family	Scientific	General Status
104	Duck Yellow-billed	*Anas undulata*	R-A
105	Duck African Black	*Anas sparsa*	R-U
106	Teal Cape	*Anas capensis*	R-C
107	Teal Hottentot	*Anas hottentota*	R-C
108	Teal Red-billed	*Anas erythrorhyncha*	R-C
112	Shoveler Cape	*Anas smithii*	**E**-C
113	Pochard Southern	*Netta erythrophthalma*	R-C
115	Duck Comb	*Sarkidiornis melanotos*	R-LC
116	Goose Spur-winged	*Plectropterus gambensis*	R-VC
117	Duck Maccoa	*Oxyura maccoa*	R-U
118	Secretarybird Secretarybird	*Sagittarius serpentarius*	R-U
122	Vulture Cape	*Gyps coprotheres*	**E**-LC
126	Kite Black	*Milvus migrans*	NBM-LC
126.1	Kite Yellow-billed	*Milvus parasitus*	BM-C
127	Kite Black-shouldered	*Elanus caeruleus*	R(n)-C
131	Eagle Verreauxs'	*Aquila verreauxii*	R-U
136	Eagle Booted	*Hieraaetus pennatus*	R/NBM-C
140	Eagle Martial	*Polemaetus bellicosus*	R-U
148	Eagle African Fish-	*Haliaeetus vocifer*	R-C
149	Buzzard Steppe	*Buteo buteo*	NBM-C
152	Buzzard Jackal	*Buteo rufofuscus*	**E**-C
158	Sparrowhawk Black	*Accipiter melanoleucus*	R-C
161	Goshawk Gabar	*Micronisus gabar*	R-C
162	Goshawk Southern Pale Chanting-	*Melierax canorus*	**E**-C
165	Harrier African Marsh-	*Circus ranivorus*	R-C
166	Harrier Montagu's	*Circus pygargus*	NBM-R
167	Harrier Pallid	*Circus macrourus*	NBM-R
168	Harrier Black	*Circus maurus*	**E**-U
169	Hawk African Harrier-	*Polyboroides typus*	R-C
170	Osprey	*Pandion haliaetus*	NBM-U
172	Falcon Lanner	*Falco biarmicus*	R-C
179	Falcon Red-footed	*Falco vespertinus*	NBM-R
180	Falcon Amur	*Falco amurensis*	NBM-C
181	Kestrel Rock	*Falco rupicolus*	R-C
182	Kestrel Greater	*Falco rupicoloides*	R-C
183	Kestrel Lesser	*Falco naumanni*	NBM-VC
193	Francolin Orange River	*Scleroptila levaillantoides*	**E**-C
196	Spurfowl Natal	*Pternistis natalensis*	**E**-C

Rob	English Family	Scientific	General Status
199	Spurfowl Swainson's	*Pternistis swainsonii*	**E**-C
200	Quail Common	*Coturnix coturnix*	BM-C
201	Quail Harlequin	*Coturnix delegorguei*	R/BM-C
203	Guineafowl Helmeted	*Numida meleagris*	R-VC
205	Buttonquail Kurrichane	*Turnix sylvaticus*	BM-U/LC
208	Crane Blue	*Anthropoides paradiseus*	**E**-U
209	Crane Grey Crowned	*Balearica regulorum*	R-C
210	Rail African	*Rallus caerulescens*	R/BM-C
213	Crake Black	*Amaurornis flavirostra*	R-C
223	Swamphen African Purple	*Porphyrio madagascariensis*	R-C
226	Moorhen Common	*Gallinula chloropus*	R-C
228	Coot Red-knobbed	*Fulica cristata*	R-A
232	Bustard Ludwig's	*Neotis ludwigii*	**E**-U
234	Korhaan Blue	*Eupodotis caerulescens*	**E**-U
239.1	Korhaan Northern Black	*Afrotis afraoides*	**E**-VC
240	Jacana African	*Actophilornis africanus*	R-VC
242	Snipe Greater Painted-	*Rostratula benghalensis*	R-U
245	Plover Common Ringed	*Charadrius hiaticula*	NBM-C
247	Plover Chestnut-banded	*Charadrius pallidus*	R-U
248	Plover Kittlitz's	*Charadrius pecuarius*	R-C
249	Plover Three-banded	*Charadrius tricollaris*	R-C
252	Plover Caspian	*Charadrius asiaticus*	NBM-U
255	Lapwing Crowned	*Vanellus coronatus*	R-C
258	Lapwing Blacksmith	*Vanellus armatus*	R-VC
260	Lapwing African Wattled	*Vanellus senegallus*	R/BM-LC
264	Sandpiper Common	*Actitis hypoleucos*	NBM-C
266	Sandpiper Wood	*Tringa glareola*	NBM-C
269	Sandpiper Marsh	*Tringa stagnatilis*	NBM-C
270	Greenshank Common	*Tringa nebularia*	NBM-C
272	Sandpiper Curlew	*Calidris ferruginea*	NBM-VC
274	Stint Little	*Calidris minuta*	NBM-C
284	Ruff	*Philomachus pugnax*	NBM-C
286	Snipe African	*Gallinago nigripennis*	R-LC
287	Godwit Black-tailed	*Limosa limosa*	NBM-R
294	Avocet Pied	*Recurvirostra avosetta*	R-LC
295	Stilt Black-winged	*Himantopus himantopus*	R-C
297	Thick-knee Spotted	*Burhinus capensis*	R-C
299	Courser Burchell's	*Cursorius rufus*	**E**-U

Rob	English Family	Scientific	General Status
300	Courser Temminck's	*Cursorius temminckii*	R-U
301	Courser Double-banded	*Rhinoptilus africanus*	R-LC
305	Pratincole Black-winged	*Glareola nordmanni*	NBM-LA
315	Gull Grey-headed	*Chroicocephalus cirrocephalus*	R-VC
322	Tern Caspian	*Hydroprogne caspia*	R-LC
338	Tern Whiskered	*Chlidonias hybrida*	R(n)-LC
339	Tern White-winged	*Chlidonias leucopterus*	NBM-A
344	Sandgrouse Namaqua	*Pterocles namaqua*	**E**-C
348	Dove Rock	*Columba livia*	R-A
349	Pigeon Speckled	*Columba guinea*	R-C
350	Pigeon African Olive-	*Columba arquatrix*	R-LC
352	Dove Red-eyed	*Streptopelia semitorquata*	R-C
354	Dove Cape Turtle-	*Streptopelia capicola*	R-VC
355	Dove Laughing	*Spilopelia senegalensis*	R-VC
356	Dove Namaqua	*Oena capensis*	R-VC
374	Cuckoo Common	*Cuculus canorus*	NBM-U
377	Cuckoo Red-chested	*Cuculus solitarius*	BM-C
380	Cuckoo Great Spotted	*Clamator glandarius*	NBM-U
382	Cuckoo Jacobin	*Clamator jacobinus*	BM-C
385	Cuckoo Klaas's	*Chrysococcyx klaas*	R/BM-C
386	Cuckoo Diderick	*Chrysococcyx caprius*	BM-VC
391	Coucal Burchell's	*Centropus burchellii*	R-C
392	Owl Barn	*Tyto alba*	R-C
393	Owl African Grass-	*Tyto capensis*	R-U
395	Owl Marsh	*Asio capensis*	R-C
397	Owl Southern White-faced Scops-	*Ptilopsis granti*	R-C
401	Owl Spotted Eagle-	*Bubo africanus*	R-C
402	Owl Verreaux's Eagle-	*Bubo lacteus*	R-U
404	Nightjar European	*Caprimulgus europaeus*	NBM-U
405	Nightjar Fiery-necked	*Caprimulgus pectoralis*	R/BM-C
406	Nightjar Rufous-cheeked	*Caprimulgus rufigena*	BM-C
408	Nightjar Freckled	*Caprimulgus tristigma*	R-C
411	Swift Common	*Apus apus*	NBM-C
412	Swift African Black	*Apus barbatus*	R-C
415	Swift White-rumped	*Apus caffer*	BM-VC
416	Swift Horus	*Apus horus*	BM-LC
417	Swift Little	*Apus affinis*	R/BM-VC
418	Swift Alpine	*Tachymarptis melba*	BM-C

Rob	English Family	Scientific	General Status
421	Swift African Palm-	*Cypsiurus parvus*	R-C
424	Mousebird Speckled	*Colius striatus*	R-C
425	Mousebird White-backed	*Colius colius*	**E**-C
426	Mousebird Red-faced	*Urocolius indicus*	R-C
428	Kingfisher Pied	*Ceryle rudis*	R-C
429	Kingfisher Giant	*Megaceryle maxima*	R-U
431	Kingfisher Malachite	*Alcedo cristata*	R-C
435	Kingfisher Brown-hooded	*Halcyon albiventris*	R-C
438	Bee-eater European	*Merops apiaster*	NBM/BM-C
443	Bee-eater White-fronted	*Merops bullockoides*	R-C
445	Bee-eater Swallow-tailed	*Merops hirundineus*	R-LC
446	Roller European	*Coracias garrulus*	NBM-C
451	Hoopoe African	*Upupa africana*	R(n)-C
452	Wood-Hoopoe Green	*Phoeniculus purpureus*	R-C
454	Scimitarbill Common	*Rhinopomastus cyanomelas*	R-C
464	Barbet Black-collared	*Lybius torquatus*	R-C
465	Barbet Acacia Pied	*Tricholaema leucomelas*	**E**-C
473	Barbet Crested	*Trachyphonus vaillantii*	R-C
474	Honeyguide Greater	*Indicator indicator*	R-U
476	Honeyguide Lesser	*Indicator minor*	R-LC
480	Woodpecker Ground	*Geocolaptes olivaceus*	**E**-LC
486	Woodpecker Cardinal	*Dendropicos fuscescens*	R-C
489	Wryneck Red-throated	*Jynx ruficollis*	R-C
492	Lark Melodious	*Mirafra cheniana*	**E**-U
494	Lark Rufous-naped	*Mirafra africana*	R-C
495.2	Lark Eastern Clapper	*Mirafra fasciolata*	**E**-C
498	Lark Sabota	*Calendulauda sabota*	**E**-C
500.2	Lark Eastern Long-billed	*Certhilauda semitorquata*	**E**-C
506	Lark Spike-heeled	*Chersomanes albofasciata*	**E**-C
507	Lark Red-capped	*Calandrella cinerea*	R(n)-C
508	Lark Pink-billed	*Spizocorys conirostris*	**E**-C
515	Sparrowlark Chestnut-backed	*Eremopterix leucotis*	R(n)-C
516	Sparrowlark Grey-backed	*Eremopterix verticalis*	**E**-VC
518	Swallow Barn	*Hirundo rustica*	NBM-A
520	Swallow White-throated	*Hirundo albigularis*	BM-C
523	Swallow Pearl-breasted	*Hirundo dimidiata*	R/BM-C
524	Swallow Red-breasted	*Cecropis semirufa*	BM-C
526	Swallow Greater Striped	*Cecropis cucullata*	BM-C

Rob	English Family	Scientific	General Status
528	Swallow South African Cliff-	*Petrochelidon spilodera*	**E**br-LC
529	Martin Rock	*Ptyonoprogne fuligula*	R-C
530	Martin Common House-	*Delichon urbicum*	NBM-LC
532	Martin Sand	*Riparia riparia*	NBM-C
533	Martin Brown-throated	*Riparia paludicola*	R-C
534	Martin Banded	*Riparia cincta*	BM-U
541	Drongo Fork-tailed	*Dicrurus adsimilis*	R-C
543	Oriole Eurasian Golden	*Oriolus oriolus*	NBM-U
547	Crow Cape	*Corvus capensis*	R-C
548	Crow Pied	*Corvus albus*	R-A
552	Tit Ashy	*Parus cinerascens*	E-U
567	Bulbul African Red-eyed	*Pycnonotus nigricans*	**E**-VC
577.1	Thrush Karoo	*Turdus smithii*	**E**-C
580	Thrush Groundscraper	*Psophocichla litsitsirupa*	R-C
586	Wheatear Mountain	*Oenanthe monticola*	**E**-C
587	Wheatear Capped	*Oenanthe pileata*	R/BM-C
589	Chat Familiar	*Cercomela familiaris*	R-C
591	Chat Sickle-winged	*Cercomela sinuata*	**E**-C
593	Chat Mocking Cliff-	*Thamnolaea cinnamomeiventris*	R-C
595	Chat Ant-eating	*Myrmecocichla formicivora*	**E**-C
596	Stonechat African	*Saxicola torquatus*	R-VC
601	Robin-Chat Cape	*Cossypha caffra*	R-C
614	Robin Karoo Scrub-	*Erythropygia coryphaeus*	**E**-C
615	Robin Kalahari Scrub-	*Erythropygia paena*	**E**-C
619	Warbler Garden	*Sylvia borin*	NBM-C
620	Whitethroat Common	*Sylvia communis*	NBM-U
621	Tit-Babbler Chestnut-vented	*Sylvia subcaerulea*	**E**-C
625	Warbler Icterine	*Hippolais icterina*	NBM-C
628	Warbler Great Reed-	*Acrocephalus arundinaceus*	NBM-C
631	Warbler African Reed-	*Acrocephalus baeticatus*	BM-C
633	Warbler Marsh	*Acrocephalus palustris*	NBM-C
634	Warbler Sedge	*Acrocephalus schoenobaenus*	NBM-C
635	Warbler Lesser Swamp-	*Acrocephalus gracilirostris*	R-C
638	Warbler Little Rush-	*Bradypterus baboecala*	R-C
643	Warbler Willow	*Phylloscopus trochilus*	NBM-VC
651	Crombec Long-billed	*Sylvietta rufescens*	R-C
653	Eremomela Yellow-bellied	*Eremomela icteropygialis*	R-U
664	Cisticola Zitting	*Cisticola juncidis*	R-VC

Rob	English Family	Scientific	General Status
665	Cisticola Desert	*Cisticola aridulus*	R-C
666	Cisticola Cloud	*Cisticola textrix*	**E**-C
667	Cisticola Wing-snapping	*Cisticola ayresii*	R-C
670	Cisticola Wailing	*Cisticola lais*	R-C
672	Cisticola Rattling	*Cisticola chiniana*	R-C
677	Cisticola Levaillant's	*Cisticola tinniens*	R-C
681	Neddicky	*Cisticola fulvicapilla*	R-C
685	Prinia Black-chested	*Prinia flavicans*	**E**-C
686	Prinia Karoo	*Prinia maculosa*	**E**-C
688	Warbler Rufous-eared	*Malcorus pectoralis*	**E**-C
689	Flycatcher Spotted	*Muscicapa striata*	NBM-C
698	Flycatcher Fiscal	*Sigelus silens*	**E**-C
703	Batis Pririt	*Batis pririt*	**E**-C
706	Flycatcher Fairy	*Stenostira scita*	**E**-C
710	Flycatcher African Paradise-	*Terpsiphone viridis*	BM-C
711	Wagtail African Pied	*Motacilla aguimp*	R-C
713	Wagtail Cape	*Motacilla capensis*	R-C
714	Wagtail Yellow	*Motacilla flava*	NBM-U
716	Pipit African	*Anthus cinnamomeus*	R-C
717	Pipit Long-billed	*Anthus similis*	R-C
718	Pipit Plain-backed	*Anthus leucophrys*	R-C
719	Pipit Buffy	*Anthus vaalensis*	R-U
719.1	Pipit Long-tailed	*Anthus longicaudatus*	NBM-R
721	Pipit African Rock	*Anthus crenatus*	**E**-LC
727	Longclaw Cape	*Macronyx capensis*	**E**-C
731	Shrike Lesser Grey	*Lanius minor*	NBM-C
732	Fiscal Common	*Lanius collaris*	R-C
733	Shrike Red-backed	*Lanius collurio*	NBM-C
743	Tchagra Brown-crowned	*Tchagra australis*	R-C
746	Bokmakierie Bokmakierie	*Telophorus zeylonus*	**E**-C
758	Myna Common	*Acridotheres tristis*	R-VC
759	Starling Pied	*Lamprotornis bicolor*	**E**-C
760	Starling Wattled	*Creatophora cinerea*	R(n)-LA
764	Starling Cape Glossy	*Lamprotornis nitens*	R-C
769	Starling Red-winged	*Onychognathus morio*	R-VC
775	Sunbird Malachite	*Nectarinia famosa*	R-C
787	Sunbird White-bellied	*Cinnyris talatala*	R-C
796	White-eye Cape	*Zosterops capensis*	**E**-VC

Rob	English Family	Scientific	General Status
796.1	White-eye Orange River	*Zosterops pallidus*	**E**-VC
799	Weaver White-browed Sparrow-	*Plocepasser mahali*	R-VC
801	Sparrow House	*Passer domesticus*	R-VC
802	Sparrow Great	*Passer motitensis*	**E**-U
803	Sparrow Cape	*Passer melanurus*	**E**-VC
804	Sparrow Southern Grey-headed	*Passer diffusus*	R-C
806	Finch Scaly-feathered	*Sporopipes squamifrons*	**E**-C
813	Weaver Cape	*Ploceus capensis*	**E**-C
814	Weaver Southern Masked-	*Ploceus velatus*	R-C
820	Finch Cuckoo	*Anomalospiza imberbis*	R/BM-U
821	Quelea Red-billed	*Quelea quelea*	R(n)-LA
824	Bishop Southern Red	*Euplectes orix*	R-C
826	Bishop Yellow-crowned	*Euplectes afer*	R(n)-LC
831	Widowbird Red-collared	*Euplectes ardens*	R(n)-LC
832	Widowbird Long-tailed	*Euplectes progne*	R(n)-C
834	Pytilia Green-winged	*Pytilia melba*	R-C
842	Firefinch Red-billed	*Lagonosticta senegala*	R-C
844	Waxbill Blue	*Uraeginthus angolensis*	R-C
845	Waxbill Violet-eared	*Uraeginthus granatinus*	R-LC
846	Waxbill Common	*Estrilda astrild*	R-C
847	Waxbill Black-faced	*Estrilda erythronotos*	R-LC
852	Quailfinch African	*Ortygospiza fuscocrissa*	R-C
854	Waxbill Orange-breasted	*Amandava subflava*	R-LC
856	Finch Red-headed	*Amadina erythrocephala*	**E**-VC
860	Whydah Pin-tailed	*Vidua macroura*	R(n)-C
861	Whydah Shaft-tailed	*Vidua regia*	**E**-C
862	Whydah Long-tailed Paradise-	*Vidua paradisaea*	R-C
867	Indigobird Village	*Vidua chalybeata*	R(n)-C
870	Canary Black-throated	*Crithagra atrogularis*	R-C
872	Canary Cape	*Serinus canicollis*	**E**-VC
878	Canary Yellow	*Crithagra flaviventris*	**E**-C
879	Canary White-throated	*Crithagra albogularis*	**E**-C
881	Seedeater Streaky-headed	*Crithagra gularis*	R-C
884	Bunting Golden-breasted	*Emberiza flaviventris*	R-U
885	Bunting Cape	*Emberiza capensis*	**E**-C
886	Bunting Cinnamon-breasted	*Emberiza tahapisi*	R(n)-LC
887	Bunting Lark-like	*Emberiza impetuani*	**E**-VC

Roberts's abbreviations:

BM	-	Breeding migrant
NBM	-	Non-breeding migrant
R	-	Resident
E	-	Endemic – Species' distribution is confined within Southern African sub-region
Eb	-	Breeding endemic – Greater portion of bird species' breeding range is in Souther African sub-region
Er	-	Near endemic - Greater portion of bird species' distribution range is in Souther African sub-region
Es	-	A sub-species whose range is wholly confined within the Southern African sub-region
(n)	-	Nomadic
R(n)	-	Qualifies resident
E(n)	-	Endemic species
(lm)	-	Local migrant
R(lm)	-	Qualifies resident
E(lm)	-	Endemic species
C	-	Common
VC	-	Very common
R	-	Rare
LC	-	Locally common
U	-	Uncommon
V	-	Vagrant

SABAP 2 Pentad Summary

English Name	Scientific Name
Barbet, Acacia Pied	*Tricholaema leucomelas*
Barbet, Crested	*Trachyphonus vaillantii*
Bee-eater, European	*Merops apiaster*
Bee-eater, White-fronted	*Merops bullockoides*
Bishop, Southern Red	*Euplectes orix*
Bishop, Yellow-crowned	*Euplectes afer*
Bokmakierie, Bokmakierie	*Telophorus zeylonus*
Bulbul, African Red-eyed	*Pycnonotus nigricans*
Bunting, Cinnamon-breasted	*Emberiza tahapisi*
Buzzard, Steppe	*Buteo vulpinus*
Canary, Black-throated	*Crithagra atrogularis*
Canary, Yellow	*Crithagra flaviventris*
Chat, Anteating	*Myrmecocichla formicivora*
Chat, Familiar	*Cercomela familiaris*
Cisticola, Levaillant's	*Cisticola tinniens*
Cisticola, Zitting	*Cisticola juncidis*
Cliff-Swallow, South African	*Hirundo spilodera*
Coot, Red-knobbed	*Fulica cristata*
Cormorant, White-breasted	*Phalacrocorax carbo*
Cuckoo, Diderick	*Chrysococcyx caprius*
Darter, African	*Anhinga rufa*
Dove, Laughing	*Streptopelia senegalensis*
Dove, Namaqua	*Oena capensis*
Dove, Red-eyed	*Streptopelia semitorquata*
Dove, Rock	*Columba livia*
Duck, White-backed	*Thalassornis leuconotus*
Duck, Yellow-billed	*Anas undulata*
Egret, Cattle	*Bubulcus ibis*
Falcon, Amur	*Falco amurensis*
Finch, Scaly-feathered	*Sporopipes squamifrons*
Fiscal, Common	*Lanius collaris*
Fish-Eagle, African	*Haliaeetus vocifer*
Flamingo, Greater	*Phoenicopterus ruber*
Flycatcher, Fiscal	*Sigelus silens*
Goose, Egyptian	*Alopochen aegyptiacus*
Goose, Spur-winged	*Plectropterus gambensis*

Goshawk, Southern Pale Chanting	*Melierax canorus*
Grebe, Great Crested	*Podiceps cristatus*
Grebe, Little	*Tachybaptus ruficollis*
Guineafowl, Helmeted	*Numida meleagris*
Harrier, Black	*Circus maurus*
Heron, Black-headed	*Ardea melanocephala*
Heron, Grey	*Ardea cinerea*
Hoopoe, African	*Upupa africana*
Ibis, Glossy	*Plegadis falcinellus*
Ibis, Hadeda	*Bostrychia hagedash*
Kestrel, Lesser	*Falco naumanni*
Kingfisher, Pied	*Ceryle rudis*
Kite, Black-shouldered	*Elanus caeruleus*
Korhaan, Blue	*Eupodotis caerulescens*
Korhaan, Northern Black	*Afrotis afraoides*
Lapwing, Blacksmith	*Vanellus armatus*
Lapwing, Crowned	*Vanellus coronatus*
Lark, Eastern Clapper	*Mirafra fasciolata*
Lark, Red-capped	*Calandrella cinerea*
Lark, Rufous-naped	*Mirafra africana*
Lark, Spike-heeled	*Chersomanes albofasciata*
Longclaw, Cape	*Macronyx capensis*
Martin, Brown-throated	*Riparia paludicola*
Masked-Weaver, Southern	*Ploceus velatus*
Moorhen, Common	*Gallinula chloropus*
Mousebird, White-backed	*Colius colius*
Myna, Common	*Acridotheres tristis*
Neddicky, Neddicky	*Cisticola fulvicapilla*
Ostrich, Common	*Struthio camelus*
Owl, Barn	*Tyto alba*
Owl, Marsh	*Asio capensis*
Pigeon, Speckled	*Columba guinea*
Pipit, African	*Anthus cinnamomeus*
Plover, Kittlitz's	*Charadrius pecuarius*
Plover, Three-banded	*Charadrius tricollaris*
Pochard, Southern	*Netta erythrophthalma*
Prinia, Black-chested	*Prinia flavicans*
Pytilia, Green-winged	*Pytilia melba*
Quailfinch, African	*Ortygospiza atricollis*

Quelea, Red-billed	*Quelea quelea*
Scrub-Robin, Karoo	*Cercotrichas coryphoeus*
Shelduck, South African	*Tadorna cana*
Shoveler, Cape	*Anas smithii*
Sparrow, House	*Passer domesticus*
Sparrow, Southern Grey-headed	*Passer diffusus*
Sparrowlark, Chestnut-backed	*Eremopterix leucotis*
Sparrow-Weaver, White-browed	*Plocepasser mahali*
Spurfowl, Swainson's	*Pternistis swainsonii*
Starling, Wattled	*Creatophora cinerea*
Stilt, Black-winged	*Himantopus himantopus*
Stonechat, African	*Saxicola torquatus*
Sunbird, White-bellied	*Cinnyris talatala*
Swallow, Barn	*Hirundo rustica*
Swallow, Greater Striped	*Hirundo cucullata*
Swift, Little	*Apus affinis*
Swift, White-rumped	*Apus caffer*
Thick-knee, Spotted	*Burhinus capensis*
Thrush, Karoo	*Turdus smithi*
Tit-Babbler, Chestnut-vented	*Parisoma subcaeruleum*
Turtle-Dove, Cape	*Streptopelia capicola*
Turtle-Dove, Cape	*Streptopelia capicola*
Wagtail, Cape	*Motacilla capensis*
Waxbill, Blue	*Uraeginthus angolensis*
Wheatear, Capped	*Oenanthe pileata*
Wheatear, Mountain	*Oenanthe monticola*
White-eye, Cape	*Zosterops virens*
Whydah, Pin-tailed	*Vidua macroura*
Widowbird, Long-tailed	*Euplectes progne*
Widowbird, White-winged	*Euplectes albonotatus*
Wood-Hoopoe, Green	*Phoeniculus purpureus*
Woodpecker, Cardinal	*Dendropicos fuscescens*

Appendix C: Mammal List

Genus	Species; subspecies	*English name*	Status
Aepyceros	*melampus*	*Impala*	Least concern
Alcelaphus	*buselaphus*	*Red Hartebeest*	Least concern
Antidorcas	*marsupialis*	*Springbok*	Least concern
Cephalophus	*natalensis*	*Red Duiler*	Least concern
Ceratotherium	*simum*	*White Rhinoceros*	Least concern
Connochaetes	*gnou*	*Black Wildebeest*	Least concern
Connochaetes	*taurinus taurinus*	*Blue Wildebeest*	Least concern
Damaliscus	*pygargus phillipsi*	*Blesbok*	Least concern
Damaliscus	*lunatus lunatus*	*Tsessebe*	Endangered
Damaliscus	*pygargus pygargus*	*Bontebok*	Vulnerable
Diceros	*bicornis bicornis*	*Black Rhinoceros*	Critically Endangered
Diceros	*bicornis minor*	*Black Rhinoceros*	Vulnerable
Equus	*burchellii*	*Plains Zebra*	Least concern
Equus	*zebra hartmannae*	*Hartmann's Mountain Zebra*	Endangered
Equus	*zebra zebra*	*Cape Mountain Zebra*	Vulnerable
Giraffa	*camelopardalis*	*Giraffe*	Least concern
Hippopotamus	*amphibius*	*Hippopotamus*	Least concern
Hippotragus	*equinus*	*Roan Antelope*	Vulnerable
Hippotragus	*niger niger*	*Sable Antelope*	Vulnerable
Kobus	*ellipsiprymnus ellipsiprymnus*	*Waterbuck*	Least concern
Oreotragus	*oreotragus*	*Klipspringer*	Least concern
Ourebia	*ourebi*	*Oribi*	Endangered
Pelea	*capreolus*	*Grey Rhebok*	Least concern
Phacochoerus	*africanus*	*Warthog*	Least concern
Potamochoerus	*porcus koiropotamus*	*Bushpig*	Least concern
Raphicerus	*campestris*	*Steenbok*	Least concern
Redunca	*fulvorufula*	*Mountain Reedbuck*	Least concern
Sylvicapra	*grimmia*	*Grey /Common Duiker*	Least concern
Taurotragus	*oryx*	*Eland*	Least concern
Tragelaphus	*angasii*	*Nyala*	Least concern
Tragelaphus	*scriptus*	*Bushbuck*	Least concern
Tragelaphus	*strepsiceros*	*Kudu*	Least concern
Procavia	*capensis*	*Rock Hyrax/Dassie*	Least concern
Aonyx	*capensis*	*Cape Clawless Otter*	Least concern
Atilax	*paludinosus*	*Water Mongoose*	Least concern
Canis	*mesomelas*	*Black-backed Jackal*	Least concern

Genus	Species; subspecies	*English name*	Status
Caracal	*caracal*	*Caracal*	Least concern
Civettictis	*civetta*	*African Civet*	Least concern
Cynictis	*penicillata*	*Yellow Mongoose*	Least concern
Felis	*silvestris*	*African Wild Cat*	Least concern
Galerella	*sanguinea*	*Slender Mongoose*	Least concern
Genetta	*genetta*	*Small-spotted Genet*	Least concern
Genetta	*tigrina*	*Large-spotted Genet*	Least concern
Helogale	*parvula*	*Dwarf Mongoose*	Least concern
Hyaena	*brunnea*	*Brown Hyaena*	Near Threatened
Ichneumia	*albicauda*	*White-tailed Mongoose*	Least concern
Ictonyx	*striatus*	*Striped Polecat*	Least concern
Leptailurus	*serval*	*Serval*	Near Threatened
Lutra	*maculicollis*	*Spotted-necked Otter*	Near Threatened
Mellivora	*capensis*	*Honey Badger*	Near Threatened
Mungos	*mungo*	*Banded Mongoose*	Least concern
Panthera	*pardus*	*Leopard*	Least concern
Poecilogale	*albinucha*	*African Weasel*	Data deficient
Proteles	*cristatus*	*Aardwolf*	Least concern
Suricata	*suricatta*	*Suricate*	Least concern
Chaerephon	*pumila*	*Little Free-tailed Bat*	Least concern
Epomophorus	*gambianus crypturus*	*Gambian Epauletted Fruit Bat*	Data deficient
Epomophorus	*wahlbergi*	*Wahlberg's Epauletted Fruit Bat*	Least concern
Hipposideros	*caffer*	*Sundevall's Leaf-nosed Bat*	Data deficient
Miniopterus	*schreibersii*	*Schreiber's Long-fingered Bat*	Near Threatened
Mops	*midas*	*Midas Free-tailed Bats*	Least concern
Myotis	*tricolor*	*Temminck's Hairy Bat*	Near Threatened
Myotis	*welwitschii*	*Welwitsch's Hairy Bat*	Near Threatened
Neoromicia	*capensis*	*Cape Serotine Bat*	Least concern
Neoromicia	*nanus*	*Banana Bat*	Least concern
Nycteris	*thebaica*	*Egyptian Slit-faced Bat*	Least concern
Pipistrellus	*hesperidus*	*African Pipistrelle*	Least concern
Rhinolophus	*clivosus*	*Geoffroy's Horseshoe Bat*	Near Threatened
Rhinolophus	*darlingi*	*Darling's Horseshoe Bat*	Near Threatened
Rhinolophus	*hildebrandtii*	*Hildebrandt's Horseshoe Bat*	Near Threatened
Rhinolophus	*landeri*	*Lander's Horseshoe Bat*	Near Threatened
Rhinolophus	*simulator*	*Bushveld Horseshoe Bat*	Least concern
Rousettus	*aegyptiacus*	*Egyptian Fruit Bat*	Least concern
Scotophilus	*dinganii*	*Yellow House Bat*	Least concern

Genus	Species; subspecies	*English name*	Status
Scotophilus	*viridis*	*Lesser Yellow House Bat*	Least concern
Tadarida	*aegyptiaca*	*Egyptian Free-tailed Bat*	Least concern
Amblysomus	*septentrionalis*	*Highveld Golden Mole*	Near Threatened
Atelerixs	*frontalis*	*South African Hedgehog*	Near Threatened
Chrysospalax	*villosus*	*Rough-haired Golden Mole*	Critically Endangered
Crocidura	*mariquensis*	*Swamp Musk Shrew*	Data deficient
Crocidura	*silacea*	*Lesser Grey-browned Musk Shrew*	Data deficient
Crocidura	*cyanea*	*Reddish-grey Musk Shrew*	Data deficient
Crocidura	*flavescens*	*Greater Musk Shrew*	Data deficient
Crocidura	*fuscomurina*	*Tiny Musk Shrew*	Data deficient
Crocidura	*hirta*	*Lesser Red Musk Shrew*	Data deficient
Myosorex	*cafer*	*Dark-footed Forest Shrew*	Data deficient
Myosorex	*varius*	*Forest Shrew*	Data deficient
Suncus	*infinitesimus*	*Least Dwarf Shrew*	Data deficient
Suncus	*lixus*	*Greater Dwarf Shrew*	Data deficient
Suncus	*varilla*	*Lesser Dwarf Shrew*	Data deficient
Lepus	*saxatilis*	*Scrub/Savannah Hare**	Least concern
Lepus	*capensis*	*Cape/desert Hare*	Least concern
Pronolagus	*crassicaudatus*	*Natal Red Rock Rabbit*	Least concern
Pronolagus	*saundersiae*	*Hewitt's Red Rock Rabbit*	Least concern
Galago	*moholi*	*Southern Lesser Galago*	Least concern
Otolemur	*crassicaudatus*	*Thick-tailed Bushbaby*	Least concern
Papio	*ursinus*	*Chacma Baboon*	Least concern
Aethomys	*ineptus*	*Tete Veld Rat*	Least concern
Aethomys	*namaquensis*	*Namaqua Rock Mouse*	Least concern
Cryptomys	*hottentotus*	*Common Mole-rat*	Least concern
Dasymys	*incomtus*	*Water Rat*	Near Threatened
Dendromus	*melanotis*	*Grey Climbing mouse*	Least concern
Dendromus	*mesomelas*	*Brant's Climbing Mouse*	Least concern
Dendromus	*mystacalis*	*Chestnut Climbing Mouse*	Least concern
Georychus	*capensis*	*Cape Mole-rat*	Least concern
Graphiurus	*murinus*	*Woodland Dormouse*	Least concern
Graphiurus	*platyops*	*Rock Dormouse*	Data deficient
Hystrix	*africeaustralis*	*Porcupine*	Least concern
Lemniscomys	*rosalia*	*Single-striped Mouse*	Data deficient
Mastomys	*coucha*	*Multimammate Mouse*	Least concern
Mus	*minutoides*	*Pygmy mouse*	Least concern

Genus	Species; subspecies	*English name*	Status
Otomys	*angoniensis*	*Angoni Vlei Rat*	Least concern
Otomys	*irroratus*	*Vlei Rat*	least concern
Otomys	*laminatus*	*Laminate Vlei Rat*	Least concern
Rhabdomys	*pumilio*	*Striped Mouse*	Least concern
Saccostomus	*campestris*	*Pouched mouse*	Least concern
Steatomys	*pratensis*	*Fat Mouse*	Least concern
Tatera	*brantsii*	*Highveld gerbill*	Least concern
Tatera	*leucogaster*	*Bushveld Gerbil*	Data deficient
Thallomys	*paedulcus*	*Tree Rat*	Least concern
Thryonomys	*swinderianus*	*Greater Cane Rat*	Least concern
Elephantulus	*myurus*	*Rock Elephant Shrew*	Least concern
Manis	*temminckii*	*Pangolin*	Vulnerable
Orycteropus	*afer*	*Aardvark/Ant bear*	Least concern

Appendix D: Expected Reptile List

Genus	Species	Subspecies	Common name	Red list category	Atlas region endemic
Agama	*atra*		Southern Rock Agama	NE	0
Homoroselaps	*lacteus*		Spotted Harlequin Snake	NE	1
Crotaphopeltis	*hotamboeia*		Red-lipped Snake	NE	0
Lamprophis	*aurora*		Aurora House Snake	NE	1
Lycophidion	*capense*	*capense*	Cape Wolf Snake	NE	0
Prosymna	*sundevallii*		Sundevall's Shovel-snout	NE	0
Psammophis	*crucifer*		Cross-marked Grass Snake	NE	0
Psammophis	*trinasalis*		Fork-marked Sand Snake	NE	0
Pseudaspis	*cana*		Mole Snake	NE	0
Elapsoidea	*sundevallii*	*media*	Highveld Garter Snake	NL	0
Hemachatus	*haemachatus*		Rinkhals	NE	0
Pachydactylus	*capensis*		Cape Gecko	NE	0
Trachylepis	*varia*		Variable Skink	NE	0
Agama	*atra*		Southern Rock Agama	NE	0
Aparallactus	*capensis*		Black-headed Centipede-eater	NE	0
Boaedon	*capensis*		Brown House Snake	NE	0
Dasypeltis	*scabra*		Rhombic Egg-eater	NE	0
Psammophis	*trinasalis*		Fork-marked Sand Snake	NE	0
Psammophylax	*rhombeatus*	*rhombeatus*	Spotted Grass Snake	NE	0
Smaug	*giganteus*		Giant Girdled Lizard	**VU**	1
Pachydactylus	*capensis*		Cape Gecko	NE	0
Trachylepis	*punctatissima*		Speckled Rock Skink	NE	0
Rhinotyphlops	*lalandei*		Delalande's Beaked Blind Snake	NE	0
Agama	*atra*		Southern Rock Agama	NE	0
Crotaphopeltis	*hotamboeia*		Red-lipped Snake	NE	0

Genus	***Species***	***Subspecies***	**Common name**	**Red list category**	**Atlas region endemic**
Lamprophis	*aurora*		Aurora House Snake	NE	1
Pseudaspis	*cana*		Mole Snake	NE	0
Smaug	*giganteus*		Giant Girdled Lizard	**VU**	1
Pachydactylus	*capensis*		Cape Gecko	NE	0

NE-Not evaluated

VU-Vulnerable

NL-Not Listed

Appendix E: Lepidoptera

Genus	*Species*	*Subspecies*	Common name	Red list category	Atlas region endemic
Thestor	*basutus*	*basutus*	Basuto skolly	LC	0
Thestor	*protumnus*	*aridus*	Boland skolly	LC	0
Belenois	*aurota*		Brown-veined white	LC	0
Aloeides	*henningi*		Henning's copper	LC	1
Hypolimnas	*misippus*		Common diadem	LC	0
Borbo	*gemella*		Twin swift	LC	0
Coeliades	*forestan*	*forestan*	Striped policeman	LC	0
Spialia	*mafa*	*mafa*	Mafa sandman	LC	0
Spialia	*spio*		Mountain sandman	LC	0
Aloeides	*pierus*		Dull copper	LC	1
Azanus	*jesous*		Topaz babul blue	LC	0
Azanus	*ubaldus*		Velvet-spotted babul blue	LC	0
Cacyreus	*marshalli*		Common geranium bronze	LC	0
Crudaria	*leroma*		Silver spotted grey	LC	0
Eicochrysops	*messapus*	*mahallakoaena*	Cupreous blue	LC	0
Lampides	*boeticus*		Pea blue	LC	0
Lepidochrysops	*patricia*		Patricia blue	LC	0
Lepidochrysops	*plebeia*	*plebeia*	Twin-spot blue	LC	0
Leptomyrina	*henningi*	*henningi*	Henning's black-eye	LC	0
Leptotes	*pirithous*	*pirithous*	Common zebra blue	LC	0
Lycaena	*clarki*		Eastern sorrel copper	LC	1
Oraidium	*barberae*		Dwarf blue	LC	0
Thestor	*basutus*	*basutus*	Basuto skolly	LC	0
Thestor	*basutus*	*capeneri*	Basuto skolly	LC	0
Zintha	*hintza*	*hintza*	Hintza pierrot	LC	0
Zizeeria	*knysna*	*knysna*	African grass blue	LC	0
Acraea	*lygus*		Lygus acraea	LC	0

Genus	*Species*	*Subspecies*	Common name	Red list category	Atlas region endemic
Acraea	*natalica*		Natal acraea	LC	0
Acraea	*neobule*	*neobule*	Wandering donkey acraea	LC	0
Acraea	*stenobea*		Suffused acraea	LC	0
Byblia	*ilithyia*		Spotted joker	LC	0
Danaus	*chrysippus*	*orientis*	African monarch, Plain tiger	LC	0
Hypolimnas	*misippus*		Common diadem	LC	0
Junonia	*hierta*	*cebrene*	Yellow pansy	LC	0
Junonia	*oenone*	*oenone*	Blue pansy	LC	0
Junonia	*orithya*	*madagascariensis*	Eyed pansy	LC	0
Melanitis	*leda*		Twilight bown	LC	0
Neptis	*laeta*		Common barred sailor	LC	0
Phalanta	*phalantha*	*aethiopica*	African leopard	LC	0
Telchinia	*rahira*	*rahira*	Marsh acraea	LC	0
Telchinia	*serena*		Dancing acraea	LC	0
Vanessa	*cardui*		Painted lady	LC	0
Papilio	*demodocus*	*demodocus*	Citrus swallowtail	LC	0
Belenois	*aurota*		Brown-veined white	LC	0
Belenois	*creona*	*severina*	African common white	LC	0
Catopsilia	*florella*		African migrant	LC	0
Colias	*electo*	*electo*	African clouded yellow	LC	0
Colotis	*evenina*	*evenina*	Orange tip	LC	0
Eurema	*brigitta*	*brigitta*	Broad-bordered grass yellow	LC	0
Mylothris	*agathina*	*agathina*	Common dotted border	LC	0
Pinacopteryx	*eriphia*	*eriphia*	Zebra white	LC	0
Pontia	*helice*	*helice*	Common meadow white	LC	0
Teracolus	*agoye*	*bowkeri*	Speckled sulphur tip	LC	0
Teracolus	*subfasciatus*		Lemon traveller	LC	0

LC-Least Concern

APPENDIX 16

TERRESTRIAL ECOLOGY AND WETLANDS STUDY (2017)

BIODIVERSITY BASELINE & IMPACT ASSESSMENT REPORT

FOR THE GOLD ONE GROUP LIMITED, VENTERSBURG PROJECT , FREE STATE

Compiled By:

Natural Scientific Services

64A Coleraine Drive
Riverclub Ext 7
Sandton
2191
Tel: (011) 787-7400
Fax: (011) 784-7599

Compiled For:

Prime Resources

The Workshop
70 7th Avenue
Parktown North
Johannesburg
South Africa
2193
Tel: +27 11 447 4888
Fax: +27 11 447 0355

NSS Ref No: 2315
Date: March 2017

All pictures taken on site

GOLD ONE GROUP LIMITED VENTERSBURG PROJECT

BIODIVERSITY BASELINE AND IMPACT ASSESSMENT REPORT

Compiled For:

Prime Resources
Parktown North
2193
Johannesburg
South Africa
Tel: +27 (0)11 447 4888
Fax: +27 (0)11 447 0355

Compiled By:

Natural Scientific Services CC

64A Colleraine Drive
Riverclub Extension 7
Sandton, Johannesburg
Tel: (011) 787-7400
Fax: (011) 784-7599

Ref No: 2315
Date: March 2017

Executive Summary

Following recommendations made in the findings of a preliminary faunal and floral study conducted in June 2013 for a more detailed assessment, Prime Resources (Pty) Ltd appointed NSS to complete a wet season floral and faunal assessment for the proposed Gold One Africa Ventersburg Project. Additionally, Prime Resources appointed NSS to undertake a wetland assessment for a proposed mine water discharge pipeline that is planned to run from the mine, to the Rietspruit. Throughout the report NSS makes reference to the site and the study area, however these words are not used interchangeably. The site refers, specifically, to the proposed mine's operational infrastructure area (otherwise referred to as the site footprint). Whereas the study area refers to a demarcated area (and associated 50 m buffer) around the site together with the proposed pipeline route and associated (30 m buffer).

The study area has long been transformed to a large extent by large-scale cultivation practices (58%). Signs of such transformation are evident (based on historical aerial imagery) from at least as far back as 1964. Vegetation communities identified within uncultivated parts of the study area include *Acacia* Thornveld, *Eragrostis* Disturbed Grassland, *Searsia lancea* Bushclump, *Themeda- Aristida* Sandy Red Soils, *Themeda* Dominated Grassland, *Themeda- Eragrostis* Clay Rich Soils, *Asparagus* Dominated Transformed Grassland, *Setaria-Persicaria* Pan System, *Sporobolus - Cynodon* Wetland and *Typha* Dominated Wetland.

From a faunal perspective the project's location and lack of rocky outcrops, suggest a low diversity of fauna. Significant from a faunal perspective is a small (141ha, partially transformed) patch of flat, relatively homogenous Central Free State Grassland (GH-6) in the south-eastern corner of the study area as well as the Whites Dam along the Rietspruit at the proposed pipeline terminus. Four broad habitat types as applicable to fauna were identified namely Thornveld, Disturbed Thornveld, Wetlands/Dams and Croplands. A rating of Moderate importance was assigned to Thornveld (for red-listed rodents, large terrestrial birds, raptors and bullfrogs) and Wetlands/Dams (for red-listed waterfowl, rodents and bullfrogs). Moderate–Low and Very Low importance ratings were, respectively, ascribed to Disturbed Thornveld (for a similar species assemblage in suboptimal thronged) and Croplands (for coursers and small carnivores). Evidently, despite being largely transformed, the site maintains, at least, some capacity to support conservation important (CI) fauna. Some of the more significant CI mammal species include Aardvark (**PS**), Southern African Hedgehog (**NT**), Free State Pygmy Mouse (**DD**), African White-tailed Rat (**EN**). Serval (**NT**), Bat-eared Fox (**PS**), Cape Fox (**PS**), African Striped Weasel (**NT**), Brown Hyena (**NT**), Aardwolf (**PG**) and Black-footed Cat (**VU**).In terms of birds Melodious Lark (**NT**) was observed on site by NSS while Digby Wells (2013) detected Blue Korhaan (**NT**). Other bird species likely to occur on site include Abdim's Stork (**NT**), Secretarybird (**VU**), Martial Eagle (**EN**), Verreauxs' Eagle (**VU**), Lanner Falcon (**VU**), Red-footed Falcon (**NT**), European Roller (**NT**) and Burchell's Courser (**VU**). Of the various CI reptile species only Leopard (**PG**) and

Striped Harlequin Snake (**NT**) are likely to occur on site. In terms of CI amphibians signs of Giant Bullfrog (**NT**) presence were detected in the nearby vicinity. Although no suitable breeding habitat was found on site the species may well utilize the site for foraging and overwintering. With regards to terrestrial macro-invertebrates no CI butterflies are likely to occur on site, however baboon spiders may well occur (PS in 2007 Free State Conservation Bill).

The vast majority of wetlands in the greater region have, similarly, long been partially or completely transformed by tillage and drainage practices with significant consequences on their natural drainage patterns and water retention capacity. Consequently some systems are mere relics, making their identification and delineation particularly challenging. In spite of this three wetland hydrogeomorphic (HGM) units were identified along the proposed water discharge pipeline route namely Rietspruit Floodplain (HGM Unit 1),Seasonal Depression (HGM Unit 2) and Hillslope Seep (HGM unit 3). These HGM units are discussed in terms of their hydrological, geomorphological and vegetation integrity, ecosystem services and importance and sensitivity further on in this report. Most impacted is HGM unit 3 which, as a result of cultivation, no longer supports any natural wetland vegetation yet still functions hydrologically.

LIST OF ACRONYMS & ABBREVIATIONS

ACRONYM	DESCRIPTION
1LC	Globally Least Concern
2LC	Regionally Least Concern
a.s.l.	above sea level
AGIS	Agricultural Geo-referenced Information System
B	Breeding
CARA	Conservation Agricultural Resources Act
CI	Conservation Important
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
D	Declining population trend
DCA	Detrended Correspondence Analysis
DD	Data Deficient
DDT	Data Deficient – Taxonomically
DEA	Department of Environmental Affairs
Dec	Declining
DWAF	Department of Water Affairs and Forestry
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EM3	Echo Meter 3 bat detector
EN	Endangered
End	Endemic
ES	Ecological Sensitivity
EWT	Endangered Wildlife Trust
FEPA	Freshwater Ecosystem Priority Area
GG	Government Gazette
GIS	Geographic Information System(s)
GN	Government Notice
HGM	Hydro-geomorphic
I	Increasing population trend
IBA	Important Bird Area
IUCN	International Union for Conservation of Nature and Natural Resources
LC	Least Concern
LoM	Life of Mine
LoO	Likelihood of Occurrence
MBG	Mining and Biodiversity Guideline
NB	Non breeding
NEM:BA	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NEMA	National Environmental Management Act
N-End	Near-Endemic
NEPAD	New Partnership for Africa's Development
NFEPA	National Freshwater Ecosystem Priority Areas

ACRONYM	DESCRIPTION
NSS	Natural Scientific Services CC
NT	Near Threatened
NWA	National Water Act
NWU	North-WestUniversity
P	Protected
PES	Present Ecological State
Pr.Nat.Sci.	Professional Natural Scientist
PRECIS	PREtoria Computerised Information System
PS	Protected Species
QDS	Quarter degree square
S	Stable population trend
SABAP 1 & 2	First and second Southern African Bird Atlas Projects
SANBI	South African National Biodiversity Institute
SASS	South African Scoring System
ToPS	Threatened or Protected Species under NEM:BA
TSF	Tailings Storage Facility
TSP	Threatened Plant Species Programme
U	Unknown population trend
UJ	University of Johannesburg
UP	University of Pretoria
UV	Ultra-violet
VU	Vulnerable
WITS	University of the Witwatersrand
WMA	Water Management Area
.wac	Acoustics Compressed
.wav	Wave
.zc	Zero crossing

TABLE OF CONTENTS

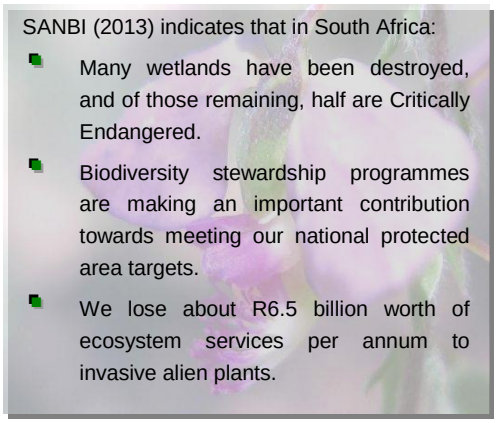
LIST OF TABLES

LIST OF FIGURES

1. Introduction

Biological diversity or biodiversity refers to the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (www.cbd.int). Although South Africa covers only 2% of the total land area on Earth, it is regarded as one of the most bio-diverse countries in the world (EWT 2002 in Driver *et al.* 2004). This is because the combined influence of South Africa's unique geology and varied climate has given rise to the formation of nine biomes, including numerous unique vegetation types and habitats, which collectively support 10% of the world's plant species and 7% of the world's reptile, mammal and bird species.

South African legislation affirms the national commitment to conservation. The National Environmental Management: Biodiversity Act (NEM:BA; Act 10 of 2004), in particular, provides for: the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act (NEMA; Act 107 of 1998); the protection of species and ecosystems that warrant national protection; and the sustainable use of indigenous biological resources.



In cognisance of NEMA, the Gold One Group Limited appointed Prime Resources (Pty) Ltd to undertake the environmental authorisation and licensing processes for an underground mining operation referred to as the Ventersburg Project, near Hennenman in the Free State. According to Prime Resources, the Scoping and Environmental Impact Assessment (EIA) process will be conducted in accordance with the NEMA EIA Regulations, and the documentation prepared will be submitted to the DMR in support of the application for a Mining Right. All of the required environmental specialist studies were undertaken to some extent during 2013, with a preliminary floral and faunal winter assessment compiled in June 2013. This assessment indicated that a more detailed wet season survey was required, which should focus on flora and fauna specifically including mammals, reptiles, birds and amphibians.

Consequently, Natural Scientific Services CC (NSS) was appointed by Prime Resources (Pty) Ltd to complete a wet season floral and faunal assessment for the Ventersburg Project. In addition to this, Prime Resources appointed NSS to undertake a wetland assessment for a pipeline that is planned to run from the mine, to the Rietspruit. This report presents the combined floral, faunal and wetland assessment findings, which were obtained from desktop research, and field work that was performed during February 2017.

2. Terms of Reference

As agreed between NSS and Prime Resources, this report provides:

- An Introduction and Terms of Reference.
- A comprehensive list of applicable international, regional, national and provincial legislation, policies, guidelines and biodiversity conservation initiatives.
- A broad description of the biophysical characteristics of the study area.
- Descriptions of the methodologies used and study limitations.
- Descriptions of local floral communities including their structure, dominant species composition and condition, and lists of potentially occurring and observed flora, including conservation important (CI) and alien, invasive species.
- Descriptions of faunal diversity in different habitats, and lists of potentially occurring and observed fauna, including CI species.
- A map showing all previously-delineated wetlands in the main study area, and newly-delineated wetlands along the proposed pipeline route and within a 50m buffer around it.
- Detailed discussion of all newly-delineated wetlands including their classification, Present Ecological State (PES), functionality and Ecological Importance and Sensitivity (EIS).
- Discussion of any international, regional, national, provincial and local areas of floral, faunal and wetland conservation significance, and prescribed buffer zones for CI species and their habitat.
- A habitat sensitivity map.
- A detailed Impact Assessment with recommended impact mitigation measures, according to Prime Resources' prescribed methodology for this.
- Concluding remarks.

3. Project Team

All aspects of the floral, faunal and wetland assessments were managed and executed by NSS (**Table 3-1**). NSS has extensive experience in project management, and desktop- and field-based biodiversity assessments. NSS has also been involved in the management of EIAs, Environmental Management Program Reports, Strategic Management Plans and Environmental Management Plans for the conservation, mining, waste, commercial and industrial sectors.Senior NSS team members are registered Professional Natural Scientists in the ecological, environmental, and zoological fields, as is legally required by the Natural Scientific Professions Act of 2003. The senior wetland specialist has been acknowledged since 2009 by the Department of Water and Sanitation as a competent wetland delineator.

Table 3-1 NSS project team

PROJECT ROLE	NAME	QUALIFICATIONS
Project Management/ Floral Specialist	Susan Abell	M.Sc. – Resource Conservation Biology (WITS). Pr.Sci.Nat. Registered – Ecology &Environmental Science.
Ecologist / Wetlands	Tyron Clark	M.Sc. - Zoology (WITS) – in progress.
Wetland Review	Kathy Taggart	M.Sc. – Resource Conservation Biology (WITS). Pr.Sci.Nat. Registered – Ecology & Environmental Science. DWS acknowledgement – Competent Wetland Delineator.
Faunal Specialist	Dr Caroline Lötter	Ph.D. – Zoology (UP). Pr.Sci.Nat. Registered – Zoology.
Field & Office Assistant	Samantha Bradley	More than 10 year's work experience with NSS.
GIS Specialist	Tim Blignaut	B.Sc. Honours– Geography (UJ).

4. Applicable Legislation, Policies & Guidelines

International, regional, national and provincial legislation, policies and guidelines, which could apply to impacts of the mining operation on biodiversity, are listed below. Although the list is comprehensive, additional legislation, policies and guidelines that have not been mentioned may apply.

4.1. International Agreements

- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
- (Ramsar) Convention on Wetlands of International Importance, especially as Waterfowl Habitat.
- (World Heritage or Stockholm) Convention Concerning the Protection of World Cultural and Natural Heritage.
- (Bonn) Convention on the Conservation of Migratory Species of Wild Animals.
- Convention on Biological Diversity including eco-systems and genetic resources.
- Agenda 21 regarding the sustainable development at global and national levels.
- United Nations Framework Convention on Climate Change.
- United Nations Convention to Combat Desertification.
- Kyoto Protocol on global warming.

- Johannesburg Declaration and Plan of Implementation for sustainable development.
- Copenhagen Accord on Climate Change.
- 17th Conference of the Parties on Climate Change.
- Paris Agreement on global warming.

4.2. International Policies & Guidelines

- Good practice guidance for mining and biodiversity (Starke 2006).
- The International Cyanide Management Institute (ICMI 2006).
- IFC Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management (IFC 2012).
- The Climate Change Performance Index.

4.3. Regional Agreements

- Action Plan of the Environmental Initiative of NEPAD for sustainable development in Africa.

4.4. National Legislation

- Conservation of Agricultural Resources Act (Act 43 of 1983).
- Environmental Conservation Act (Act 73 of 1989).
- Constitution of the Republic of South Africa (Act 108 of 1996).
- Water Services Act (Act 108 of 1997).
- National Water Act (Act 36 of 1998).
- National Forests Act (Act 84 of 1998) and Protected Tree Species.
- National Veld and Forest Fire Act (Act 101 of 1998).
- National Environmental Management Act (NEMA; Act 107 of 1998).
- National Heritage Resources Act (Act 25 of 1999).
- National Mineral and Petroleum Resources Development Act (Act 28 of 2002).
- National Environmental Management: Protected Areas Act (Act 57 of 2003).
- National Environmental Management: Biodiversity Act (NEM:BA; Act 10 of 2004):
    - National list of Ecosystems Threatened and in need of Protection under Section 52(1)(a) of NEM:BA (Government Gazette [GG] 34809 - Government Notice [GN] 1002, 9 December 2011).
    - Alien and Invasive Species Regulations (GG 37885 - GN 598, 1 August 2014).
    - Threatened or Protected Species (ToPS) Regulations (GG 38600 - GN 255, 31 March 2015).
- National Environmental Management: Air Quality Act (Act 39 of 2004).
- GN R. 704: Regulating the use of water for mining and related activities.

4.5. National Policies, Guidelines& Programmes

- National Aquatic Ecosystem Health Monitoring Program and River Health Program.
- South African Water Quality Guidelines (DWAF 1996).

- National Spatial Biodiversity Assessment (Driver *et al*. 2004) including identified Priority Areas and Threatened Ecosystems.
- National Biodiversity Strategy and Action Plan (DEAT 2005).
- National Water Resource Strategy (DWA 2004).
- Review of biodiversity management in the mining industry in South Africa (Kuntonen-van't Riet 2007).
- National Protected Areas Expansion Strategy (DEA 2010).
- National Freshwater Ecosystem Priority Areas (FEPAs; Driver *et al*. 2011).
- Mining and Biodiversity Guideline (MBG; DEA *et al*. 2013).
- National Water Resource Strategy. Second Edition. (DWA 2013).
- Draft Minimum Requirements for Biodiversity in Impact Assessments (DEA 2016).

4.6. Free State Legislation, Policies & Guidelines

- Free State Nature Conservation Ordinance (Act 8 of 1969).
- Ordinance Free State Nature Conservation Regulations (1983).
- Free State Environment Outlook (2008) - A report on the state of the environment in the Free State Province.
- Free State Nature Conservation Bill, published under Notice No. 10, Provincial Gazette 23, dated 7 May 2010.
- Free State Conservation Plan (C-Plan) (not yet published).

5. Study Region

5.1. Locality & Land Use

The Ventersburg Project surface infrastructure footprint is approximately 250 ha. The ecological study is required to investigate the footprint and immediate surrounds. This is approximately 407ha in extent and will be known as the Study Area within this report (**Figure 5-2**). The project is situated on the farms Klippan 77, La Rochelle 760, Vogels Rand, Uitsig and Strydfontein. It is situated adjacent to the R70 provincial road route, immediately south of the town of Hennenman, and approximately 7.5km north-west of Ventersburg in the central Free State Province (**Figure 5-1**). The study area has been extensively transformed by commercial crop cultivation and other agricultural activities at least as far back as 1964 (**Figure 5-3**). Surrounding forms of land-use include extensive commercial crop cultivation, gold mining (to the west), and game farming (to the north-west, where the land was subject to the historical lime mining). There is also informal and formal human settlement at Henneman, Whites, and Phomolong, situated to the north, north-west and north-east of the Project, respectively. To the south and south-east of the Project, most land appears to remain in a semi-natural condition.

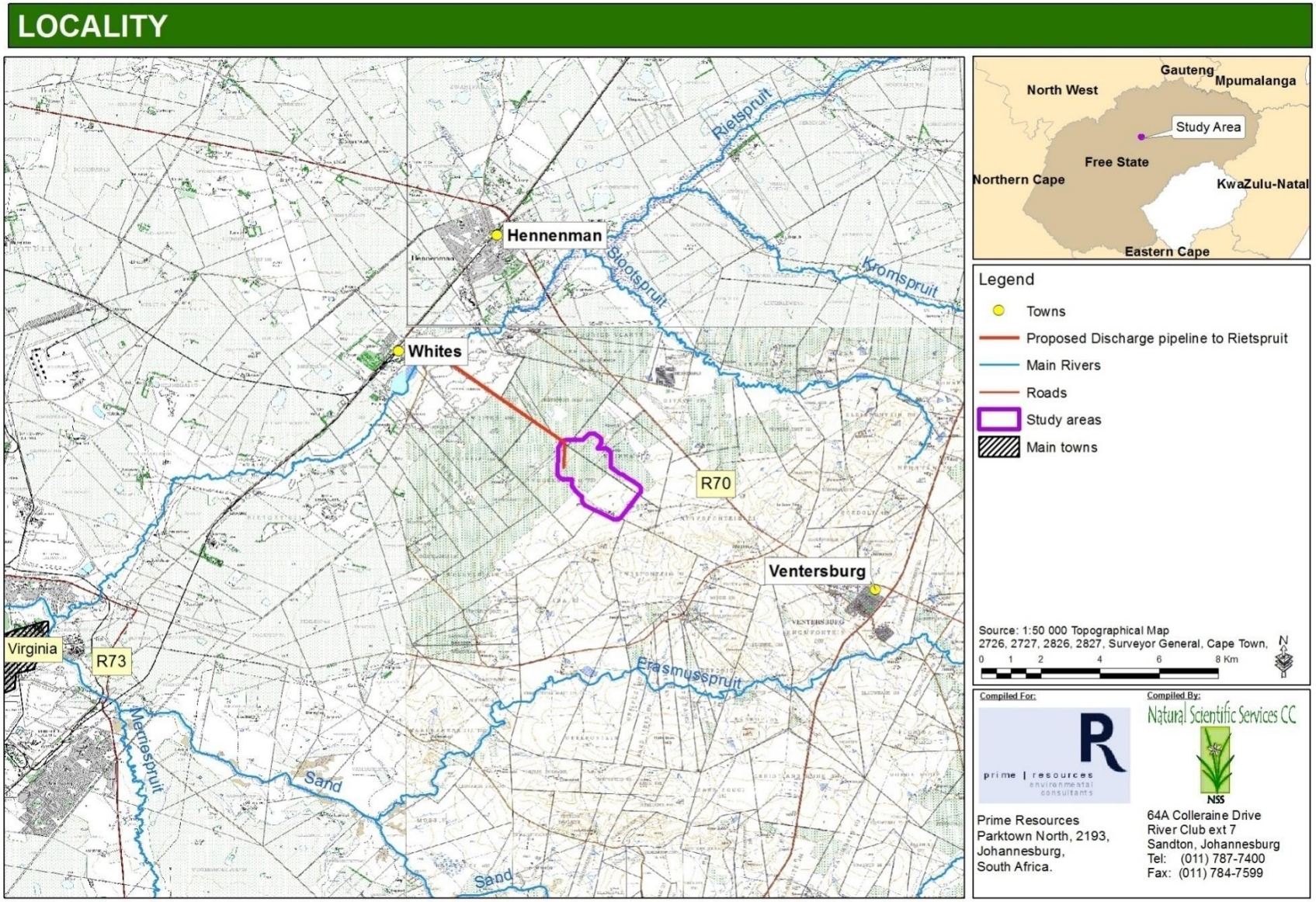


Figure 5-1 Location of the Ventersburg Project

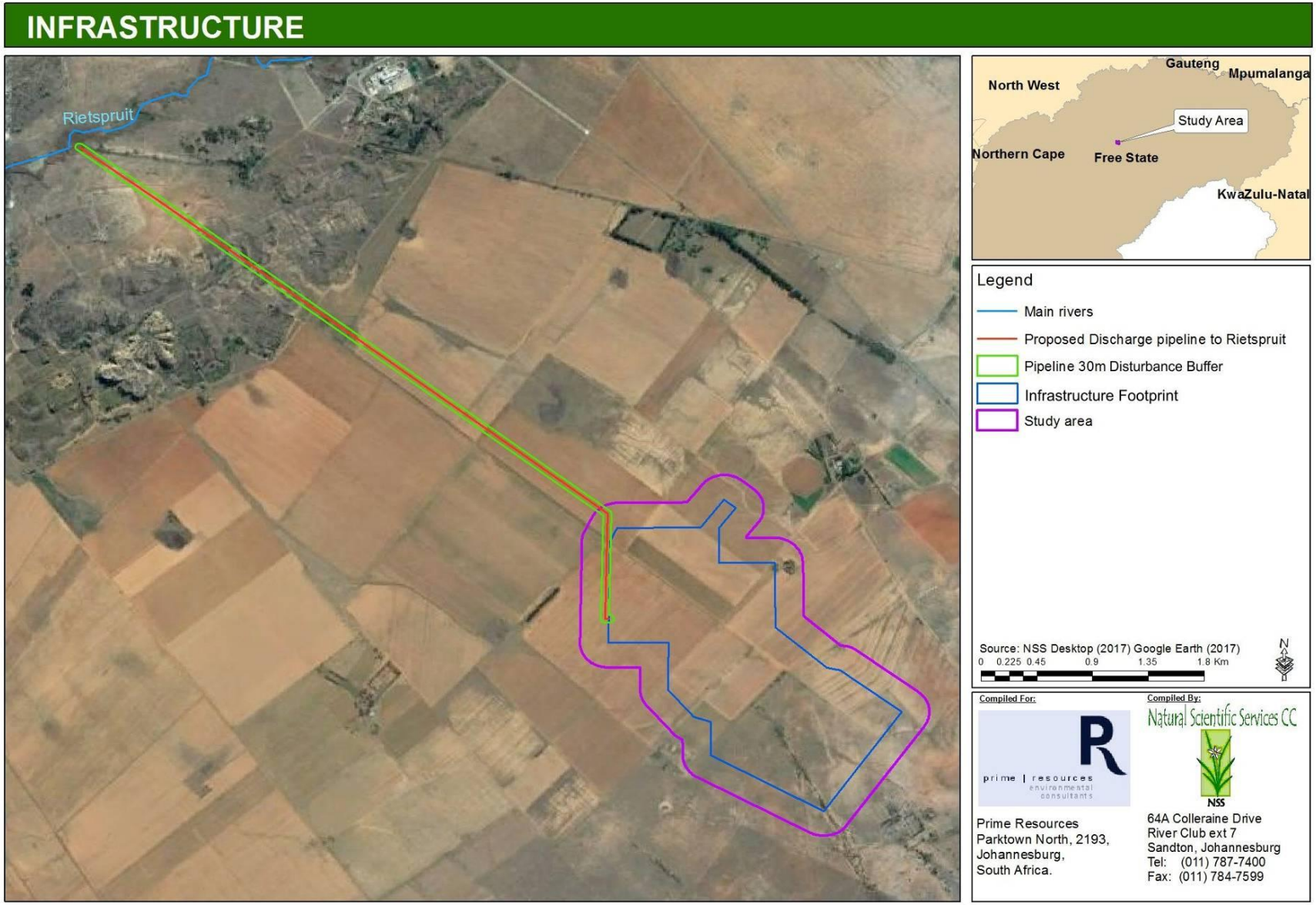


Figure 5-2 Infrastructure layout and study area

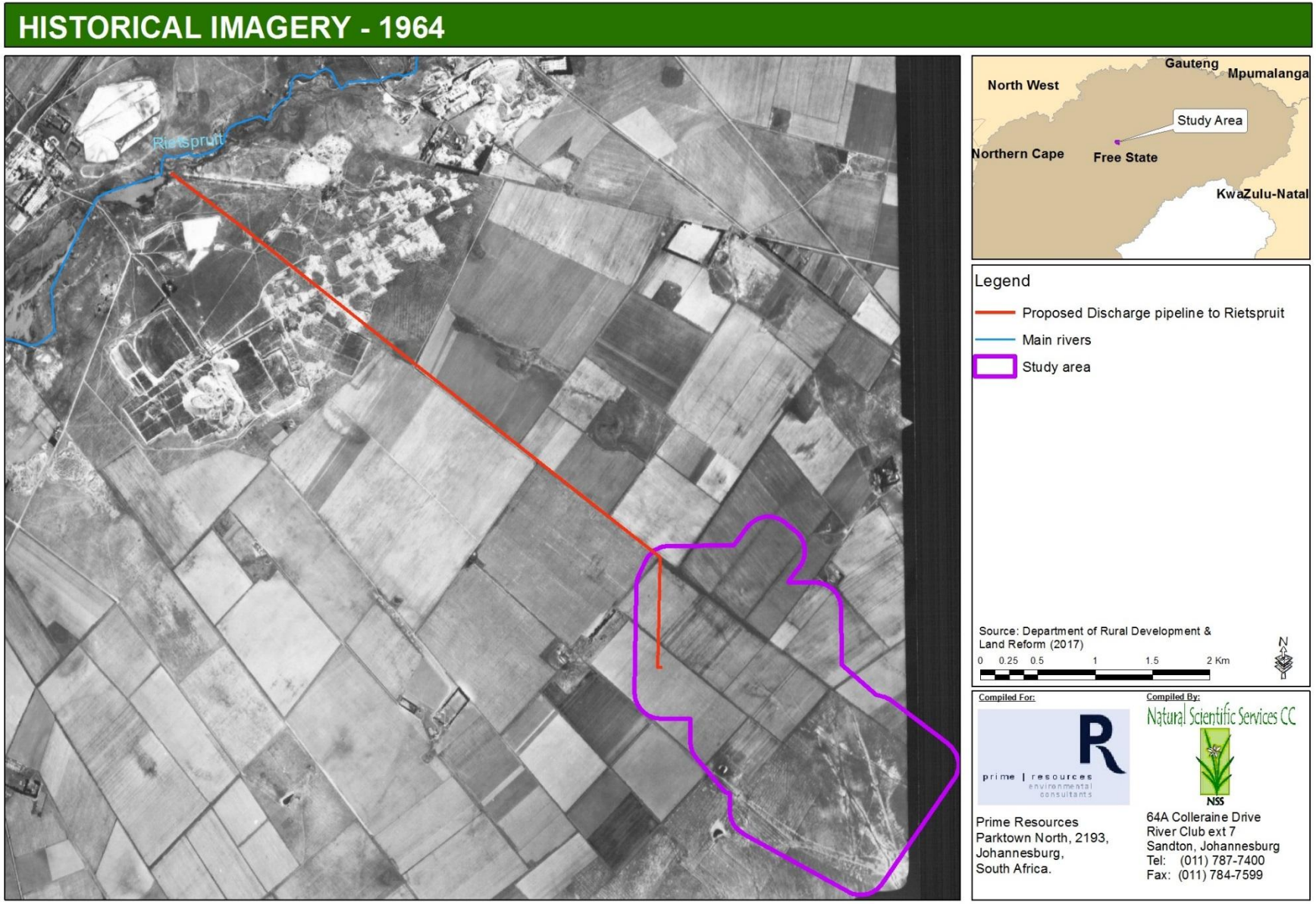


Figure 5-3 **1964 aerial photographic imagery of the Ventersburg Project area**

5.2. Climate

The study area falls within a summer rainfall and cool-temperate region with thermic continentality (i.e. high extremes between maximum summer and minimum winter temperatures). There are also large thermic diurnal differences (especially in autumn and spring). Winters are very dry with frequent frost. The predominant vegetation type in the region is characterized by mean annual precipitation of 530mm, with peak rainfall in summer i.e. December-January. Overall mean annual temperature is approximately 16.4°C. Summer temperatures can be high (>30°C), and frost is frequent in winter (37 to 43 frost days per annum on average; Mucina & Rutherford 2006).

Shown in **Figure 5-4** is the monthly amount of rainfall measured at Hennenman from January2016 to March 2017(AccuWeather 2017). South Africa has been experiencing a severe drought and during the 12-month period that preceded our surveys on 7-9February 2017, Hennenman had received a total of 156mm rain (as opposed to the annual average of approximately 530mm), of which 68mm was received during January 2017. These approximate rainfall data suggest that the region received a significant below-average amount of rainfall during the 12 months preceding the February 2017 eco-scan. The area received 89mm of rainfall during February 2017 (AccuWeather 2017).

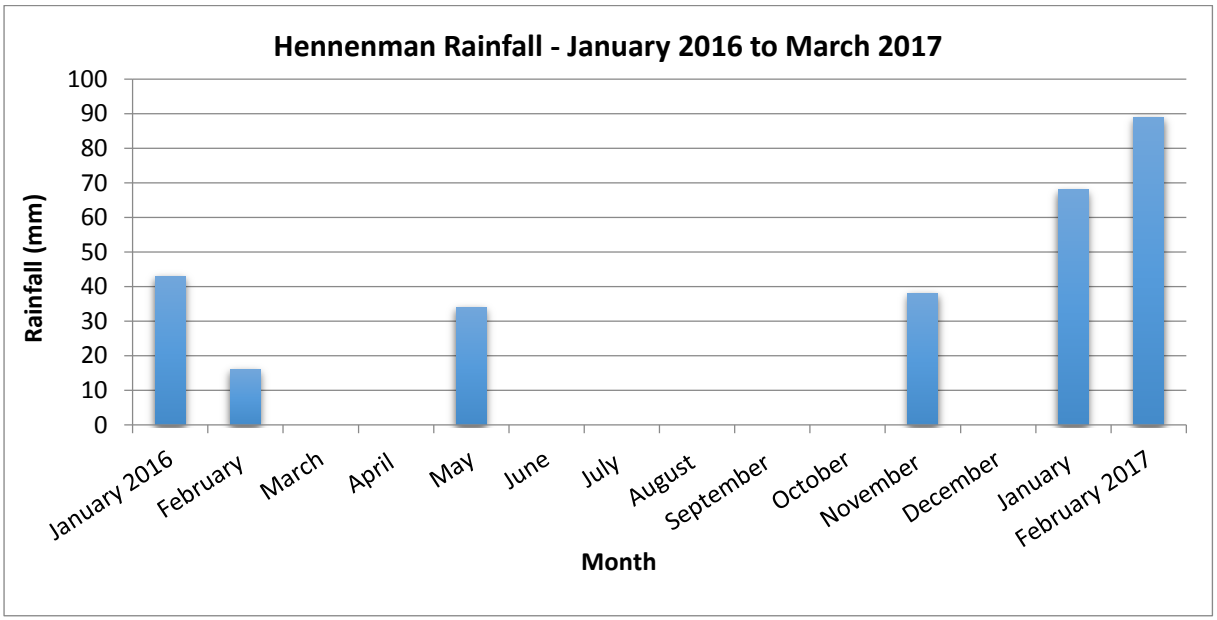


Figure 5-4 Measurements of monthly rainfall at Hennenman (AccuWeather 2017)

The approximate temperature data in **Figure 5-5** indicate that during July 2016, the mean temperature was 14°C, and the minimum was 2°C. Conditions were typically hot during the 2016-2017 summer season when the mean temperature was 21.5°C, and a maximum of 33°C was measured in December 2016.

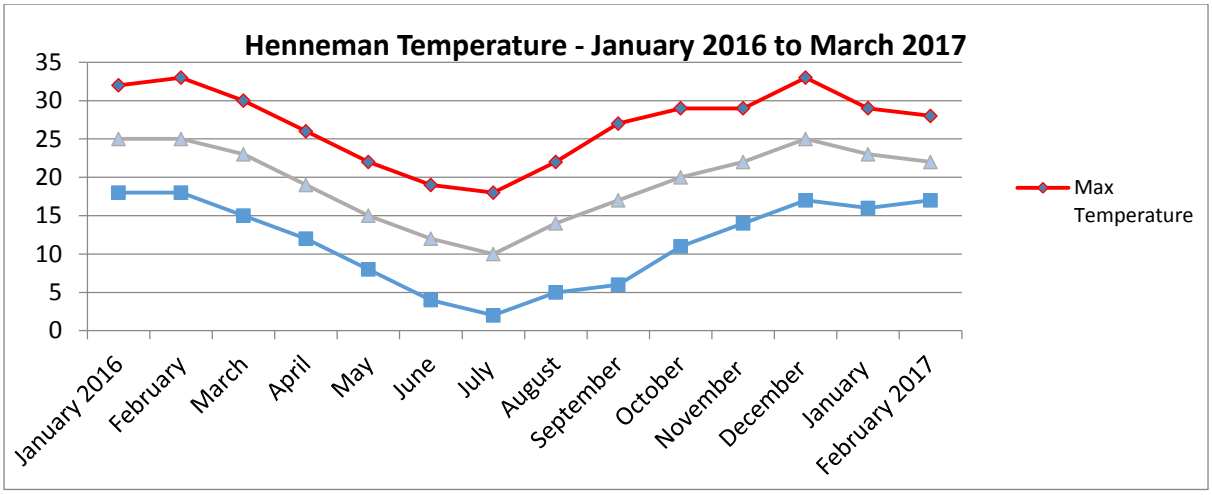


Figure 5-5 Measurements of air temperature at Hennenman (AccuWeather 2017)

5.3. Geology& Soils

"Land types," which have been identified by the ARC's Institute for Soil, Climate and Water, represent areas that are uniform with respect to climate, terrain form, geology and soil. The data, obtained through the Agricultural Geo-referenced Information System (AGIS 2010), provide useful baseline information on land capability (especially agricultural potential). According to this data, the Ventersburg Project is situated predominantly in land types Bc30 and Dc12 (**Figure 5-8)**.

Land type Bc30 features plains-dominated landscapes with some scattered, slightly irregular undulating plains and hills. Aeolian and colluvial sands overly sandstone, mudstone and shale of the Karoo Supergroup, as well as the older Ventersdorp Supergroup (Mucina & Rutherford 2006). Soil forms are mostly Avalon, Westleigh and Clovelly. Land type Dc12features undulating plains, and the underlying geology is characterized by sedimentary mudstones and sandstone of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) as well as those of the Ecca Group (Karoo Supergroup). The geology supports soils of the Arcadia, Bonheim, Kroonstad, Valsrivier and Rensburg forms, which are vertic, melanic and red in nature (Mucina & Rutherford 2006). Within the study area, the terrain slopes gradually downwards from 1 434m a.s.l. in the south-east to 1399m a.s.l. in the north-west.

5.4. Hydrology

The Ventersburg Project is situated in the Middle Vaal Water Management Area (WMA) 9 and the Sand-Vet Catchment area, where the Sand-Vet River system varies from fair to poor health. More specifically, the Project is situated in quaternary catchment C42J, between the Slotspruit River in the east, and the Erasmusspruit in the west and south. The Rietspruit is immediately to the north of the study area(**Figure 5-6**).The proposed pipeline would discharge into the Rietspruit, which is a tributary of the Sand River, which is a tributary of the Vet River. The Rietspruit becomes the Sand River approximately 17km downstream of the discharge point. This small river system is heavily regulated and impacted by catchment activities. Due to the great demand for irrigation and domestic use, very little or no flow is

released out of the dams for environmental requirements. Canals transfer water to irrigation schemes and the nearby town of Welkom, Virginia, Odendaalsrus and Hoopstad. In some sections of these rivers, the entire flow during the winter months is made up of treated sewage effluent.This flow is sometimes supplemented with irrigation return flows and industrial effluent. Water seepage through the Allemanskraal Dam wall provides base flow that sustains the aquatic habitats for a short distance downstream. However, the reaches above the Allemanskraal and Erfenis dams only have flow following summer rains. During the dry months, some reaches completely dry up, whilst others maintain a slight flow that is sufficient to sustain the pools that serve as refugia for fish. Fish health is good to fair during the summer rainy season, but during winter low flows, salt encrusts the rocks in the middle reach while the upper reaches are often dry (RHP 2005).

The major contributing factors to the high salt concentrations in the rivers are the mining activities and irrigation return flows. Regarding agriculture and urban development, the water abstracted from the various canal systems is used by the Sand/Vet Irrigation scheme, as well as for domestic supply by Sedibeng Water. Sewage works in the area are notorious for spills caused by poor maintenance and under-capacity. The stocking of alien fish species like bass has displaced indigenous fish species including Red Data species such as the Near Threatened Largemouth Yellowfish, *Labeobarbus kimberleyensis* (RHP 2005).

A summary of the (desktop-based) Present Ecological State (PES), Ecological Importance (EI), Ecological Sensitivity (ES) and current impacts on the Sand/Rietspruit River, as reported by the Department of Water and Sanitation (DWS 2014), is presented in **Table 5-1**. The Sand River/Rietspruit are moderately modified (C) due to loss and change of natural habitats and biota, but basic ecosystem functions are still predominately unchanged. The high EI of the Sandriver/Rietspruit is due to the presence of two protected species in these sub-quaternary catchments. ES is dependent on stream size, morphology and geomorphic habitat diversity. The Sandriver/Rietspruit are moderately sensitive to modified flow conditions and water level changes. The degree of flow change will elicit a particular level of response and the smaller streams are usually more sensitive i.e. rapid loss of useable habitats as flows decrease (DWS 2014). The Sand River/Rietspruit represents a **Critically Endangered** Lowland River. None of these rivers are protected (Nel & Driver 2012; Driver *et al*. 2011).

Table 5-1 Summary of the eco-status and impacts on local rivers (DWS 2014)

Quaternary Catchment	Water Resource	Present Ecological State (PES)	Ecological Importance (EI)	Ecological Sensitivity (ES)	Current Impacts
C42L	Sand River	**C Moderately Modified**	HIGH	MODERATE	Roads, instream weirs, agriculture and erosion. After merging with the Palmietkuilspruit, the Sand River is also impacted by irrigation from channel (Allemanskraal dam), return flows and alien invasive plants.

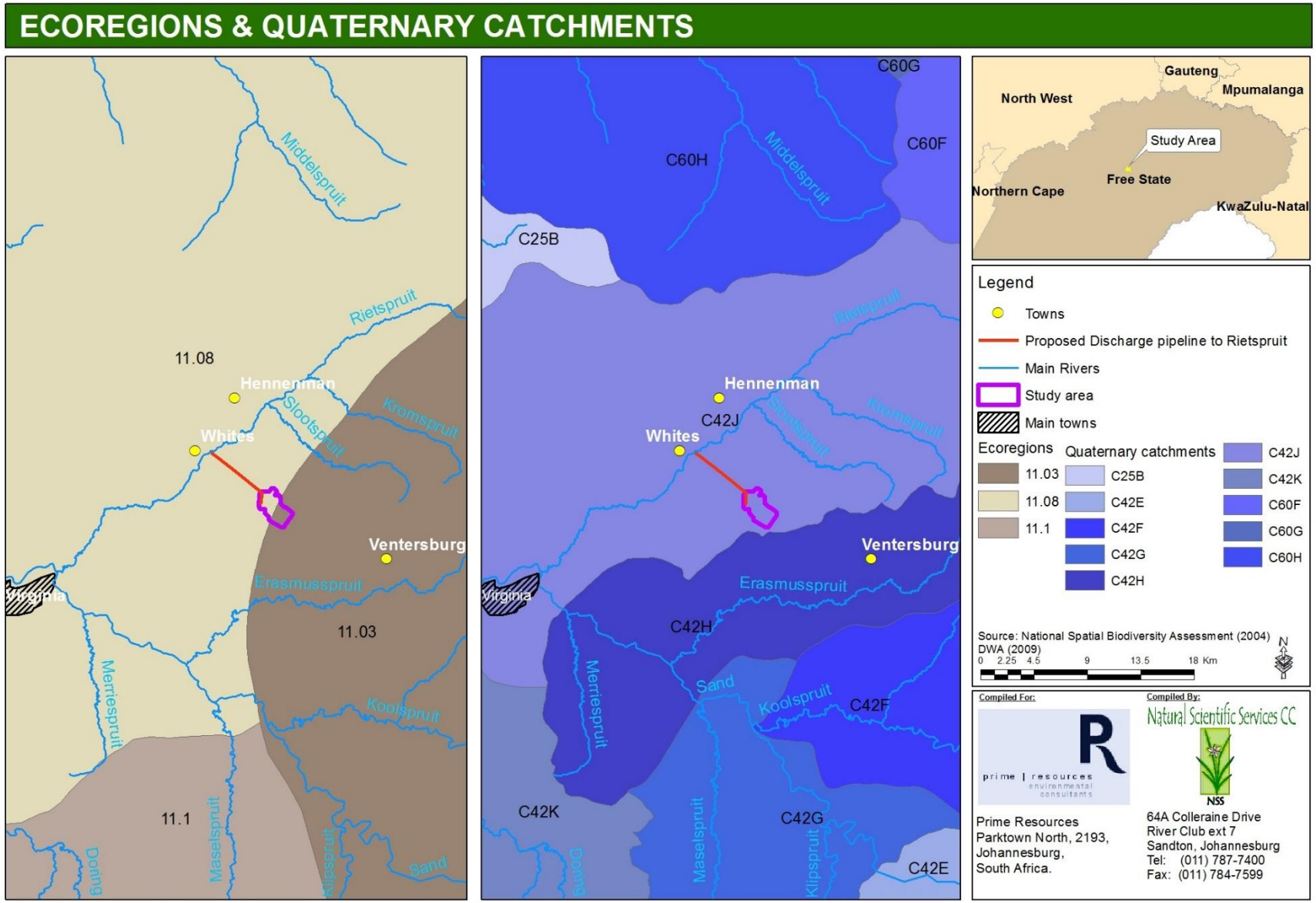


Figure 5-6 Ecoregions and quaternary catchments

5.5. Regional Vegetation

The Ventersburg Project is situated in South Africa's Grassland Biome (**Figure 5-7**), and the predominant regional vegetation types are classified by Mucina & Rutherford (2006) as Gh10 Vaal-Vet Sandy Grassland and Gh6 Central Free State Grassland (**Figure 5-8**).The Grassland Biome is found primarily on the high central plateau of South Africa including the inland regions of KwaZulu-Natal and the Eastern Cape. The majority of plant species within grasslands are non-grassy herbs (forbs), most of which are perennial plants with large underground storage structures. Frost, fire and grazing maintain the herbaceous grass and forb layer, and ultimately prevent the establishment of tall woody plants (Tainton 1999).

The proposed pipeline and northern section of the Ventersburg mining area is situated in the Vaal-Vet Sandy Grassland vegetation type, which represents a karroid, low-tussock type of grassland that is dominated by the Red Grass *Themeda triandra*. In areas with erratic rainfall and/or heavy grazing, there is an associated increase in *Elionurus muticus, Cymbopogonpospischilii* and *Aristida congesta* at the expense of *T. triandra* (Mucina & Rutherford 2006). Vaal-Vet Sandy Grassland is regarded as **Endangered** by Mucina & Rutherford (2006), since more than 63% of this vegetation type has been transformed by agriculture, and only 0.3% is statutorily conserved. Plant species which are diagnostic of Vaal-Vet Sandy Grassland are listed in **Table 5-2.**

Table 5-2 Diagnostic plant species comprising Vaal-Vet Sandy Grassland

GROWTH FORM	TAXA
Graminoids:	*Anthephora pubescens* (d), *Aristida congesta* (d), *Chloris virgata* (d), *Cymbopogon caesius*(d), *Cynodon dactylon* (d), *Digitaria argyrograpta* (d), Elionurus muticus (d), *Eragrostis chloromelas* (d), *Eragrostis lehmanniana* (d), *Eragostis plana* (d), *Eragrostis trichophora* (d), *Heteropogon contortus* (d), *Panicum gilvum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus berteronianus* (d), *Brachiara serrata*, *Cymbopogon pospischillii*, *Digitaria eriantha*, *Eragrostis curvula*, *Eragrostis obtusa*, *Eragrostis superba*, *Panicum coloratum*, *Pogonarthria squarrosa*, *Trichneura grandiglumis*, *Triraphis andropogonoides*
Herbs:	*Stachys spathulata* (d), *Barleria macrostegia, Berkheya onopordifolia* var. *onopordifolia, Euphorbia (Chamaesyce) inaequilatera*, *Geigeria aspera* var. *aspera, Helichrysum caespititium, Hermannia depressa, Hibiscus pusillus, Monsonia burkeana, Rhynchosia adenodes, Selago densiflora, Ledebouria marginata*
Succulent Herb:	*Tripteris aghillana* var. *integrifolia*
Low Shrubs:	*Felicia muricata* (d), *Pentzia globosa* (d), *Anthospermum rigidum*subsp. *pumilum, Helichrysum dregeanum, Helichrysum paronychioides, Ziziphus zeyheriana*
Herb:	*Lessertia phillipsiana*

The southern section of the mining area is situated in the Central Free State Grassland, which represents assort grassland type, which in its natural condition is dominated by *Themeda triandra. Eragrostis curvula* and *Eragrostis chloromelas* become dominant in degraded areas. Dwarf karoo bushes establish in severely degraded clayey bottomlands. Overgrazed and trampled low – lying areas with heavy clayey soils are prone to *Acacia karroo*encroachment. Central Free State Grassland is regarded as **Vulnerable** by Mucina & Rutherford (2006), since approximately 25% of this vegetation type has been transformed by agriculture and dams, and only a very small percentage is statutorily conserved.

Table 5-3 Diagnostic plant species comprising Central Free State Grassland

GROWTH FORM	TAXA
Graminoids:	*Aristida adscensionis* (d), *Aristida congesta* (d), *Cynodon dactylon* (d), *Eragrostis chloromelas* (d), *Eragrostis curvula* (d), *Eragrostis plana* (d), *Panicum coloratum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus koelerioides (*d), *Agrostis lachnantha*, *Andropogon appendiculatus*, *Aristida bipartita, Aristida canescens, Cymbopogon pospischilii, Cynodon transvaalensis, Digitaria argyrograpta, Elionurus muticus, Eragrostis lehmanniana, Eragrostis micrantha, Eragrostis obtusa, Eragrostis recemosa, Eragrostis trichophora, Heteropogon contortus, Microchloa caffra, Setaria incrassata, Sporoobolus discosporus*
Herbs:	*Berkheya onopordifolia* var. *onopordifolia, Chamaesyce inaequilatera, Conyza pinnata, Crabbea acaulis, Geigeria aspera* var. *Aspera, Hermannia depressa, Hibiscus pusillus, Pseudognaphalium luteo – album, Salvia stenophylla, Selago densiflora, Sonchus dregeanus*
Geophytic Herbs:	*Oxalis depressa, Raphionacme dyeri*
Succulent Herb:	*Tripteris aghillana* var. *integrifolia*
Low Shrubs:	*Felicia muricata* (d), *Anthospermum rigidum* subsp. *pumilum*, *Helichrysum dregeanum*, *Melolobium candicans*, *Pentzia globosa*

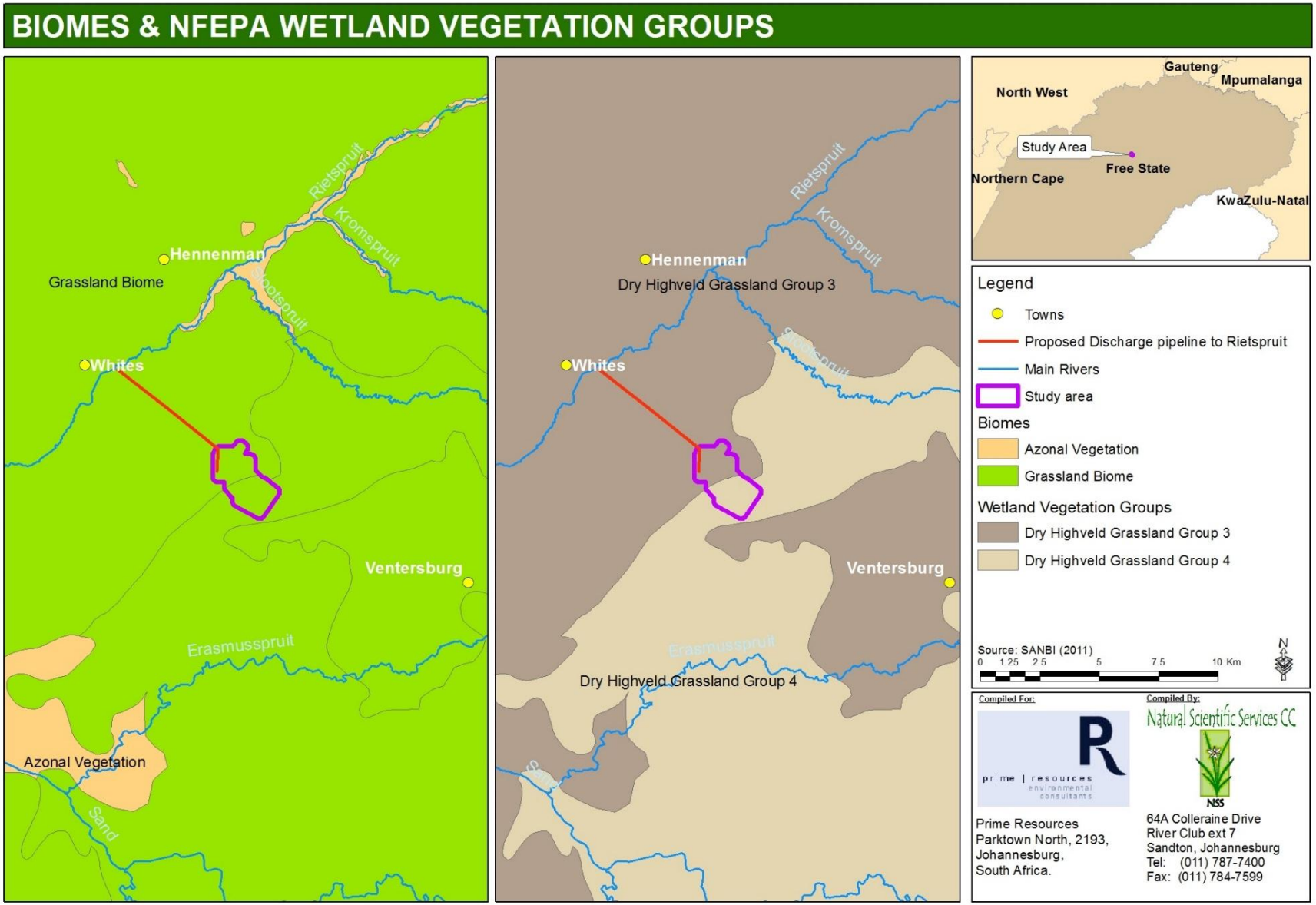


Figure 5-7 Biomes and wetland vegetation groups

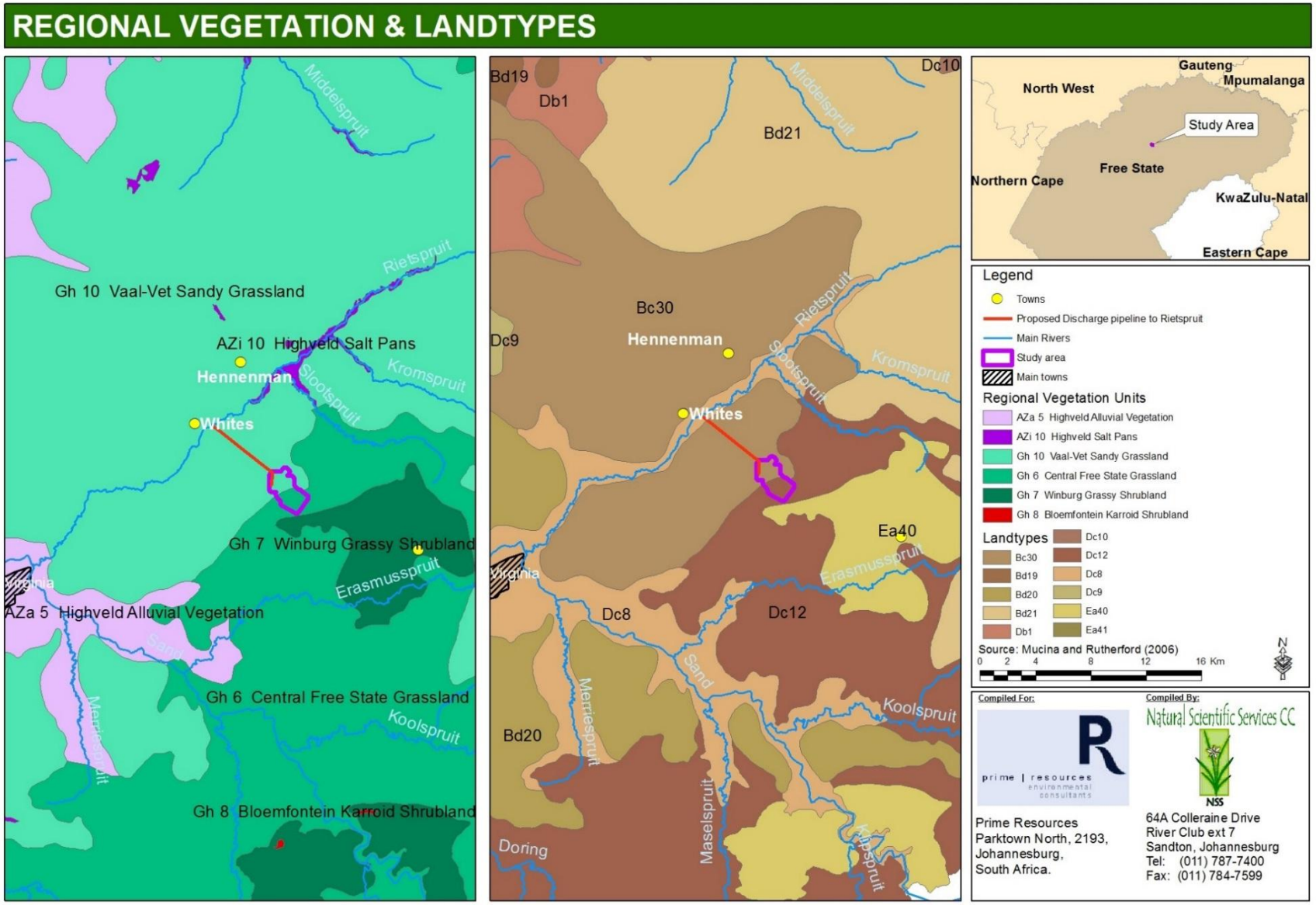


Figure 5-8 Regional vegetation and land types

6. Methodology

6.1. Vegetation & Floral Communities

The Study Area, as discussing in **Section 5.1** above, is approximately 407 hectares in extent and largely under cultivation (over 55%). This left 170 hectares open for vegetation community sampling, of which over 140 was monospecific *Themeda* grassland (with past agricultural activities).In addition to this, the proposed pipeline route is linear and narrow in nature and bisected mainly crop fields with only semi-natural habitat to the west. From this it was difficult to employ sampling methods such as Braun-Blanquet cover-abundance approach (Mueller-Dombois & Ellenberg, 1974). Therefore this was only used as a basis to form broader habitat units but the data was not analysed using TWINSPAN.

The vegetation component therefore included:

- A desktop assessment of the vegetation within the region and potential community structure based on the information obtained from:
  - SANBI's[1] Plants of South Africa (POSA) 2827AA QDS
  - Mucina & Rutherford's (2006) vegetation map of southern Africa.
  - The current Free State C-Plan data (unpublished).
  - CI plant species records in the study region (mainly obtained through POSA)
  - Digby Wells (2013), Flora and fauna baseline assessment for a feasibility study for the proposed Ventersburg mine. Gold one Africa limited.
- A three day field investigation in early February 2017 walking transects through the Study Area:
  - Noting species, habitats and cover abundance. Sampling points are presented in **Figure 6-1** and excluded sampling in crop fields. Plant taxa were identified to species level (some cases, cf would be used if identification was limiting – cf means 'confer' or 'looks like'). Scientific names follow POSA (Accessed, March 2017).
  - Recording any observed alien and invasive plant species on site was also conducted. The identification of declared weeds and invader species as promulgated under: the NEMBA August 2014 regulations (GG37885); and the amended regulations (Regulation 15) of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983).
- Reporting including vegetation community descriptions, mapping of broad habitat types / vegetation communities and CI species analysis. For CI floral species, Likelihood of Occurrence (LO) rating is assigned to each species based on the availability of suitable habitat using the following scale: Present; Highly likely; Possible; Unlikely or No Habitat available.

[1] The South African National Biodiversity Institute

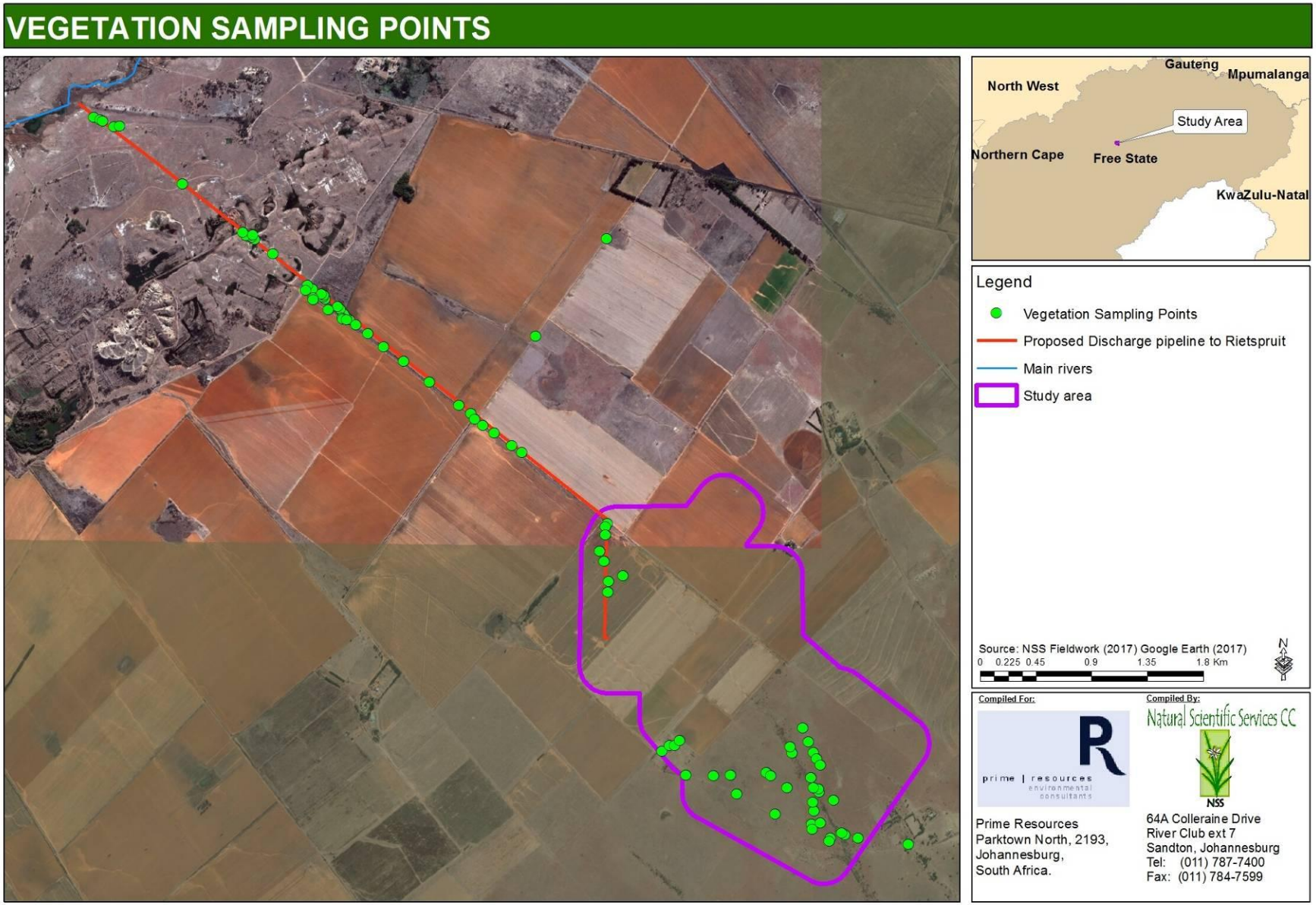


Figure 6-1 Main vegetation sampling points

6.1.1. Limitations

It is important to note that the absence of species on site does not conclude that the species is not present at the site. Reasons for not finding certain species during the mid summer visit may be due to:

- The short duration of fieldwork
- The 2015/2016 season also experienced below average rainfall in the beginning of the season.
- Some plant species, which are small, have short flowering times, rare or otherwise difficult to detect may not have been detected even though they were potentially present on site.
- Vegetation mapping was based on the brief in-field survey as well as aerial imagery. Positioning of the vegetation units may not be exact due to potential georeferencing errors displayed in Google Earth, GPS accuracy in field as well as the age of the aerial image.

6.2. Fauna

6.2.1. Desktop Research

Lists of potentially occurring faunal species were compiled, based on distribution data sourced for:

- Mammals, using the published species distribution maps in Friedmann & Daly (2004), as well as the online species distribution data provided by the ADU's MammalMap (2017) for the QDS 2827AA.
- Birds, using the online species distribution data from the first and second Southern African Bird Atlas Projects (SABAP 1 & 2, 2017) for the QDS 2827AA and pentad 2800_2700.
- Reptiles, using the published species distribution maps in Bates *et al.* (2014) and the online species distribution data from ReptileMap (2017) for the QDS.
- Frogs, using the published species distribution maps in Minter *et al.* (2004) and the online species distribution data from FrogMap (2017) for the QDS.
- Butterflies, using the online species distribution data from Mecenero *et al.* (2015) and LepiMap (2017) for the QDS.
- Dragonflies and damselflies (odonata), using distribution maps and habitat information provided in Samways (2008).
- Scorpions, using distribution maps and habitat information provided in Leeming (2003).
- Baboon spiders, using distribution maps provided in Dippenaar-Schoeman (2002).

A Likelihood of Occurrence (LO) rating was then assigned to each species based on distribution and the availability of suitable habitat using the following scale:

1 Present

2 High

3 Moderate
4 Low / Unlikely
5 Would only occur as a managed population.

6.2.2. Fieldwork

Faunal surveys were conducted during 7-9 February 2017, and involved active searching, sweep-netting, live-trapping, camera-trapping, night drives and mist-netting.


Motion-sensitive camera


Mat trap


Sherman rodent trap


Mist-net to live-trap bats


EM3 bat call detector


Multi-entry insectivore trap

Figure 6-2 Faunal sampling methods

Visual observations, grab-sampling and sweep-netting

Faunal observations were made during active point searches by day on foot and incidentally while driving in and around the study area. Mammals were detected from observations of dead or live animals and their spoor, droppings, burrows and other evidence. Birds were identified based on their direct observation or from their calls and flight behaviour. The "BirdLasser" (Lejint 2017) mobile app. was used to record the first location of each detected bird species. Herpetofauna and scorpions were searched for by turning rocks and other surface debris. Sweep-netting was used to sample butterflies and odonata. Spot-lighting during slow night drives was used to detect nocturnal fauna.

Live-trapping

At two localities (one in grassland; the other amidst croplands), a series comprising 14 small mammal (rodent and insectivore) traps was deployed. The traps were spaced approximately

5m apart, and placed where vegetation provided some cover around the traps. Each trap was baited, and provisioned with cotton wool and a cover board to provide warmth and shade for trapped animals, and the traps were checked daily. In addition, a "mat" trap was placed on the ground in the vicinity of each series of small mammal traps. The 0.5m x 0.5m AstroTurf mats were used to assist in sampling small terrestrial reptiles, frogs and other fauna by providing these with artificial shelter.

Camera-trapping

Motion-sensitive cameras were deployed in the study area at six locations where vertebrate activity seemed likely, such as along wildlife paths, roads and fence lines (**Figure 6-4**). In front of each camera a handful of wet cat / dog food was placed, to purposefully attract secretive nocturnal carnivores.

Bat mist-netting and acoustic transects

An ultrafine 6m x 2.5m mist net was erected on the evening of 8 February 2017. The net was positioned across a dirt road, amidst *Acacia* trees in grassland, so as to live trap any bats using the road as a movement corridor between the trees. The net was checked at regular intervals. Each captured bat was photographed, and the length of its right forearm was measured. An ultra-sonic Echo Meter 3 (EM3) detector (Wildlife Acoustics Inc., USA) was held near each bat to record its echo locating calls upon release. In addition, bat calls were recorded using the EM3 while slowly driving through the study area.

Wildlife Acoustics Compressed (.wac) files of bat calls recorded by the EM3 detector were converted to zero crossing (.zc) and wave (.wav) files using the Kaleidoscope programme (Wildlife Acoustics Inc., USA). The converted data were subsequently examined using the Analook (Titley Electronics, USA) and BatSound Pro (Pettersson Elektronik, Sweden) programmes to identify bat taxa from detailed examination of the peak frequency, duration and band width of their calls (**Appendix 9**).

6.2.3. Conservation Status of Species

The appended faunal lists indicate the status of relevant species according to:

- The latest (2015) list of Threatened or Protected Species (ToPS) under the National Environmental Management: Biodiversity Act (NEM:BA 2004).
- The latest list of Threatened or Protected Species under the relevant provincial legislation, in this case, the Free State Nature Conservation Ordinance (1969).
- The latest national or regional Red List assessment for:
  - Mammals by the SANBI & EWT (2016).
  - Birds by Taylor *et al*. (2015).
  - Reptiles by Bates *et al.* (2014).
  - Frogs by Minter *et al.* (2004).
  - Butterflies by Mecenero *et al.* (2013).
  - Dragonflies and damselflies (odonata) by Samways (2006).

- The IUCN Red List, where the global Red List status of a taxon has not been assessed during the relevant afore-mentioned national or regional Red List assessment.

An atlas and Red List assessment for South African scorpion species has not yet been published. Due to spatio-temporal variation in human disturbances, the conservation status of some species differs between the NEM:BA, provincial legislation and the relevant regional or national Red List assessment publication. Unless otherwise stated, the *most* threatened status of a species is provided in text, whether this is at a global or other spatial scale. Shown in **Figure 6-3** are the IUCN's Red List categories, which have been adopted to a large extent in regional / national assessments of animal taxa.

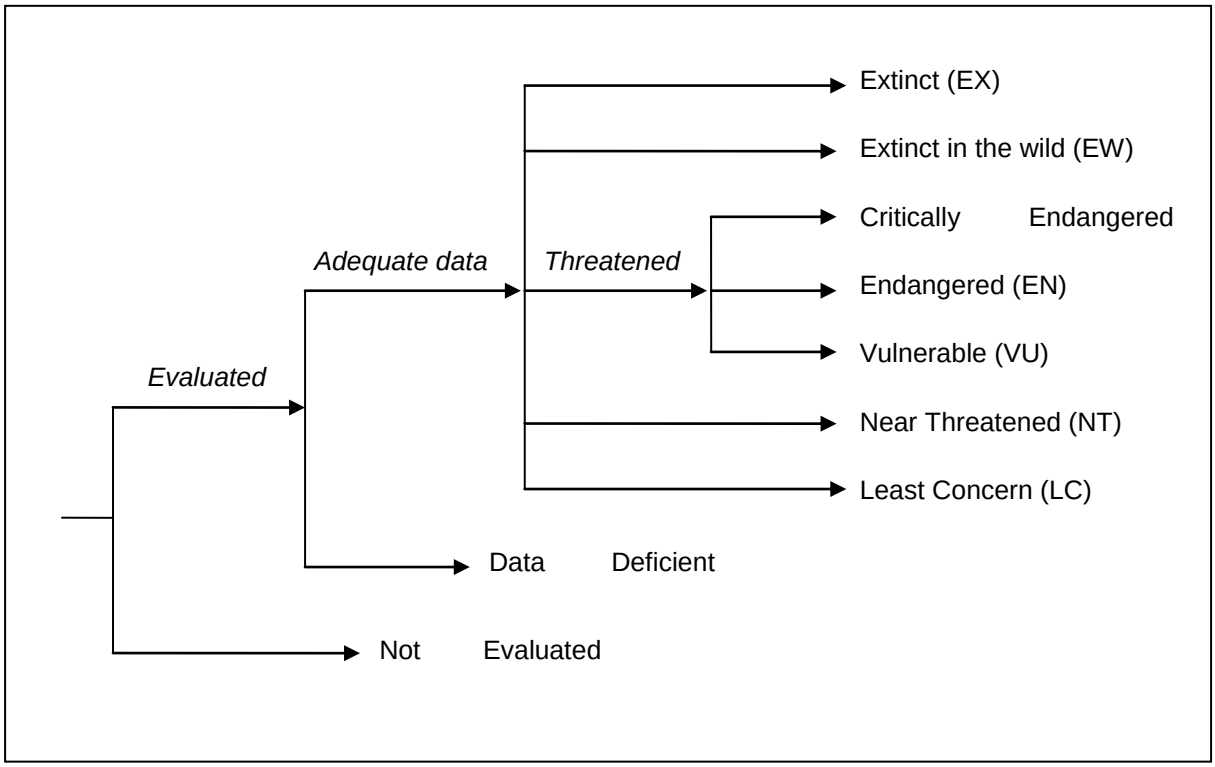


Figure 6-3 IUCN Red List categories

Limitations

Several inherent and unavoidable limitations need to be considered when interpreting survey results. Reasons for the lack of detection of some faunal species include:

- The small extent of the study area, and the considerable transformation and fragmentation of native vegetation.
- The short duration of fieldwork.
- Heavy rain and muddy roads, which limited access for trap installations and survey equipment (traps, cameras, etc.).
- The cryptic nature of certain species, such as those that are uncommon, small, migratory, secretive or otherwise difficult to find.

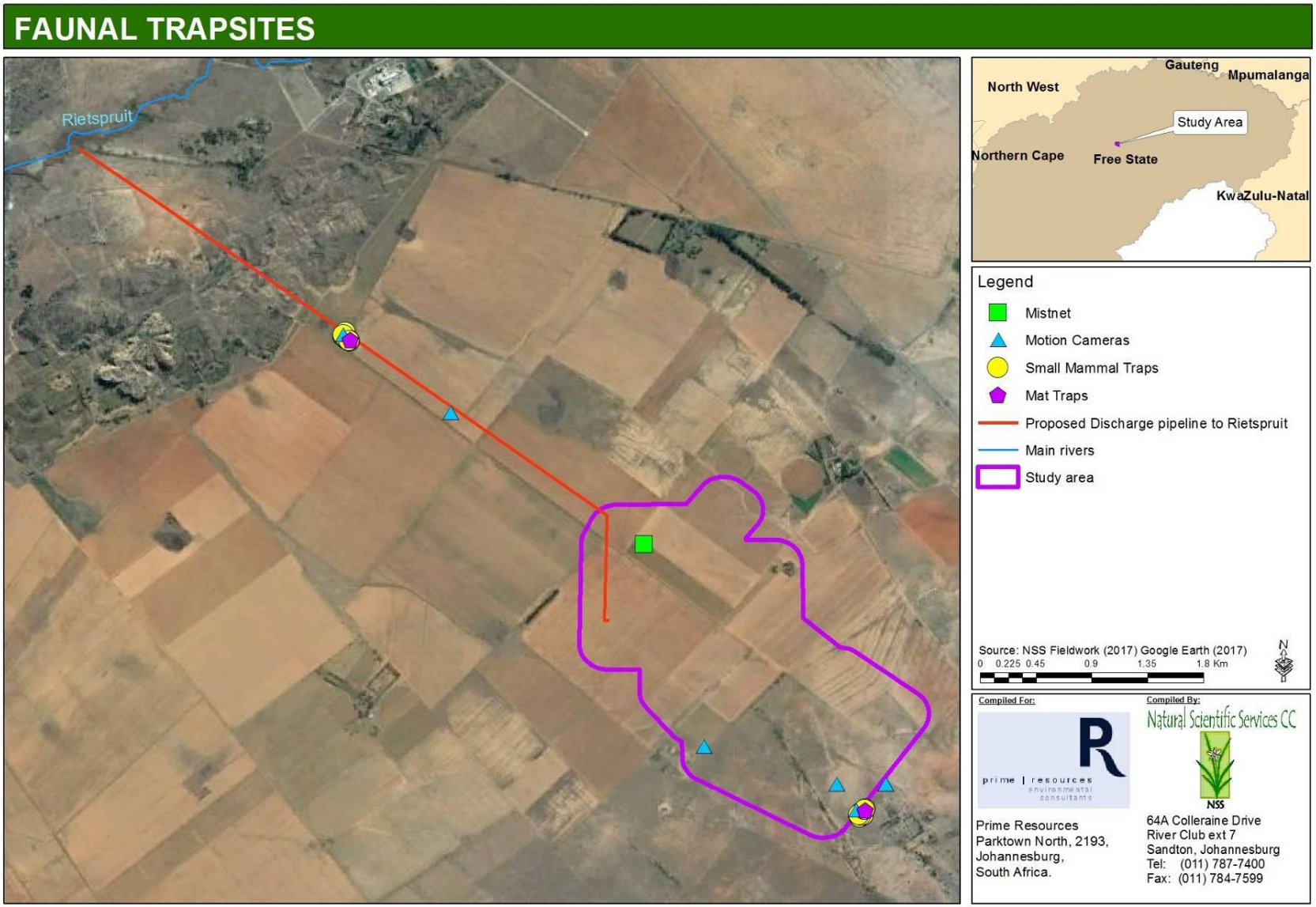


Figure 6-4 Location of the small mammal traps, mat traps, camera traps and mist-net

6.3. Wetlands

Prior to any field investigations being undertaken, the area was surveyed at a desktop level using contour data, Google Earth™ imagery from the last decade and historical aerial imagery from the 1960's to determine the layout of potential natural and artificial wetlands within the study area and the historical disturbances to the site.

6.3.1. Wetland Classification

Wetlands were defined using the recently-published "Classification system for Wetlands and other Aquatic Ecosystems in South Africa" by Ollis *et al*. (2013), hereafter referred to as "the Classification System." Ecosystems included by the Classification System encompass all those that are listed under the Ramsar Convention as "wetlands", and include all freshwater (non-marine) systems. The Classification System recognizes three broad inland systems: rivers, wetlands and open waterbodies. Like Kotze ***et al's*** (2008) classification of wetlands based on hydro-geomorphic (HGM) units, the Ollis *et al*. (2013) Classification System asserts that the functioning of an inland aquatic ecosystem is determined fundamentally by hydrology and geomorphology.

The Classification System has a six-tiered structure where under the determination of a system's HGM unit (Level 4) is the most fundamental (**Figure 6-5**):

- Level 1 – Type of Systems (Marine, estuarine or Inland)
- Level 2 – Regional Setting (Level 1 Ecoregions; NFEPA WetVeg units etc)
- Level 3 – Landscape Unit (Valley Floor, Slope, Plain, Bench)
- Level 4 – Hydrogeomorphic (HGM) Unit
- Level 5 – Hydrological Regime
- Level 6 – Descriptors (e.g. Natural vs. Artificial; Salinity; pH etc)

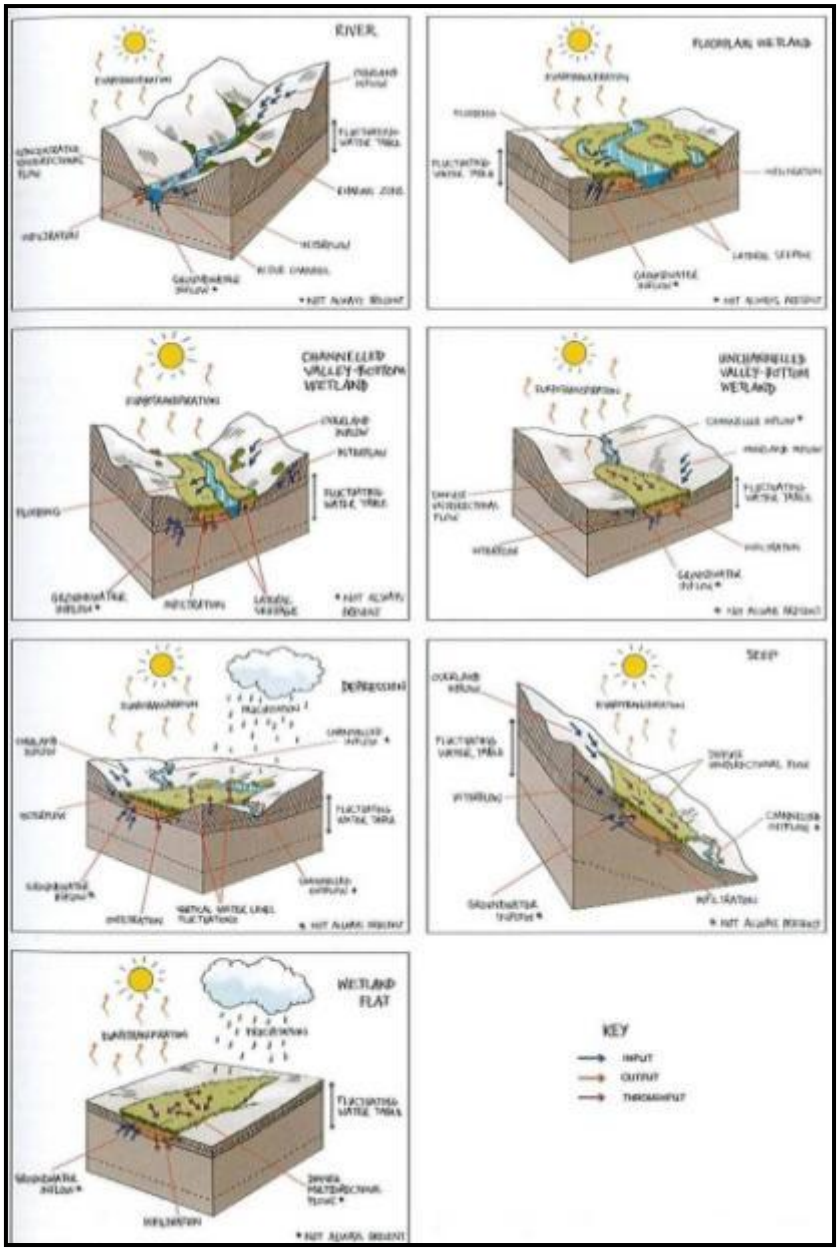


Figure 6-5 Primary HGM types, highlighting dominant water inputs, throughputs & outputs (Ollis *et al.* 2013)

6.3.2. Wetland Extent

The wetland delineation methods used in the field were the same as those outlined in the DWS field procedure for identification and delineation of wetlands and riparian areas (DWAF, 2005). The following three indicators described by DWAF (2005) were used:

- **Terrain Unit Indicator:** The topography of the area was used to determine where in the landscape wetlands were likely to occur. McVicar et al. (1977) defines five terrain units. Most wetlands will be found in valley bottoms (unit 5), but can occur on crests, midslopes and footslopes (units 1, 3 and 4). Land type data extracted from the AGIS website (Land Type Survey Staff, 1972 – 2006) provides an overview of the terrain units to be expected on the site (Figure 6-6).

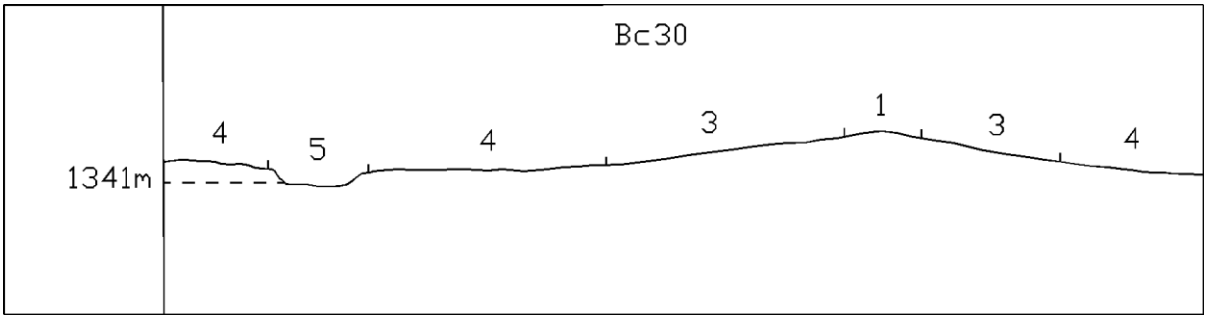


Figure 6-6 Simple depiction of terrain units (Landtype B30-Landtype survey 1972-2006)

- **Soil Wetness Indicator**: The soil wetness and duration of wetness are indicated by the colour of the soil. A grey soil matrix such as a G-horizon is an indication of wetness for prolonged periods of time and mottles indicate a fluctuating water table. In terms of the DWS guidelines (DWAF, 2005), signs of soil wetness must be found within the top 50 cm of the soil surface to classify as a wetland. The permanent zone of a wetland is therefore characterised by grey soil, the seasonal zone has a high frequency of low chroma mottles and the temporary zone has less, high chroma, mottles. These mottles are normally most prominent just below the A-horizon. Mottles may occur in non-wetland soils that have a high chroma matrix, and the colour of the matrix must always be considered in conjunction with the presence of mottles.
- **Vegetation Indicator**: Vegetation is a key component of the wetland definition in the National Water Act, 1998 (Act No 36 of 1998), and vegetation can be used as an indicator of wetland conditions. The presence / absence of hydrophytes provide a useful additional criterion in determining the boundaries of wetlands.

The study site was traversed, on foot, with soil samples, within the top 50cm and deeper where necessary, of the soil profile, taken using a hand auger at select points within the study area. The soil samples were assessed for the above wetland indicators. Each auger point sampled was marked with a handheld Global Positioning System (GPS) device (Geographic projection, WGS 84 Datum).

6.3.3. Wetland Present Ecological State

The PES of systems were assessed using the Level 1 WET-HEALTH tool, as described by Macfarlane *et al.* (2008). The WET-HEALTH tool is designed to assess the health or integrity of a wetland. In assessing the health of the wetlands, the tool uses indicators based on the main wetland drivers: geomorphology, hydrology and vegetation. Macfarlane *et al.* (2008) describe the application and methodology of WET- HEALTH as follows: The system uses:

- An impact-based approach for those activities that do not produce clearly visible responses in wetland structure and function. The impact of irrigation or afforestation in the catchment, for example, produces invisible impacts on water inputs. This is the main approach used in the hydrological assessment.

- An indicator-based approach for activities that produce clearly visible responses in wetland structure and function such as the presence of erosion gullies or alien plant species. This approach is mainly used in the assessment of geomorphological and vegetation health.

The wetland is first classified into hydrogeomorphic (HGM) units (as discussed above). Each HGM unit is then assessed separately for hydrological, geomorphological and vegetation health based on extent, intensity and magnitude of impact. This is translated into a health score. The approach, as defined by Macfarlane *et al.* (2008) is as follows:

5 The extent of impact is measured as the proportion of a wetland and/or its catchment that is affected by an activity. Extent is expressed as a percentage.
6 The intensity of impact is estimated by evaluating the degree of alteration that results from a given activity.
7 The magnitude of impact for individual activities is the product of extent and intensity.
8 The magnitude of individual activities in each HGM unit is combined in a structured and transparent way to calculate the overall impact of all activities that affect hydrological, geomorphological or vegetation health. Present State health categories are scored on a scale of A-F (**Table 6-1**).

Using a combination of threat and/or vulnerability, an assessment is also made in each module on the likely Trajectory of Change within the wetland (**Table 6-2**). Overall health of the wetland is then presented for each module by jointly representing the Present State and likely Trajectory of Change. This approach not only provides an indication of hydrological, geomorphological and vegetation health, but also highlights the key causes of wetland degradation.

Table 6-1 Impact Scores and Present Ecological State categories

ECOLOGICAL CATEGORY	DESCRIPTION	COMBINED IMPACT SCORE
A	**Unmodified, natural**	0-0.9
B	**Largely natural with few modifications**. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9
C	**Moderately modified**. A moderate change in ecosystem processes and loss of natural habitat has taken place but the natural habitat remains predominantly intact.	2-3.9
D	**Largely modified**. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9
E	**Seriously modified**. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9
F	**Critically modified**. Modifications have reached a critical level and	8-10

ECOLOGICAL CATEGORY	DESCRIPTION	COMBINED IMPACT SCORE
	the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	

Source: Modified from Macfarlane *et al.* (2008)

Table 6-2 Trajectory of change classes, scores and symbols

TRAJECTORY CLASS	DESCRIPTION	CHANGE SCORE	CLASSRANGE*	SYMBOL
Improve markedly	Condition is likely to improve substantially over the next five years	2	1.1 to 2	↑↑
Improve	Condition is likely to improve over the next five years	1	.3 to 1	↑
Remains stable	Condition is likely to remain stable over the next five years	0	-0.2 to +0.2	→
Deterioration slight	Condition is likely to deteriorate slightly over the next five years	-1	-0.3 to -1	↓
Deterioration substantial	Condition is likely to deteriorate substantially over the next five years	-2	-1.1 to 2	↓↓

Source: Modified from Macfarlane *et al.* (2008)

* Used when determining a trajectory score for a wetland comprising several HGM units

6.3.4. Wetland Ecosystem Services

The WET – EcoServices tool is a technique for rapidly assessing ecosystem services supplied by wetlands (Kotze *et. al.,* 2008). This tool has been designed for inland palustrine wetlands, i.e. marshes, floodplains, vleis and seeps and has been developed to help assess the goods and services that individual wetlands provide to support planning and decision-making.

The wetland benefits included in the WET-EcoServices model are selected based on their importance for South African wetlands, and how readily these can be assessed. Benefits such as groundwater recharge / discharge and biomass export may be important but are difficult to characterise at a rapid assessment level, and have thus been excluded. **Table 6-3** identifies and describes the ecosystem services assessed during the rapid field assessment.

Table 6-3 Ecosystem services assessed using the WET-EcoServices model (Kotze *et al.* 2008)

Ecosystem Services supplied by Wetlands	Indirect Benefits	Regulating & supporting benefits	Flood attenuation	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
			Streamflow regulation	Sustaining streamflow during low flow periods
			Water quality enhancements: Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters
			Water quality enhancements: Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters
			Water quality enhancements: Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters
			Water quality enhancements: Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff water
			Water quality enhancements: Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation
			Carbon storage	The trapping of carbon by the wetland, principally as soil organic matter
	Direct Benefits	**Biodiversity maintenance**		Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity
		Biodiversity maintenance is not an ecosystem service as such, but encompasses attributes widely acknowledged as having potentially high value to society		
		Provisioning benefits	Provision of water for human use	The provision of water extracted directly from the wetland for domestic, agriculture or other purposes
			Provision of harvestable resources	The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
			Provision of cultivated foods	The provision of areas in the wetland favourable for the cultivation of foods
		Cultural benefits	Cultural heritage	Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants
			Tourism and recreation	Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
			Education and research	Sites of value in the wetland for education or research

6.3.5. Ecological Importance and Sensitivity

Available National and Provincial data were used to feed into the assessment of the EIS. The capacity of the wetland systems and associated grassland on site to support Conservation Important Species (CIS) was taken into account based on with the findings of the ecoscan assessment undertaken by NSS.

The assessment of wetland EIS was based on the EIS tool developed by Rountree and Kotze (2012). The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts.

The Importance and Sensitivity tool for wetlands thus proposed three suites of importance criteria, namely:

- Ecological Importance and Sensitivity, incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWS and thus enabling consistent assessment approaches across water resource types;
- Hydro-functional importance, which considers water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- Importance in terms of basic human benefits - this suite of criteria consider the subsistence uses and cultural benefits of the wetland system.

It is recommended that the highest of these three suites of scores be used to determine the overall Importance and Sensitivity category (**Table 6-4**) of the wetland system.

Table 6-4 Ecological importance and sensitivity categories – Interpretation of median scores for biotic and habitat determinants

Range of Median	Ecological Importance & Sensitivity (EIS)	Recommended EMC
>3 and <=4	**Very high** Wetlands that are considered ecologically important and sensitive on a national / international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	A
>2 and <=3	**High** Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	B
>1 and <=2	**Moderate** Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	C
>0 and <=1	**Low/Marginal** Wetlands which are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	D

6.3.6. Buffer Requirements

A buffer is a strip of land surrounding a wetland in which activities are controlled or restricted. Wetland buffers serve to: reduce the impact of adjacent land uses; slow potentially erosive run-off; capture sediments; absorb nutrients; and provide habitats for wetland-dependant organisms. The legal requirement, from a national perspective, for buffer

zones on wetland systems is still in a draft format and no guidelines are available for the Free State. The basis for the determination of buffers for wetlands will therefore be based upon recommendations made in the Mpumalanga Guidelines (MTPA, 2014), the Gauteng minimum the requirements for biodiversity (GDARD, 2014), and the requirements of Government Notice No. 704 (GN 704). The INR buffer guidelines are still in a draft state. The Mpumalanga Guidelines state that a 100m buffer is to be placed on all rivers and wetlands (MTPA, 2014), whilst GDARD (2014) recommend a 50m for all wetlands outside of the urban edge. Gauteng Province specifies that: "*The wetland and a protective buffer zone, beginning from the outer edge of the* wetland *temporary zone, must be designated as sensitive. Rules for buffer zone widths are as follows:*

- *30m for wetlands occurring inside the urban edge; and*
- *50m for wetlands occurring outside the urban edge.*

Note that these buffer zones are essential to ensure healthy functioning and maintenance of wetland ecosystems. Larger buffer zones may be required for wetlands supporting sensitive species. In addition, the catchment of all pan wetlands must be designated as sensitive" (GDARD 2014).

In addition to the above, DWS, with the aim of protecting the countries water resources, promulgated regulations, on 4 June 1999 (Government Notice No. 704), that dealt with the use of water for mining and mining related activities. These regulations state that:

"No person in control of a mine or activity may-

(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;

6.3.7. Limitations

Limitations and uncertainties often exist within the various techniques adopted to assess the condition of natural ecosystems. The following limitations apply to the techniques and methodologies utilised to undertake the wetland assessment:

- For the series of artificial wetlands in the central region of the proposed pipeline route, the wetland tools to assess PES, ecosystem services and EIS are not applicable and therefore have not been assessed.
- The wetland assessment tools and techniques used for assessing PES, EIS and ecosystem services are highly subjective.
- Wetland boundaries can often occur within a certain tolerance because of the potential for the change in gradient of the wetness zones within wetlands.

- The modification of the soil profile related to extensive crop cultivation and modification of the hydrological conditions within the areas disturbed by past limestone mining severely limits the accuracy of the resulting boundary as the sampling methodology, in the absence of reliable vegetation indicators, relies heavily on interpretation of soil morphology and characteristics which are themselves largely transformed in places

6.4. Impact Assessment

The Impact Assessment was performed according to Prime Resources' impact rating methodology, which takes into account impact magnitude, duration, scale and probability, as explained in **Table 6-5**. The rating of overall impact significance is explained in **Table 6-6**and calculated as follows:

Significance = (magnitude + duration + scale) x probability

Table 6-5 Prime Resources' rating of impact magnitude, duration, scale and probability

MAGNITUDE (M)	DURATION (D)
10 – Very high (or unknown)	5 – Permanent
8 – High	4 – Long-term (ceases at the end of operation)
6 – Moderate	3 – Medium-term (6-12 years)
4 – Low	2 – Short-term (0-5 years)
2 – Minor	1 – Immediate
SCALE (S)	**PROBABILITY (P)**
5 – International	5 – Definite (or unknown)
4 – National	4 – High probability
3 – Regional	3 – Medium probability
2 – Local	2 – Low probability
1 – Site	1 – Improbable
0 – None	0 – None

Table 6-6 Prime Resources' rating of impact significance

SIGNIFICANCE	POINTS
High	60 - 100
Medium	30 - 59
Low	0 - 29

Impacts were rated for each phase of the Project including construction, operation, de-commissioning, and post-closure.

7. Results

7.1. Vegetation & Floral Communities

It is important to note that vegetation and flora is a major component when studying ecosystems. The composition, diversity, and structure of vegetation are important factors for assessing biological diversity. Vegetation is the source of primary production, plays a direct role in water and nutrient cycling, and interacts strongly with other biotic components being a determinant habitat for many species. Within the study region, the vegetation is representative of the Grassland Biome. Grasslands provide essential ecosystem services, which include water production, wetland functioning and flood attenuation, good quality soil and forage for livestock; cultural and heritage value and the support for livelihoods (i.e. the use of medicinal plants). It is well documented that grasslands contain a high diversity of both plants and animals and is second only to the Cape Floristic Region.

Vegetation has also been identified as a specific target for the calculation of critical loads/levels. The composition and structure of vegetation can serve as bio-indicators for environmental changes to ecosystems. Changes in vegetation and in underlying environmental factors can serve as indicators of the status of other organisms based on our current knowledge of the ecological niches of numerous plant species.

7.1.1. Regional Floral Diversity

From the PRECIS data supplied by SANBI (2827AA), only 24 plant species have been captured for this QDG. The region for both plants and animals is poorly surveyed and limited data exists. Therefore, in order to have a better understanding of the vegetation within the region, NSS utilised information from 4 QDGs around the site namely 2827AA, 2726DD, 2727CC and 2826BB which contained information for 48 species of 24 families (PRECIS data accessed March 2017). The dominant families are listed as Poaceae, Asteraceae and Cyperaceae (**Table 7-1**). This is further supported by the fact that 29% of the species expected in the Study Area are grasses and 16% herbs, with a large percentage belonging to the Asteraceae family (**Table 7-1**). Sedges, succulents and geophytes also play a large role in the structure of the different communities.

These findings from POSA data similarly correspond with the vegetation structure found in the Study Area as represented in **Table 7-1**. Poaceae and Asteraceae dominate the site with Cyperaceae being the third dominant family. This is due to the wetland systems that are present along the pipeline route and within the Study Area (encompassing the infrastructural footprint), which harbour species such as *Cyperus, Eleocharis* and *Kyllinga.* Geophytic species are within the top four dominant growth forms on site representing species such as *Hypoxis, Ledibouria* and *Bulbine*.

Table 7-1 Top Ten Dominant Families within the QDG's square and the Ventersburg Study Area

IMPORTANT FAMILIES	No. OF SPP	GROWTH FORMS	% TOTAL SPP	STUDY AREA^^
POACEAE	14	Graminoid	29.17	27.36
ASTERACEAE	3	Herb	16.67	33.96
CYPERACEAE	3	Geophyte	10.42	8.49
AMARYLLIDACEAE	2	Dwarf shrub	8.33	7.55
ASPHODELACEAE	2	Cyperoid	6.25	4.72
CHENOPODIACEAE	2	Bryophyte	4.17	0.94
CONVOLVULACEAE	2	Helophyte	4.17	1.89
CRASSULACEAE	2	Shrub	4.17	6.6
FABACEAE	2	Shrub, tree	4.17	5.66
SOLANACEAE	2	Tree	4.17	0.94
BUDDLEJACEAE	1	Climber	2.08	-
CARYOPHYLLACEAE	1	Succulent	2.08	0.94

^^ From NSS Field data

7.1.2. Local Habitats and Floral Communities

The majority of the study area is under some form of transformation (**Figure 7-2** and **Figure 7-3**), whether it is crop production, historical lime mining, alien bush encroachment or infrastructural development. The following broad habitats were identified (**Figure 7-1**, Figure 7-2**, Figure 7-4**):

Semi Natural Habitats

- **Semi - Natural Terrestrial Grasslands** (**Table 7-3** and **Table 7-4**)
  - *Acacia* Thornveld
  - *Searsia lancea* Bushclump
  - *Eragrostis* Disturbed Grassland
  - *Themeda- Aristida* Sandy Red Soils
  - *Themeda* Dominated Grassland , some areas showing past tillage - even back to the 1960's
  - *Themeda- Eragrostis* Clay Rich Soils
  - *Transformed: Asparagus* Dominated
- **Moist -Hydromorphic Grasslands / Wetlands (Table 7-5**)
  - *Setaria-Persicaria* Pan System
  - *Sporobolus - Cynodon* Wetland
  - *Typha* Dominated Wetland

Transformed Habitats

- **Transformed Habitats** including different forms of agriculture, alien bushclumps and infrastructure

The identified communities are listed in **Table 7-2** and mapped in **Figure 7-3.**

Agriculture: Crop Production – Zea mays

Transformed: Excavations

Sporobolus - Cynodon Wetland

Acacia Thornveld

Themeda Grassland

Disturbed Grassland

Figure 7-1 Photographic representation of broad habitats in Ventersburg Study Area

Table 7-2 Floral communities identified in the Study Area

UNIT	Community	% Site Cover	Floral Rating
A	**Semi - Natural Terrestrial Grasslands**		
	Acacia Thornveld	4.06	Moderate
	Eragrostis Disturbed Grassland	1.08	Moderate-Low
	Searsia lancea Bushclump	0.06	Moderate-Low

UNIT	Community	% Site Cover	Floral Rating
	Themeda- Aristida Sandy Red Soils	0.89	Moderate-High
	Themeda Dominated Grassland	16.74	Moderate
	Themeda Dominated Grassland (past farming)	16.67	Moderate
	Themeda- Eragrostis Clay Rich Soils	0.58	Moderate-High
	Transformed: *Asparagus* Dominated	0.59	Moderate-Low
B	**Moist -Hydromorphic Grasslands / Wetlands**		
	Setaria-Persicaria Pan System	0.15	Moderate-High
	Sporobolus- Cynodon Wetland	0.22	Moderate-High
	Typha Dominated Wetland	0.01	Moderate-High
C	**Transformed Habitats**		
	Agriculture - Crops	54.89	Low
	Agriculture - Old Fields	0.63	Low
	Agriculture - Pasture	0.34	Low
	Alien Bushclumps	0.14	Low
	Transformed - Built Up	0.01	Low
	Transformed - Canal	0.58	Low
	Transformed - Excavations	1.37	Moderate-Low
	Transformed - Soil Disturbances	0.99	Low
	Transformed - Soils Stockpiles	0.01	Low

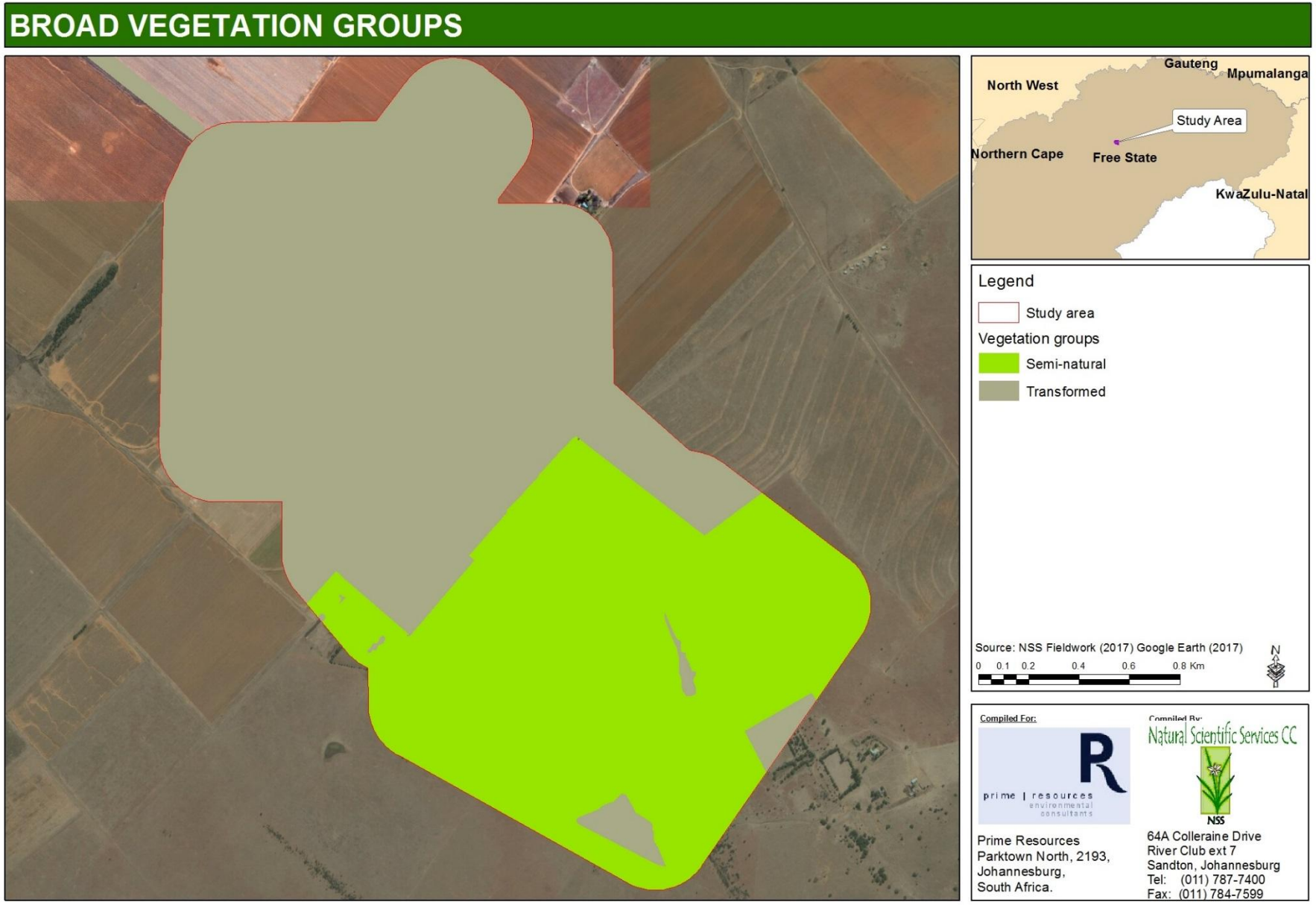


Figure 7-2 Map of the semi-natural and transformed vegetation groups identified in Ventersburg Study Area

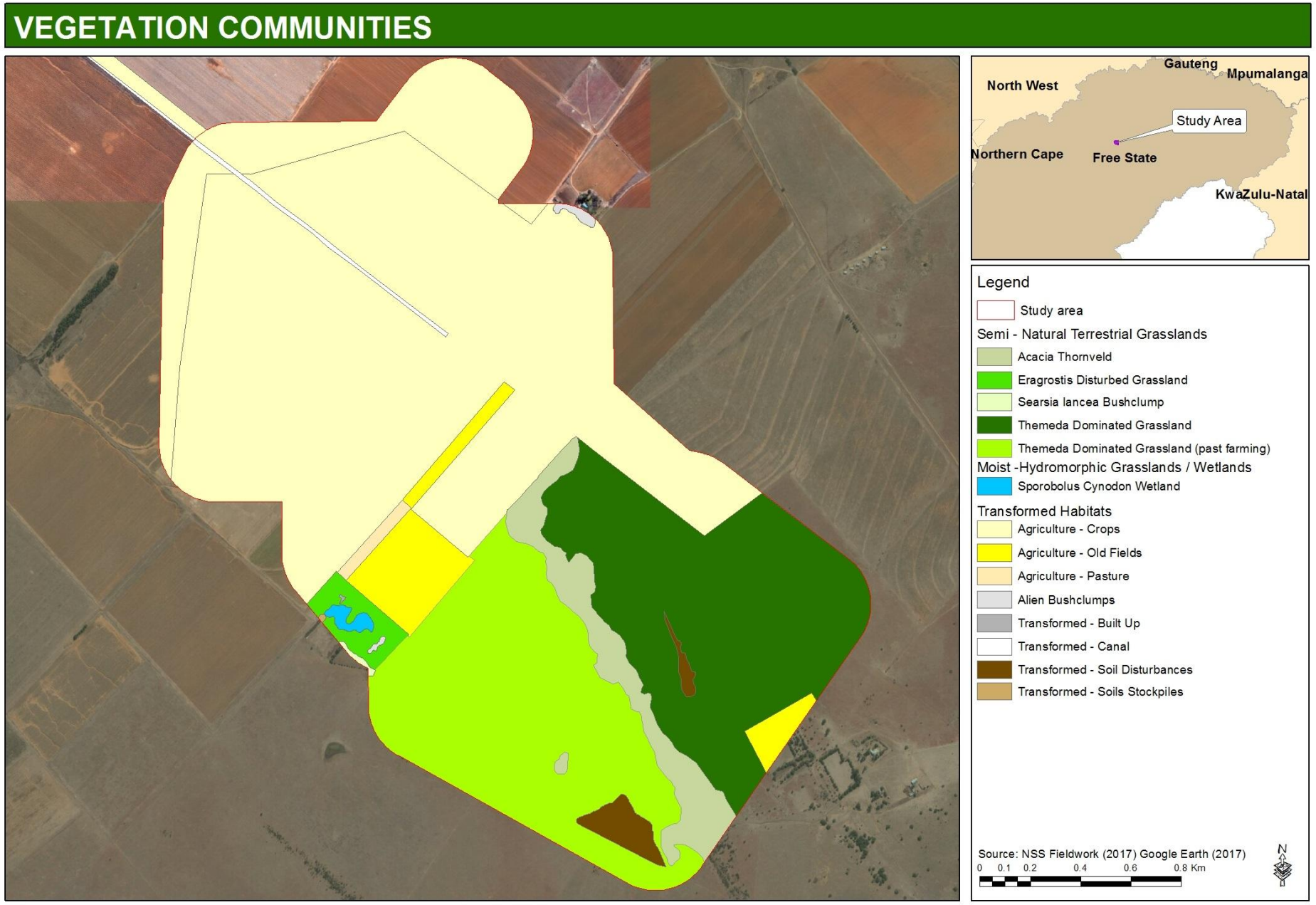


Figure 7-3 Map of the floral communities identified in Ventersburg Study Area – Infrastructure Area

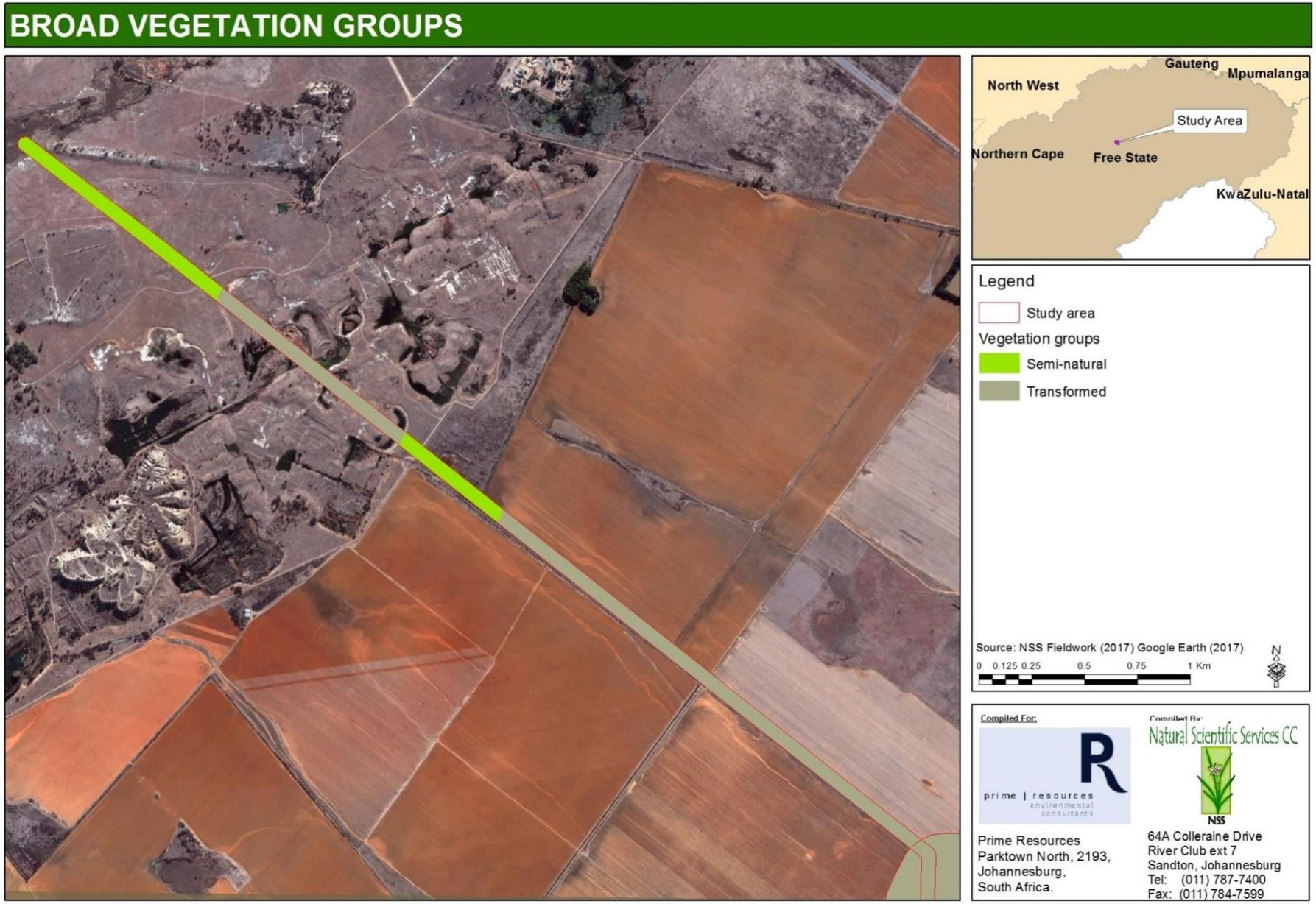


Figure 7-4 **Map of the semi-natural and transformed vegetation groups identified in Ventersburg Study Area – Pipeline Route**

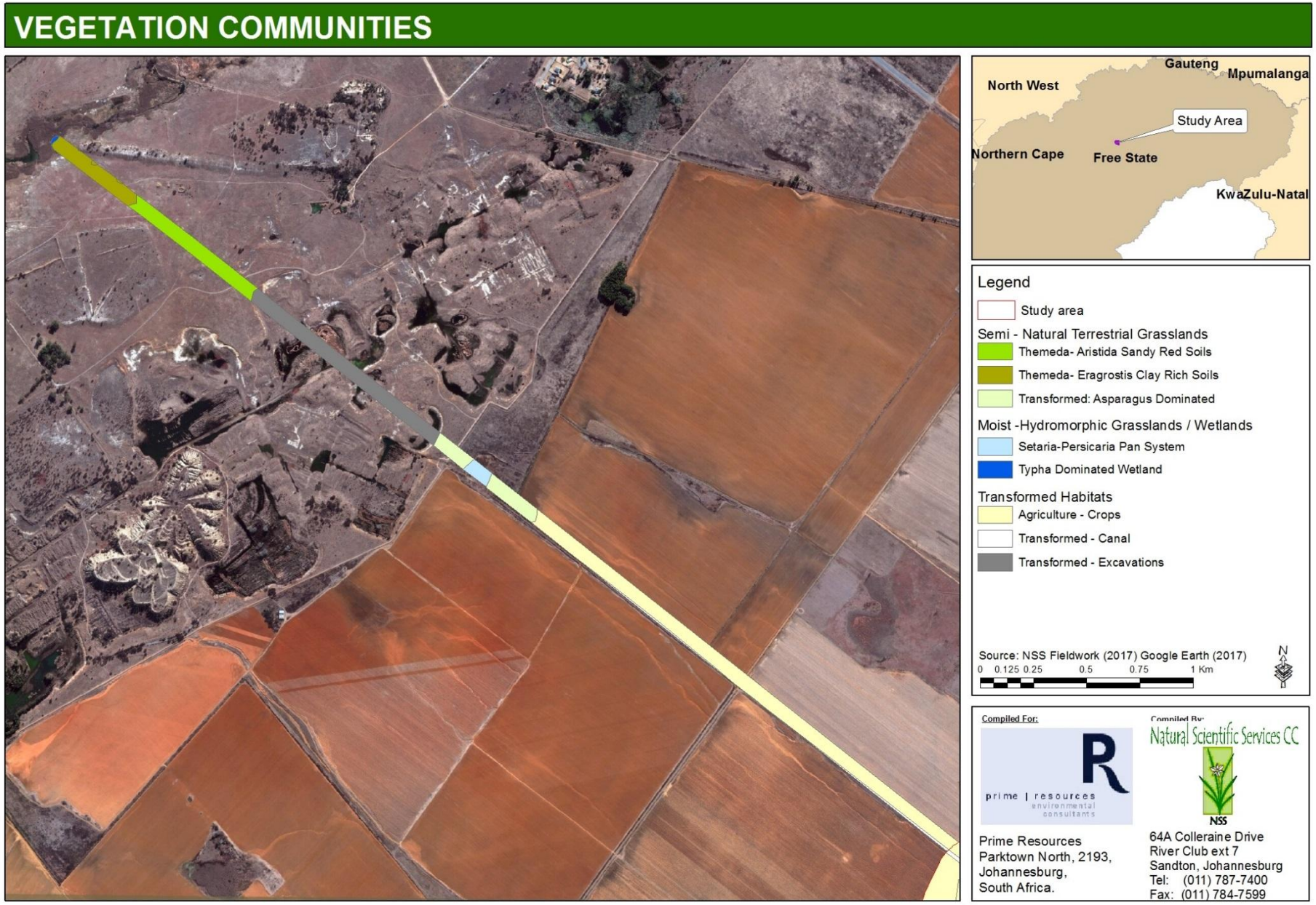


Figure 7-5 Map of the floral communities identified in Ventersburg Study Area – Pipeline Route

The more natural units are described under Bushveld, Grassland and Wetland community structure in **Table 7-3** to **Table 7-5**

Table 7-3 Bushveld Community

Bushveld Community			
Photographic representation	 		
National Zones:	**Vulnerable** Central Free State Grassland; C-Plan (Other habitat); Central Grasslands Priority Area		
Est Herbaceous Height:	30-45cm	**Estimated ground cover:**	30-40% - Some areas with limited cover and more exposed
Units:	*Acacia* Thornveld *Searsia lancea* Bushclump		
Extent of Units	5.14%		
Condition:	The *Acacia* Thornveld is located within the eastern section of the study area along a previously channelled system (refer to the historical imagery below from the 1960's which highlights the channel without the presence of the *Acacia* trees). This has developed over time. According to Mucina & Rutherford (2006), disturbed, overgrazed and trampled low – lying areas with heavy clayey soils are prone to *Acacia karroo* encroachment. This is not seen as a diverse habit and has limited diversity within the under growth.   Although indigenous, the *Searsia lancea* bushclumps were presumably planted in the past. These do, however, provide important habitat for faunal species dependant on trees for nesting and foraging.		
CI Species:	▪ *No CI species detected*		
CI Faunal Species:	▪ Serval (NT)		
Common species:	▪ *Acacia karroo Hayne* ▪ *Aptosimum cf indivisum Burch. ex Benth.* ▪ *Gazania krebsiana Less. subsp. krebsiana* ▪ *Geigeria burkei Harv.*		

Bushveld Community		
	▪ *Aptosimum elongatum Engl.* ▪ *Aristida spp* ▪ *Asparagus laricinus Burch.* ▪ *Brachiaria serrata (Thunb.) Stapf* ▪ *Chloris virgata Sw.* ▪ *Conyza bonariensis (L.) Cronquist** ▪ *Pentzia globosa* ▪ *Ehretia rigida (Thunb.) Druce subsp. rigida* ▪ *Eragrostis x pseud-obtusa* ▪ *Eragrostis superba Peyr.* ▪ *Felicia muricata (Thunb.) Nees subsp. muricata*	▪ *Salvia spp* ▪ *Schkuhria pinnata (Lam.) Kuntze ex Thell.** ▪ *Searsia lancea (L.f.) F.A.Barkley* ▪ *Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. sphacelata* ▪ *Syncolostemon (Hemizygia) spp* ▪ *Tagetes minuta L.** ▪ *Themeda triandra Forssk.* ▪ *Tragus berteronianus Schult.* ▪ *Tribulus terrestris L.* ▪ *Ziziphus mucronata Willd. subsp. mucronata*
Species Examples:		
	Aptosimum elongatum	*Barleria macrostegia*

* Alien Species; VU: Vulnerable; NT: Near Threatened; P: Protected Species;

Table 7-4 Grassland Community

Grassland Community			
Photographic representation			
National Zones:	**Vulnerable** Central Free State Grassland; C-Plan (Other habitat); Central Grasslands Priority Area; A portion within the Threatened Vaal-Vet Grassland		
Est Herbaceous	45cm-80cm	**Estimated ground**	50-60% - Some areas over grazed

Grassland Community			
Height:		**cover:**	
Units:	*Themeda- Aristida* Sandy Red Soils *Themeda* Dominated Grassland (including areas where past farming occurred) *Themeda- Eragrostis* Clay Rich Soils *Eragrostis* Disturbed Grassland		
Extent of Units	35.96%		
Condition:	The *Themeda* dominated grassland to the east typically represents the Central Free State Grassland. It is a short grassland type, which in its natural condition is dominated by *Themeda triandra*. *Eragrostis* species become dominant within degraded areas as can be seen on site within the *Eragrostis* Disturbed Grassland. The *Themeda* grasslands to the east are verging on a homeogenous landscape that is limited in diversity and richness. This unit is dominated by *Themeda triandra* and contains limited forb species. On the ground density of the sward is also sparse. It can be seen from historical imagery (1964's), the southern section, that this unit has undergone transformation in the past – potentially pasture or crop farming  The *Themeda* grasslands towards the Rietspruit show a higher level of diversity but are also showing signs of heavy grazing pressure.		
CI Species:	▪ *Nerine* species (P)		
CI Faunal Species:	▪ Melodious Lark (*Mirafra cheniana*) (**NT**) ▪ Aardvark ▪ Leopard Tortoise (ToPs) ▪ Black-winged Pratincole (**NT**), ▪ Blue Korhaan (**NT**) (Digby Wells, 2013).		
Common species:	▪ *Aptosimum cf indivisum Burch. ex Benth.* ▪ *Aristida bipartita (Nees) Trin. & Rupr.* ▪ *Aristida congesta Roem. & Schult. subsp. barbicollis (Trin. & Rupr.) De*	▪ *Felicia muricata (Thunb.) Nees subsp. muricata* ▪ *Gazania krebsiana Less. subsp. krebsiana* ▪ *Gomphrena celosioides Mart.* ▪ *Heliotropium lineare (A.DC.) Gurke*	

Grassland Community	
	Winter • *Asparagus laricinus Burch.* • *Berkheya onopordifolia var. onopordifolia* • *Blepharis cf. espinosa E.Phillips* • *Brachiaria serrata (Thunb.) Stapf* • *Bulbine narcissifolia Salm-Dyck* • *Chloris virgata Sw.* • *Chlorophytum fasciculatum (Baker) Kativu* • *Chrysocoma ciliata L.* • *Crabbea acaulis N.E.Br.* • *Cucumis zeyheri Sond.* • *Cymbopogon nardus (validus) (L.) Rendle* • *Cymbopogon sp.* • *Cynodon dactylon (L.) Pers.* • *Cyperus rupestris Kunth var. rupestris* • *Digitaria eriantha Steud.* • *Eragrostis chloromelas Steud.* • *Eragrostis gummiflua Nees* • *Eragrostis lehmanniana Nees var. lehmanniana* • *Eragrostis superba Peyr.* • *Eriospermum spp (only leaves present)* • *Hermannia depressa N.E.Br.* • *Hermannia erodioides (Burch. ex DC.) Kuntze* • *Hermannia floribunda Harv.* • *Heteropogon contortus (L.) Roem. & Schult.* • *Hibiscus trionum L.** • *Hilliardiella oligocephala* • *Hypericum cf. aethiopicum Thunb.* • *Hypoxis acuminata Baker* • *Ledebouria spp* • *Lippia javanica (Burm.f.) Spreng.* • *Lotononis spp* • *Monsonia angustifolia E.Mey. ex A.Rich.* • *Oxalis obliquifolia Steud. ex A.Rich.* • *Oxalis sp.* • *Pentzia cf globosa* • *Riccia spp* • *Scabiosa columbaria L.* • *Selago corymbosa L.* • *Sesamum rigidum Peyr. subsp. rigidum* • *Solanum panduriforme Droge ex Dunal* • *Themeda triandra Forssk.* • *Trachyandra asperata Kunth var. asperata* • *Trichoneura grandiglumis (Nees) Ekman*
Species Examples:	 *Pentzia globosa*  *Crabbea acaulis*

* Alien Species; VU: Vulnerable; NT: Near Threatened; P: Protected Species;

Table 7-5 Wetland Community

Wetland Community			
Photographic representation	 		
National Zones:	**Vulnerable** Central Free State Grassland; C-Plan (Other habitat); Central Grasslands Priority Area; A portion within the Threatened Vaal-Vet Grassland		
Est Herbaceous Height:	60-80cm (variable between the different wetlands)	**Estimated ground cover:**	60-70% (excluding open water)
Units:	*Setaria-Persicaria* Pan System *Sporobolus - Cynodon* Wetland *Typha* Dominated Wetland		
Extent of Units	0.38%		
Condition:	The *Setaria-Persicaria* Pan System and *Sporobolus - Cynodon* Wetlands are small wetlands found along the pipeline route and within the study area bordering on the infrastructural footprint. These two units can be seen on aerial imagery as far back as 1964. Limited species are present, however, those that are, are moisture dependant species. Within these systems alien species include *Verbenas, Cirsium* and *Xanthium*. These are all Category 1b^ species. Weedy species include *Persicaria,* and *Paspalum.* Additional wet areas include patches within the old lime quarry workings where water has collected over time. Within these areas species such as *Juncus*, *Imperata* and *Typha* dominate. Further details on these systems are provided in **Section 6.3**.		
CI Species:	▪ No CI species detected		
CI Faunal Species:	▪ Yellow-billed Stork (**EN**) ▪ Black-winged Pratincole (**NT**) ▪ African Grass-owl (**VU**) (Recorded by Digby Wells, 2013)		
Common species:	▪ *Andropogon eucomus Nees* ▪ *Aristida junciformis Trin. & Rupr. subsp. junciformis* ▪ *Asparagus laricinus Burch.* ▪ *Berkheya onopordifolia (DC.) O.Hoffm. ex Burtt Davy var. onopordifolia* ▪ *Berkheya sp.* ▪ *Brachiaria eruciformis* ▪ *Chloris virgata Sw.* ▪ *Cirsium vulgare (Savi) Ten.*[Cat 1] ▪ *Conyza bonariensis (L.) Cronquist**	▪ *Hibiscus trionum L.** ▪ *Imperata cylindrica (L.) Raeusch.* ▪ *Juncus cf rigidus* ▪ *Kyllinga erecta Schumach. var. erecta* ▪ *Marsilea spp* ▪ *Monsonia angustifolia E.Mey. ex A.Rich.* ▪ *Oenothera rosea L'Hor. ex Aiton** ▪ *Persicaria spp* ▪ *Pyracantha coccinea M.Roem. (in excavated wetlands)*[Cat 1] ▪ *Scirpus spp*	

Wetland Community		
	• *Cynodon dactylon (L.) Pers.* • *Cyperus esculensis* • *Eleocharis dregeana Steud.* • *Eragrostis gummiflua Nees* • *Eragrostis plana Nees* • *Eragrostis sp.* • *Eragrostis superba Peyr.*	• *Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss* • *Sporobolus spp* • *Stipagrostis uniplumis (Licht.) De Winter* • *Typha capensis (Rohrb.) N.E.Br.* • *Urochloa mosambicensis (Hack.) Dandy* • *Verbena bonariensis L.* Cat 1 • *Xanthium spinosum L.* Cat 1
Species Examples:		
	Juncus cf rigidus	*Andropogon eucomis*

* Alien Species; VU: Vulnerable; NT: Near Threatened; P: Protected Species;
^ Refer to Section 7.1.4.

7.1.3. Conservation Important Species

National Protected Species

It is well documented that heterogeneous landscapes, diverse geology and a range of environmental conditions, provide a diverse number of habitats for plant species (Pickett, *et.al*. 1997; O'Farrell, 2006; KNNCS, 1999). These areas are normally associated with high levels of species endemism and richness. For example, at least 74% of the 23 threatened Highveld plant taxa occur on the crests and slopes of ridges and hills (Pfab & Victor 2002). However, homogenous landscapes, either natural or that have been transformed through historical farming practices and infrastructural development contain minimal diversity and endemism. The current site has been affected historically by agricultural and mining practices with the majority of the area being under croplands and therefore are considered transformed and within a recovery phase.

Within this section the CI species are discussed. These include the National Threatened Plant Species Programme (TSP) lists, the Protected species according to the Free State Nature Conservation Ordinance (Act 8 of 1969) to be repealed by the Free State Nature Conservation Bill (published under Notice No. 10, Provincial Gazette 23, dated 7 May 2010) and any specific Endemic or Rare species.

The Threatened Plant Species Programme (TSP) is an ongoing assessment that revises all threatened plant species assessments made by Craig Hilton-Taylor (1996), using IUCN Red Listing Criteria modified from Davis *et al.* (1986). According to the TSP Red Data list of South African plant taxa (POSA, May 2015; June 2016), there are 67 Red Data listed species (**Table 7-6**) within Free State Province (including Data Deficient species) of which 3 species are Endangered (EN), 7 are Vulnerable (VU) and 11 are Near Threatened (NT). In addition to this a number of species are considered Data Deficient (23 species).

Table 7-6 Numbers of CI plant species per Red Data category within South Africa and Free State (accessed March 2017)

THREAT STATUS	SOUTH AFRICA	FREE STATE	QDS AROUND SITE
EX (Extinct)	28	0	0
EW (Extinct in the wild)	7	0	0
CR PE (Critically Endangered, Possibly Extinct)	57	0	0
CR (Critically Endangered)	332	0	0
EN (Endangered)	716	3	0
VU (Vulnerable)	1 217	7	0
NT (Near Threatened)	402	11	0
Critically Rare (known to occur only at a single site)	153	1	0
Rare (Limited population but not exposed to any direct or potential threat)	1 212	13	0
Declining (not threatened but processes are causing a continuing decline in the population)	47	9	0
LC (Least Concern)	13 856	2266	43
DDD (Data Deficient - Insufficient Information)	348	8	0
DDT (Data Deficient - Taxonomically Problematic)	904	15	0
Total spp (including those not evaluated)	**23 399**	**2333**	**48**

**Date accessed – March 2017

As no CI species have been recorded in the relevant QDGs, NSS extracted the CR, EN, VU, NT species that have been recorded within the Free State (**Table 7-7**). Of these species, habitat preferences were assigned and a likelihood of occurrence determined. From this, 10 species could possibly occur on site or, if not on site within the surrounding areas. Three of these are Endangered, two Vulnerable and 4 Near-Threatened. It must be noted that the site visit was conducted during the flowering time of most of these species, and so detection would have been easier than outside of the flowering season. Therefore as none of these species were found during the survey, the possibility of them occurring in the Study Area is lessened (although still not discounted).

Habitat Availability	Species
Highly Possible	2
Possible	8
Unlikely	9

No habitat	2

Provincially Protected Species

From the field investigations, only one Protected species under Provincial legislation (Nature Conservation Ordinance 8 of 1969[2]) was found within the Study Area (but outside of the infrastructural footprint). This was a *Nerine species (possibly Nerine cf huttoniae but currently awaiting species confirmation).* All Protected species under the Nature Conservation Ordinance of 1969 require a permit application to the authorities for removal or translocation.

Nerine (P)

Figure 7-6 Photographic evidence of CI plant species on Site

Buffer Zones for CI Flora

No specific Red Data Plant Policy is available for Free State Province, however, GDARD's Policy (2001) followed a systematic and researched approach to buffer zones for rare and threatened species. This approach has been used successfully and is supported by the Threatened Plant Programme (D Raimondo *pers comm*.). Within both surveys only the lower order Provincially Protected species were detected. These species do not require a buffer. However, any CI species would require a permit application to the relevant provincial authority to remove or relocate.

Ferns

All indigenous species of true ferns excluding *Pteridium aquilinum* (bracken) and are considered to have conservation significance and are therefore highlighted in this section.

[2] NB. The administration of the whole of this Ordinance has under Proclamation 113 of 1994, published in Government Gazette 15813 of 17 June 1994, been assigned to Free State Province with effect from 17 June 1994.

The main fern species found within the Study Area (including the infrastructural area) was a *Riccia* species (**Figure 7-7**):

Riccia spp.

Figure 7-7 Photographic evidence of CI[3] fern plant species within the Study Area

Fungi

Fungi (Mushrooms) along with bacteria, are the major decomposers in most terrestrial ecosystems, and therefore play a critical role in biogeochemical cycles and an essential role in nutrient cycling, especially as saprotrophs and symbionts. Mycorrhizal symbiosis between plants and fungi is one of the most well-known plant–fungus associations (approximately 90% of all plants) and is of significant importance for plant growth and persistence in many ecosystems. In addition to this, Mycorrhiza-forming fungi are considered as bio-indicators of air pollution (Fellner, 2003). Species such as *Russula* are designated as bio-indicator in climax forests.

According to Gryzenhout, Jefwa & Yorou (2012), in Africa that is endowed with high biodiversity and unique but vulnerable ecosystems, mycology is an endangered discipline. Fungal components of any ecosystem are seldom characterised and almost never included in biodiversity data. Proper fungal inventories and databases are largely non-existent, while those that exist contain only scanty and basic information. Due to the lack of human capacities, national monographs of biodiversity in many African countries rarely encompass fungi. This not only leads to an unfortunate bias in the complete assessment of biodiversity, but also pertains to the unawareness of public and decision makers of fungi as important organisms. Needless to say fungal biodiversity does not feature in biological checklists and red data listings of countries.

[3] Although of conservation importance,under the Free State Ordinance, ferns and fungi are not recognised as Protected and therefore do not require a permit.

There were numerous fungi species recorded within the field investigations. Examples of these are presented in **Figure 7-8**. In terms of cultural and medicinal use, *Termitomyces microcarpus* is known in Nigeria to treat gonorrhoea and in Tanzania, it is a health promoter and inducer of breast lactation. *Scleroderma flavidum* is used in wound healing.

Coltricia sp.(Inedible)

Crinipellis scabella(Inedible)
Hairy Parachute

Scleroderma flavidum(Inedible)
Puffball

Termitomyces microcarpus(Edible)
Termite Mushrooms

Figure 7-8 Photographic evidence of CI Fungi plant species in the Study Area

Table 7-7 Conservation Important plant (EN, VU & NT) plant species listed within POSA for the Free State Province

Family	Species	Threat status/POSA	Flowering Times	Habitat-HSA	Habitat
APIACEAE	*Alepidea longeciliata Schinz ex Dummer*	EN	Not Known	Possible	Grassland, Karoo Sandstone, above 1600 m. Possibly associated with edges of pans.
MESEMBRYANTHEMACEAE	*Delosperma macellum (N.E.Br.) N.E.Br.*	EN	August-March	Possible	In loose gravel in open places near trees.
ASPHODELACEAE	*Aloe kniphofioides Baker*	VU	November	Unlikely	Montane grassland.
HYACINTHACEAE	*Bowiea volubilis Harv. ex Hook.f. subsp. volubilis*	VU	January - March	Possible	Usually found along mountain ranges, in thickly vegetated river valleys, under bush clumps and in boulder screes
HYACINTHACEAE	*Ledebouria mokobulanensis Hankey & T.J.Edwards*	VU	September-November	Unlikely	Montane grassland above 2000 m.
HYPOXIDACEAE	*Hypoxis uniflorata Markötter*	VU	Not Known	Possible	Moist grassland.
PROTEACEAE	*Protea subvestita N.E.Br.*	VU	December - June, mainly January - March	Unlikely	Montane, highland sourveld and fynbos, 1200-2300m
ROSACEAE	*Prunus africana (Hook.f.) Kalkman*	VU	October - May	No habitat	Confined to evergreen forests from near the coast to the mist belt and montane forests in KZN, Eastern Cape, Swaziland, Mpumalanga, Zimbabwe.
ZAMIACEAE	*Encephalartos ghellinckii Lem.*	VU	N/A	No habitat	Rocky outcrops in montane grasslands, sandstone cliffs and associated with montane fynbos in the Drakensberg.
ANACARDIACEAE	*Searsia dracomontana (Moffett) Moffett*	NT	October-January	Unlikely	Dolerite grasslands at the edge of scrub forest, 1700-2100 m.
APOCYNACEAE	*Hoodia officinalis (N.E.Br.) Plowes subsp. officinalis*	NT	Early summer / late autumn	Unlikely	Inside bushes in flat or gently sloping areas.
APOCYNACEAE	*Riocreuxia aberrans R.A.Dyer*	NT	November -	Unlikely	Wedged in cracks among rocks on exposed

Family	Species	Threat status/POSA	Flowering Times	Habitat-HSA	Habitat
			January		quartzite ridges.
APOCYNACEAE	*Stenostelma umbelluliferum (Schltr.) S.P.Bester & Nicholas*	NT	September to March	Possible	Deep black turf, mainly near drainage lines on vertic soils with high clay content in grassland or savanna, at altitudes between 1 050 and 1 280 m
ASPHODELACEAE	*Kniphofia ensifolia Baker subsp. autumnalis Codd*	EN	October	Possible	Grasslands along streams
ASPHODELACEAE	*Kniphofia typhoides Codd*	NT	February - March	Highly Possible (pipeline route)	Low lying wetlands and seasonally wet areas in climax *Themeda triandra* grasslands on heavy black clay soils, tends to disappear from degraded grasslands.
FABACEAE	*Argyrolobium campicola Harms*	NT	November - February	Possible	Highveld grassland
HYACINTHACEAE	*Eucomis bicolor Baker*	NT	Late Summer - Autumn	Unlikely	Well-drained, grassy mountain slopes, sometimes in forests, along watercourses and on rocky cliffs, generally at higher altitudes up to 2800 m.
HYACINTHACEAE	*Merwilla plumbea (Lindl.) Speta*	NT	October	Unlikely	Found growing in a variety of habitats from sunny slopes, rocky hills, cliffs and ledges, to damp cliff faces, near waterfalls, in moist depressions, on the edges of streams and vleis (wetlands) to coastal areas, in groups or as solitary specimens.
IRIDACEAE	*Gladiolus robertsoniae F.Bolus*	NT	November - December	Unlikely	Moist highveld grasslands, found in wet, rocky sites, mostly dolerite outcrops, wedged in rock crevices.
MESEMBRYANTHEMACEAE	*Lithops lesliei (N.E.Br.) N.E.Br. subsp. lesliei*	NT	March - June	Possible (to the east)	Primary habitat appears to be the arid grasslands in the interior of South Africa where it usually occurs in rocky places, growing under the protection of surrounding forbs and grasses.

Family	Species	Threat status/POSA	Flowering Times	Habitat-HSA	Habitat
RANUNCULACEAE	*Anemone fanninii Harv. ex Mast.*	NT	Dependent on veld burning in preceding winter.	Possible	Found in moist depressions and near streams, but it has also been seen on dry hillsides and even in disturbed areas.

Highlighted in green – high / possible within the study area; FS-FreeState; LC = Least Concern; VU = Vulnerable; NT = Near Threatened; EN = Endangered; DDT: Data Deficient

7.1.4. Alien Invasive Species

Alien, especially invasive plant species are a major threat to the ecological functioning of natural systems and to the productive use of land. Their potential impacts include:

- A loss of biodiversity and ecosystem resilience as alien species out-compete indigenous flora, and in doing, so reduce complex ecosystems to mono-cultures therefore destroying habitats for both plant and animals.
- Through increased evaporative transpiration rates, 'alien thickets' reduce the amount of groundwater thus reducing the volume of water entering our river systems.
- Alien invasive species dry out wetlands and riparian areas thereby increasing the potential for erosion in these areas.
- Loss of potentially productive land and loss of grazing potential and livestock production.
- Poisoning of humans and livestock.
- An increase in the cost of fire protection and damage due to wildfires, due to alien invasive stands being denser than natural vegetation and the wood more resinous, creating hotter fires.
- An increased level of erosion following fires in heavily invaded areas, as well as the siltation of dams.

Two main pieces of national legislation are applicable to alien, invasive plants, namely the:

- Conservation of Agriculture Resources Act (CARA; Act 43 of 1983); and
- National Environmental Management: Biodiversity Act (NEMBA; Act 10 of 2004):
    - NEMBA Regulations August 2014 -Government Gazette Vol. 590, No. 37885.

In terms of the amendments to the regulations under CARA, landowners are legally responsible for the control of alien species on their properties. Declared weeds and invasive species had been divided into three categories in accordance with the Act. These categories are as follows:

Category 1: Declared weeds that are prohibited on any land or water surface in South Africa. These species must be controlled, or eradicated where possible.

Category 2: Declared invader species that are only allowed in demarcated areas under controlled conditions and prohibited within 30m of the 1:50 year flood line of any watercourse or wetland.

Category 3: Declared invader species that may remain, but must be prevented from spreading. No further planting of these species are allowed.

The protection of our natural systems from invasive species is further strengthened within Sections 70-77 of NEMBA. Chapter 5 of this Act specifically deals with species and organisms posing potential threats to biodiversity.

To summarise, the purpose of Chapter 5 is to:

- Prevent the unauthorised introduction and spread of alien species and invasive species to ecosystems and habitats where they do not naturally occur.

- Manage and control alien species and invasive species to prevent or minimise harm to the environment and to biodiversity in particular.
- Eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats.

Furthermore Section 73 (2) states that a person who is the owner of land on which a listed invasive species occurs must:

- Notify any relevant competent authority, in writing, of the listed invasive species occurring on that land.
- Take steps to control and eradicate the listed invasive species and to prevent it from spreading.
- Take all the required steps to prevent or minimise negative impacts to biodiversity.

The regulations for this Act were issued for public comment on 3 April 2009 (Government Gazette Vol. 526, No. 32090) and promulgated in August 2014 (Government Gazette Vol. 590, No. 37885). The regulations list the categories for alien and listed invasive species. These are:

- Exempted species.
- **Category 1a** Listed Invasive Species -Species requiring compulsory control.
- **Category 1b** Listed Invasive Species - Invasive species controlled by an invasive species management programme.
- **Category 2** Listed Invasive Species- Invasive species controlled by area (2).
- **Category 3** Listed Invasive Species - Invasive species controlled by activity (3).

A species may be listed in different categories for different parts of the country.

Alien species are present on site but mainly within disturbed areas where soils have been exposed or where anthropogenic activities occur (old field, edge of current fields, around the farm houses and within the old lime mine quarry/excavations). Over 18 species were recorded with 4 species listed as Category 1b invasives. Species recorded are listed in **Table 7-8**, and examples of observed specimens are shown in **Figure 7-9**. The Category 1 species *Cirsium vulgare* (Scottish Thistle) was located within the moist environments along the wetlands and moist grasslands. The Category 1 *Tamarix chinensis* (Salt Cedar) was located within the old excavations of the Lime Quarry and *Xanthium spinosum* (Spiny Cocklebur) (Category 1) was recorded along the edges of disturbed areas such as the crop fields and wet areas.

Schinus molle

Xanthium spinosum

Tamarix chinensis

Pyracantha cf. coccinea

Figure 7-9 Examples of observed alien invasives in Ventersburg Study Area

Table 7-8 Alien and Invasive species within the Ventersburg Study Area

FAMILY	SPECIES	Common Names	GROWTH FORM	CARA	NEMBA
SOLANACEAE	*Cestrum aurantiacum Lindl.*	Yellow Cestrum	Shrub, tree	Weed	
ASTERACEAE	*Cirsium vulgare (Savi) Ten.*	Scotch Thistle	Herb	1	1b
ASTERACEAE	*Conyza bonariensis (L.) Cronquist*	Flaxleaf Fleebane	Herb	Weed	
AMARANTHACEAE	*Gomphrena celosioides Mart.*	Batchelor's Button	Herb	Weed	
MALVACEAE	*Hibiscus trionum L.*	Bladder Hibiscus	Herb	Weed	
ASTERACEAE	*Hypochaeris microcephala (Sch.Bip.) Cabrera*	Smallhead Cat's Ear	Herb	Weed	
ONAGRACEAE	*Oenothera rosea L'Hor. ex Aiton*	Pink Evening Primrose	Herb	Weed	
SOLANACEAE	*Physalis peruviana L.*	Cape Gooseberry	Shrub	Weed	
PORTULACACEAE	*Portulaca oleracea L.*	Common Purslane	Succulent	Weed	
ROSACEAE	*Pyracantha cf coccinea M.Roem.*	Red Firethorn	Shrub	Weed	1b
SALICACEAE	*Salix babylonica L. var. babylonica*	Weeping Willow	Tree	Weed	
ANACARDIACEAE	*Schinus molle L.*	California Pepper Tree	Tree	Weed	

FAMILY	SPECIES	Common Names	GROWTH FORM	CARA	NEMBA
ASTERACEAE	*Schkuhria pinnata (Lam.) Kuntze ex Thell.*	Dwarf Marigold	Herb	Weed	
ASTERACEAE	*Tagetes minuta L.*	Khaki Weed	Herb	Weed	
TAMARICACEAE	*Tamarix chinensis Lour.*	Chinese Tamarisk	Tree	1	1b
VERBENACEAE	*Verbena bonariensis L.*	Tall Verbena	Herb	Weed	1b
ASTERACEAE	*Xanthium spinosum L.*	Spiny Cocklebur	Herb	1	1b
POACEAE	*Zea mays*	Maize	Graminoid		

* WC-WesternCape

7.2. Fauna

Due to the location of the proposed Gold One Africa Ventersburg Project in the central Free State on land where there is a high degree of habitat transformation and a lack of rocky outcrops, a low diversity of fauna is expected to occur. Within the study area natural ecosystems have been extensively transformed by crop cultivation since before the 1960's (as evidenced by historical aerial photographs; **Figure 5-3**). Today only a small (141ha, partially transformed) patch of flat, relatively homogenous Central Free State Grassland (GH-6) remains in the south-eastern corner of the study area. The proposed (5.7km) route for the treated water pipeline traverses a large portion of cropland before entering a private game farm (on land previously disturbed by lime mining activities), terminating at a large dam along the Rietspruit. Four broad habitat types as applicable to fauna were identified namely Thornveld, Disturbed Thornveld, Wetlands/Dams and Croplands.

Lists of potentially occurring fauna for the study area are provided in **Appendices 2-9**. Presented in **Table 7-9**for each faunal group is a comparison of the species richness observed in the study area, with that expected for the region. In total, the faunal survey yielded 25 mammal, 88 bird, two reptile, five frog, seven butterfly and three odonata species in the study area. Although suitable habitat is present, no scorpions or megalomorph spiders were detected (**Table 7-9**).

Depicted in **Figure 7-10**are the locations of CI species that were detected in the study area during our surveys. The various habitats within the study area were ranked in terms of their relative importance in representing the region's conservation important species (CIS) of fauna. This was done using a CIS Index (CISI) and is represented in **Table 7-10**. The CISI incorporates both the likelihood of occurrence and conservation status of each potentially occurring non-game species, to rank a habitat's potential to support the region's CIS. A rating of Moderate importance was assigned to Thornveld (for CI rodents, large terrestrial birds, raptors and bullfrogs) and Wetlands/Dams (for CI waterfowl, rodents and bullfrogs). Moderate–Low and Very Low importance ratings were, respectively, ascribed to Disturbed Thornveld (for a similar CI species assemblage in suboptimal thornveld) and Croplands (for CI coursers and small carnivores). Evidently, despite being largely transformed, the study area maintains at least some capacity to support CI species of fauna.

Table 7-9 Summary of faunal species richness within the study area as compared to a regional scale

FAUNAL GROUP	SPECIES RICHNESS			
	POTENTIAL			OBSERVED[4]
	REGION[1]	ATLAS[2]	SITE[3]	
Mammals	82	29	63	25
Birds	268	163	246	88
Reptiles	43	1	39	2
Frogs	14	6	11	5
Butterflies	62	2	58	7
Dragonflies & Damselflies	18	-	16	3
Scorpions	2	-	2	0
Baboon Spiders	2	-	1	0
KEY				
[1]Considered to potentially occur within the QDS 2827AA based on distribution data				
[2]Recorded during atlas projects within the QDSs 2827AA (ADU, 2015)				
[3]Considered likely to occur on site based on distribution and habitat availability (LO of 2 or 3)				
[4]Observed on site by NSS				

Table 7-10 Conservation Important Species Sensitivity Index (CISI) habitat comparison

GROUP		CISI			
		THORNVELD	DISTURBED THORNVELD	WETLANDS/DAMS	CROPLAND
Mammals		0.46	0.39	0.51	0.22
Birds		0.43	0.27	0.46	0.11
Reptiles		0.30	0.11	0.19	0.04
Frogs		0.67	0.33	1.00	0.00
Butterflies		-	-	-	-
Scorpions		-	-	-	-
Baboon spiders		0.33	0.33	0.17	0.00
Odonata		-	-	-	-
CISSI	Score	**0.44**	**0.29**	**0.47**	**0.07**
	Rating	**Moderate**	**Mod-Low**	**Moderate**	**Very Low**
CISI = Conservation Important Species Index (a measure of the site's importance in representing the region's conservation important species diversity)					
Note: Numbers exclude species restricted to managed populations i.e. game, butterflies as there are no regionally occurring CI butterfly species and arachnids due to a lack of conclusive sampling during the first brief site visit					

7.2.1. Mammals

Of the approximately 82 regionally-occurring mammal species, some 63 species (with a LO of 1, 2 or 3 in **Appendix 2**) are considered likely to occur within the study area based on their location and habitat diversity. MammalMap (2017) has records for 29 species from the QDS covering the study area, and during our surveys a total of 25 mammal species was recorded in the study area

(**Figure 7-12**; **Figure 7-13**). All regionally-occurring rupicolous (rock-dwelling) fauna i.e. Rock Elephant-shrew, Rock Hyrax, **EN** Mountain Reedbuck and Klipspringer are precluded by a lack of rocky habitat on site. Of some 30 CI animal species which occurred historically in the region, only 18 are currently likely to occur naturally outside of reserves. Of these, all but the **EN** Mountain Reedbuck have the potential to occur within the study area (**Table 7-10**).

The presence of Aardvark (**PS**) was confirmed by means of burrows, spoor and photographic evidence. The species appears restricted to sandier substrates in the study area. Although both the Cape and Scrub Hare may occur in the study area, only the former was detected throughout (and particularly within the Croplands) on site.

A range of insectivore (mainly shrew) species may occur, of which only the Southern African Hedgehog (**NT**) is of conservation importance. If present, hedgehogs are likely to be restricted to the remaining patch of natural Thornveld in the south-eastern corner of the study area. This is a widespread but generally uncommon species that prefers thick, dry vegetation (Skinner & Chimimba 2005).

Various rodent species may occur, three of which are of conservation importance. These include the **NT** Southern African Vlei Rat (which inhabits wetland habitat), the **DD** Free State Pygmy Mouse, and the **EN** African White-tailed Rat (which burrows in relatively short, moist undulating grassland). Target rodent-trapping conducted at two locations within the study area repeatedly revealed the presence of two species namely Xeric Four-striped Grass Rat and Southern African Mastomys. Ground Squirrels were observed in abundance in most untilled areas.

Based on distribution, no primate species are likely to occur on site. Yellow Mongoose, Slender Mongoose, Black-backed Jackal and **NT** Serval were detected, and several additional mammalian Carnivore species may occur. Of these, the most significant of which include the **PS** Bat-eared Fox (open sandy areas), **PS** Cape Fox (throughout), **NT** African Clawless and **VU** Spotted-necked otters (large dam along Rietspruit), **NT** African Striped Weasel (throughout), **NT** Brown Hyena and **PG** Aardwolf (throughout but concentrated in game reserve) and **VU** Black-footed Cat (potentially within rank [4] *Themeda* grasslands of the Thornveld habitat).

The study area is likely to be utilised by a modest diversity of bat species, none of which are of conservation importance. Mist-netting and analysis of bat acoustic data on site revealed the presence of three widespread and generally common species namely African Pipistrelle (trapped in mist net), Cape Serotine and Yellow-bellied House Bat (example of sonograms in **Figure 7-11**).

Naturally occurring ungulates observed on site included Bush Duiker and Steenbok. The property in which the proposed clean water pipeline terminates has been stocked with game. Those observed included Plains Zebra, Giraffe, Common Eland, Black Wildebeest, Red

[4] denote tall or otherwise dense vgetation.

Hartebeest, Blesbok, Sable Antelope (**VU**), Gemsbok, Waterbuck, Lechwe, Springbok and Impala.

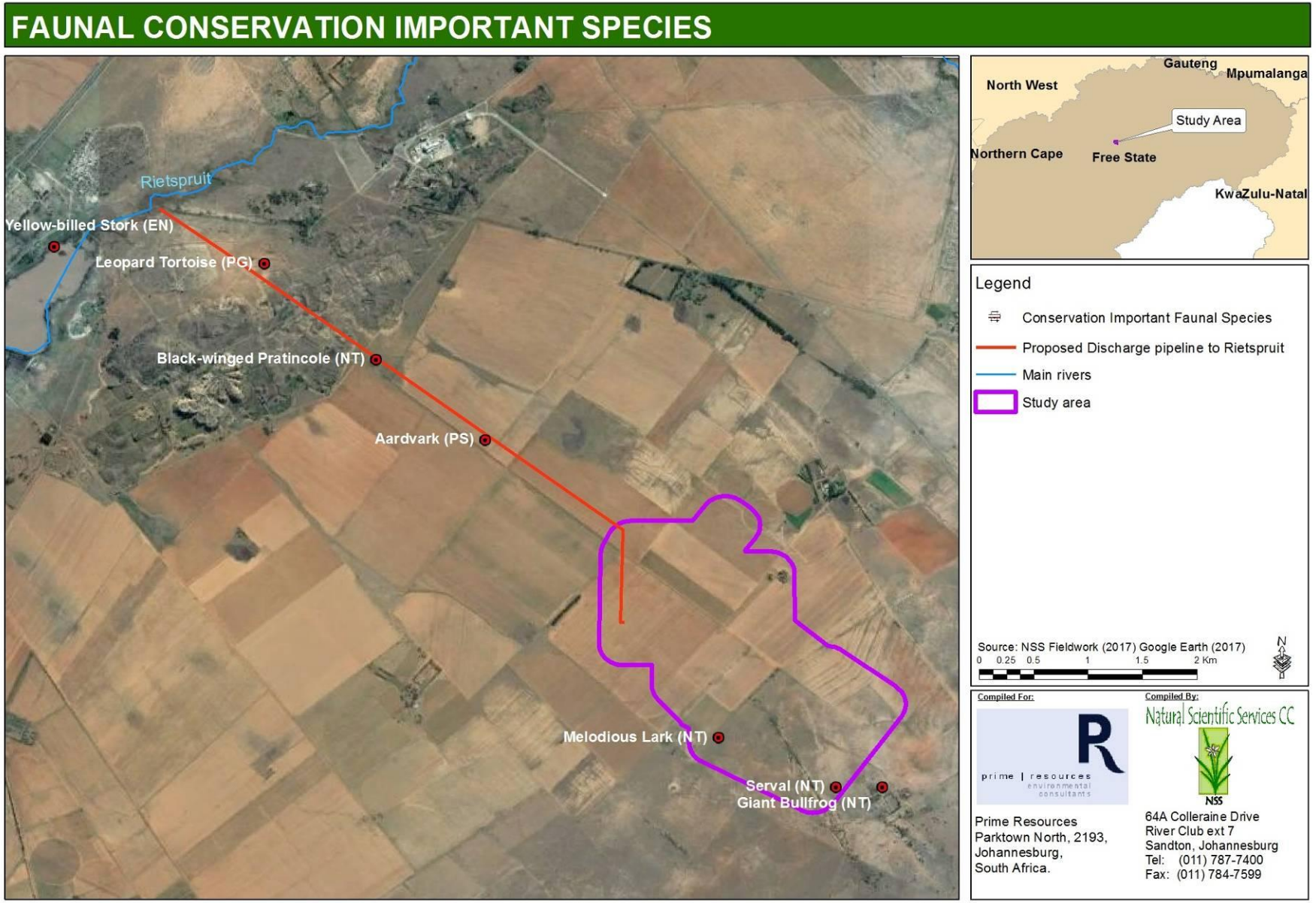
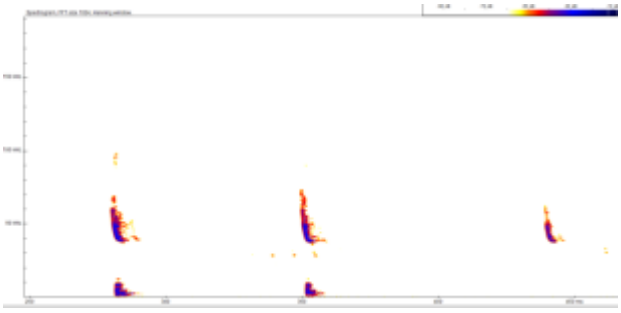
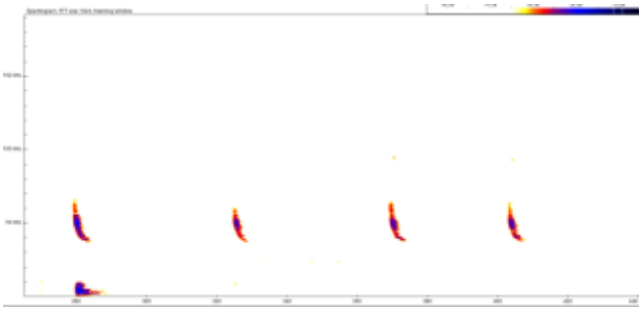


Figure 7-10 Localities of Conservation Important Fauna



Cape Serotine
(*Neoromicia capensis*)

Yellow-bellied House Bat
(*Scotophilus dinganii*)



African Pipistrelle
(*Pipistrellus hesperidus*)

Figure 7-11 Echolocation sonograms for three of the bat species recorded on site

Yellow Mongoose
(*Cynictis penicillata*)

Ground Squirrel
(*Xerus inauris*)

African Pipistrelle
(*Pipistrellus hesperidus*)

Aardvark
(*Orycteropus afer*)

Cape Hare
(*Lepus capensis*)

Southern African Mastomys
(*Mastomys coucha*)

Figure 7-12 Examples of some of the naturally occurring mammal species detected in the study area

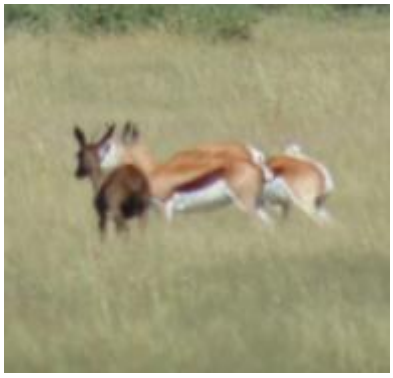
Red Hartebeest (*Alcelaphus caama*)

Springbok (*Antidorcas marsupialis*) and Black Wildebeest (*Connochaetes gnou*)

Lechwe (*Kobus leche*)

Waterbuck (*Kobus ellipsiprymnus*)

Impala (*Aepyceros melampus*)



Springbuck (*Antidorcas marsupialis*) with Black (melanistic) individual

Black Wildebeest (*Connochaetes gnou*)

Plains / Burchell's Zebra (*Equus quagga*)

Giraffe (*Giraffa camelopardalis*)

Figure 7-13 Examples of some of the stocked mammal species detected in the game farm traversed by the proposed pipeline

Table 7-11 Present and potentially occurring CI mammal species

FAMILY[1]& SPECIES[2,4]	COMMON NAME[2,4]	LO	CONSERVATION STATUS					ATLAS[6]
			GLOBAL RED LIST[5]	REGIONAL RED LIST (2017)[8]	RSA RED LIST (2004)[2]	RSA LEGAL[3]	FS LEGAL[7]	
ERINACEIDAE (Hedgehog)								
Atelerix frontalis (frontalis)	Southern African Hedgehog	2	LC (S)	**NT**	**NT**		**PG**	

FAMILY[1] & SPECIES[2,4]	COMMON NAME[2,4]	LO	CONSERVATION STATUS					ATLAS[6]
			GLOBAL RED LIST[5]	REGIONAL RED LIST (2017)[8]	RSA RED LIST (2004)[2]	RSA LEGAL[3]	FS LEGAL[7]	
RHINOLOPHIDAE (Horseshoe bats)								
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	2	LC (U)	LC	**NT**			
VESPERTILIONIDAE (House, pipistrelle, serotine & related bats)								
Miniopterus natalensis	Natal / Shreiber's Long-fingered Bat	3	LC (U)	LC	**NT**			
MURIDAE (Gerbils, rock mice, vlei rats & relatives)								
Otomys auratus / irroratus	Southern African Vlei Rat	2	LC (S)	**NT**	LC			
Mus orangiae	Free State Pygmy Mouse	2	LC (U)	NE	**DD**			
NESOMYIDAE (Climbing & fat mice & relatives)								
Mystromys albicaudatus	African White-tailed Rat	2	**EN (D)**	**VU**	**EN**			
CANIDAE (Dogs, foxes, jackals & relatives)								
Lycaon pictus	African wild dog	5	**EN (D)**	**EN**	**EN**	**EN**		1
Otocyon megalotis	Bat-eared Fox	2	LC (U)	LC	LC	**PS**	**PG**	
Vulpes chama	Cape Fox	2	LC (S)	LC	LC	**PS**		
MUSTELIDAE (Badger, otters, polecat & weasel)								
Aonyx capensis	African Clawless Otter	2	LC (S)	**NT**	LC			
Hydrictis maculicollis	Spotted-necked Otter	3	LC (D)	**VU**	**NT**			
Mellivora capensis	Honey Badger	2	LC (D)	LC	**NT**			
Poecilogale albinucha	African Striped Weasel	2	LC (U)	**NT**	**DD**			
HYAENIDAE (Aardwolf & hyenas)								
Hyaena brunnea	Brown Hyena	2	**NT (D)**	**NT**	**NT**	**PS**		
Proteles cristata	Aardwolf	2	LC (S)	LC	LC		**PG**	
FELIDAE (Cats)								
Felis nigripes	Black-footed Cat	2	**VU (D)**	**VU**	LC	**PS**		
Leptailurus serval	Serval	1	LC (S)	**NT**	**NT**	**PS**		
ORYCTEROPODIDAE (Aardvark)								
Orycteropus afer	Aardvark	1	LC (U)	LC	LC	**PS**	**PG**	
EQUIDAE (Zebras)								
Equus quagga	Plains Zebra	1	LC (S)	LC	LC	**PS***	**OG**	6
Equus zebra hartmannae	Hartmann's Zebra	5	**VU (U)***	**VU**	**EN**	**VU**	**OG**	2
BOVIDAE (Even-toed antelope)								
Alcelaphus caama	Red Hartebeest	1	LC (D)	LC	LC	**PS**	**OG**	8
Connochaetes gnou	Black Wildebeest	1	LC (I)	LC	LC	**PS**	**OG**	6
Connochaetes taurinus taurinus	Blue Wildebeest	5	LC (S)	LC	LC	**PS**	**OG**	4
Damaliscus lunatus	Tsessebe	5	LC (D)	**VU**	**EN**	**PS**		3
Damaliscus pygargus phillipsi	Blesbok	1	LC (S)*	LC	LC	**PS**	**OG**	7
Hippotragus equinus	Roan Antelope	5	LC (D)	**EN**	**VU**	**EN**	**PG**	2
Hippotragus niger niger	Sable Antelope	1	LC (S)	**VU**	**VU**	**VU**	**PG**	5
Ourebia ourebi	Oribi	5	LC (D)	**End**	**EN**	**EN**	**PG**	1
Pelea capreolus	Vaal Rhebok	5	LC (S)	**NT**	LC		**OG**	1

FAMILY[1]& SPECIES[2,4]	COMMON NAME[2,4]	LO	CONSERVATION STATUS					ATLAS[6]
			GLOBAL RED LIST[5]	REGIONAL RED LIST (2017)[8]	RSA RED LIST (2004)[2]	RSA LEGAL[3]	FS LEGAL[7]	
Redunca fulvorufula	Mountain Reedbuck	4	LC (S)	**EN**	LC		**OG**	5
Key								
Status: DD = Data Deficient; EN = Endangered; G = Game; LC = Least Concern; NIWA = Non-indigenous Wild Animal; NT = Near Threatened; OG = Ordinary Game; PG = Protected Game; PS = Protected Species; VU = Vulnerable								
Likelihood of Occurrence (LO): 1 = Present; 2 = High; 3 = Moderate; 45 = Managed								
Sources: [1]Stuart & Stuart (2007); [2]Friedmann & Daly (2004); [3]ToPS List (2015); [4]Monadjem *et al.* (2010); [5]IUCN (2015-4); [6]MammalMap (2016); 7Free State Nature Conservation Ordinance (1969); [8]EWT & SANBI (in press).								

7.2.2. Birds

Of approximately 268 regionally-occurring bird species, some 264 species (with a LO of 1, 2 or 3 in **Appendix 3**) are considered likely to occur within the study are based on its location and habitat diversity. During the SABAP 1 and 2, 163 and 39 bird species were, respectively, recorded in the QDS and pentad covering the study area. During the NSS survey, the presence of88 bird species was confirmed in the study area (**Figure 7-14**). Bird species locations, which were recorded in the study area using BirdLasser, are shown in **Figure 7-15**.

Immature Kittlitz's Plover (*Charadrius pecuarius*)

Northern Black Korhaan (*Afrotis afraoides*)

Double-banded Courser (*Rhinoptilus africanus*)

Namaqua Dove (*Oena capensis*)

Wood Sandpiper (*Tringa glareola*)

South African Cliff Swallow (*Petrochelidon spilodera*) nests

Figure 7-14 Examples of some of the bird species detected in the study area

Of 21 regionally-occurring CI bird species, all have at least some potential to occur within the study area, with 14 considered highly likely to occur (LO of 2 in **Table 7-12**). Of these, NSS observed Yellow-billed Stork (**EN**),Black-winged Pratincole (**NT**), and Melodious Lark (**NT**), and Digby Wells (2013) observed (**Figure 7-16**) African Grass-owl (**VU**) and Blue Korhaan (**NT**) in the study area.

- **Yellow-billed Stork (*Mycteria ibis*)**

  A single Yellow-billed Stork was observed foraging at the large dam. The conservation status of this species has recently been updated from Near Threatened to Endangered (Taylor 2015). Although widespread, this species is generally uncommon, with a small South African population supplemented by intra-African migrants during summer. Breeding occurs mainly in KwaZulu-Natal. The species is described as being facultatively nomadic, tracking rainfall events and being largely dependent on sufficiently large wetland systems. It is mainly threatened by loss and degradation of wetland systems.

- **Black-winged Pratincole (*Glareola nordmanni*)**

  On two occasions a small flock of Black-winged Pratincole was seen flying over the study area. The Black-winged Pratincole has a very large global distribution, but evidence of breeding population declines in Europe, Central Asia and West Africa, and non-breeding population declines in southern Africa, indicates that this species has experienced moderately rapid overall declines, and thus warrants a global NT status (BirdLife International 2016). Non-breeding populations in southern Africa frequent open high-altitude grassland and mudflats, where they feed on epigeic and airborne insects, particularly swarming taxa such as locusts. Population declines have been attributed to agricultural practices and grassland degradation, which have reduced the area of suitable available habitat for these birds. Insect control measures may also be negatively impacting populations (BirdLife International 2016).

- **Melodious Lark (*Mirafra cheniana*)**

  Melodious Lark was repeatedly detected during aerial displays within the open *Themeda* grassland of the largely natural Thornveld habitat. The species favours areas where the grass is short and there are open spaces between grass tussocks. This species tends to avoid wetter low-lying areas and is sensitive to grazing by livestock (BirdLife International 2015).

- **African Grass-owl (*Tyto capensis*)**

  African Grass-owl was detected by Digby Wells (2013) along a drainage feature immediately north of the focal study area, as shown in **Figure 7-16**. The Grass-owl is a habitat specialist requiring tall (at least knee-high), dense grasses and sedges in which to construct nests and roost tunnels. Suitable habitat is typically found along drainage systems, around pans, and within slope seepage zones and the occurrence

of these owls in an area is dependent on the retention of such areas. Nesting has been recorded even in small (≤4m²) patches of suitable habitat within generally unsuitable *Hyparrhenia hirta* grassland (Geoff Lockwood pers. comm.). Grass-owls hunt over a mixture of wetland, grassland, cropland and fallow fields, and have been shown through radio telemetry to forage up to 4km away from their roosts and nests (Geoff Lockwood pers. comm.). During foraging, grass-owls are able to fly over extensive areas of unsuitable habitat to reach favoured hunting areas, and it is this behaviour combined with the species' nesting adaptability, which enables this species to occur in the study area.

- **Blue Korhaan (*Eupodotis caerulescens*)**
  Blue Korhaan was also detected by Digby Wells (2013), close to where they recorded African Grass-owl. The Blue Korhaan is endemic to the grassland biome in South Africa and Lesotho where increasing habitat transformation is the main threat to the species (BirdLife International, 2013). Compared to White-bellied Korhaans, Blue Korhaans typically feed and nest in areas with shorter grass, and seem capable of persisting in areas where there is crop cultivation, livestock grazing, and a low density of human settlement (NSS pers. obs.).

In addition to Yellow-billed Stork and Black-winged Pratincole the large dam at the terminus of the pipeline route also has the potential to support African Marsh Harrier (suitable breeding habitat in large reedbed), Pallid Harrier (non-breeding Palaearctic migrant) Caspian Tern (small islets on dam suitable for inland breeding), Greater Flamingo (foraging habitat present but no suitable breeding habitat), Maccoa Duck (suitable breeding habitat present), Chestnut-banded Plover (no suitable breeding habitat frequents saline systems, uncommon in freshwater habitats, marginal distribution, moderate to low likelihood of occurrence), Blue Crane (very occasional) and Curlew Sandpiper (common non-breeding Palaearctic migrant).

The Thornveld habitat in the south-eastern corner of the study area may support Abdim's Stork (no suitable breeding habitat sporadic visits by small flocks), Secretarybird (suitable breeding habitat present), Martial Eagle, Verreauxs' Eagle, Lanner Falcon, Red-footed Falcon (no suitable breeding habitat for any of the CI raptor spp.) and European Roller (non-breeding migrant). The Disturbed Thornveld habitat may see visitation by a similar compliment of CI bird species, but are less likely to support CI bird breeding and long-term persistence. With the exception of the **VU** Burchell's Courser, the Croplands provide little important habitat for CI bird species.

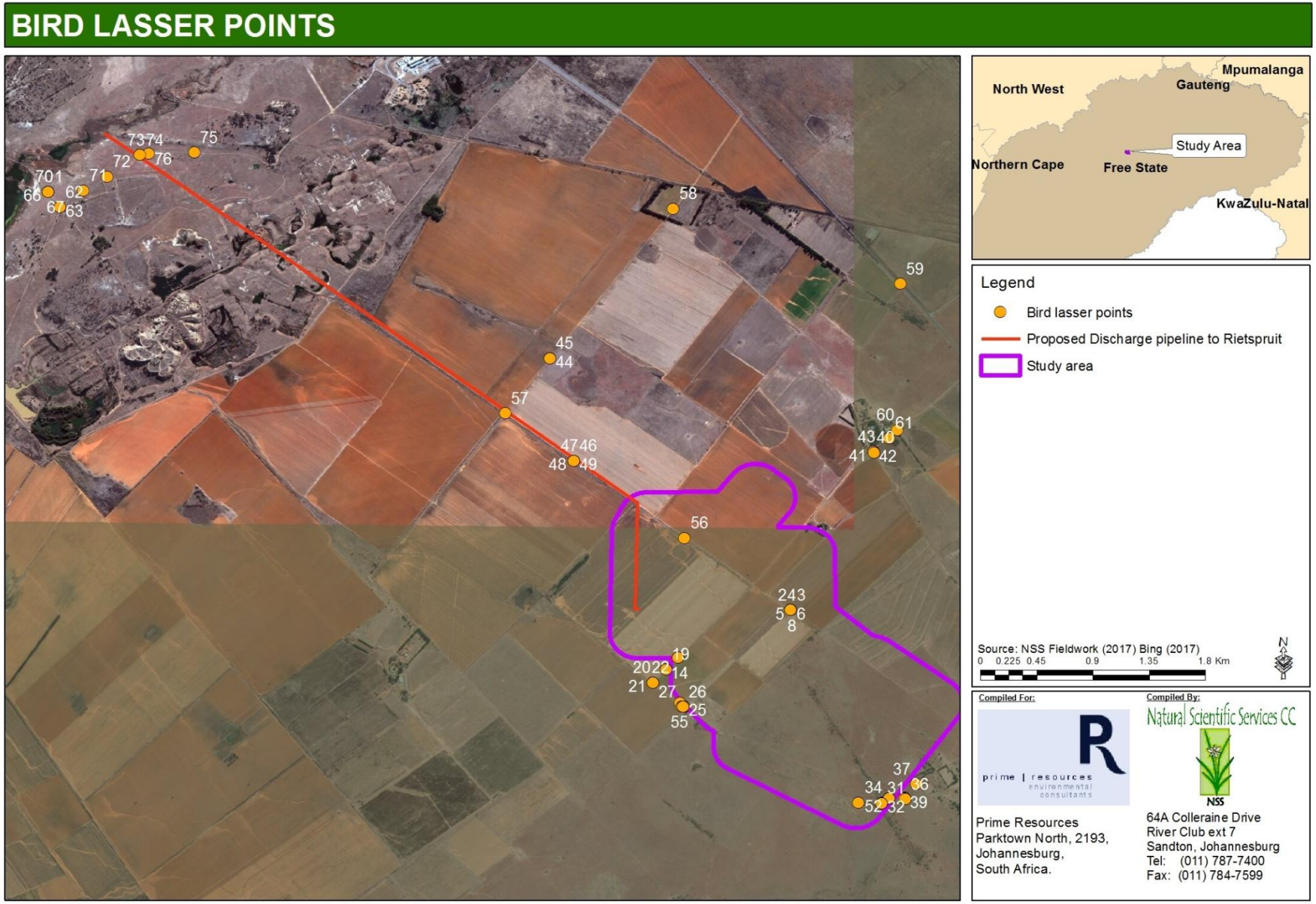


Figure 7-15 NSS BirdLasser records for the study area

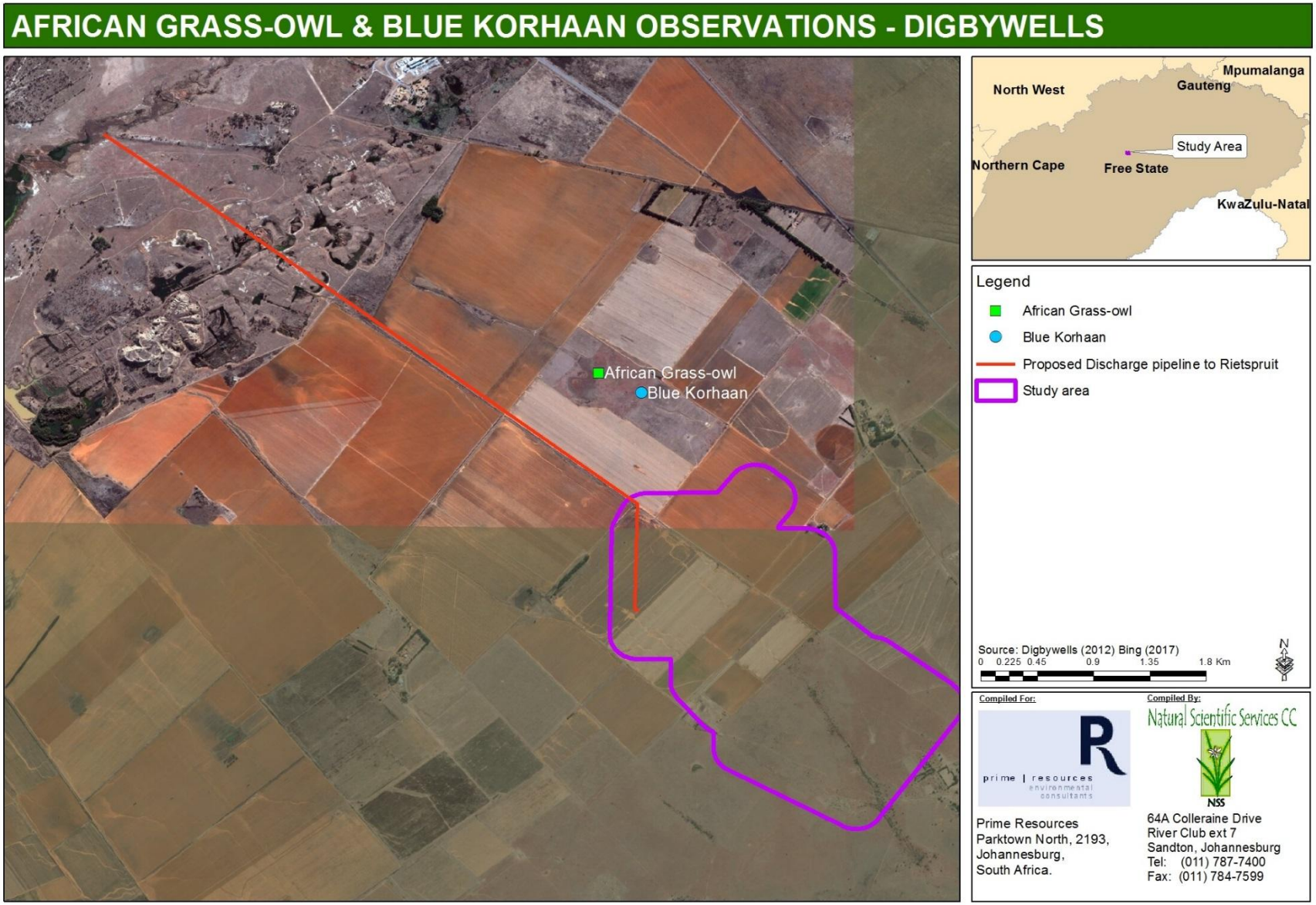


Figure 7-16 Map from Digby Wells (2013) indicating the location of observed African Grass-owl and Blue Korhaan

Table 7-12 Present and potentially occurring CI bird species

CATEGORY & SCIENTIFIC NAME	COMMON NAME	LO	CONSERVATION STAUS				ATLASSING (2800_2700)			
			GLOBAL RED LIST[1]	REGIONAL RED LIST[1]	RSA LEGAL[2]	FS LEGAL[3]	SABAP[4]			NSS
							FP (RR%)	AP (RR%)	IR	RO
1. Ocean birds										
Sterna caspia	Caspian Tern	3	LC	VU	-	PG				
2. Inland water birds										
Phoenicopterus roseus	Greater Flamingo	2	LC	NT	-	PG				
Glareola nordmanni	Black-winged Pratincole	1	NT	NT	-	PG				47
Ciconia abdimii	Abdim's Stork	2	LC	NT	-	PG				
Mycteria ibis	Yellow-billed Stork	1	LC	EN	-	PG				62
3. Ducks & wading birds										
Oxyura maccoa	Maccoa Duck	2	NT	NT	-	PG				
Charadrius pallidus	Chestnut-banded Plover	3	NT	NT	-	PG				
Calidris ferruginea	Curlew Sandpiper	2	NT	LC	-	PG				
4. Large terrestrial birds										
Cursorius rufus	Burchell's Courser	3	LC	VU	-	PG				
Eupodotis caerulescens	Blue Korhaan	1*	NT	LC	-	PG				
Sagittarius serpentarius	Secretarybird	2	VU	VU	-	PG				
Anthropoides paradiseus	Blue Crane	3	VU	NT	PS	OG				
5. Raptors										
Polemaetus bellicosus	Martial Eagle	2	VU	EN	EN	PG				
Aquila verreauxii	Verreauxs' Eagle	3	LC	VU	-	PG				
Falco biarmicus	Lanner Falcon	2	LC	VU	-	PG				
Falco vespertinus	Red-footed Falcon	3	NT	NT	-	PG				
Circus ranivorus	African Marsh Harrier	2	LC	EN	-	PG				
Circus macrourus	Pallid Harrier	2	NT	NT	-	PG				
6. Owls & nightjars										
Tyto capensis	African Grass-owl	1*	LC	VU	-	PG				
8. Aerial feeders, etc										
Coracias garrulus	European Roller	2	LC	NT	-	PG				
9. Cryptic & elusive insect-eaters										
Mirafra cheniana	Melodious Lark	1	NT	LC	-	PG				27

Key

Status: EN = Endangered; LC = Least Concern; NT = Near Threatened; OG = Ordinary Game; PG = Protected Game; PS = Protected Species; VU = Vulnerable;

Likelihood of Occurrence (LO): 1 = Present; 1* = Present (recorded by Digby Wells 2013); 2 = High; 3 = Moderate

Sources: [1]Taylor *et al.* (2015); [2]ToPS (2015); [3]Free State Nature Conservation Ordinance (1969); [4]SABAP 2 (2016)

7.2.3. Reptiles

Of some 43 regionally-occurring reptile species, 39(with a LO of 1, 2 or 3 in **Appendix 4**) are considered likely to occur in the study area based on its location and habitat diversity. Available atlas data (Bates *et al.* 2014; ReptileMap 2017) yielded only one species record from the QDS. Although only two reptile species (Marsh Terrapin and Leopard Tortoise) were detected during the site visit (**Figure 7-17**), more certainly occur. Reptiles are generally difficult to detect, and live-trapping over longer periods would certainly increase their detection.

Reptile species that are likely to be common on site include Cape Gecko, Yellow-throated Plated Lizard, Cape Skink, Speckled Rock Skink, Variable Skink, Distant's Ground Agama, Eastern Thread Snake, Puff Adder, Black-headed Centipede-eater, Brown House Snake, Aurora House Snake, Brown Water Snake, Cape Wolf Snake, Spotted Grass Snake, Mole Snake, Rinkhals, Red-lipped Snake and Rhombic Egg-eater.

Four CI reptile species are known to occur in the region, namely Serrated Tent Tortoise (**PG**), Leopard Tortoise (**PG**), Giant Dragon Lizard (**VU**) and Striped Harlequin Snake (**NT**).

Table 7-13 Present and potentially occurring CI reptile species

FAMILY & SPECIES[1]	COMMON NAME[1]	LO	CONSERVATION STATUS				
			GLOBAL RED LIST[3]	SA RED LIST[1]	RSA LEGAL[2]	FS LEGAL[5]	ATLAS[4]
TESTUDINIDAE (Tortoises)							
Psammobates oculifer	Serrated Tent Tortoise	4		1LC		**PG**	
Stigmochelys pardalis	Leopard Tortoise	1		1LC		**PG**	
CORDYLIDAE (Crag, flat, dragon & girdled lizards)							
Smaug giganteus	Giant Dragon Lizard	4	**VU**	**1VU**	**VU**	**PG**	
LAMPROPHIIDAE (Lamprophid snakes)							
Homoroselaps dorsalis	Striped Harlequin Snake	3	**NT**	1LC			
Key							
Status: 1 = Global; LC = Least Concern; PG = Protected Game; VU = Vulnerable; NT = Near-threatened							
Likelihood of Occurrence (LO): 1 = Present; 3 = Moderate; 4 = Low							
Sources:[1]Bates *et al.* (2014); [2]ToPS List (2015); [3]IUCN (2015-4); [4]ReptileMap (2014); [5]Free State Nature Conservation Ordinance (1969)							

Of the four regionally-occurring CI reptile species, only (a single large female) Leopard Tortoise was observed along the proposed pipeline route (in the Disturbed Thornveld of the game reserve).

Of the three remaining CI reptile species, only Striped Harlequin Snake is likely to occur. This secretive and generally rare species frequents undisturbed habitat and, if present, would likely be restricted to the natural Thornveld habitat where it would be found almost exclusively within termitaria.

The distribution of Serrated Tent Tortoise is highly marginal and the species is, therefore, considered unlikely to occur.

Although the study area is situated within distribution range of the Giant Dragon Lizard, it has not yet been recorded in the QDS covering the study area. This may be an artefact of under sampling, but after extensive searching, no burrows were found on site, nor does the natural Thornveld habitat appear suitable for this species. NSS has encountered Giant Dragon Lizards at various other locations, and is very familiar with this species' habitat preferences and signs of activity. Indeed, property to the south of the study area appears suitable for this species, but due to our scope of work for the present assessment, no burrow searches were conducted in this area (outside of study area bounds). It should be noted, however, that despite extensive searching and the fact that habitat on site appears unsuitable for this species, it is **easily overlooked**, and the (albeit low) potential for their occurrence on site cannot be ruled out.

Leopard Tortoise
(*Stigmochelys pardalis*)

Power's Toad
(*Sclerophrys poweri*)

Common Platanna
(*Xenopus laevis*)

Figure 7-17 Examples of some of the herpetofauna observed on site

7.2.4. Frogs

Some14frog species are expected to occur regionally. Of these,11species (with a LO of 1, 2 or 3 in **Appendix 5**) are likely to occur on site based on its location and the availability of suitable habitat. Current atlas data (FrogMap 2017) includes records for six species from the QDS covering the study area, and five frog species were detected during the survey. These included Power's Toad, Bubbling Kassina, Common Platanna, Common Caco and Tandy's Sand Frog (**Figure 7-17**).

Only one CI frog species occurs regionally: the Giant Bullfrog. Signs of this species' presence (spoor and burrows) were found at a wetland situated 580m south-east of the study area boundary as defined in **Figure 7-10**, and it is highly likely that breeding takes place at the three dams along this wetland. Although no suitable breeding habitat was found *inside* the study area, the natural Thornveld habitat likely provides important foraging and overwintering habitat for these frogs. Any persisting populations are likely to be highly threatened by crop cultivation given that bullfrogs spend most of their lives buried underground.

Table 7-14 Potentially occurring CI frog species

FAMILY[1,4] & SPECIES[4]	COMMON NAME[3]	CONSERVATION STATUS			LoO[3,5]	ATLAS (N)[3,5]
		GLOBAL IUCN[2]	S.A. RED DATA[3]	S.A. NEM:BA[1]		
PYXICEPHALIDAE (Moss, river, sand & stream frogs)						
Pyxicephalus adspersus	Giant Bullfrog	LC (D)	**NT**	-	2	
Key						
Status: LC = Least Concern; NT = Near Threatened; PS = Protected Species						
Likelihood of Occurrence (LO): 1 = Present; 2 = High; 4 = Low						
Sources: [1]ToPS List (2007); [2]IUCN (2015-4); [3]Minter et al. (2004); [4]Du Preez & Carruthers (2009); [5]FrogMap (2016)						

7.2.5. Terrestrial Macro-invertebrates

Some 62 species of butterfly may occur regionally (**Appendix 6**) based on their distributions (Henning *et al*. 2009; Mecenero *et al*. 2013). Suitable habitat exists within the study area for most of these species. Atlas data (LepiMap 2017) include records for only two species from the QDS covering the study area. During the site visit seven widespread and common butterfly species were detected (**Figure 7-18**) namely Citrus Swallowtail, Brown-veined White, African Migrant, Broad-bordered Grass Yellow, African Monarch, Plain Tiger, Common Diadem and Yellow Pansy. There is considerable scope for the detection of additional species given greater sampling time on site. No CI butterfly species is known to occur in the region.

Interpretation of distribution data for dragonflies and damselflies provided in Samways (2008) suggests that about18 odonata species have the potential to occur in the region **(Appendix 7)**. None of these potentially occurring species are Red-listed. During the site visit three odonata species were observed at a depression, inundated with overflow from a windmill on the south-western border of the study area. These included the resilient and widespread Swamp Bluet, Marsh Bluetail, and Pantala.

Suitable habitat exists within the study area for at least two scorpion species, namely *Uroplectes triangulifer* and *Opistophthalmus carinatus*. Both species are widespread and common. They occupy similar habitats, generally favouring sandier substrates, and are of low conservation concern. The potency of their venom is considered to be of low medical importance. The lack of any significant rocky outcrops limits the abundance and diversity of scorpion species likely to occur on site.

Target searches for selected megalomorph spiders (baboon and trapdoor spiders) did not yield any individuals. Two species of baboon spider are listed for the Free State Province, namely *Harpactira hamiltoni* and *Harpactirella schwarzi*. Of the two, *H. hamiltoni* is more likely to occur, but conclusive identification of any specimen on site would require close examination of mouthparts. No cork-lid trapdoor spiders (*Stasimopus* sp.) or burrows were detected.

All baboon spider species of the genera *Ceratgyrus*, *Harpactira* and *Pterinochilus* together with the scorpion species of the genera *Hadogenes*, *Opisthacanthus* and *Opistophthalmus* were listed in 2007 as Threatened or Protected Species (ToPS) under NEM:BA (Act 10 of 2004). Although the latest (2015) ToPS list omits these taxa altogether, the Free State Nature Conservation Bill (2007) recognises all baboon spider (family: Theraphosidae) and selected trapdoor spider families (Ctenizidae, Nemesiidae and Cyrtancheniidae) as Protected in the province.

Swamp Bluet
(*Africallagma glaucum*)

Marsh Bluetail
(*Ischnura senegalensis*)

Brown-veined White
(*Belenois aurota*)

Figure 7-18 Examples of odonatan and butterfly species detected in the study area

Table 7-15 Potentially occurring CI arachnid species

SPECIES & FAMILY	STATUS[1]		LO[2,3]	ATLAS
	ToPS (2007)	BILL (2007)		
THERAPHOSIDAE (Baboon spiders)				
Harpactira hamiltoni	*	**	2	
Harpactirella schwarzi	*	**	4	
SCORPIONIDAE (Burrowing scorpions)				
Opistophthalmus carinatus	*		*2*	

Key
Likelihood of Occurrence (LO): 2 = High; 4 = Low
* Listed as Protected under ToPS (2007)
** Listed as Protected under Free State Nature Conservation Bill (2007)

7.3. Wetlands

Naturally the gently undulating landscape within the greater study area would have been comprised of a matrix of pans and seeps draining in a north-westerly direction towards the Rietspruit. However, extensive crop cultivation has long dominated land use practices in the region, with the vast majority of wetlands having been partially or completely transformed by tillage and drainage practices from as far back as the 1960's (see **Figure 5-3**) and undoubtedly longer. The extent and intensity of crop production in the area, as evidenced by the 1964 historical ortho-photographs, has changed little for more than half a century. Consequently some systems are relictual, making their identification and delineation particularly challenging.

In spite of this three wetland hydrogeomorphic (HGM) units were identified along the proposed water discharge pipeline route namely Rietspruit Floodplain (HGM Unit 1), Seasonal Depression (HGM Unit 2) and Hillslope Seep (HGM unit 3). Results of the wetland assessment for these three HGM units are summarised in **Table 7-16** to **Table** 7-17**.**The current delineated wetland extent and sampling points is depicted in **Figure 7-19**. A Pipeline route alternative proposed by NSS (pink line) to minimize loss/degredation of HGM unit 2 is shown in (**Figure 7-22**) It should be noted that the discharge pipeline terminates at the Rietspruit Floodplain (HGM unit 1) an area zoned as being of Highest Biodiversity Importance and Risk for Mining according to the SANBI Mining and Biodiversity Guidelines (MBG).

Table 7-16 Wetland summary HGM Unit 1

HGM Unit 1 –Channelled Valley-bottom			
			
	Facing north-east	Facing west	
			
HGM Unit 1 and Sampling Points	Dam to the west	“Gleying” with mottles	

SETTING			
Coordinates (Centroid)	28°0'34.21"S 27°0'36.81"E	Level 1: System	Inland
Altitude (m.a.s.l)	1356	Level 2a: Ecoregion	11.08
Aspect	North-west	Level 2b: NFEPA WetVeg	DHGG 3
Regional vegetation	GM-10	Level 3: Landscape unit	Valley floor
Quaternary catchment	C42J	Level 4a:	Channelled valley-bottom
Free State CPLAN	CBA 1	Level 4b:	NA
MBG	B: Highest NB& risk	Level 4c	NA
Area (ha)	1.8	Status	LT & NP

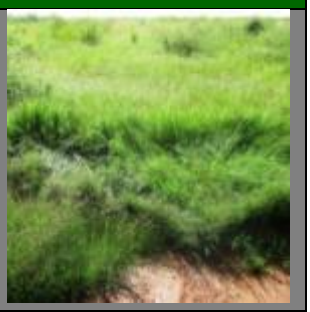
SITE DESCRIPTION	
Overview	Part of a large well inundated perennial system (Rietspruit). Predominantly channeled with moderate to high sinuosity. Signs of braiding, depressions and oxbows within a narrow floodplain-like setting evident upstream, but less obvious at proposed pipeline terminus due to backlogging from large dam which has created a vlei like setting dominated by reedbeds. Soil wetness indicators evident <170 m from reedbed.
Wetland indicators	Topographic and soil indicators present, vegetation indicators only present within permanent and seasonal zones but not in temporary zone (intensive grazing by game).
Impacts	Obsolete dam walls upstream, backlogging from large dam downstream, heavy grazing pressure by game in temporary zone, some trampling evident, nutrient loading.
Dominant species	*Phragmites australis, Typha capensis, Eragrostis plana, Sporobolis africanus, Themeda triandra*
Soil characteristics	Dark brown vertic Rensburgs (“gleying” clay content = 70 %) progressing to melanic Willowbrook near wetland margin (lower clay content and feint mottles).

Present Ecological State (PES)		
Hydrology	Geomorphology	Vegetation
E	C	D

Wetland Ecosystem Services
Important for regulating and supporting functions but also biodiversity maintenance and recreation (fishing and game).

Wetland Importance and Sensitivity		
Hydrological	Ecological	Cultural
Very High (3.3)	**High (2.9)**	**Moderate (1.5)**

Table 7-17 Wetland summary HGM Unit 2

HGM Unit 2 – Seasonal Depression			
			
	Facing south-west	Facing north-east	
			
HGM Unit 2 and Sampling Points	Saturated Willowbrooks	*Persicaria amplexicaulis* (wetland indicator)	
SETTING			
Coordinates at centroid	28°1'16.60"S 27°1'37.94"E	Level 1: System	Inland
Altitude at centroid (masl)	1376	Level 2a: Ecoregion	11.08
Aspect	Inwards (depression)	Level 2b: NFEPA WetVeg	DHGG 3
Regional vegetation	GM-10	Level 3: Landscape unit	Slope
Quaternary catchment	C42J	Level 4a:	Depression
Free State CPLAN	Degraded	Level 4b:	Endorheic
MBG	B: Highest NB and risk	Level 4c	Without channelled outflow
Area (ha)	0.8	Status	LT & NP
SITE DESCRIPTION			
Overview	Small seasonally inundated, well vegetated, endoreic depression without channelled outflow.		
Wetland indicators	Topographic, soil and vegetation wetness indicators present.		
Impacts	Soil disturbances evident. Drainage berm on western margin, original extent of pan vegetation displaced by croplands. Moderate encroachment by herbaceous alien species.		
Dominant species	*Persicaria lapathifolia, Setaria sphacelata* var.*sericea, Kyllinga erecta*		
Soil characteristics	Brown moderately structured Willowbrook		
Present Ecological State (PES)			
Hydrology	Geomorphology	Vegetation	
E	**B**	**E**	
Wetland Ecosystem Services			
Important in terms of sediment trapping and biodiversity maintenance.			
Wetland Importance and Sensitivity			
Hydrological	Ecological	Cultural	
High (2.4)	**High (2.8)**	**Low (0.9)**	

DHGG 3: Dry Highveld Grassland Group 3

Table 7-18 Wetland summary HGM Unit 3

HGM Unit 3 – Hillsope Seep			
	 Facing south	 Facing north	
HGM Unit 3 and Sampling Points	 Soil mottling	 Soft plinthic layer	
SETTING			
Coordinates (Centroid)	28°2'28.65"S 27°2'51.52"E	Level 1: System	Inland
Altitude (m.a.s.l)	1403	Level 2a: Ecoregion	11.08
Aspect	West	Level 2b: NFEPA WetVeg	DHGG 3
Regional vegetation	GM 8	Level 3: Landscape unit	Slope
Quaternary catchment	C21D	Level 4a:	Seep
Free State CPLAN	Degraded	Level 4b:	Without channelled outflow
MBG	-	Level 4c	NA
Area (ha)	2.9	Status	EN& NP
SITE DESCRIPTION			
Overview	Part of a large seemingly isolated hillslope seep. Vegetation completely displaced by active crop farming at least as far back as the early 1960's.		
Wetland indicators	Soil wetness indicators (soil form, soft plinthic horizon, gleying and mottling)		
Impacts	Vegetation completely displaced, hydrology significantly altered through contoured drainage furrows and tilling practices which have served to decrease saturation, runoff is high and erosion is evident.		
Dominant species	*Zea mays*		
Soil characteristics	Poorly structured red sandy Bainsvlei soils. Apedal A and B horizons give way to soft plinthic layer with black oxides before a G horizon at 70 cm with distinct mottling.		
Present Ecological State (PES)			
Hydrology	Geomorphology	Vegetation	
F	**C**	**E**	
Wetland Ecosystem Services			
Completely transformed, in current state provides little in terms of ecosystem services			
Wetland Importance and Sensitivity			
Hydrological	Ecological	Cultural	
High (2.6)	**High (3)**	**Moderate (1.6)**	

MHGG: Mesic Highveld Grassland Group; UVB: Unchannelled Valley-bottom

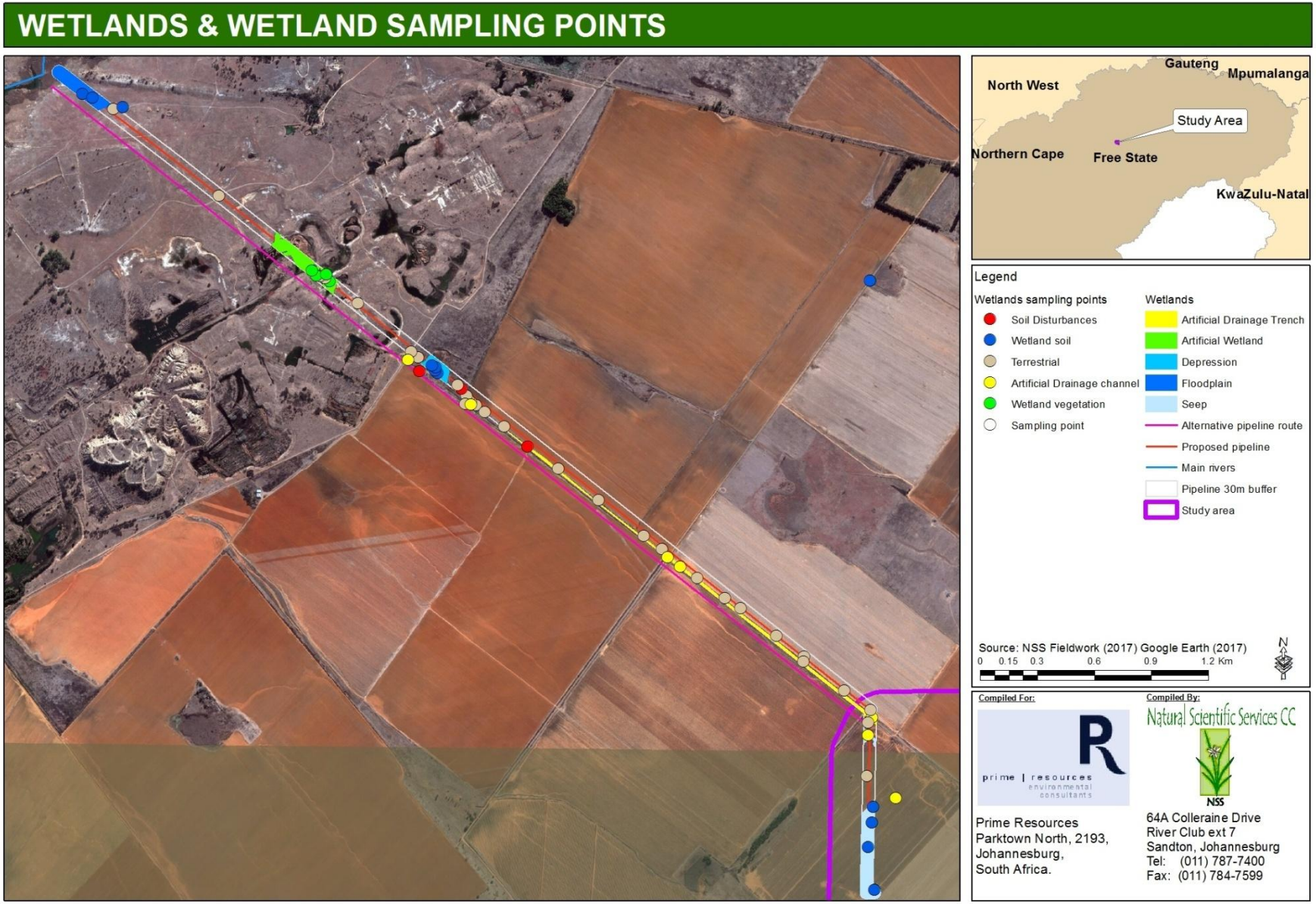


Figure 7-19 Current wetland extent – overview. Pink line represents a pipeline route alternative proposed by NSS.

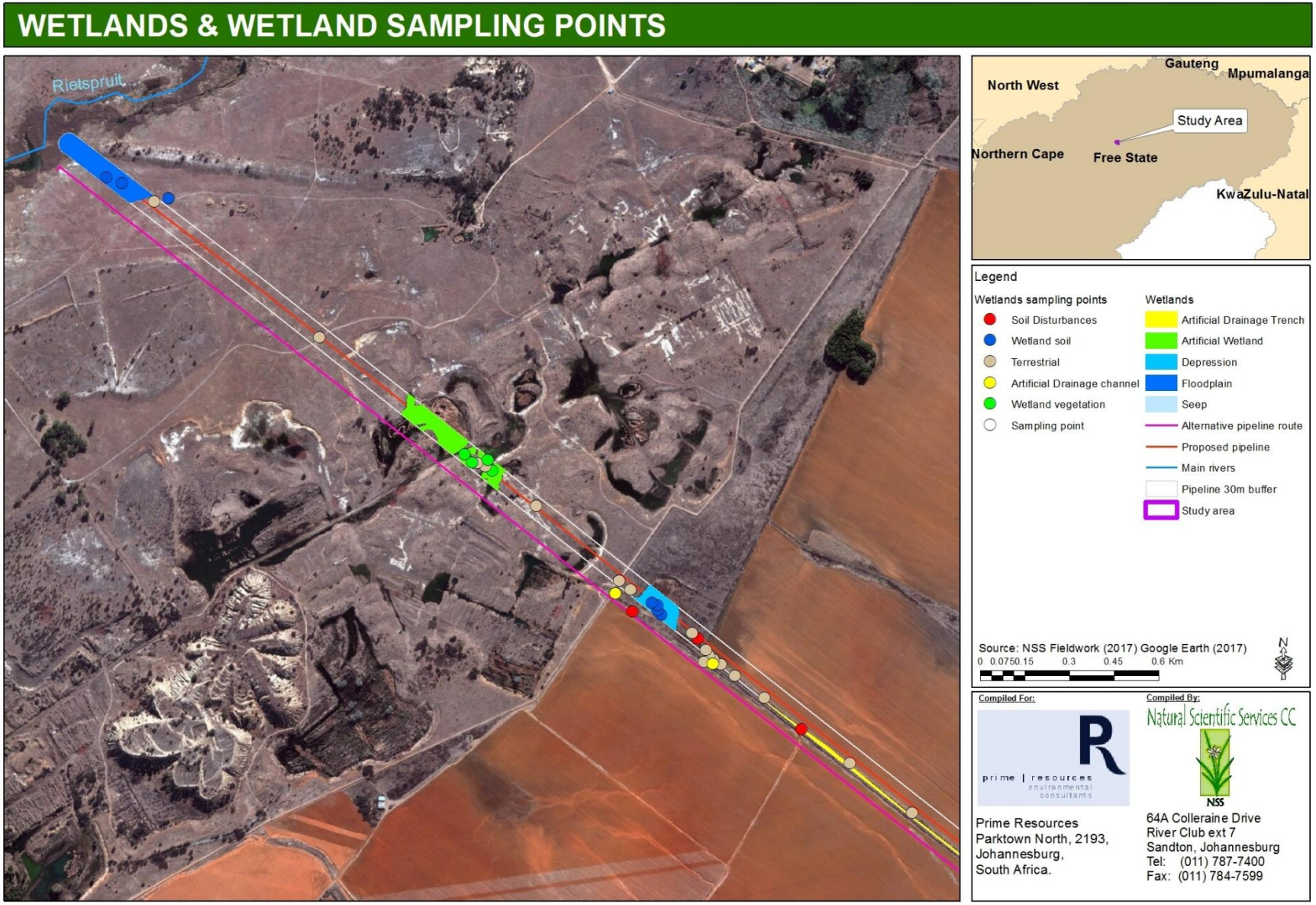


Figure 7-20 Current wetland extent – north-western portion. Pink line represents a pipeline route alternative proposed by NSS

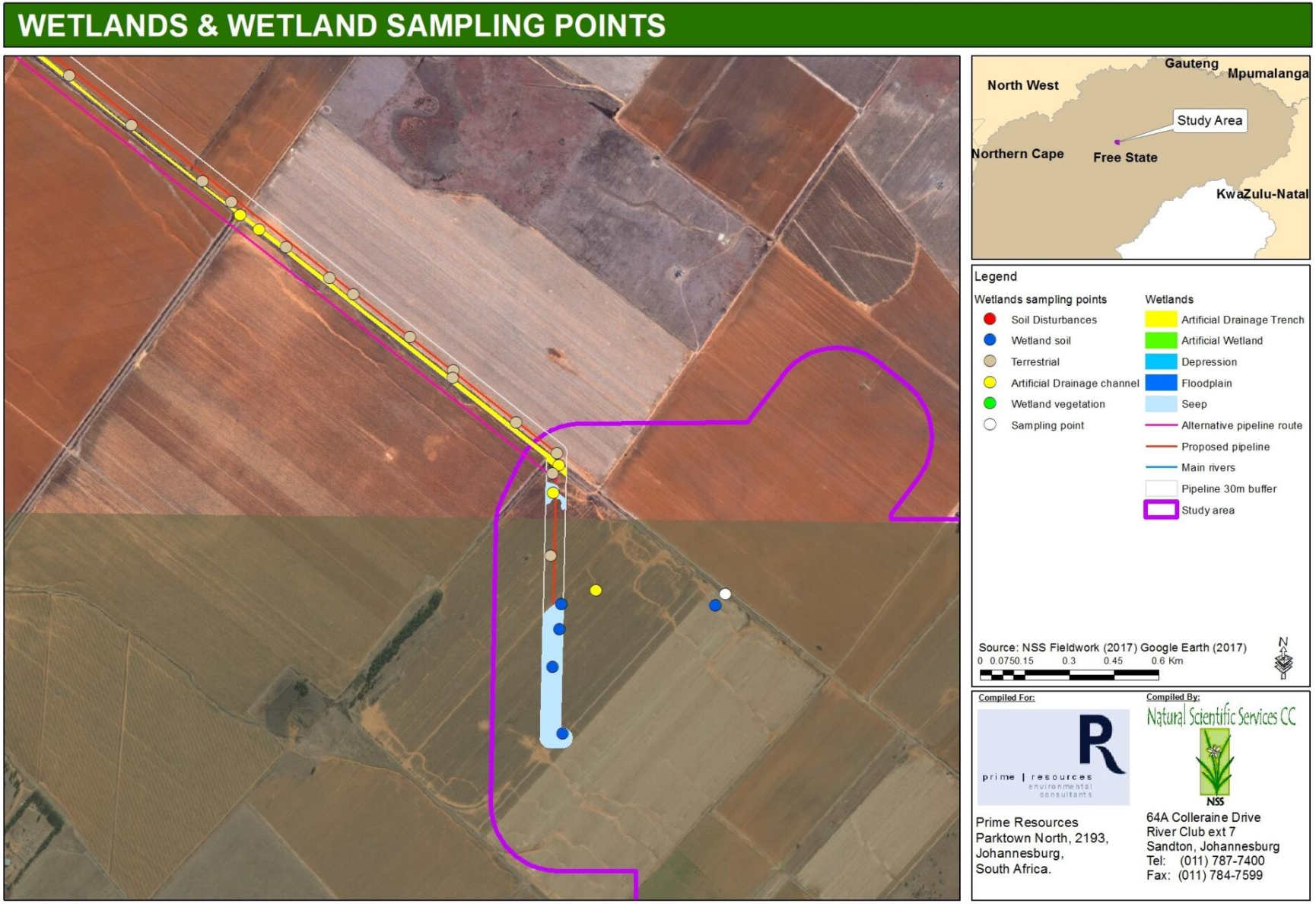


Figure 7-21 Current wetland extent – south-eastern portion. Pink line represents a pipeline route alternative proposed by NSS.

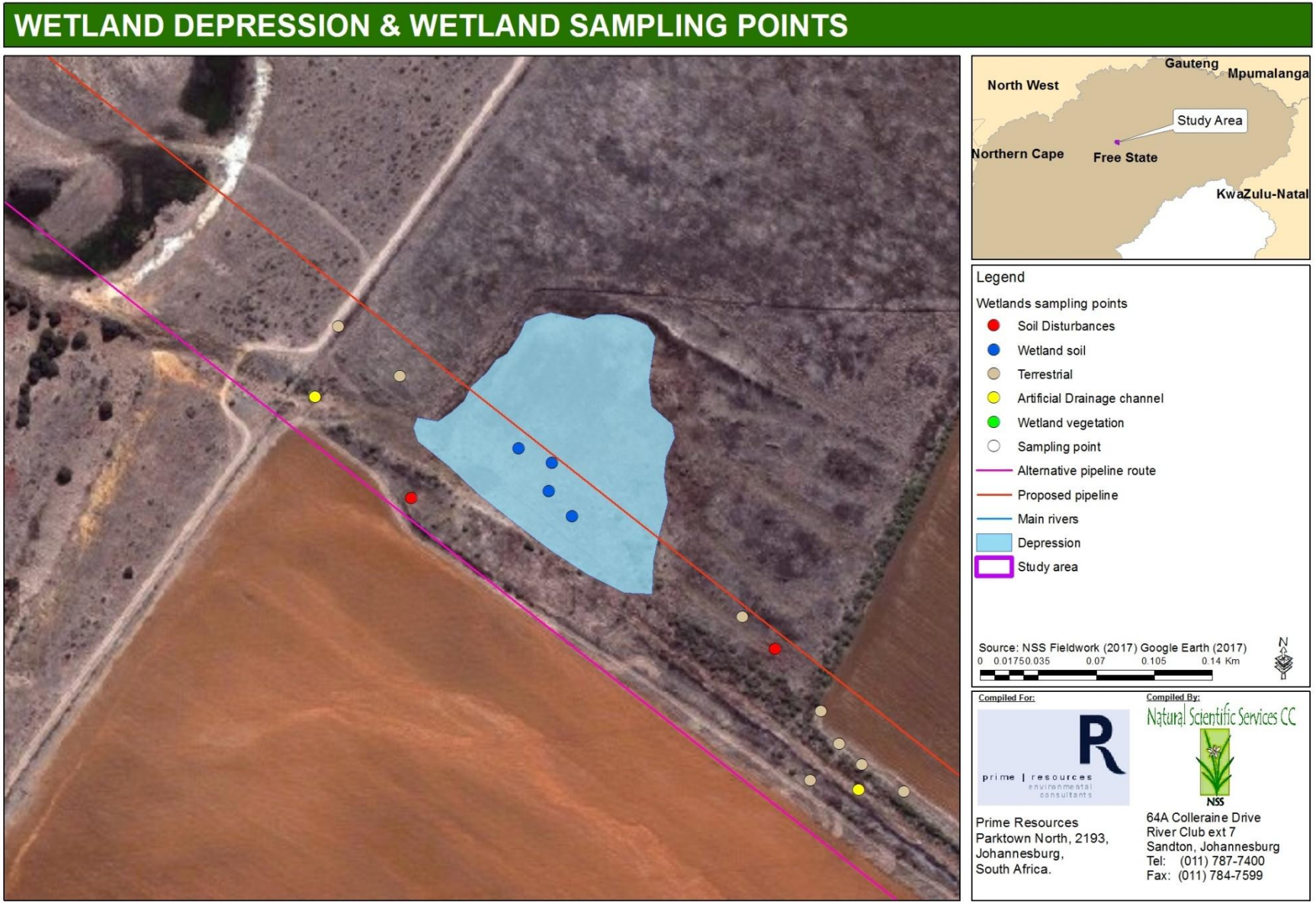


Figure 7-22 Pipeline route alternative proposed by NSS (pink line) to minimize loss/degredation of HGM unit 2.

7.3.1. Wetland classification and delineation

Three wetland HGM units were identified along the proposed water discharge pipeline route. These include the Rietspruit Unchannelled Valley-bottom (HGM Unit 1), Seasonal Depression (HGM Unit 2) and Seep (HGM Unit 3) wetlands. The spatial distribution of the wetlands within the study site was determined using a combination of standard in-field delineation techniques including terrain, soil and vegetation indicators (DWAF, 2005), available contour data, satellite imagery (Google Earth) and historical ortho-photographs (1964). The combined wetland extent within the study area is estimated 8.4 ha, which equates to approximately 31.14% of the study area. The current wetland extent is illustrated in **Figure 7-19**.The Level 1-4wetland classification (Ollis *et al.* 2013) for the various HGM units together with their threat status and conservation status is given in **Table 7-19**. Following standard practice, the active channel of the Rietspruit, itself, was identified as a fourth river HGM unit. As rivers are distinguished from wetlands in the national classification system it has been excluded from the PES, ES and EIS assessments below. Likewise a series of artificial wetlands were identified in the north-western section of the proposed discharge pipeline route that appear to have been created through excavations associated with old lime mining activities and have too been excluded from the assessment. The various HGM units identified on site are discussed in more detail below:

- **Rietspruit Channelled Valley-bottom (HGM unit 1)**

  This HGM unit is part of a large, well inundated, perennial system known as the Rietspruit. The system is predominantly channeled with moderate to high sinuosity; however, in certain reaches the channel is not obvious. Although signs of braiding, depressions and oxbows more consistent with a narrow floodplain-like setting are evident immediately upstream, these features are less obvious at the proposed pipeline terminus due to backlogging from large dam which has created a vlei like setting dominated by reedbeds. Consequently the system has been identified in this report as a channeled valley-bottom wetland in line with the FEPA wetlands spatial database designation. Soil wetness indicators are evident as far as 170 m upslope from the reedbed. By definition channelled valley-bottom wetland systems are situated in a valley-bottom landscape unit and exhibit an active channel. Both topographic and soil indicators were present. Soils characteristics include dark brown vertic Rensburgs with a high clay content (ca. 70 %) followed by gleying near 50 cm progressing to a melanic Willowbrook nearer the wetland margin (lower clay content and feint mottles). Vegetation indicators were only present within permanent and seasonal zones but not in temporary zone likely as a result of intensive grazing by game.

- **Seasonal Depression (HGM unit 2)**

  The proposed pipeline route intercepts a single small depression at its midpoint between the proposed operational area and the discharge point at the Rietspruit. It is best described as a seasonally inundated, well vegetated, endorheic depression without channelled outflow. Depression such as these are defined as a wetland area

with a closed (or near closed) elevation profile. Contours within these wetlands increase in depth from the perimeter towards a central area. Pans are typical example of a depression system, which may have inlets and / or outlets or lack them all together. Most commonly pans are driven by surface water inputs but may be influenced in some cases by groundwater regimes. Pans can be grouped into those that are inward draining (endorheic) and those that outward draining (exorheic). Topographic, soil and vegetation wetness indicators present. Soils within this depression are characterized by a brown moderately structured Willowbrook.

- **Hillslope Seep (HGM unit 3)**

  This HGM unit forms part of a large relictual seep system now completely transformed by crop cultivation. Seeps are wetland areas located on gently to steeply sloping land that are dominated by colluvial (i.e. gravity driven), unidirectional movement of water and material down-slope. The seep identified in the study area is considered not to have a channelled outflow. This means that water exits the seep by means of a combination of diffuse surface flow, interflow, evaporation and infiltration. These systems are normally associated with groundwater discharges (likely the case given the prevailing sandstone/mudstone substrate), although flow through them may be supplemented by surface water contribution. Despite high levels of transformation through tillage practices, signs of surface and subsurface movement of water through this system are still evident in the field. Surface flows, following a high rain event during the site visit, have left a clearly disenable network of drainage channels through the recently ploughed land. Subsurface flow was evidenced by the Bainsvlei soils which showed seasonal fluctuation of the water table through a soft yellow plinthic layer with black oxides which was followed by a "G" horizon near 70 cm showing clearly discernible high chroma mottles.

Table 7-19 Wetland classification

LEVEL 1	LEVEL 2		LEVEL 3	LEVEL 4			STATUS
System	Eco-region	NFEPA WetVeg	Landscape Unit	4a	4b	4c	
Rietspruit Channelled valley-bottom (HGM Unit 1)							
Inland	11.08	DHGG3	Valley floor	CVB	NA	NA	LT, NP
Seasonal Depression (HGM Unit 2)							
Inland	11.08	DHGG4	Slope	D	Endorheic	Without channelled outflow	NT, NP
Hillslope Seep (HGM Unit 3)							
Inland	11.08	DHGG5	Slope	S	Without channelled outflow	NA	EN, NP
Rietspruit River (HGM Unit 4)							
Inland	11.08	DHGG6	Valley floor	R	Lower foothill	Active channel	EN, NP

Key: CR = Critically Endangered; HGM = Hydrogeomorphic Unit; MHGG Mesic Highveld Grassland Group; S= Seep; CVB = Unchannelled Valley Bottom; D = Depression; S = Seep; R = River

7.3.2. Present Ecological State

A summary of the PES of both wetland HGM units identified on site is provided in**Table 7-20**and discussed in greater detail per wetland driver (hydrology, geomorphology and vegetation) below. Examples of the main existing wetland impacts are given in **Figure 7-23**.

Wash channels in HGM unit 3

Culverts along drainage trench

Artificial wetlands

Gas pipeline

Drainage trench

Past limestone mining

Figure 7-23 Existing wetland impacts

Overall HGM Unit 1 scored an **E** for hydrology (due to backlogging from the dam and erosion of the channel downstream), a **C** for geomorphology (mainly due to sedimentation as a result of flow path modifications, dams and road crossings) and a **D** for vegetation (mostly due to the artificially increased prevalence of relatively monospecific rank vegetation and short species poor grassland in temporary zone due to high game grazing pressure). HGM Unit 2 scored an **E** for hydrology (due to decreased surface roughness and surrounding tilling practices), **B** for geomorphology (due to its relatively intact drainage profile) and **E** for vegetation (due to the disturbed weedy nature of the vegetation within and surrounding the depression). Lastly HGM unit 3 scored an **F** for hydrology (due to its hydrological regime being critically modified by tilling practices such as contoured drainage furrows that have served to decrease water retention within the wetland), **B** for geomorphology (the system's geomorphic shape remains relatively intact) and **F** for vegetation (due to complete displacement of natural hydromorphic grassland vegetation to cropland).

Table 7-20 Wetland present ecological state

HGM UNIT	Ha	EXTENT (%)	HYDROLOGY		GEOMORPHOLOGY		VEGETATION	
			IMPACT	CHANGE	IMPACT	CHANGE	IMPACT	CHANGE
1	1.78	32.62	7.5	-1	2.0875	-1	5.9	-1
			E	↓	C	↓	D	↓
2	0.77	14.09	6.5	-1	1.375	-1	6.5	-1
			E	↓	B	↓	E	↓
3	2.91	53.29	9.5	-1	1.5375	-1	9	-1
			F	↓	B	↓	F	↓
Area weighted impact scores*			8.42	-1	1.69	-1	7.64	-1.00

HGM UNIT	Ha	EXTENT (%)	HYDROLOGY		GEOMORPHOLOGY		VEGETATION	
			IMPACT	CHANGE	IMPACT	CHANGE	IMPACT	CHANGE
PES Category			F	↓	B	↓	E	↓

*Calculated by summing the area-weighted HGM scores for each HGM unit.

Hydrology

- Changes in water input characteristics from the catchment:
  - *Reduction in water inputs*: All three wetland HGM units within the study area have been significantly affected by a decrease in water input as a result of longstanding and extensive crop cultivation (predominantly maize and soya) within their catchments. For HGM unit 1 this impact is likely exacerbated by water abstraction for agricultural purposes.
  - *Increase in water inputs*: Some increase in water inputs from the towns of Hennenman and Whites is expected. This impact is, however, only of relevance to HGM unit 1. Although inputs from a small water treatment plant (between these towns) is evident (Google Earth imagery), it is highly likely that the system receives considerably more water from these towns. Overall the system associated with HGM 1 appears marginally larger and more inundated than in the 1964ortho-photograph, suggesting increased input from these towns, however, the confounding influence of climatic fluctuations cannot be ruled out.
  - *Change in flood peaks*: Hardened and exposed soil surfaces from extensive crop cultivation in the catchment have likely caused an increase in flood peaks across all the HGM units. HGM unit 1, in particular, is likely to receive additional runoff from the hardened surfaces in the towns of Whites and Hennenman. However, such flows are likely to be attenuated and regulated to a considerable degree by a number of road crossing and obsolete dam walls in the catchment thereby decreasing the frequency and/or severity of flood peaks. HGM unit 3 has likely experienced a large increase in runoff potential from natural state due to increased prevalence of bare ground. Although storm flows are partially attenuated by large drainage berms between croplands high rainfall events nevertheless have the effect of concentrating flows in drainage channels through the fields.
  - In terms of water quality, contamination of the wetland systems on site from nitrates, phosphates, pesticides, herbicides, fertilizers and other agricultural chemicals in their catchment is a possibility. Certainly HGM unit 1 shows signs of significant nutrient loading.
- Changes to water distribution and retention patterns within the HGM Unit:
  - The following impacts associated with extensive crop cultivation practices have had a significant effect on the infiltration and retention time of water within HGM units 1 and 2, ultimately decreasing saturation levels from the reference state:

- Ridge and furrow tilling (the channelling of water by means of berms and contoured drainage furrows to a large central drainage channel running along pipeline route) all serve to decrease water retention time within the wetland and facilitate its rapid movement out of the wetland.
- Tilling itself has also resulted in a drastic increased in the prevalence of bare ground from the natural state. Decreased grass cover leads to a decrease in the degree of rain splash protection, an increase in soil crust hardness and ultimately decreased infiltration and increased runoff.
- A decrease and complete loss in the vegetation roughness of HGM units 2 and 3 respectively (thinning/loss of grass sward) has likely drastically increased evaporative loss from the soil surface.
- Cultivation of high yielding annual crops such as maize and soya has further increased evapotranspirative loss from the wetlands.
- Margins of HGM unit 2 have been tilled and reduced saturation compared to reference state would likely result in decreased roughness.

- In contrast, based on historical ortho-photographs HGM unit 1 appears to have undergone an increase in overall surface roughness since 1964, evidenced by the marked increase in the density of reeds and rushes particularly *Typha capensis* as a result of increased saturation and nutrient levels presumably from urban growth.
- Backlogging and widening of HGM units 1 is occurring as a result of the large dam trapping sediments washed in from surrounding croplands.
- The dam downstream and sand road just upstream of HGM Unit 1, although somewhat helpful in attenuating flood peaks, act as impeding features to the natural flow regime of the wetland.

Geomorphology

- *Runoff*: HGM units 2 and 3 are affected by increased runoff due to extensive crop cultivation. This is most evident in HGM unit 3 where runoff is evident in the form of a network of drainage channels. Runoff within HGM unit 1 is effectively attenuated by the large dam high surface runoff and sinuosity of the system.
- *Erosional features*: Although the wetland soil forms identified on site all have a high erosivity severe erosion is limited likely due to the relatively flat topography and low rainfall of the study area. Nevertheless downstream of the dam wall at HGM unit 1 the water is relatively sediment deprived which together with a narrow outlet point has resulted in some channel erosion.
- *Depositional features*: The sediment environment or HGM units 1 and 2 is mostly depositional due to a flow impeding structure and inward draining profile respectively whereas HGM unit 3 is mostly erosional.

Vegetation

- Crop cultivation has largely displaced natural wetland vegetation along the pipeline route.
- Natural hydromorphic vegetation has been completely lost in HGM unit 3 such that the wetland is only readily discernible by means of soil wetness indicators.
- Vegetation within HGM unit 2 has been largely transformed by past crop farming and is now comprised of low diversity hydromorphic grasses interspersed with weedy annuals.
- Increased saturation and nutrient loading in HGM unit 1 has resulted in the proliferation of tall rank emergent vegetation such as *Typha capensis* and *Phragmites australis* artificially increasing surface roughness from the reference state. The temporary zone however is subject to high grazing pressure from stocked game and as such comprised of short homogenous grassland that is largely devoid of the expected compliment of facultative hydrophytes.

7.3.3. Wetland ecosystem services

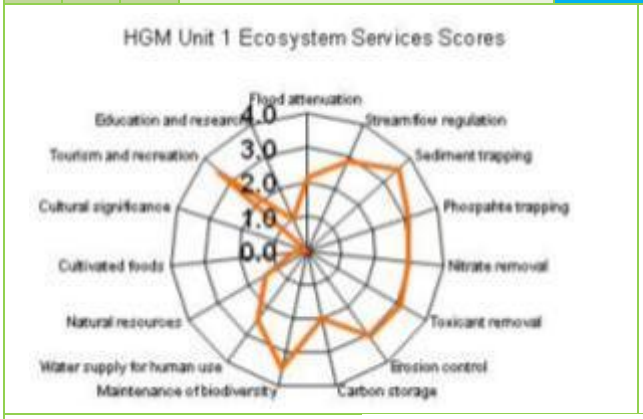
The results of the eco-system services assessment for both HGM units are summarised in **Table 7-21**. Overall HGM unit 1 provides by far the most meaningful ecosystem services followed by HGM unit 2 with HGM unit 3 providing little meaningful ecological functions in its current state. In terms of flood attenuation HGM unit 1 outperforms the other two HGM units both in terms of opportunity (source of runoff not only croplands but also hardened surfaces in Hennenman and Whites) and its effectiveness to do so (presence of dams, degree of channel sinuosity, higher surface roughness and lower average slope). Although seeps are generally renowned for their importance in streamflow regulation particularly during dry periods, the temporary nature of HGM unit 2 together with its low connectivity to downstream systems limits its importance in this case. HGM unit 1 in contrast exhibits far greater hydrological zonation and maintains a much larger capacity provide water to downstream systems during low flow periods. The depressions in the region, however, maintain at least some connectivity to downstream systems (likely through diffuse subsurface flows) and as such HGM unit 2 is considered to provide a meaningful contribution to streamflow regulation. Both HGM units 1 and 2 contribute meaningfully to sediment trapping while HGM unit 3 is least effective in this regard.

HGM unit 1 and to a lesser extent HGM unit 2 provide important nutrient and toxicant removal benefits. The former is considered more important in this regard due to it s higher opportunity to receive nutrients and toxicants (storm water runoff from towns and inputs from water treatment plants versus only croplands) but also its effectiveness to remove them due to its greater hydrological zonation (seasonal and permanent zones occupying a large proportion of the wetland area) and extent of rank vegetation within the permanent zone. Although the soils within the various HGM units vary little in terms of erodibility (all high) their efficacy at controlling erosion differs markedly with HGM Unit 1 being the highest and HGM

unit being the lowest with the modifying determinants being slope, presence of impeding features and vegetation cover.

Table 7-21 Ecosystem services supplied by the wetland HGM Units

			HYDRO-GEOMORPHIC SETTING	RATING		
				HGM UNIT 1	HGM UNIT 2	HGM UNIT 3
Ecosystem Services	Indirect benefits	Regulating/supporting	Flood attenuation	Moderately High	Moderately Low	Moderately Low
			Streamflow regulation	Moderately High	Intermediate	Intermediate
			Sediment trapping	High	High	Moderately High
			Phosphate trapping	High	Moderately High	Moderately High
			Nitrate removal	High	Intermediate	Intermediate
			Toxicant removal	High	Moderately High	Intermediate
			Erosion control	High	Moderately High	Intermediate
			Carbon storage	Intermediate	Moderately Low	Moderately Low
	Direct benefits		Maintenance of biodiversity	High	High	Intermediate
		Provisional	Water supply for human use	Moderately High	Intermediate	Moderately Low
			Natural resources	Moderately Low	Low	Low
			Cultivated foods	Low	Intermediate	Intermediate
		Cultural	Cultural significance	Low	Low	Low
			Tourism and recreation	High	Moderately Low	Low
			Education and research	Moderately Low	Moderately Low	Moderately Low



HGM unit 1, in particular, is highly important from a biodiversity maintenance perspective due to its capacity to support CI species as well as significant congregations of resident and migratory waterfowl. Only HGM unit 1 contributes meaningfully towards water provision for human use. Although the wetlands provide little in the way of cultural and educational

benefits the large dam within HGM unit 1 is however highly important from a recreational perspective.

7.3.4. Wetland importance and sensitivity

The results of the EIS assessment for the two HGM units identified on site are summarised in **Table 7-22** and discussed below. At a landscape scale all HGM units drain the C42J-02590 reach of the Rietspruit (26.88 km in length). This reach has a PES rating (from an aquatic perspective) of D Largely Modified (due to road crossings, instream dams, urban impacts from Hennenman at head of reach and Virginia at toe, small holdings, water purification works and agriculture), an EI and ES rating of Moderate (due to its moderate aquatic diversity and rarity of species). Although this reach of the Rietspruit remains unclassified in the FEPA rivers database lower foothill active channels such as these are classified as Endangered within the Dry Highveld Grassland Group 3 (DHGG3) NFEPA Wet Veg region. In terms of wetland protection status, within the DHGG3 NFEPA wetlands recognises channelled valley-bottoms (HGM unit 1), depressions (HGM unit 2) and hillslope seeps as Least Threatened, Near Threatened and Endangered wetland systems respectively. None of these wetlands types are protected within DHGG3.

The large heterogeneous habitat of the Rietspruit wetland system (HGM unit 1) has the potential to support a number of CI species. During the site visit the EN Yellow-billed stork was observed in this system. The open water may be visited by Maccoa Duck while the islet provides potentially suitable inland breeding habitat for Caspian tern. The mudflats and waters on the margins of the dam are likely to be utilised by Greater Flamingo and Curlew Sandpiper whereas the surrounding rank vegetation provide suitable breeding habitat for African marsh-Harrier. A number of rare and illusive waterfowl such as certain crake, rail and orchid species may also occur. This habitat diversity and extent of open water provides suitable conditions to support significant congregations of both resident and migratory waterfowl. Habitat within HGM unit 2 and its surrounding transformed grassland maintains at least some capacity to support CIS albeit of suboptimal quality. Similar habitat in the adjacent Hillslope seep was found to support African Grass Owl and Blue Korhaan (Digby Wells, 2013). Additional CI bird species likely to occur include Abdims Stork, Curlew Sandpiper, Blue Crane and African Marsh Harrier. CI mammals that likely occur include Southern African Vlei Rat and Serval. Habitat at HGM unit 2 may be utilised by Giant Bullfrog however mainly from a foraging and dispersal perspective as the dense emergent vegetation within the depression suggests habitat that is suboptimal for breeding suboptimal but not altogether unsuitable. Vegetation surrounding this depression has been previously tilled and is unlikely to support any orchids or populations of other unique and/or CI floral species. HGM unit 3 in contrast has a particularly limited capacity to support CI, unique or migratory species due to its complete and longstanding transformation to cropland.

Table 7-22 Wetland importance and sensitivity

WETLAND IMPORTANCE AND SENSITIVITY			
HGM UNIT	ECOLOGICAL	HYDROLOGICAL	HUMAN
1	Very High (3.3)	High (2.9)	Moderate (1.5)
2	High (2)	High (2)	Moderate(1)
3	Moderate (1.6)	Moderate (1.7)	Low (0.7)

8. Areas of Significance

The sensitivity assessment was based on findings from the ecological scan, as well as relevant national and provincial planning and other biodiversity conservation initiatives as described below. The assessment includes maps which show the relative sensitivity, or rather, the relative biodiversity conservation importance of patches within the main study area, and along the proposed pipeline route.

8.1. National and Provincial Areas of Conservation Significance

As alluded to in the earlier legislation section of this report, a number of features in the study area, which are of recognized national or provincial biodiversity conservation importance, require consideration.

8.1.1. Water Resources

A broad spectrum of international, regional and national legislation and guidelines applies to the protection of wetlands and their biodiversity (including e.g. CI species such as the grass-owl and bullfrog). The National Water Act (NWA; Act 36 of 1998) is the principle legal instrument relating to water resource management in South Africa. Under the NWA, all wetlands and their buffer zones are protected.

The NWA points out that it is:

> "*the National Government's overall responsibility for and authority over the nation's water resources and their use, including the equitable allocation of water for beneficial use, the redistribution of water, and international water matters.*"

According to Chapter 3 of the NWA on the protection of water resources:

> *"The protection of water resources is fundamentally related to their use, development, conservation, management and control. Parts 1, 2 and 3 of this Chapter lay down a series of measures which are together intended to ensure the comprehensive protection of all water resources."*

8.1.2. National Terrestrial Priority Areas & Threatened Ecosystems

The National (Terrestrial) Priority Area (NPA) assessment was based on integrating data on species, habitats and ecological processes to identify areas of greatest biodiversity significance. This resulted in the identification of nine spatial priority areas for terrestrial biodiversity. These priority areas represent areas with high concentrations of biodiversity features and/or areas where there are few options for meeting biodiversity targets (Rouget *et al.* 2004). The study area is situated in the Central Grassland Priority Area (**Figure 8-1**), which faces the highest pressure of the nine identified national Priority Areas (NBI 2004).

Box 2: Criterion A1: Irreversible loss of natural habitat

This criterion identifies ecosystems that have undergone loss of natural habitat, impacting on their structure, function and composition. Loss of natural habitat includes outright loss, for example the removal of natural habitat for cultivation, building of infrastructure, mining etc., as well as severe degradation. For this purpose, habitat is considered severely degraded if it would be unable to recover to a natural or near-natural state following the removal of the cause of the degradation (e.g. invasive aliens, over-grazing}, even after very long time periods.

A list of Threatened Ecosystems within each Priority Area was gazetted on 9 December 2011 under the NEM:BA (Act 10 of 2004). The Threatened Ecosystems occupy 9.5% of South Africa, and were selected according to six criteria which included;(1) irreversible habitat loss,(2) ecosystem degradation,(3) rate of habitat loss,(4) limited habitat extent and imminent threat,(5) threatened plant species associations, and (6) threatened animal species associations.

The proposed study area is situated in the Endangered Vaal-Vet Sandy Grassland Ecosystem (**Figure 8-1**). This Ecosystem is listed under Criteria A1 for Threatened Ecosystems (explained in **Box 2**). Dominance of the grass *Themeda triandra* is an important feature of the ecosystem. Where there is heavy grazing and/or erratic rainfall there is locally a low cover of *T. triandra* and an associated increase in *Elionurus muticus, Cymbopogon pospischilii* and *Aristida congesta*. At least one endemic plant species occurs in the Ecosystem, but less than 1% of the Ecosystem is protected in the Bloemhof Dam, Schoonspruit, Sandveld, Faan Mountains, Wolvespruit and Soetdoring nature reserves.

8.1.3. National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Area (NFEPA) project (Driver *et al.* 2011) provides strategic spatial priorities for conserving freshwater ecosystems and supporting sustainable use of water resources in South Africa. Freshwater Ecosystem Priority Areas (FEPAs) were identified using 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 NFEPA guidelines state that FEPAs should be regarded as ecologically important, and as generally sensitive to changes in water quality and quantity, owing to their role in protecting freshwater ecosystems and supporting sustainable use of water resources. FEPAs that are in a good condition should remain so, and FEPAs that are not in a good condition should be rehabilitated to their best attainable ecological condition. Land-use practices or activities that will lead to deterioration in the current condition of a FEPA are considered unacceptable, and land-use practices or activities that will make rehabilitation of a FEPA difficult or impossible are also considered unacceptable.

The NFEPA spatial data indicate that there is no Category 1 wetland FEPA on or within 500m of the Project area (**Figure 8-2**). Certain wetlands in the study area link with the Rietspruit, which feeds into the Sand River, 17km downstream. The Rietspruit and Sand River are both unclassified systems according to the NFEPA data. However 4km east (upstream) of the study area, is the Slootspruit (tributary of the Rietspruit), which is classified as a FEPA river.

"Applications for mining and prospecting in FEPAs and associated sub-quaternary catchments should be subject to rigorous environmental and water assessment and authorisation processes, as mining has a widespread and major negative impact on freshwater ecosystems" (Driver *et al*. 2011). Furthermore: mining in any form should not be permitted in FEPAs, or within 1km of a riverine FEPA buffer. No prospecting should occur in FEPAs or within 1km of a riverine FEPA buffer. Care should be taken to reduce the risks of aquifer penetration when drilling, wherever this occurs.

8.1.4. Mining and Biodiversity Guideline

The mining industry plays a vital role in South Africa's growth and development. But if mining is not strategically planned and carefully implemented, it has significant negative impacts on Biodiversity and ecosystems, in particular, catchments, rivers and wetlands that support water-related services. The Mining and Biodiversity Guideline (MBG; DEA *et al.* 2013) interprets the best available biodiversity knowledge and science in terms of the implications and risks for mining in a practical and user-friendly guideline for integrating relevant biodiversity information into decision making. The development of this guideline was initiated by the Chamber of Mines and the South African Mining and Biodiversity Forum, in partnership with the Department of Environmental Affairs and the Department of Mineral Resources, and with technical input and co-ordination by the SANBI Grasslands Programme.

The north-west "half" of the proposed pipeline route, including the discharge point, is situated where the land is classified in the MBG Atlas as having "**Highest Importance**" for biodiversity and "Highest Risk" to mining (**Figure 8-3**). MBG areas of Highest Importance include:

- Ramsar sites.

- Critically Endangered and Endangered Ecosystems.
- River and wetland FEPAs and a 1km buffer around these.
- Critical Biodiversity Areas from provincial spatial biodiversity plans.

The MBG stipulates that in areas of Highest Importance for biodiversity: "*Environmental screening, EIAs and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, and to provide site-specific basis on which to apply the mitigation hierarchy to inform regulatory decision-making for mining, water use licences, and environmental authorisations…If they are confirmed, the likelihood of a fatal flaw for new mining projects is very high because of the significance of the biodiversity features in these areas and the associated ecosystem services. These areas are viewed as necessary to ensure protection of biodiversity, environmental sustainability, and human well-being. Authorisations may well not be granted. If granted, the authorisation may set limits on allowed activities and impacts, and may specify biodiversity offsets that would be written into licence agreements and/or authorisations*."

8.1.5. Free State Conservation Plan

The Free State Department of Economic Development, Tourism and Environmental Affairs (DETEA) is in the process of finalising the Free State Biodiversity Sector or Conservation Plan (C-Plan). Although the spatial component of the Free State C-Plan is complete, the technical report and land-use guidelines are still in progress. Like other provincial C-Plans, the Free State C-Plan is based on the systematic classification of land into the following categories of (descending) biodiversity conservation importance: Protected Areas, Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), Degraded Areas, Other Areas and Non-natural Areas.

CBAs can include Irreplaceable and Important Areas. They are considered critical for meeting provincial biodiversity targets, and are required to ensure the persistence of species and the functioning of ecosystems. ESAs are generally not regarded as being essential for meeting provincial biodiversity targets, but play an important role in supporting CBAs and/or in delivering ecosystem services. ESA1 and ESA2 sites are generally distinguished on account of the degree of disturbance within them.

According to the Free State C-Plan information provided to NSS by the DETEA (unpubl. data), the land through which the north-western section of the proposed pipeline runs (which falls within the **Endangered** Vaal-Vet Sandy Grassland vegetation type), and a wetland to the east of the pipeline, have been classified as Irreplaceable CBAs (1). Presented in **Table 8-1** are the land-use objectives for CBAs (1), according to the draft Free State C-Plan guidelines (DETEA unpubl. data).

Table 8-1 Free State C-Plan land-use objectives for CBAs (1)

CBA MAP CATEGORY	DESCRIPTION	LAND MANAGEMENT OBJECTIVES
Critical Biodiversity Areas (1)	Irreplaceable Sites. Areas required to meet biodiversity pattern and/or ecological processes targets. No alternative sites are available to meet targets.	Maintain in a natural state with limited or no biodiversity loss. Rehabilitate degraded areas to a natural or near natural state, and manage for no further degradation.

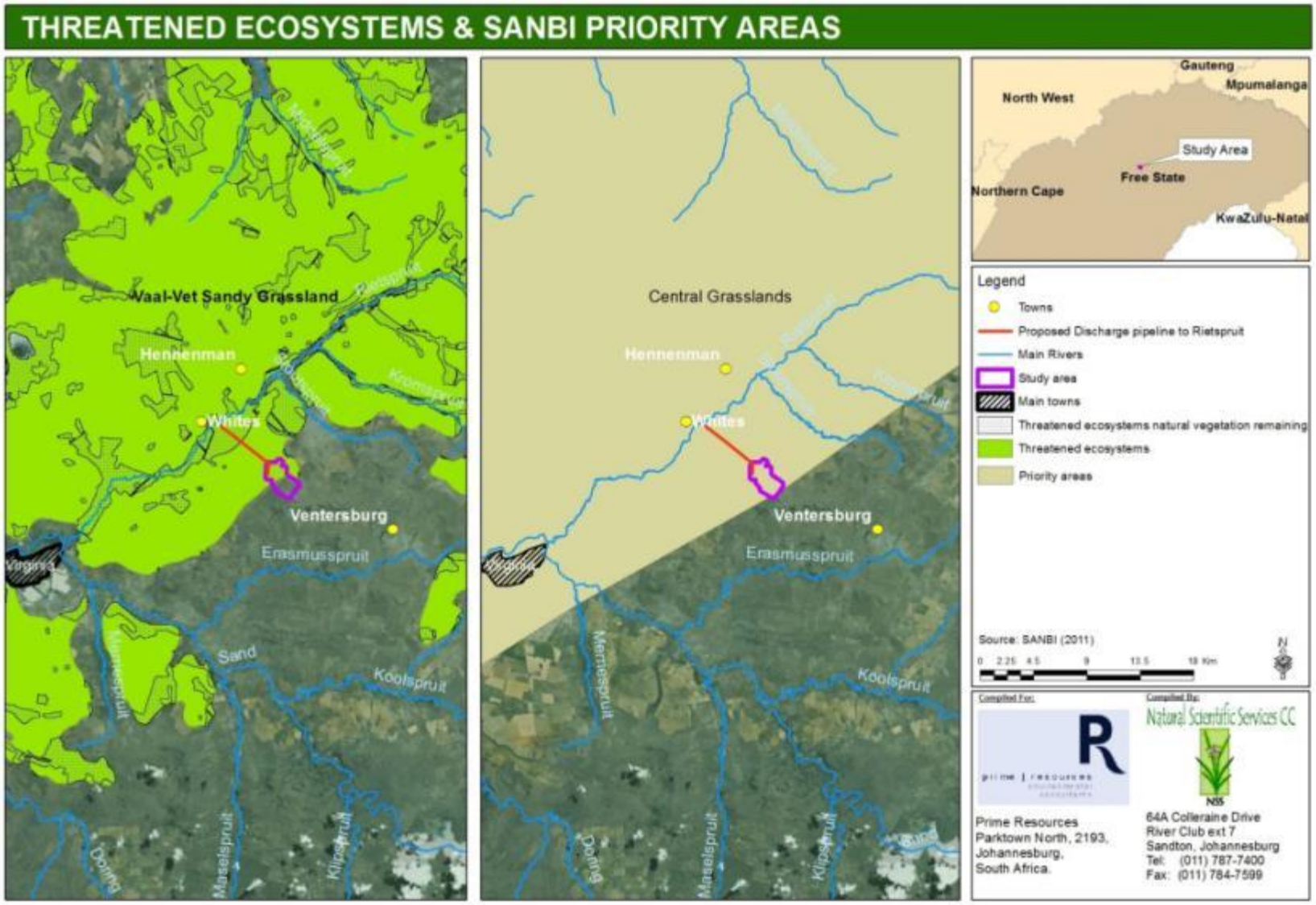


Figure 8-1 Terrestrial Priority Areas and Threatened Ecosystems

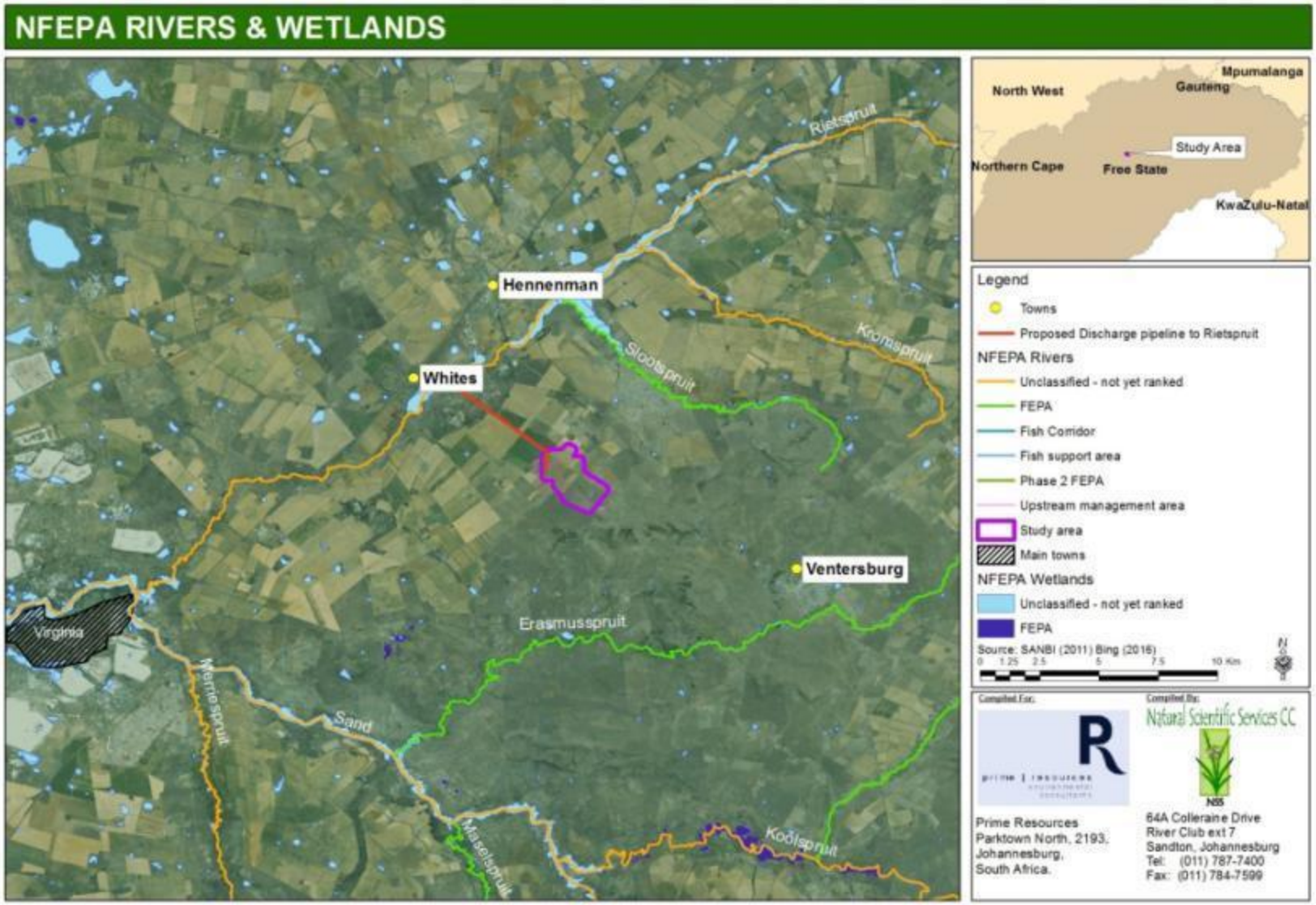


Figure 8-2 Freshwater Ecosystem Priority Areas

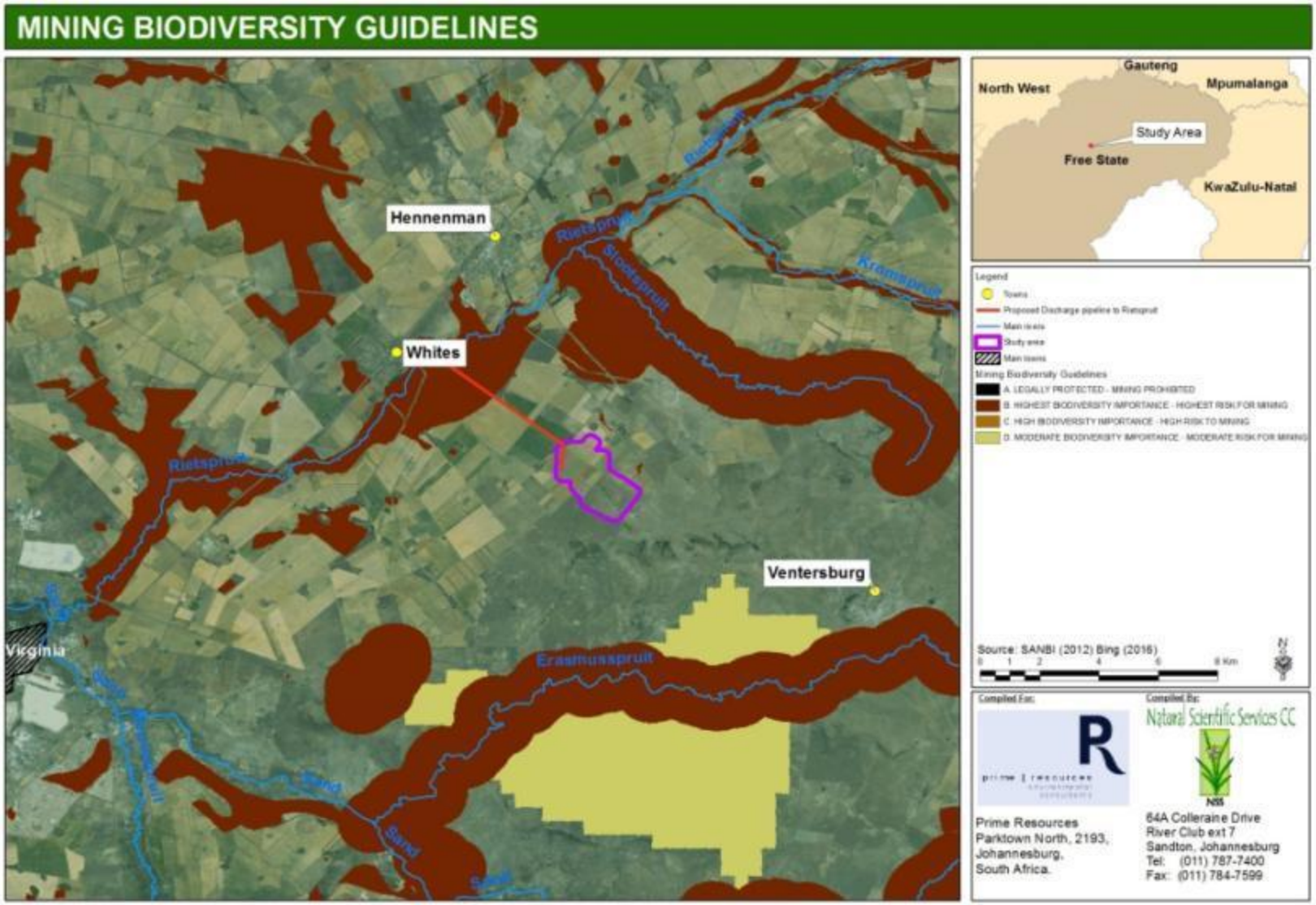


Figure 8-3 Spatial data from the Mining and Biodiversity Guideline

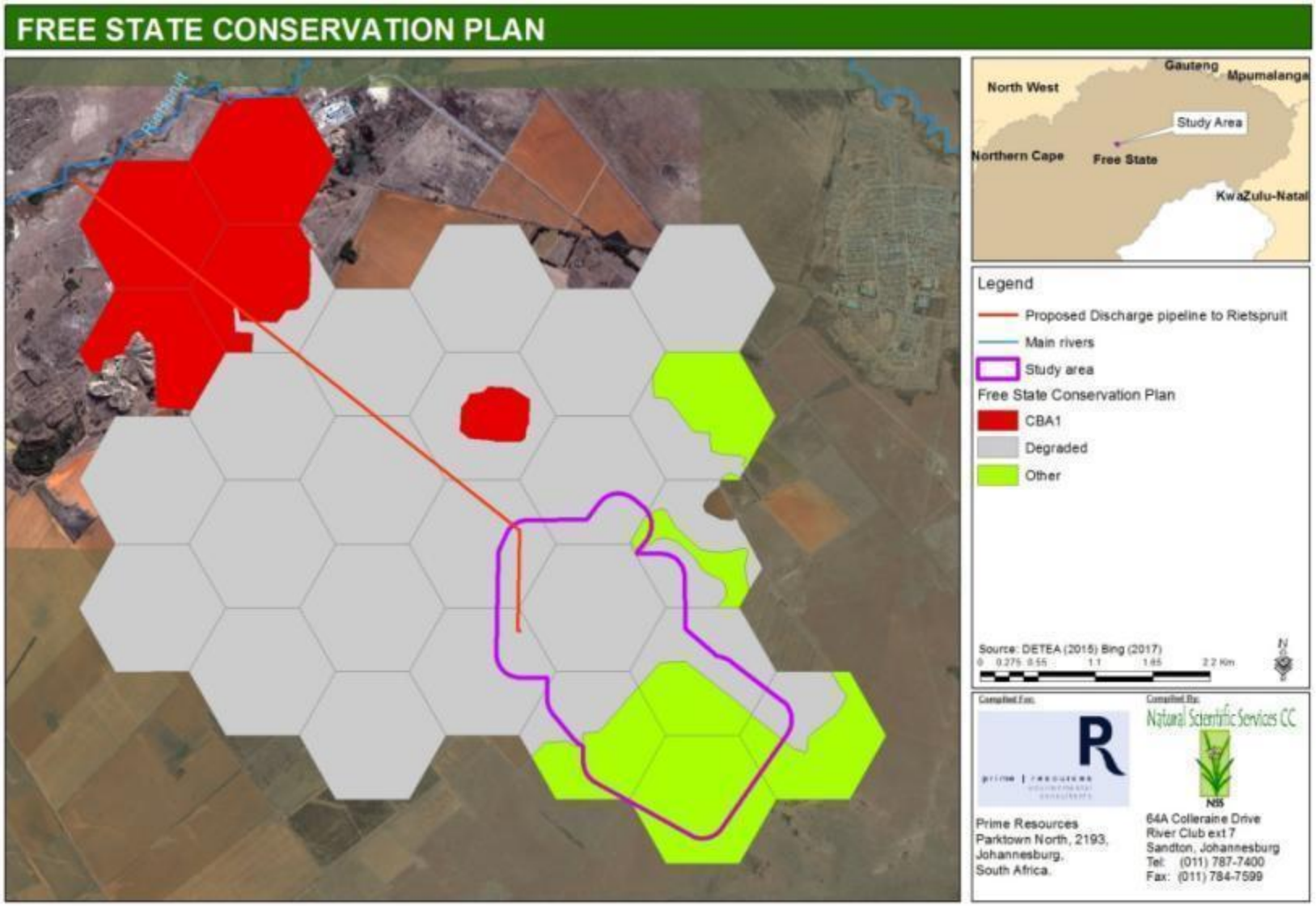


Figure 8-4 Spatial data from the Free State Conservation Plan (DETEA unpubl. data)

8.2. Local Areas of Conservation Significance

The conservation significance of local biodiversity was rated and mapped based on:

- Ecological sensitivity (including renewability/success for rehabilitation);
- Level/Extent of disturbance;
- Presence of CI species (identified at the vegetation unit/habitat level); and
- Conservation value (at a regional, national, provincial and local scale).

Areas within the study area were ranked with ***High***, ***Moderate-high***, ***Moderate, Moderate-low*** or ***Low*** biodiversity conservation significance according to the scoring system shown in **Table 8-1.**

Table 8-1 Scoring Range for the Areas of Significance

Category	Scoring Range	
	Upper	Lower
High	15	11.1
Moderate - High	11	7.1
Moderate	7	3.1
Moderate - Low	3	-0.9
Low	-1	-5

The relative conservation importance of different patches within the main study area, and within the 30m-wide survey buffer around the proposed pipeline route, is shown in **Figure 8-5** and **Figure 8-6**, respectively and summarised in **Table 8-2**, where:

- **High** rated areas include:
  - All wetland areas, which are protected under the National Water Act. Although the vegetation component in HGM 3 has been displaced, it still functions from a hydrological and geomorphological perspective. Despite high levels of transformation through tillage practices, signs of surface and subsurface movement of water through this system are still evident in the field. Surface flows, following a high rain event during the site visit, have left a clearly disenable network of drainage channels through the recently ploughed land. Subsurface flow was evidenced by the Bainsvlei soils which showed seasonal fluctuation of the water table through a soft yellow plinthic layer with black oxides which was followed by a "G" horizon near 70 cm showing clearly discernible high chroma mottles. It is thus still a wetland and all wetlands are protected by legislation South Africa. With this in mind and following GDARD minimum requirements for biodiversity assessments the wetland has been designated as sensitive.
- **Moderate-High** rated areas include:
  - A 100m buffer around all wetlands, based on the DWS requirements.
  - The natural to semi-natural *Themeda* Grassland Community, which is representative of the **Vulnerable** Central Free State Grassland vegetation type and is habitat for a number of confirmed Red Listed Faunal Species.

- **Moderate** rated areas include:
  - The disturbed Grasslands and patchy Thornveld Community within the old mined lime quarry, which supports a high diversity of game animals.
- **Moderate-Low** rated areas include areas that are disturbed but still providing sufficient habitat for faunal and floral species. These are mainly found along the pipeline route:
  - *Eragrostis* Disturbed Grassland
  - *Searsia lancea* Bushclump
  - Transformed: *Asparagus* Dominated
- **Low** rated areas include:
  - Cultivated fields.
  - Roads
  - Infrastructure.
  - Alien bush clumps.
  - Areas denude of vegetation.

The maps should guide the proposed development where:

- Disturbances should preferentially occur in Low and Moderate-low sensitive areas.
- **High** sensitive areas should be avoided.
- **Moderate-High** sensitive areas should be subject to very limited disturbance and rigorous mitigation.
- **Moderate** sensitive areas may be disturbed with effective mitigation.
- **Moderate-Low** sensitive areas may be disturbed with minimal or no mitigation.
- **Low** sensitive areas should be rehabilitated if not developed.

Table 8-2 A summary of both the floral and combined biodiversity (fauna/flora/wetland) ratings

Community	Floral Rating	Combined Biodiversity Rating
Semi - Natural Terrestrial Grasslands		
Acacia Thornveld	Moderate	Moderate-High
Eragrostis Disturbed Grassland	Moderate-Low	Moderate-Low
Searsia lancea Bushclump	Moderate-Low	Moderate
Themeda- Aristida Sandy Red Soils	Moderate-High	Moderate-High
Themeda Dominated Grassland	Moderate	Moderate-High
Themeda Dominated Grassland (past farming)	Moderate	Moderate-High
Themeda- Eragrostis Clay Rich Soils	Moderate-High	Moderate-High
Transformed: *Asparagus* Dominated	Moderate-Low	Moderate-Low
Moist -Hydromorphic Grasslands / Wetlands		
Setaria-Persicaria Pan System	Moderate-High	Moderate-High
Sporobolus- Cynodon Wetland	Moderate-High	High

Community	Floral Rating	Combined Biodiversity Rating
Typha Dominated Wetland	Moderate-High	High
Transformed Habitats		
Agriculture - Crops	Low	Low
Agriculture - Old Fields	Low	Low
Agriculture - Pasture	Low	Low
Alien Bushclumps	Low	Low
Transformed - Built Up	Low	Low
Transformed - Canal	Low	Low
Transformed - Excavations	Moderate-Low	Moderate-Low
Transformed - Soil Disturbances	Low	Low
Transformed - Soils Stockpiles	Low	Low

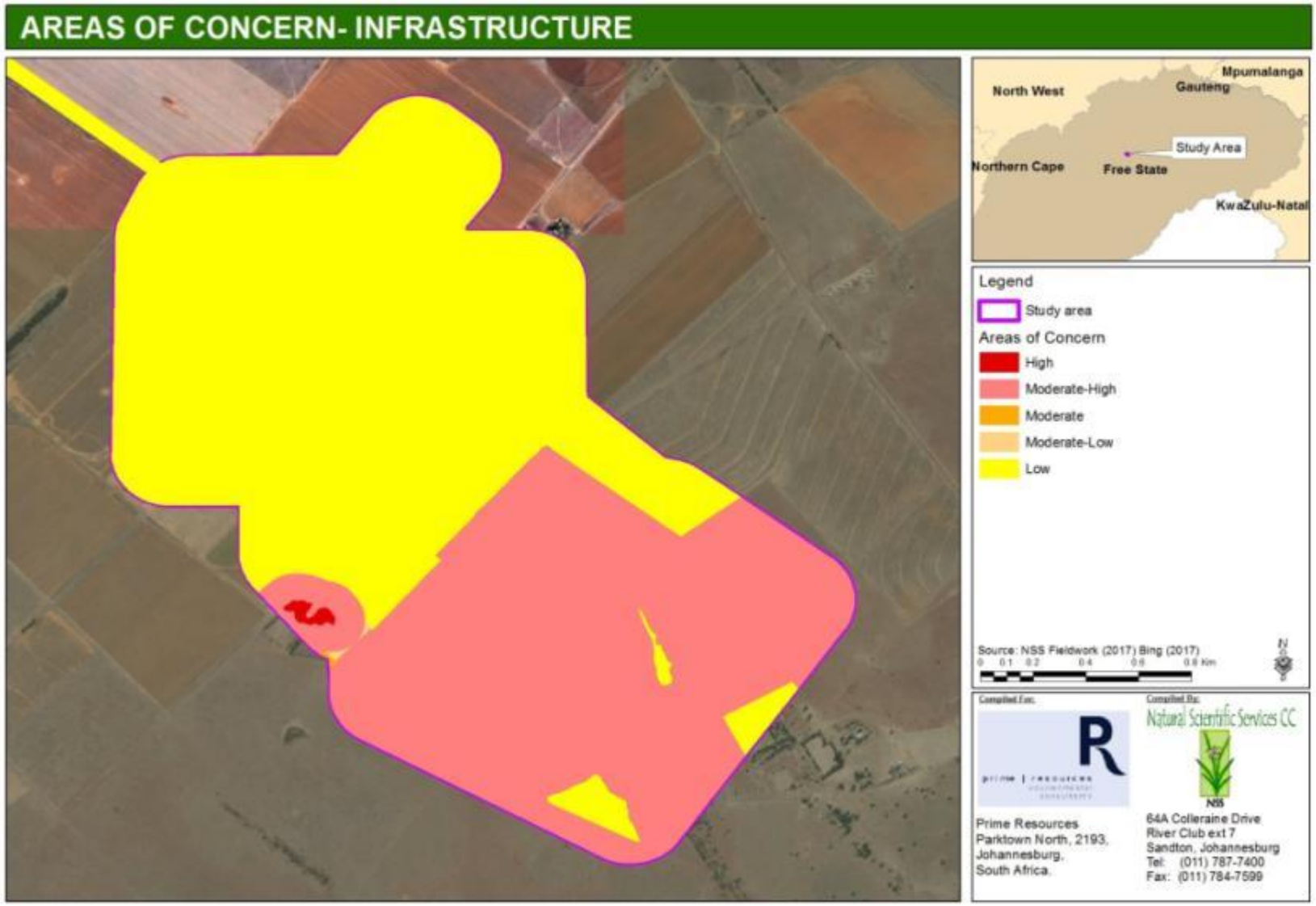


Figure 8-5 Relative conservation importance of biodiversity in the main study area

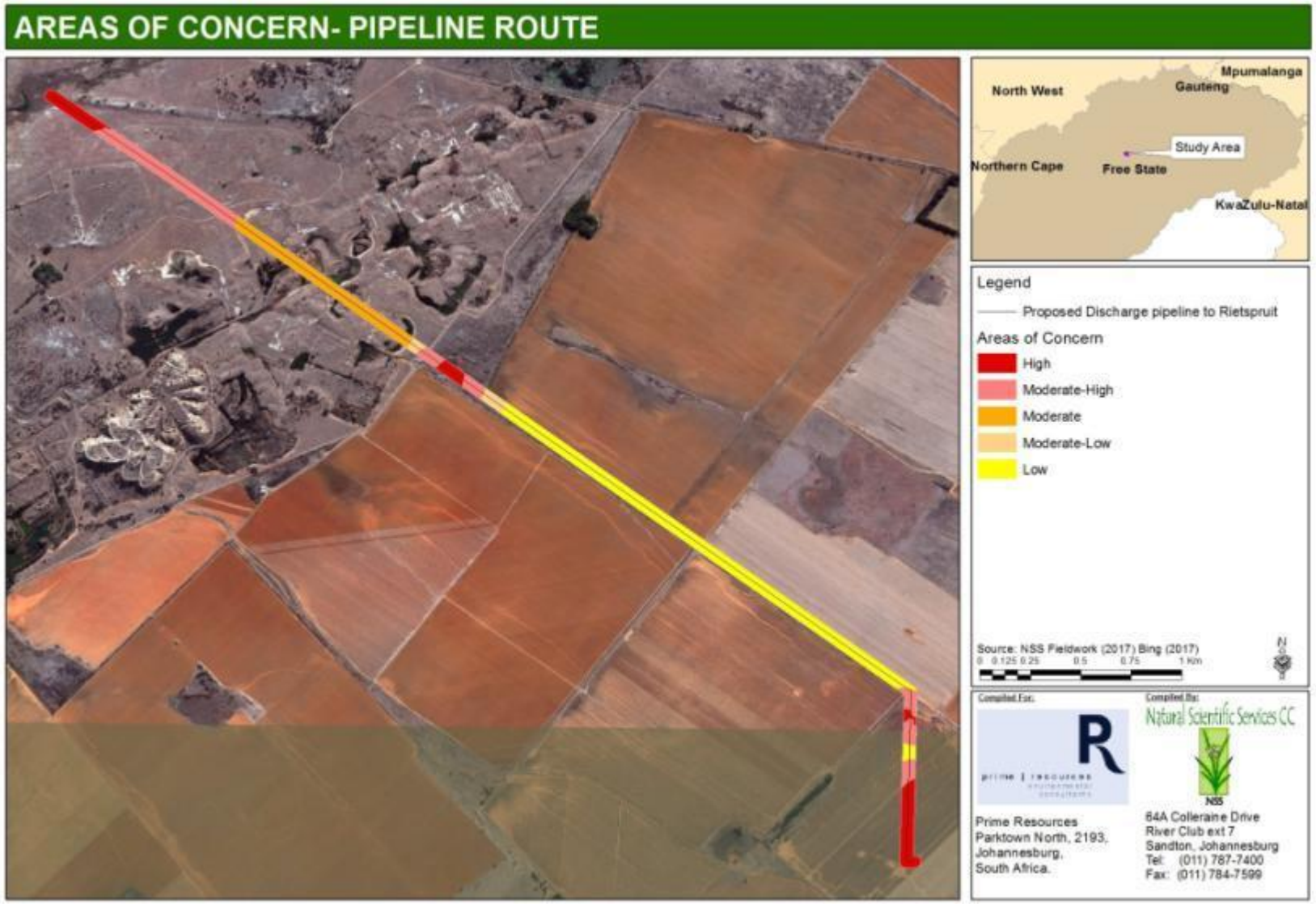


Figure 8-6 Relative conservation importance of biodiversity along the proposed pipeline route

9. Impact Assessment & Recommendations

9.1. Current Impacts

9.1.1. Crop cultivation

Approximately 55% of the study area (including the proposed pipeline route) has been transformed by crop cultivation. Historical imagery has shown that this has been occurring since at least as far back as the early 1960's. This has resulted in the loss of native terrestrial vegetation, wetlands, and certain plant and animal taxa. The crop cultivation has also caused considerable disturbance to the soil, and increased dust, erosion and sedimentation. Along the edges of cultivated fields, weedy and invasive alien flora have established. Fertilizers, pesticides, and other animal control methods that have likely been used in the crop fields may have had an impact on biodiversity within the surrounding areas.

9.1.2. Livestock farming

Livestock camps and watering points are scattered throughout the study area, and cattle grazing was evident in the Thornveld in the southern section of the study area. Currently, grazing, trampling, erosion, and eutrophication of water resources from manure, affect those areas in which the cattle concentrate. Antibiotics and dips, which are known to adversely affect dung beetles and other taxa, have potentially been used to control livestock diseases and parasites.

9.1.3. Lime mining (Historical)

The transformation of the grasslands to the north-west have altered and transformed into new types of habitats, predominantly seasonal artificial wetlands. These areas, however, also contain a number of alien and invasives species.

9.1.4. Harvesting of natural resources

Although no direct signs of harvesting of wood and medicinal plants or hunting of wildlife was observed, it likely does take place given the study area's proximity to rural settlements.

9.2. Potential Fauna and Floral Impacts

For each phase of the proposed mining operation, potential impacts on terrestrial flora and fauna have been in **Table 9-3**. Potential impacts of the proposed pipeline on wetlands have been ranked in **Table 9-4.** Provided next, is a brief discussion of how each foreseeable activity will potentially impact flora, fauna and/or wetlands.

9.2.1. Influx / Activity of people

During construction the project will likely cause dramatic influx of people into the study area, which is likely to increase steadily through operation. The more people there are, the more likely it will be that flora, fauna and their habitats will be subjected to unintentional

disturbance and even deliberate exploitation. Since much of the study area comprises cultivated fields, it is anticipated that harvesting of fire wood, medicinal flora, and game animals will continue (and likely increase) and be focussed on the natural and disturbed Thornveld habitats and the natural areas (including the kloofs) to the east. If not controlled, such practices can become unsustainable and result in the extirpation of targeted taxa. Although not in the direct infrastructural footprint, of particular concern are Geophytic species such as the *Nerine.* An additional impact associated with the influx in people would be the increased persecution and sensory disturbance faced by fauna.

9.2.2. Use and maintenance of roads, and the transport of materials

The dramatic increase in road traffic during construction, which may even increase during operation, will result in collisions of vehicles with fauna. Nocturnal fauna will be especially vulnerable if there is road traffic at night. Apart from injuring and killing fauna, road traffic is likely to disturb fauna that are sensitive to noise, vibrations and bright lights. Such disturbance could cause displacement of sensitive faunal taxa, such as mammalian carnivores, nightjars, owls and large terrestrial birds.

Plants can expand their range through natural dispersal, such as through wind, water or animal dispersal. However, it is a known fact that, with the advent of widespread human movement, humans have aided the process of species dispersal, by, amongst other things, carrying organisms or propagules with them around the world (whether intentional or unintentional). In this project, through vectors such as vehicles and trucks, the transport of materials may introduce additional invasive alien plant and animal (e.g. Common Rat, House Mouse, House Sparrow and Common Myna) species into the Project area, create further propogule pressure. Propagule pressure is directly linked to the number of individuals (or propagules) of a particular species that is introduced and the frequency thereof, as this increases the likelihood of a founding population being established. Increases in traffic volume may therefore increased propagule pressure.

9.2.3. Storage of materials (equipment, fuel, explosives, etc)

During construction, initial storage of materials will result in the loss of affected habitat patches and certain fauna (esp. small taxa with poor mobility) therein. Of greater concern is that with long-term storage of materials (such as through operation), accidental environmental contamination might occur. Fauna and their habitats could be adversely affected by this, depending on the intensity and extent of contamination incidents. Without rapid and effective remediation / rehabilitation, contaminated areas could impact biodiversity long term.

9.2.4. Clearing of vegetation and topsoil

Clearing of vegetation and topsoil (mainly during construction) will result in the destruction of cultivated fields, as well as some natural and disturbed *Themeda* grasslands and *Acacia* Thornveld, as well as a broad spectrum of fauna therein. The significant habitats / vegetation

communities that will mainly be affected are those found within the infrastructural footprint (specifically the Tailings Storage Facility) are highlighted below in **Table 9-1**:

Table 9-1 Habitats / Vegetation Communities affected within the Study Area

Community	Combined Biodiversity Rating
Acacia Thornveld	Moderate-High
Themeda Dominated Grassland	Moderate-High
Themeda Dominated Grassland (past farming)	Moderate-High

The *Sporobolus - Cynodon* Wetland is found on the edge of the infrastructural footprint and may also be affected through edge effects.

From a floral perspective these habitats contain a relatively limited floral diversity and have undergone structural changes from past agricultural activities. In terms of small faunal taxa with poor mobility, these will be the most vulnerable to destruction from such activities. Additional fauna will be displaced by the destruction of these habitats, or disturbed by the noise and dust from clearing vegetation and topsoil. Of particular concern is that CI species could be impacted, such as the Aardvark (displacement), overwintering or foraging Giant Bullfrog (destruction and displacement), and the ground-nesting Melodious Lark (displacement).

9.2.5. Stockpiling of soil and organic debris

As with the previously-mentioned storage of (non-organic) materials, during construction, initial stockpiling of soil and organic debris will result in the loss of affected habitat patches and certain fauna contained therein. Of greater concern is that, if poorly managed, stockpiles can contribute to increased dust, erosion, sedimentation, and alien plant proliferation in the surrounding area. Fauna are also likely to be disturbed by the noise, vibrations and dust caused by truck traffic and soil dumping.

9.2.6. Development of infrastructure (involving blasting, drilling, construction)

With the progressive development of infrastructure, the availability of habitable conditions and the diversity of potentially occurring fauna will diminish within the construction footprint. Over one third of the area is considered semi-natural and did contain a number of CI faunal species.

According to Prime Resources, construction will involve surface blasting. The shafts will be sunk by drilling and blasting rounds vertically downwards using a typical multi-boomed shaft jumbo drill rig. The overall period of construction of the shafts will be approximately 40 months. Underground mining operations will also involve blasting. Seismic monitoring and independent assessments have shown that blasting at 350 m below surface will not result in surface vibrations significant enough to cause damage to surface infrastructure. The Ventersburg Project will undertake blasting at even greater depths, reaching close to 570 m.

Surface blasting, drilling, and construction activities will create considerable noise, vibrations and dust, which will likely disturb a broad spectrum of fauna within a wide (several km) radius of the activities. Many fauna are likely to return to remaining suitable habitats in the surrounding area once construction activities have ceased as operational blasting is not considered to impact above or just below surface. With time, some adaptable indigenous and alien fauna will colonize the built development.

9.2.7. Stockpiling of ore and waste rock

The remaining natural habitat that will be affected by the construction of the TSF and Waste Rock areas is approximately 38% of the total infrastructural area. During operation, initial stockpiling of ore and waste rock will result in the loss of affected habitat patches and certain fauna contained therein. Of greater concern is that with long-term existence of the stockpiles, environmental contamination could occur. Depending on the treatment / handling of ore and waste rock, the design of the stockpiles, and their management, contamination could impact ground water, surface water, soil, dust and air quality, which could have a far-reaching impact on habitats and fauna.

As part of the mitigation, Prime Resources indicated that for all surface pollution sources (waste rock dump, TSF, RoM stockpile and dams), these will include lining according to legislative requirements preventing contamination of groundwater resources.

9.2.8. Re-vegetation of TSF

Gold mine waste poses a significant challenge for rehabilitation practitioners and can negatively impact on soil, air, surface water and groundwater quality. This, in turn, can affect the environmental quality of biota in surrounding ecosystems. Gold TSF's are known to have caused significant impacts on the environment through windblown tailings dust as well as acid mine drainage. Research has shown (an ecotoxicological study performed in 2008) that environmental impacts of TSFs did not increase with age, but were more likely to be an indication of the rehabilitation measures administered to the different TSFs. Therefore dust control, seepage treatment, rehabilitation, and spill management as well as closure and long-term maintenance of TSFs are imperative. Successful re-vegetation with indigenous species of the TSF could greatly reduce the impact on the receiving environment.

9.2.9. Demolition of infrastructure

The demolition of infrastructure during decommissioning will destroy some artificial faunal habitat, and certain fauna (e.g. doves, rodents and skinks) that have occupied this. The noise, vibrations and dust associated with demolition activities will also likely cause disturbance of sensitive fauna, which could be (temporarily) displaced from the area. If in an area, demolition activities are followed by successful indigenous rehabilitation activities, this would ultimately have a positive impact on biodiversity.

9.2.10. Waste management

During decommissioning, poor management of waste (waste rock, explosives, fuel sewage, other dirty water, building rubble, office waste, etc.) will adversely impact habitat integrity and faunal health. Without removal from the site, and appropriate disposal / recycling, abandoned waste will likely have long-term and possibly extensive adverse impacts.

9.2.11. Rehabilitation (contouring, soil preparation, re-vegetation)

As would be expected, rehabilitation of disturbed areas (surface infrastructure) was rated as an activity with a positive impact, namely, the creation of semi-natural habitat, which would enable its recolonization by certain fauna. Prime Resources indicated that the planned end-land use would be grazing land. If locally indigenous flora are used for re-vegetation, and if measures are implemented to ensure that re-vegetation and other remedial measures are successful, the impact of the mining operations on the receiving environment in the long term could be reduced. Species that could be used in rehabilitation efforts are mentioned in the mitigation below.

9.3. Recommended Mitigation and Management Measures

Below follows a consolidated list of recommended impact management and mitigation measures (Provided for flora and fauna in **Table 9-3**, and wetlands in **Table 9-4**.).

9.3.1. Pre-Construction

Prior to construction the following should be implemented:

- Compile a comprehensive and effective Biodiversity Management Plan (BMP). This plan should include not only the direct infrastructural footprint but the Study Area surveyed as well as the properties owned by Gold One. The plan should include:
    - An alien plant control programme,
    - Storm water management plan,
    - Soil management plan,
    - Fire control programme, and
    - A Rehabilitation Plan.

      As part of the rehabilitation plan the following grassland species can be considered: *Eragrostis chloromelas, Eragrostis lehmanniana, Themeda triandra, Eragostis plana, Eragrostis trichophora, Anthephora pubescens, Aristida congesta, Chloris virgata, Cymbopogon caesius, Cynodon dactylon, Digitaria argyrograpta, Elionurus muticus, Heteropogon contortus and Setaria sphacelata.*
- Awareness raising and training of staff. This is essential within any mining operation. The Environmental Officer (EO) appointed for the Ventersburg Project must undergo rigorous training in all biodiverse areas but also will be required to focus on alien invasives and the eradication thereof. These courses must be certified and when completed must be presented to the relevant departments to ensure that the EO is

fully qualified. The EO must be kept up-to-date with all biodiversity legislation updates and changes and must do refresher courses annually.

- In addition, as part of the initial introduction to the site for all teams, staff contractors, a biodiversity session should be incorporated into the induction process. This should highlight:
    - The importance of biodiversity;
    - The different habitats in the area;
    - The habitats that the teams must avoid;
    - Reasoning why species should not be harvested or used as firewood;
    - Speeding and the impacts on biodiversity;
    - Alien Invasive Species;
    - Incentives for reporting any instances of speeding or harvesting etc;
    - Reporting of biodiversity sightings;
    - Avoidance (and not destruction) of feared species such as snakes;
    - Contacts for snake removals and biodiversity reporting of species such as Giant Bullfrog, African Grass Owl, Serval occurrences, etc.
- Obtain permits to relocate any Protected CI floral species – this could include Geophytic species such as *Gladiolus, Bulbines, Nerines, Hypoxis hemerocallidea, Boophone* etc.
- If found within the footprint during the construction period, relocate CI fauna (notably the potentially occurring White-tailed Rat, Striped Harlequin Snake, Leopard Tortoise and Giant Bullfrog) from the construction footprint with advice from an appropriate specialist.

9.3.2. Construction, Operation and Decommissioning

- As part of the Alien Removal and Control plan species that need to be removed and monitored are highlighted in **Section 7.1.4** above. More specifically, the Category 1 species that are likely to spread and increase are listed below in **Table 9-2.**

Table 9-2 Species to look out for in surrounding areas and wetlands

FAMILY	SPECIES	GROWTH FORM	CARA	NEMBA
ASTERACEAE	*Cirsium vulgare (Savi) Ten.*	Herb	1	1b
ROSACEAE	*Pyracantha cf coccinea M.Roem.*	Shrub	Weed	1b
TAMARICACEAE	*Tamarix chinensis Lour.*	Tree	1	1b
VERBENACEAE	*Verbena bonariensis L.*	Herb	Weed	1b
ASTERACEAE	*Xanthium spinosum L.*	Herb	1	1b

- Limit construction / decommissioning activities to day time.
- Demarcations
    - Any sensitive areas (mainly wetland habitats in this project) should be demarcated and avoided by all personnel. This includes areas outside of the infrastructural footprint. No access via vehicle or by foot within these areas.

An incentive reporting programme on violations should be implemented. This will also apply to workers and communities from disturbing, collecting or poaching fauna.
    - Demarcate and fence in the construction / decommissioning site.
    - Demarcate all areas for stockpiling and bund these areas. These areas should also be regularly monitored for any alien species regrowth.
- All surface pollution sources (waste rock dump, TSF, RoM stockpile and dams) will need to include lining according to legislative requirements.
- Stockpiling
    - Limit stockpiling activities to day time and dry weather.
    - Commence (and preferably complete) construction / stockpiling / decommissioning during winter.
    - Stockpiled soil should be used to rehabilitate disturbed areas as soon as possible. There will be ongoing and progressive rehabilitation.
    - Any topsoil that is to be stockpiled for future use must be stored at a minimum height to retain the viability of the seed bank. Remove the top 100mm of topsoil and stockpile in small mounds, where possible. The recommended depth of removal is between 100–200 mm of topsoil as this contains the indigenous seed bank (only within natural areas that have been cleared. This is also applicable to the pipeline route. Stockpiling should occur for the shortest possible time to minimize propagule death.
    - A study by Harris *et al*. (1989) states stockpiled soil exceeding a meter deep, results in chemical effects such as accumulation of ammonium and anaerobic conditions at the base of the pile. The suggested height of the stock pile is below 2m (1-1.5m preferably), (ARC *pers. comm*., 2006). Although this is highly recommended for successful rehabilitation, the trade-off between this, and the increase in footprint and impact of a greater area, needs to be considered.
    - If there is a limited availability of topsoil, the introduction of top soil should be considered as this would potentially support a higher diversity of plants.
- Road Networks
    - Signpost the main access road/s, and all no entry roads.
    - Ensure that the Project road network includes traffic speed control measures.
    - Limit road use at night.
- Rehabilitation of TSFs

  Rehabilitate the TSF, stockpiles and other disturbed areas as soon as possible.
    - Obtain guidance from Gold Tailings rehabilitation specialists before commencing;
    - The proper establishment of vegetative cover depends mainly on the selection of plant species that will grow, spread and thrive under the hostile conditions provided by the nature of dump material. The revegetation of tailings dams requires some preparatory measures prior to vegetating. This is

because the tailings dams are acid generating on the surface and lack organic nutrients for plants to grow and are thus totally inappropriate for vegetation growth. Therefore preparatory measures should look at altering these conditions through potential liming and leaching;

- Effective Windbreaks will need to be set up: This is to prevent vegetation being buried by sand on the slopes.
- Tailings materials will need to be turned into a medium favourable for plant growth by addressing the chemical, physical and biological deficiencies of the media.
- Re-vegetate using stockpiled soil (if available) and locally indigenous flora. Annuals and legumes must be included in the seed mixture to produce plant debris after a short time. This will improve the organic matter content.
- Avoid Rock cladding as this could cause erosion and slumping. (Rock cladding is normally limited to TSFs with slopes of more than 50^{o}).
- Monitoring through an effective tool such as the Landscape Function Analysis (LFA)

- Alien Invasive Species
  - Implement the BMP and Alien Invasive programme which could include:
    - Identification of Priority areas for removal and monitoring – i.e. Control invasive alien flora along all roads in sensitive areas such as the wetlands.
  - A mitigation measure that must be a requirement would be to source construction (building sand etc) and rehabilitation (topsoil if required) materials from reliable suppliers that can certify limited to no weed presence. This is not the norm within South Africa and there are no strict controls or certifications in place. Checks on the source of materials brought in during construction can also be tedious, costly and time consuming. This may be difficult but a necessity to prevent further encroachment.
- Water Management
  - Ensure that all WUL requirements are met.
  - Ensure that emergency procedures are in place for water management issues.
- Waste Management
  - Signpost all storage areas.
  - Ensure that employees know how to handle and dispose of hazardous substances.
  - Ensure safe storage, handling and disposal of hazardous materials.
  - Ensure that all hazardous materials are disposed of at an appropriate licensed facility.
  - Ensure that all waste (including building rubble, general and domestic waste, fuel, explosives) is removed.
  - Ensure that recyclable waste is taken to an appropriate recycling facility.

- Effectively rehabilitate contaminated areas with advice from an appropriate specialist.

9.4. Potential Wetland Impacts Associated with the pipeline

9.4.1. Transport and storage of construction materials (equipment, cement, pipes)

Impact: *Wetland disturbance as a result of the transport and storage of construction materials.*

Transport of construction materials to the site has the potential to negatively impact the receiving wetlands by driving of heavy vehicles through the wetland. This impact is likely to be intensified following high rainfall events. Soil disturbances from vehicles can trigger the proliferation of alien and invasive species while tyre tracks can leave longstanding marks on wetlands. Storage of pipes and other construction materials will inadvertently lead to a die-back of vegetation underlying the laydown area and may be particularly deleterious if placed within a wetland. Additionally an increased in soil compaction is likely to accompany laydown and construction areas with the effect of decreasing infiltration and overall runoff within the wetland systems. During construction heavy excavation vehicles and other machinery have the potential to contaminate the wetland with petrochemicals and other hydrocarbons.

Mitigation:

- Clearly demarcate the wetland areas on the ground from the edge of the 100 m buffer zone and signpost them as sensitive ecological areas (see wetland extent and sensitivity maps and request where necessary the spatial /gpx files)
- Ensure all construction material including heavy vehicles are stored at a single designated laydown area situated not only outside of the delineated wetland areas and their associated 100 m buffer but also the 1:100 year Rietspruit floodline.
- Avoid driving to the pipeline construction site following high rainfall events.

9.4.2. Site preparation

Impact: *Alteration of wetland sediment regime.*

Clearing of vegetation, removal of topsoil and levelling of ground is anticipated to increase the extent of bare ground and hardened surfaces with implications for infiltration, runoff and sedimentation. The effects of increased runoff are likely to be exacerbated by the highly erosive nature of the prevailing Bainsvlei, Willowbrook and Rensberg soils. Such an impact is likely to exacerbate erosion in HGM unit 3 and result in increased sediment deposition within HGM units 1 and 2.Ultimately the effects of increased sedimentation are likely to further impact on the already Largely Modified ecological state of the downstream Rietspruit. This impact should be viewed in context of the far reaching and pervasive effects of agriculture and the vast expanses of land that have long been cleared for crop cultivation. Overall the significance of this impact is considered to be of Low significance for this reason

and given the already completely cleared nature of HGM unit 3 together with the overall small extent of natural vegetation that remains to be cleared.

Mitigation:

- Clearly demarcate (on the ground) the construction footprint area and strictly limit all construction activities to within this area
- Commence (and preferably complete) construction during winter
- The use of herbicides is not recommended, and all tree alien plant species should be removed mechanically.
- Care must be taken so as to not disturb/destroy any CI biodiversity found on site. Species may include **NT** Southern African Vlei Rat, **EN** African White-tailed Rat, **NT** Serval, **NT** African Clawless and **VU** Spotted-necked otters (large dam along Rietspruit),
- Take care not to walk or drive through dense stands of wetland vegetation particularly *Imperata cylindrica* so as not to disturb CI African Grass Owl.
- If conservation important plant species are in the direct removal area, they must be carefully transplanted to the surrounding grassland.

9.4.3. Installation of pipeline – above ground alternative (option preferred by client)

Impact: *Loss and deterioration in wetland integrity as a result of above ground pipeline construction*

Assuming a 30 m disturbance[5] footprint on either side of the proposed pipeline route, it is anticipated that a total of 39.7 ha of wetland habitat will be temporarily degraded. It is important to note that the HGM unit 2 stands to sustain the greatest proportional loss of (44% of its area) yet due to its small size (0.8 ha) it also maintains the greatest potential to be saved through positioning of the pipeline above ground. Effects on wetland integrity will include loss / degradation of vegetation component in HGM units 1 and 2, minor alteration of the soil profile beneath struts, soil compaction and minor loss of topsoil along the pipeline route. Some contamination may occur if there are inadequate sanitation and waste management facilities (dustbins and storage structures for concrete and other construction chemicals and materials) on site during construction. Overall these impacts are expected to be relatively short term, and of moderate magnitude. As such the significance of this rating is Moderate.

Mitigation:

- During the planning phase attempt as far as possible to align the pipeline route so as to minimise the extent of wetland intercepted by the pipeline. HGM unit 2 in particular can be saved by constructing the pipeline above ground.

[5] It has been NSS's experience that pipeline construction activities inherently disturb habitat on either side of the pipeline by the very nature of moving vehicles, equipment or soil. This distance was deemed reasonable based on our professional experience in the absence of linear disturbance buffer guidelines.

- When preparing concrete for the struts keep in mind that mixing of concrete must under no circumstances take place within the permanent or seasonal zones of the wetland and should take place above plastic sheeting and bunded.
- Washing of equipment should be prohibited in or near water courses where contamination of water can occur.
- Appropriate self-contained, clean and serviced sanitation should be provided throughout construction.

9.4.4. Installation of pipeline – below ground alternative

Impact: *Loss and deterioration in wetland integrity as a result of below ground pipeline construction*

Disturbance of the wetland soil profile is one of the most potentially deleterious impacts with implications for vegetation recovery and hydrological regimes. Any disturbance of the soil profile has the potential to have serious consequences on the water distribution and retention patterns of the wetland by disrupting both the vertical infiltration and horizontal movement of water through the system. Additionally trenches excavated for the pipeline are likely to fill as water seeps in from the saturated wetland soils. This is likely to result in a slight and temporary decrease in hydrological zonation as water is channelled into the trench effectively of draining the wetlands. If left unfilled or if the soil profile is returned incorrectly this drainage effect may be permanent. NSS has frequently observed that in areas where the soil horizons have not been replaced in the correct order (nutrient poor anoxic clays below humus rich topsoils) vegetation recovery is severely impaired or non-existent. Additionally soil disturbances of this nature are almost invariably associated with a longstanding proliferation of alien and invasive species. The degradation in wetland integrity through disturbance of the soil profile associated with pipeline construction below surface is considered to be more deleterious and long-lasting than the above ground alternative and has been rated to be of High significance.

Mitigation:

- Avoid this alternative as far as possible and opt for placing the pipeline infrastructure above ground.
- If this eventuality is deemed unfeasible (the motivation should be strongly justified)
- In such an eventually ensure that all soil removed is carefully stockpiled and returned in the same order it was removed
- Ensure that trenches remain open for as brief a time as possible
- Appropriately deal with ingress water into the trench by pumping using a sandbags to minimise erosion from overland flow

9.4.5. Operation: Use and maintenance of pipeline service road

Impact: *Wetland disturbance as a result of pipeline maintenance*

The construction and operation of the service road along the pipeline route is likely to be associated with increased soil compaction, surface runoff, vegetation trampling and dust

deposition. These impacts are likely to be accompanied by a decrease in water infiltration and retention time within the wetland, an increased concentration of storm flows and consequently increased prevalence of erosion and proliferation of alien and invasive vegetation. Such impacts will be intensified if adequate wetland road crossings and culverts are not implemented. Additionally the use of dust suppressant chemicals when spraying roads poses as threat of wetland contamination. Given the presence of existing cropland service roads along the majority of the proposed pipeline route this impact is considered to be of Moderate significance.

Mitigation:

- Ensure if the service road crosses a delineated wetland or drainage feature that the appropriate culverting systems are installed.
- Clearly mark the start and exit of wetland systems with signage. This is to inform the construction contractors that they are entering a wetland area and as such should not store construction materials within it, minimize disturbances and not contaminate it.
- Switch off dust suppression sprayers when passing into a wetland system.

9.4.6. Operation: Pipeline operation - routine

Impact: *Deterioration in wetland integrity as a result of flow modifications*

Based on project information supplied by Prime Resources it is anticipated that that, "*the maximum volume of treated water to be discharged is 6 Mℓ per day at steady state for 13 years, with a ramp up of between 1 and 3 Mℓ per day for the first four years during construction*". Excluding potential contamination events, this amount of water has the potential to significantly alter the hydrological regime of HGM 1 and the Rietspruit as a whole. Most immediately concerning is the design of the pipeline receiving environment interface. If the discharge point is inappropriately engineered (i.e. flow energy inappropriately dissipated and attenuated) such high volumes of water may result in significant head cut erosion and bank destabilisation. Upstream of the dam wall discharge of this magnitude will drastically increase saturation levels effectively increasing hydrological zonation (i.e. the extent and proportion of wetland occupied by the permanent zone) while intensifying the proliferation of dense stands of *Phragmites australis and Typha capensis.* Such prolonged inundation can decrease the effectiveness of a wetland as a natural filter by removing the natural period of dormancy and regeneration (GDARD, 2008). Although species depauperate and invasive, these dense stands of *Phragmites* play an important role in assimilating pollutants and purifying influent water (Coetzee, 2003). However, it is important to understand that although the wetlands provide a service of being a pollution trap they do not have infinite capacities to do so. These plants are also very useful for food and cover for wildlife and many waterfowl; however a heavy infestation may result in a change in habitat from the closing of open water bodies and the resultant establishment of a mono-culture. Given the gradient of the banks it is likely that such inundation may decrease the proportion of mudflats and as a result decreasing the wetlands capacity to support significant congregations of resident and migratory wading birds. Such a "drowning" effect (although on

a much larger scale) of wetlands has been observed along the Blesbokspruit where water bird counts at Marievale Bird Sanctuary have showed a drastic decrease in wading bird numbers of the years following increased water levels from upstream mines and industries. From a geomorphological perspective the large volumes of water entering the system are likely to result in an increase in bed and bank erosion downstream of the dam wall due to increased flow volumes and the dilution of sediment loads. Such an impact will likely result in scouring of the channel bed and increase incisement of its banks. The likely consequence of such an impact would be a general draining effect ultimately resulting in a decrease in hydrological zonation and contraction of the outer wetland margin.

Mitigation:

- From a wetland persective the preferred option would be upstream of the dam wall as it would help to alleviate the affects of bed and bank erosion as well as scouring of the benthic environment downstream. NSS has specified a preliminary preffered pipeline route alternative and discharge point from a wetland perspective (**Figure 7-19**). However the final and precise discharge outlet point should, ideally, be chosen strategically following integration workshops between all relevant specialists and carefully engineered, taking cognisance of the various flow related impacts that may result at various locations (i.e. upstream or downstream of the dam wall
- Based on preliminary project information supplied by Prime Resources it is anticipated that the pipe configuration at the discharge point will be branched such that the total discharge volume is diverged. Each of the branches will discharge over a section of stone pitching/Reno mattresses for energy dissipation.
- The discharge point should be landscaped to spread the water as wide as possible to allow the system to vlei out before the active channel of the Rietspruit.
- Every effort should be taken by the mine to recycle as much of their ground water as possible to limit the amount of flow entering the Rietspruit.
- The discharge point and associated flow attenuation structures must be fenced to prevent direct access of game and other wildlife to the discharge water.

9.4.7. Pipeline operation – potential contamination events

Deterioration in wetland integrity as a result of contamination[6] in the unlikely event that the water treatment standards are not upheld

Although water to be discharged to the Rietspruit from the proposed mine is intended to be treated to acceptable DWA standards, an inherent risk associated with the installation of any mine discharge pipeline is the potential for leaks which may vary in severity from minor localised seepages to major spills with major consequence for the wetland systems identified on site and the Rietspruit. Contamination may arise though accidental spill events or through inadequate maintenance of the proposed water treatment facility and discharge pipeline.

HGM units 2 and 3 are most likely to be affected through minor pipeline leakages whereas HGM unit 1 and the Rietspruit have the potential to be more adversely impacted through point source outfall from the pipeline and / or diffuse overland runoff from leaks. Based on the studies conducted by AED (2017) it is anticipated that mine groundwater discharge from the Ventersburg Project is most likely to be associated with an influx of NaCl accompanied by elevated salinity. Although AED is of the opinion that the treated groundwater will not detrimentally impact the Rietspruit due to dilution effects, the possibility exists for contamination of the Rietspruit with highly saline water should the water treatment facility fail. Current analysis of the groundwater pumped from the deeper aquifer suggests that the salinity levels are unsuitable for direct decant and considered unfit for livestock consumption. The current proposed pipeline discharge point is situated at a large dam on a privately owned game farm. During the site visit the landowner raised fair concerns regarding the wellbeing of his game of which many are of considerable value. Contamination of the Rietspruit and Whites Dam with untreated groundwater (due to poor treatment plant maintenance, leaks or otherwise) therefore poses a threat to this game or other wildlife. This is an aspect that warrants thorough investigation and it is recommended that the opinion of an appropriately qualified ecotoxicologist be sought with regards to the potential effects of the proposed mine on wildlife.

An additional threat associated with gold mining is contamination through acid mine drainage or AMD. However, communications with Prime Resources and Ground Water Square Consulting state that AMD will not be a cause for concern within the groundwater due to it being regularly pumped from a borehole and not directly from the mine shafts. It is mentioned that AMD would likely only result (1) post closure in the water that may collect in the shaft (2) from tailings runoff following rainfall events both during operation and post-closure. With regards to the first point AMD collecting within the mine shaft is considered unlikely to pose any contamination effects to the shallow Karoo aquifer used by farmers and the local community as this aquifer will be sealed off and decant is considered unlikely to occur due to the flat topography of the land and lack of large groundwater reservoirs as is the case with the dolomitic compartments of the Far West Rand. With regards to the second point tailings facilities are to be appropriately lined. Furthermore a stormwater infrastructure plan has been designed around the tailings and wasterock dumps to capture any runoff (in lined V-drains) from these facilities and direct it into pollution control dams. These control dams are considered closed systems.

However, if such measures (as currently planned) are not taken contamination of surrounding wetlands and ultimately the Rietspruit remains a possibility (e.g. as a result of linings failures on tailings facilities, waste rock stockpiles, stormwater drains and pollution control dams or due to water ingress into underground workings from unexpected pump failures, inaccurate groundwater volume predictions or unanticipated intersections of faults or other transmissive geological features). This would manifest in a number of water quality parameters (e.g. pH, temperature, salinity, sulphates, radionuclides and various heavy

metals). AMD forms when ore and waste materials, containing sulphide minerals such as pyrite, are exposed to water and oxygen. The resulting decrease in pH varies in magnitude on a per mine basis depending on various factors. In most cases, however, the water becomes increasingly more acidic until it reaches a point, usually not lower than pH of 3 (Tutu *et al.,* 2008), where it becomes unsuitable for domestic or biodiversity use (DWAF, 2006). Although not as corrosive as most conventional acids at this pH and still "drinkable" the acidity of the water liberates metals, including any toxic metals and radionuclides from the rocks it interacts with. The same holds true for any toxicants already present in the Rietspruit. Additionally any AMD contamination is likely to be accompanied by a significant increase in the accumulation of sulphates and consequently an increase in salinity. Severe contamination events have the potential to result in acute and chronic toxicity not only to human users but also the biota dependant on the wetlands, generally rendering the water unfit for most uses including agricultural and industrial (Coetzee *et al*., 2006; Wade *et al*., 2002).

Additionally, assuming water from the sewerage treatment facility is to be discharged to the Rietspruit via the proposed discharge pipeline, the wetland may be further contaminated due to the lack of appropriate sanitation maintenance. Contamination of the wetland through these various means will result in further eutrophication of the soils, loss of aquatic biota and the increased prevalence of *E. coli*, cholera and other waterborne diseases and pathogens.

Mitigation:

- Ensure all water treatment facilities and pipeline infrastructure is regularly maintained.
- Test water quality before discharge point.
- Ensure that water quality parameters comply with water use licence requirements and include all parameters usually analysed for gold mining.
- Compile a Spill Contingency and Emergency Response Plan that deals with spills into the wetland systems and associated Rietspruit.
- Appropriately dispose all flocculent or polluted water as per the water use license requirements.

9.4.8. Decommissioning: Removal and rehabilitation of pipeline infrastructure (contouring, soil preparation, re-vegetation)

Positive impact associated with decommissioning and rehabilitation

Decommissioning and removal of pipeline infrastructure together with landscaping, contouring, soil preparation and revegitation of any impacted wetlands will have a net positive impact on the wetland systems on site as well as the downstream Rietspruit.

Mitigation:

- Remove all pipeline infrastructure
- If a service road was created till it with a rotovator to loosen the soil surface

- Remove any culverts, gabions, concrete slabs or flow attenuation structures that were constructed.
- Landscape and revegetate using locally indigenous wetland seed mixes and whole plant transplanting for source material along Rietspruit.

Table 9-3 Potential impacts on flora & fauna, and their recommended management / mitigation and monitoring

Receptor / Resource	Process/Activity	Environmental Impact	Impact Effect	Magnitude (M)	Duration (D)	Scale (S)	Probability (P)	Significance		Mitigation and Management Measures	Impact Monitoring	
								Rating	Value		Monitoring	Time Frame for Monitoring
CONSTRUCTION												
. Fauna and Flora (incl. CI taxa)	· Influx of people	· Disturbance of fauna from e.g. noise · Disturbance of habitat from e.g. collection of firewood · Displacement of fauna from disturbance · Loss of fauna from poaching and collecting · Harvesting of flora and specifically those used for medicinal and cultural purposes	Negative	6	2	2	3	**Medium**	30	· Commence construction during winter · Demarcate the construction site · Limit construction activities to day time · Prohibit employees from disturbing areas beyond the construction footprint · Prohibit employees from disturbing, collecting or poaching fauna · Establish a Biodiversity Educational Programme · Compile a comprehensive and effective Biodiversity Action Plan (BMP)	· Ensure that the construction site remains clearly demarcated · Ensure that notices about prohibited activities remain effective · Effectively educate workers about prohibited activities · Incentives for reporting biodiversity sightings and detecting wrong doing · EO on site must undergo rigorous environmental training	· Monitor all erected fences, signage throughout construction · A detailed initial session, and thereafter with each new team that enters the site · When necessary throughout construction · Report must be set complete prior to construction
			Negative	4	1	1	2	**Low**	12			
Fauna and Flora (incl. CI taxa)	· Transport of materials	· Collision of fauna with vehicles · Disturbance of fauna from e.g. noise · Displacement of fauna from disturbance · Disturbance of habitat from e.g. invasive alien flora	Negative	8	2	2	4	**Medium**	48	· Amend the Project road network to avoid sensitive areas · Demarcate the construction site · Commence the main earthwork activities during winter · Signpost the main access road(s), and all no entry roads · Limit construction activities to day time · Prohibit workers from disturbing areas beyond the construction footprint · Ensure that the Project road network includes traffic speed control measures (speed bumps and restricting speed to 40 km/hour) · Implement the Alien Invasive Control plan (AICP) - Phase for Construction Activities	· Ensure that the construction site remains clearly demarcated · Effectively educate workers about prohibited activities · Ensure that road signs remain effective · Check the speed of vehicles on the Project road network · Enforce fines for prohibited activities · Monitor invasive alien flora along all roads specifically in High sensitive areas	· Monitor all erected fences, signage throughout construction · A detailed initial session, and thereafter with each new team that enters the site · Quarterly throughout construction · Adhoc monitoring · When necessary throughout construction · Bi-monthly - Monitor more frequently during the growing season
			Negative	4	2	2	3	**Low**	24			
Fauna and Flora (incl. CI taxa)	· Storage of materials (equipment, fuel, explosives, etc)	· Loss of habitat under storage · Loss of fauna under storage · Degradation of habitat from e.g. contamination · Illness or mortality of fauna from e.g. contamination	Negative	4	2	1	3	**Low**	21	· Ensure that storage of hazardous materials avoids High sensitive areas · Demarcate the construction site · Commence the main earthwork activities during winter · Signpost all storage areas	· Train workers to handle and dispose relevant hazardous substances · Effectively educate workers about prohibited activities · Ensure that the construction site remains clearly demarcated · Ensure that signs for storage areas remain effective	· Initial Detailed Inductions; Monthly follow-ups through construction · Quarterly throughout construction · Monitor all erected fences, signage throughout construction
			Negative	2	2	1	2	**Low**	10			

Recept	Process/Activity	Environmental Impact	Impact	Magnitude	Duration	Scale	Prob	Significance		Mitigation and Management Measures	Impact Monitoring	
		· Disturbance of habitat from e.g. invasive alien flora								· Prohibit workers from disturbing areas beyond the construction footprint · Ensure safe storage, handling and disposal of hazardous materials · Ensure that workers know how to handle and dispose of hazardous substances · Effectively rehabilitate contaminated areas with advice from an appropriate specialist	· Ensure that notices about prohibited activities remain effective · Enforce fines for prohibited activities · Monitor the rehabilitation of contaminated areas	· When necessary throughout construction · Bi-monthly throughout construction
Fauna and Flora (incl. CI taxa)	· Clearing of vegetation and topsoil	· Destruction of some semi-natural Themeda grasslands & Acacia Thornveld	Negative	8	4	2	5	**High**	70	· Any High sensitive areas (mainly wetland habitats in this project) should be demarcated and avoided by all personnel · Obtain permits to relocate any Protected CI floral species – this could include Geophytic species such as Gladiolus, Bulbines, Nerines, Hypoxis hemerocallidea, Boophone etc · Relocate CI from the construction footprint with advice from a botanist / zoologist · Commence the main earthwork activities during winter · Demarcate the construction site · Limit construction activities to day time · Prohibit workers from disturbing areas beyond the construction footprint · Rehabilitate disturbed areas as soon as possible	· Ensure that the construction site remains clearly demarcated · Effectively educate workers about prohibited activities · Ensure that notices about prohibited activities remain effective (keep up to date and visual) · Enforce fines for prohibited activities · Monitor invasive alien flora dispersals through regular visual counts / photos or new species through regular visual counts / photos entering the site and adhere to the AICP · Regularly monitor cover of any rehabilitated area	· Monthly throughout construction · Quarterly throughout construction · Monitor all erected fences, signage throughout construction · When necessary throughout construction · When necessary throughout construction · Bi-monthly throughout construction, more frequent during the rainy season
		· Destruction of fauna inside footprint	Negative	4	2	1	3	**Low**	21			
		· Disturbance of surrounding habitat from e.g. earth-movers · Disturbance of fauna from e.g. noise										
		· Displacement of fauna from disturbance										
		· Displacement of fauna from disturbance										
Fauna and Flora (incl. CI taxa)	· Stockpiling of soil and organic debris	· Loss of habitat / vegetation communities under stockpiles	Negative	6	4	2	3	**Medium**	36	· Ensure that the location of stockpiles avoids High sensitive areas · Commence stockpiling during winter · Demarcate all areas for stockpiling · Limit stockpiling activities to day time and dry weather · Store indigenous plant debris with stockpiled soil · Stockpiled soil should be used to rehabilitate disturbed areas as soon as possible · Remove the top 100mm of topsoil and stockpile in small mounds, where possible.	· Ensure that stockpile areas remain clearly demarcated and no sedimentation erosion is occurring · Monitor invasive alien flora dispersals through regular visual counts / photos or new species through regular visual counts / photos entering the site and adhere to the AICP	· Monthly throughout construction · Bi-monthly throughout construction, more frequent during the rainy season
		· Loss of fauna under stockpiles	Negative	2	4	1	2	**Low**	14			
		· Disturbance of surrounding habitat from e.g. trucks · Disturbance of fauna from e.g. noise · Displacement of fauna from disturbance										
Fauna and Flora (incl. CI taxa)	· Development of infrastructure (involving blasting, drilling, construction)	· Degradation of surrounding habitat from e.g. poor waste management, prohibiting natural fires etc	Negative	6	3	2	4	**Medium**	44	· Commence (and preferably complete) construction during winter	· Train workers to handle and dispose relevant hazardous substances	· Initial Detailed Inductions; Monthly follow-ups through construction

Recept	Process/Activity	Environmental Impact	Impact	Magnitude	Duration	Scale	Prob	Significance		Mitigation and Management Measures	Impact Monitoring	
		· Disturbance of fauna from e.g. noise · Displacement of fauna from disturbance · Disturbance of habitat from e.g. invasive alien flora	Negative	4	3	1	3	Low	24	· Demarcate the construction site · Limit construction activities to day time · Prohibit workers from disturbing areas beyond the construction footprint · Ensure safe storage, handling and disposal of hazardous materials · Ensure that workers know how to handle and dispose of hazardous substances · Effectively rehabilitate contaminated areas with advice from an appropriate specialist	· Effectively educate workers about prohibited activities · Ensure that the construction site remains clearly demarcated · Ensure that notices about prohibited activities remain effective · EO to check open trenches for trapped animals (and team) · Enforce fines for prohibited activities · Monitor the rehabilitation of contaminated areas	· Quarterly throughout construction · Quarterly throughout construction · Monitor all erected fences, signage throughout construction · Daily whenever there are open trenches · When necessary throughout construction · Monthly throughout construction
OPERATION												
Fauna and Flora (incl. CI taxa)	· Use and maintenance of roads	· Collision of fauna with vehicles	Negative	8	4	2	5	High	70	· Any High sensitive areas (mainly wetland habitats in this project) should be demarcated and avoided by all personnel · Signpost the main access road(s), and all no entry roads · Limit road use at night · Prohibit workers from driving off-road · Ensure that the Project road network includes traffic speed control measures · Implement the Alien Invasive Control plan (AICP) - Phase for Operational Activities	· Effectively educate workers and communities about prohibited activities · Ensure that road signs remain effective · Check the speed of vehicles on the Project road network · Enforce fines for prohibited activities · Monitor invasive alien flora- Priority areas set out in AICP · EO on site must keep up to date with environmental training	· Bi-annually throughout operation · Quarterly throughout operation · Quarterly throughout operation · When necessary throughout operation · To be determined by the AICP
		· Disturbance of fauna from e.g. noise · Displacement of fauna from disturbance · Disturbance of habitat from e.g. invasive alien flora	Negative	4	4	1	3	Low	27			
Fauna and Flora (incl. CI taxa)	· Activity of people	· Disturbance of fauna from e.g. noise · Disturbance of habitat from e.g. collection of firewood · Displacement of fauna from disturbance · Loss of fauna from poaching and collecting · Harvesting of flora and specifically those used for medicinal and cultural purposes	Negative	8	4	2	4	Medium	56	· Any High sensitive areas (mainly wetland habitats in this project) should be demarcated and avoided by all personnel · Prohibit workers and communities from disturbing, collecting or poaching fauna · Prohibit workers and communities from harvesting floral species	· Effectively educate workers and communities about prohibited activities · Ensure that notices about prohibited activities remain effective · Enforce fines for prohibited activities · Prohibit access of people into sensitive areas by e.g. erecting fences	· Bi-annually throughout operation · Quarterly throughout operation · When necessary throughout operation · Monitor all erected fences, signage during regular monitoring on site
			Negative	4	4	1	3	Low	27			
Fauna and Flora (incl. CI taxa)	· Storage of materials (equipment, fuel, explosives, etc)	· Degradation of habitat from e.g. contamination · Illness or mortality of fauna from e.g. contamination	Negative	8	5	2	4	High	60	· No storage of hazardous materials within sensitive areas · Signpost all storage areas · Prohibit workers from disturbing areas beyond the operational footprint · Ensure safe storage, handling and disposal of hazardous materials · Ensure that workers know how to handle and dispose of hazardous substances	· Train workers to handle and dispose relevant hazardous substances · Effectively educate workers about prohibited activities · Ensure that signs for storage areas remain effective · Ensure that notices about prohibited activities remain effective · Enforce fines for prohibited activities	· Bi-annually throughout operation · Bi-annually throughout operation · Quarterly throughout operation · Quarterly throughout operation · When necessary throughout operation
			Negative	4	2	1	3	Low	21			

Recept	Process/Activity	Environmental Impact	Impact	Magnitude	Duration	Scale	Prob	Significance		Mitigation and Management Measures	Impact Monitoring	
										· Effectively rehabilitate contaminated areas with advice from an appropriate specialist	· Monitor the rehabilitation of contaminated areas	· Seasonally throughout operation
Fauna and Flora (incl. CI taxa)	· Stockpiling of ore and waste rock	· Loss of habitat under stockpiles	Negative	6	4	2	4	Medium	48	· No storage of stockpiling in sensitive areas	· Ensure that stockpile areas remain clearly demarcated	· Monthly throughout operation
		· Loss of fauna under stockpiles · Disturbance of surrounding habitat from e.g. pollution · Disturbance of fauna from e.g. noise · Displacement of fauna from disturbance · Degradation of surrounding habitat through alien invasions etc	Negative	2	4	1	2	Low	14	· Demarcate all areas for stockpiling · Limit stockpiling activities to day time and dry weather · Rehabilitate the stockpiles as soon as possible	· Monitor the rehabilitation of the stockpiles · Monitor invasive alien flora- Priority areas set out in AICP	· Seasonally until rehabilitation is acceptable · To be determined by the AICP
Fauna and Flora (incl. CI taxa)	· Water use, treatment, storage and discharge	· Disturbance/transformation of habitat from increase in nutrient loads from poor water management · Illness or mortality of fauna (incl. Game) from e.g. contamination · Displacement of fauna from disturbance	Negative	8	5	2	4	High	60	· Necessary water management measures must not impact on any sensitive areas	· Perform all monitoring at stipulated in the WUL	· As stipulated in the WUL
			Negative	4	2	1	3	Low	21	· Ensure that all WUL requirements are met · Ensure that emergency procedures are in place for water management issues · Rehabilitate contaminated and other disturbed areas as and when it happens	· Update emergency procedures e.g. with advancements in technology · Train workers to undertake emergency water management procedures · Monitor the rehabilitation of contaminated and other disturbed areas	· Bi-annually throughout operation · Bi-annually throughout operation · Seasonally throughout operation
Fauna and Flora (incl. CI taxa)	· Re-vegetation of TSF	· Reduction in windblown dust (altering ecosystem processes)	Positive	4	4	1	3	Low	27	· Control invasive alien flora on the TSF	· Monitor invasive alien flora on the TSF -set out in AICP	· To be determined by the AICP - This report will require regular updating
		· Re-colonization by certain fauna	Positive	6	5	1	4	Medium	48	· Obtain guidance from Gold Tailings rehabilitation specialists before commencing (Rehabilitation Plan) · Look at different preparatory measures for altering the harsh growing conditions · Set up effective Windbreaks · Turn Tailings materials into a medium favourable for plant growth by addressing the chemical, physical and biological deficiencies of the media · Re-vegetate the TSF using stockpiled soil and locally indigenous flora	· Monitor the establishment of indigenous flora on the TSF 9set out in a rehabilitation plan0 · Monitoring through an effective tool such as the Landscape Function Analysis (LFA)	· Seasonally until rehabilitation is acceptable · Yearly LFA assessment (within the same season every year)
DE-COMMISSIONING												
· Fauna and Flora (incl. CI taxa)	· Demolition of infrastructure	· Destruction of artificial habitat in footprint	Negative	6	5	1	3	Medium	36	· Commence (and preferably complete) decommissioning during winter	· Ensure that the decommissioning site remains clearly demarcated	· Monthly throughout decommissioning
		· Destruction of hardy fauna in footprint · Disturbance of fauna from e.g. noise	Positive	6	5	1	3	Medium	36	· Demarcate the decommissioning site · Limit decommissioning activities to day time	· Effectively educate workers about prohibited activities · Ensure that notices about prohibited activities remain effective	· Quarterly throughout decommissioning · Quarterly throughout decommissioning

Recept	Process/Activity	Environmental Impact	Impact	Magnitude	Duration	Scale	Prob	Significance		Mitigation and Management Measures	Impact Monitoring	
		· Displacement of fauna from disturbance								· Prohibit workers from disturbing areas beyond the decommissioning footprint	· Enforce fines for prohibited activities	· When necessary throughout decommissioning
Fauna and Flora (incl. CI taxa)	· Waste management	· Degradation of habitat from contamination	Negative	10	5	2	4	High	68	· Demarcate the decommissioning site · Prohibit workers from disturbing areas beyond the decommissioning footprint · Ensure that workers know how to handle and dispose of hazardous substances · Ensure that all hazardous materials are disposed of at an appropriate licensed facility · Ensure that all waste (including building rubble, sewage, fuel, explosives) is removed · Ensure that recyclable waste is taken to an appropriate recycling facility · Rehabilitate contaminated areas as soon as possible	· Ensure that the decommissioning site remains clearly demarcated · Train workers to handle and dispose relevant hazardous substances · Effectively educate workers about prohibited activities · Ensure that notices about prohibited activities remain effective · Enforce fines for prohibited activities · Monitor the rehabilitation of contaminated areas	· Quarterly throughout decommissioning · Quarterly throughout decommissioning · Quarterly throughout decommissioning · Quarterly throughout decommissioning · When necessary throughout decommissioning · Seasonally until rehabilitation is acceptable
		· Illness or mortality of fauna from contamination	Negative	4	3	1	2	Low	16			
	· Rehabilitation (contouring, soil preparation, re-vegetation)	· Creation of semi-natural habitat	Positive	4	4	1	3	Low	27	· Control invasive alien flora throughout the footprint · Re-vegetate disturbed areas using stockpiled soil and locally indigenous flora	· Monitor invasive alien flora throughout the footprint area - The AICP will need to be updated during operation · Monitor the establishment of indigenous flora in disturbed areas	· To be determined by the updated AICP · Seasonally until rehabilitation is acceptable
		· Re-colonization by certain fauna	Positive	8	5	1	4	Medium	56			

Table 9-4 Potential impacts of the proposed pipeline on wetlands, and their recommended management / mitigation and monitoring

No.	Receptor / Resource	Process/Activity	Environmental Impact	Impact Effect	Mitigation	Magnitude (M)	Duration (D)	Scale (S)	Probability (P)	Significance		Mitigation and Management Measures	Impact Monitoring	
										Rating	Value		Monitoring	Time Frame for Monitoring
CONSTRUCTION														
	· Wetlands	Transport and storage of construction materials (equipment, cement, pipes)	Wetland disturbance as a result of the transport and storage of construction materials.	Negative	**WITHOUT**	4	3	2	3	**Low**	27	· Clearly demarcate the wetland areas on the ground from the edge of the 100 m buffer zone and signpost them as sensitive ecological areas (see wetland extent and sensitivity maps and request where necessary the gpx files) · Ensure all construction material including heavy vehicles are stored at a single designated laydown area situated not only outside of the delineated wetland areas and their associated 100 m buffer but also the 1:100 year Rietspruit floodline. · Avoid driving to the pipeline construction site following high rainfall events.	Commence water quality monitoring Conduct regular site inspection to ensure environmental compliance and adherence to mitigation measures	· Twice-weekly during construction
					[WITH]	2	2	1	1	**Low**	5			
	· Wetlands	Site preparation	Alteration of wetland sediment regime.	Negative	**WITHOUT**	4	3	2	4	**Medium**	36	· Clearly demarcate (on the ground) the construction footprint area and strictly limit all construction activities to within this area · Commence (and preferably complete) construction during winter · The use of herbicides is not recommended, and all tree alien plant species should be removed mechanically. · Care must be taken so as to not disturb/destroy any conservation important biodiversity found on site. · Take care not to walk or drive through dense stands of wetland vegetation particularly *Imperata cylindrica* so as not to disturb CI African Grass Owls · If conservation important plant species are in the direct removal area, they must be carefully transplanted to the surrounding grassland.	Conduct regular site inspection to ensure environmental compliance and adherence to mitigation measures	· Daily during construction
					[WITH]	2	2	1	2	**Low**	10			
	· Wetlands	Installation of pipeline – above ground alternative	Loss and deterioration in wetland integrity as a result of above ground pipeline construction	Negative	**WITHOUT**	6	3	2	4	**Medium**	44	· During the planning phase attempt as far as possible to align the pipeline route so as to minimise the extent of wetland intercepted by the pipeline. HGM unit 2 in particular can be saved through only minor alteration to the proposed route (see **Figure 7-19**). · When preparing concrete for the struts keep in mind that mixing of concrete must under no circumstances take place within the permanent or seasonal zones of the wetland and should take place above plastic sheeting and bunded. · Washing of equipment should be prohibited in or near water courses where contamination of water can occur. · Appropriate self-contained, clean and serviced sanitation should be provided throughout construction	Conduct regular site inspection to ensure environmental compliance and adherence to mitigation measures	· Daily during construction
					[WITH]	4	2	1	4	**Low**	28			

N	Receptor /	Process/Activity	Environmental Impact	Impact		Magnitud	Duration	Scale (S)	Probabilit	Significance		Mitigation and Management Measures	Impact Monitoring	
	· Wetlands	Installation of pipeline – below ground alternative	Loss and deterioration in wetland integrity as a result of below ground pipeline construction	Negative	**WITHOUT**	8	5	3	5	**High**	80	· Avoid this alternative as far as possible and opt for placing the pipeline infrastructure above ground. · If this is deemed unfeasible (the motivation should be strongly justified) · In such an eventually ensure that all soil removed is carefully stockpiled and returned in the same order it was removed · Ensure that trenches remain open for as brief a time as possible · Appropriately deal with ingress water into the trench by pumping using a sandbags to minimise erosion from overland flow	Conduct regular site inspection to ensure environmental compliance and adherence to mitigation measures · Check open trenches for trapped animals	· Daily during construction
					[WITH]	4	2	1	1	**Low**	7			
OPERATION														
	· Wetlands	Use and maintenance of pipeline service road	Wetland disturbance as a result of pipeline maintenance	Negative	**WITHOUT**	6	5	2	4	**Medium**	52	Ensure if the service road crosses a delineated wetland or drainage feature that the appropriate culverting systems are installed Clearly mark the start and exit of wetland systems with signage Switch off dust suppression sprayers when passing into a wetland system	Conduct regular inspections along route, report on any wetland disturbances	· Weekly during construction
					[WITH]	4	4	1	2	**Low**	18			
	· Wetlands	Pipeline operation – routine	Deterioration in wetland integrity as a result of flow modifications	Negative	**WITHOUT**	8	5	3	5	**High**	80	· From a wetland perspective the preferred option would be upstream of the dam wall as it would help to alleviate the affects of bed and bank erosion as well as scouring of the benthic environment downstream. NSS has specified a preliminary preferred pipeline route alternative and discharge point from a wetland perspective upstream of the Whites Dam (**Figure 7-19**). However the final and precise discharge outlet point should, ideally, be chosen strategically following integration workshops between all relevant specialists and carefully engineered, taking cognisance of the various flow related impacts that may result at various locations (i.e. upstream or downstream of the dam wall). · Based on preliminary project information supplied by Prime Resources it is anticipated that the pipe configuration at the discharge point will be branched (four outlets) such that the total discharge volume is diverged. Each of the outlets will discharge over a section of stone pitching/Reno mattresses for energy dissipation. · The discharge point should be landscaped to spread the water as wide as possible to allow the system to vlei out before the active channel of the Rietspruit. · Every effort should be taken by the mine to recycle as much of their ground water as possible to limit the amount of flow entering the Rietspruit.	Install gauging point to effectively monitor flows, keep diligent records. Conduct water quality monitoring Conduct aquatic biomonitoring	Once off at start of operation As a frequency stipulated in WULA At least bi-annually or more frequently if recommended in WULA
					[WITH]	6	4	2	4	**Medium**	48			

N	Receptor /	Process/Activity	Environmental Impact	Impact		Magnitud	Duration	Scale (S)	Probabilit	Significance		Mitigation and Management Measures	Impact Monitoring	
												· The pipeline discharge point and associated flow attenuation structures should be fenced to prevent direct access of game and other wildlife to the discharge water.		
	· Wetlands	Pipeline operation – contamination events	Deterioration in wetland integrity as a result of contamination	Negative	**WITHOUT**	10	5	3	5	**High**	90	Ensure all water treatment facilities and pipeline infrastructure is regularly maintained.	Conduct aquatic biomonitoring (bi-annual sampling within at least two sampling sites situated upstream and downstream of the discharge point). The study must aim to take cognisance of the baseline aquatic assessment findings and speak to the baseline water quality and hydrological studies. It must also take in-situ water quality (physical and chemical including heavy metals and toxicants most commonly associated with mining practices) and diatom samples. At a later stage the findings of the aquatic bio-monitoring should incorporate the mine's water quality data.	At least bi-annually or more frequently if recommended in WULA
					[WITH]	6	4	2	4	**Medium**	48	Test water quality before discharge point Ensure that water quality parameters comply with water use licence requirements and include all parameters usually analysed for gold mining. Compile a Spill Contingency and Emergency Response Plan that deals with spills into the wetland systems and associated Rietspruit. Appropriately dispose all flocculent or polluted water as per the water use license requirements	Conduct regular water quality monitoring in line with the requirements as stipulated in the water use licence	As a frequency stipulated in WULA Planning Phase, Updated 3-5 years of after a spill event or following publication of advances in best practice guidelines
DE-COMMISSIONING														
	· Wetlands	Removal and rehabilitation of pipeline infrastructure	Positive impact associated with decommissioning and rehabilitation	Positive	**WITHOUT**	4	5	2	5	**Medium**	55	Remove all pipeline infrastructure	Monitor progress of rehabilitation	Three years (DWA standard) on a quarterly basis for or as otherwise stipulated by DWA
					[WITH]	2	4	1	2	**Low**	14	If a service road was created till it with a rotovator to loosen the soil surface Remove any culverts, gabions, concrete slabs or flow attenuation structures that were constructed. Landscape and revegetate using locally indigenous wetland seed mixes and whole plant		

N	Receptor /	Process/Activity	Environmental Impact	Impact		Magnitud	Duration	Scale (S)	Probabilit	Significance		Mitigation and Management Measures	Impact Monitoring	
												transplanting for source material along Rietspruit.		

10. References

ACCUWEATHER. 2017. Website: www.accuweather.com. Accessed in February 2017.

AGIS (AGRICULTURAL GEO-REFERENCED INFORMATION SYSTEM). 2010. Website: www.agis.agric.za. Accessed in 2010.

AGIS, 2014. Agricultural Geo-Referenced Information System – land type data. Website: www.agis.agric.za.

BATES, M.F., BRANCH, W.R., BAUER, A.M., BURGER, M., MARAIS, J., ALEXANDER, G.J. & DE VILLIERS, M.S. 2014. Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. Strelitzia 32. SANBI, Pretoria.

COETZEE, H., WADE, P. & WINDE, F. 2006 An assessment of sources, pathways, mechanisms and risks of current and future pollution of water and sediments in the Wonderfontein Spruit Catchment, Water Research Commission, WRC Report No. 1214/1/06, Pretoria: 202 p.

COETZEE, M.A.S. 2003. Water pollution in South Africa: It's Impact on Wetland Biota. Centre for Water in the Environment, WITS

DAVIS S.D, DROOP S.J.M., GREGERSON P., HENSON L., LEON C.J., VILA-LOBOS J.L., SYNGE H. & ZANTOVSKA J. 1986. Plants in Danger: What do we Know? IUCN, Gland.

DEA (DEPARTMENT OF ENVIRONMENTAL AFFAIRS), DMR (DEPARTMENT OF MINERAL RESOURCES), CoM (CHAMBER OF MINES), SAMBF (SOUTH AFRICAN MINING & BIODIVERSITY FORUM) & SANBI (SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE). 2013. Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector. DEA, Pretoria.

DEPARTMENT OF ENVIRONMENTAL AFFAIRS (DEA). 2005. National Biodiversity Strategy and Action Plan. Pretoria: Department of Environmental Aff-airs.

DEPARTMENT OF WATER AFFAIRS & FORESTRY (DWAF). 2008. Integrated Mine Water Management, Best Practice Guideline H1, Directorate: Resource Protection and Waste, Pretoria, 67 pp.

DEPARTMENT OF WATER AND SANITATION (DWS). 2014. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Secondary: A2. Compiled by RQIS-RDM: http://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx

DRIVER A., MAZE K., LOMBARD A.T., NEL J., ROUGET M. & TURPIE J.K. 2004. South African National Spatial Biodiversity Assessment Summary Report.

DRIVER A., MAZE K., LOMBARD A.T., NEL J., ROUGET M. & TURPIE J.K. 2004. South African National Spatial Biodiversity Assessment Summary Report.

DRIVER A., NEL J.L., SNADDON K., MURRAY K., ROUX D.J., HILL L., SWARTZ E.R., MANUEL J. & FUNKE N. 2011. Implementation Manual for Freshwater Ecosystem Priority Areas. Water Research Commission, Pretoria.

DRIVER, A., Nel, J.L., SNADDON, K., MURRAY, K., ROUX, D.J., HILL L., SWARTZ, E.R., MANUEL, J. & FUNKE, N. 2011. Implementation Manual for Freshwater Ecosystem Priority Areas. Water Research Commission, Pretoria.

DU PREEZ L. & CARRUTHERS V. 2009. A Complete Guide to the Frogs of Southern Africa. Struik Nature, Cape Town.

DWAF. 1999. Resource Directed Measures for Protection of Water Resources. Volume 4. Wetland Ecosystems. Version 1.0. DWAF, Pretoria.

DWAF. 2005. A practical field procedure for identification and delineation of wetland riparian areas. DWAF, Pretoria.

DWAF. 2013. Website: http://www.dwaf.gov.za/WAR/systems.html. Accessed in August 2011.

DWS, 2014. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Secondary: B3. Compiled by RQIS-RDM: http://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx

FRIEDMANN Y. & DALY B. 2004. Red Data Book of the Mammals of South Africa: A Conservation Assessment. CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), EWT, Johannesburg.

FROGMAP. 2017. Website: http://vmus.adu.org.za. Accessed in February 2017.

GAUTENG DEPARTMENT OF AGRICULTURE, AND RURAL DEVELOPMENT (GDARD), 2008.MINING AND ENVIRONMENTAL IMPACT GUIDE.

GERMISHUIZEN , G. & MEYER, N.L. (EDS.). 2003. Plants of Southern Africa: an annotated checklist. *Strelitzia 17*, SANBI, Pretoria

HENNING G.A., TERBLANCHE R.F. & BALL J.B. 2009. South African Red Data Book: Butterflies. SANBI Biodiversity Series 13. SANBI, Pretoria.

HILTON-TAYLOR, C. 1996. Red Data List of southern African plants. Strelitzia 4. National Botanical Institute, Pretoria, South Africa.

IUCN. 2017. The IUCN Red List of Threatened Species Version 2016-3. Website: www.iucnredlist.org. Accessed in 2017.

KNNCS, 1999. Nomination Proposal for the DrakensbergPark alternatively known as UkhahlambaPark to be listed as a World Heritage Site. Kwazulu-Natal Nature Conservation Service. Amafa Akwazulu Natali - Heritage Kwazulu Natal.

KOTZE, D., MARNEWECK, G. C., BATCHELOR, A. L., LINDLEY, D. S., &COLLINS, N. B. 2008. WET-EcoServices:A technique for rapidly assessing ecosystem services supplied by wetlands. Water ResearchCommission. WRC Report TT 339/08. Republic of South Africa

KOTZE, D.C, MARNEWECK, G.C, BATCHELOR, A.L., LINDLEY, D.S. & COLLINS, N.B., 2008. WET-EcoServices: A technique for rapidly assessing ecosystem services

supplied by wetlands. WRC Report No TT 339/08, Water Research Commission, Pretoria.

LEEMING J. 2003. Scorpions of Southern Africa. Struik Publishers, Cape Town.

LEPIMAP. 2017. Website: http://vmus.adu.org.za. Accessed in February 2017.

MACFARLANE D.M., KOTZE D.C., ELLERY W.N., WALTERS D., KOOPMAN V., GOODMAN P., GOODMAN P. & GOGE C. 2008. WETLAND TOOLS ASSESSMENT. WRC REPORT

MACFARLANE, D. M., KOTZE, D. C., ELLERY, W. N., WALTERS, D., KOOPMAN, V., GOODMAN, P., et al. 2008. WET-Health: a technique for rapidly assessing wetland health. WRC report TT340/08. South Africa: WRC

MACVICAR, C N, DE VILLIERS, J M, LOXTON, R F, VERSTER, E, LAMBRECHTS, J J N, MERRYWEATHER, F R, LEROUX, J, VANROOYEN, T H &HARMSE, H J von M 1977. Soil classification - A binomial system for South Africa. Scientific Bulletin No 390, Pretoria: Department of Agricultural Technical Services.

MAMMALMAP. 2017. Website: http://vmus.adu.org.za. Accessed in February 2017.

MECENERO, S., BALL J.B., EDGE D.A., HAMER M.L., HENNING G.A., KRUGER M.A., PRINGLE, E.L., TERBLANCHE R.F. & WILLIAMS M.C. 2013. Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas. Saftronics and the ADU, University of Cape Town, Cape Town.

MINTER L., BURGER M., HARRISON J.A., BRAACK H.H., BISHOP P.J. & KLOEPFER D. 2004. Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. SI/MAB Series 9. Smithsonian Institution, WashingtonDC.

MONADJEM A., TAYLOR P.J., COTTERILL F.P.D. & SCHOEMAN M.C. 2010. Bats of Southern and Central Africa – A Biogeographic and Taxonomic Synthesis. WitsUniversity Press, Johannesburg.

MUCINA L. & RUTHERFORD M.C. 2006. The Vegetation Map of South Africa, Lesotho and Swaziland. Strelitzia 19, SANBI, Pretoria.

MUCINA, L & RUTHERFORD, M.C. (eds). 2006. The vegetation map of South Africa, Lesotho and Swaziland. Strelitzia 19, South African National Biodiversity Institute.

MUELLER-DOMBOIS, D., and H. ELLENBERG: 1974 Aims and Methods of Vegetation Ecology. John Wiley and Sons, New York

NBI, (2004). National spatial biodiversity assessment, Strelizia 17, NBI, Kirstenbosch.

NEL, L.J. & DRIVER, A. 2012: National Biodiversity Assessment 2011: Technical Report: Volume 2: Freshwater Component. CSIR & SANBI, Pretoria.

NEWMAN K. 2002. Newman's Birds of Southern Africa. Struik Publishers, Cape Town.

O'FARRELL P. 2006. Ecosystem Services and Benefits to Farmers. Conservation Farming Project.

ODONATAMAP. 2017. Website: http://vmus.adu.org.za. Accessed in February 2017.

OLLIS, D., SNADDON, K., JOB, N & MBONA, N. 2013. Wetland Classification using the recently published Classification Systems for Wetlands: Inland Systems. SANBI, Pretoria.

OLLIS, D., SNADDON, K., JOB, N & MBONA, N. 2013. Wetland Classification using the recently published Classification Systems for Wetlands: Inland Systems. SANBI, Pretoria.

PFAB M.F. & VICTOR J.E. 2002. Threatened Plants of Gauteng, South Africa. SouthAfrican Journal of Botany 68: 370-375.

PICKETT S.T.A., OSTFELD R.S., SHACHAK M. & LICKENS G.E. 1997. The Ecological Basis of Conservation: Heterogeneity, Ecosystems, and Biodiversity. Chapman and Hall. New York.

REPTILEMAP. 2017. Website: http://vmus.adu.org.za. Accessed in February 2017.

ROUGET, M., REYERS, B., JONAS, Z., DESMET, P., DRIVER, A., MAZE, K., EGOH, B., COWLING, R.M., MUCINA, L. & RUTHERFORD, M.C. 2004. South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 1: Terrestrial Component. South African National Biodiversity Institute, Pretoria.

SABAP 1 & 2 (FIRST AND SECOND SOUTHERN AFRICAN BIRD ATLAS PROJECTS). 2017. Website: http://sabap2.adu.org.za. Accessed in February 2017.

SAMWAYS, M. J. 2008. Dragonflies and Damselflies of South Africa. Pensoft, Sofia, 297 pp.

SAMWAYS, M.J. 2006. National Red List of South African dragonflies (Odonata). Odonatologica, 35: 341–368.

SCORPIONMAP. 2017. Website: http://vmus.adu.org.za. Accessed in February 2017.

STUART C. & STUART T. 2007. Field Guide to the Mammals of Southern Africa. Struik Nature, Cape Town.

TUTU, H., MCCARTHY, T.S. and CUKROWSKA, E. 2008. The chemical characteristics of acid mine drainage with particular reference to sources, distribution and remediation: The Witwatersrand Basin, South Africa as a case study. Applied Geochemistry, 23, 3666–3684.

WADE, P.W., WOODBOURNE, S., MORRIS, W., VOS, P. and JARVIS, N. 2002. Tier 1 risk assessment of radionuclides in selected sediments of the Mooi River, Water Research Commission, WRC Report 1095/1/02, Pretoria: 93 p.

YETMAN C.A. 2012. Conservation Biology of the Giant Bullfrog, *Pyxicephalus adspersus* (Tschudi, 1838). PhD thesis. University of Pretoria, Pretoria

11. Appendices

11.1. Appendix 1 SANBI POSA DATA – Flora for the surrounding QDGS

Family		*Species*	Threat status	Growth forms
FABACEAE		*Acacia karroo Hayne*	LC	Shrub, tree
MENISPERMACEAE		*Antizoma angustifolia (Burch.) Miers ex Harv.*	LC	Climber
POACEAE		*Aristida diffusa Trin. subsp. burkei (Stapf) Melderis*	LC	Graminoid
POACEAE		*Aristida junciformis Trin. & Rupr. subsp. junciformis*	LC	Graminoid
CHENOPODIACEAE		*Atriplex semibaccata R.Br. var. typica Aellen*	NE	Dwarf shrub
CHENOPODIACEAE		*Atriplex suberecta I.Verd.*	LC	Herb
PORTULACACEAE		*Avonia ustulata (E.Mey. ex Fenzl) G.D.Rowley*	LC	Herb, succulent
POACEAE		*Brachiaria serrata (Thunb.) Stapf*	LC	Graminoid
AMARYLLIDACEAE		*Brunsvigia radulosa Herb.*	LC	Geophyte
SOLANACEAE	*	*Cestrum aurantiacum Lindl.*	NE	Shrub, tree
MESEMBRYANTHEMACEAE		*Chasmatophyllum musculinum (Haw.) Dinter & Schwantes*	LC	Succulent
CARYOPHYLLACEAE		*Corrigiola litoralis L. subsp. litoralis var. litoralis*	LC	Herb
CRASSULACEAE		*Crassula corallina Thunb. subsp. corallina*	LC	Herb, succulent
CRASSULACEAE		*Crassula tabularis Dinter*	LC	Herb, succulent
POACEAE		*Cynodon dactylon (L.) Pers.*	LC	Graminoid
CYPERACEAE		*Cyperus esculentus L. var. esculentus*	LC	Cyperoid, geophyte, herb, mesophyte
CYPERACEAE		*Cyperus marginatus Thunb.*	LC	Cyperoid, helophyte, herb
CYPERACEAE		*Cyperus semitrifidus Schrad.*	LC	Cyperoid, herb, mesophyte
POACEAE		*Digitaria eriantha Steud.*	LC	Graminoid
POACEAE		*Digitaria tricholaenoides Stapf*	LC	Graminoid
IRIDACEAE		*Duthieastrum linifolium (E.Phillips) M.P.de Vos*	LC	Geophyte, herb
POACEAE		*Eragrostis curvula (Schrad.) Nees*	LC	Graminoid
POACEAE		*Eragrostis lappula Nees*	LC	Graminoid
POACEAE		*Eragrostis lehmanniana Nees var. lehmanniana*	LC	Graminoid
POACEAE		*Eragrostis nindensis Ficalho & Hiern*	LC	Graminoid

Family		*Species*	Threat status	Growth forms
POACEAE		*Eragrostis superba Peyr.*	LC	Graminoid
ASTERACEAE		*Geigeria aspera Harv. var. aspera*	LC	Herb
BUDDLEJACEAE		*Gomphostigma virgatum (L.f.) Baill.*	LC	Dwarf shrub, herb, shrub
ASTERACEAE		*Helichrysum pumilio (O.Hoffm.) Hilliard & B.L.Burtt subsp. pumilio*	LC	Dwarf shrub, herb
MALVACEAE		*Hibiscus calyphyllus Cav.*	LC	Dwarf shrub, herb
ASTERACEAE	*	*Hypochaeris microcephala (Sch.Bip.) Cabrera var. albiflora (Kuntze) Cabrera*	NE	Herb
CONVOLVULACEAE		*Ipomoea simplex Thunb.*	LC	Herb, succulent
JUNCACEAE		*Juncus rigidus Desf.*	LC	Helophyte, herb
SOLANACEAE		*Lycium arenicola Miers*	LC	Shrub
AMARYLLIDACEAE		*Nerine laticoma (Ker Gawl.) T.Durand & Schinz*	LC	Geophyte
POACEAE		*Panicum stapfianum Fourc.*	LC	Graminoid
PSORACEAE		*Psora crenata (Taylor) Reinke*	LC	Lichen
RICCIACEAE		*Riccia simii Perold*	LC	Bryophyte
SALICACEAE	*	*Salix babylonica L. var. babylonica*	NE	Tree
CONVOLVULACEAE		*Seddera capensis (E.Mey. ex Choisy) Hallier f.*	LC	Suffrutex
POACEAE		*Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. sphacelata*	LC	Graminoid
FABACEAE		*Sutherlandia microphylla Burch. ex DC.*	LC	Shrub
TAMARICACEAE	*	*Tamarix chinensis Lour.*	NE	Tree
POACEAE		*Themeda triandra Forssk.*	LC	Graminoid
ASPHODELACEAE		*Trachyandra asperata Kunth var. asperata*	LC	Geophyte, succulent
POTTIACEAE		*Trichostomum brachydontium Bruch*	LC	Bryophyte
XYRIDACEAE		*Xyris gerrardii N.E.Br.*	LC	Helophyte, herb, hydrophyte

11.2. Appendix 2 Present and potentially occurring mammal species

FAMILY[1]& SPECIES[2,4]	COMMON NAME[2,4]	LO	CONSERVATION STATUS					ATLAS[6]
			GLOBAL RED LIST[5]	REGIONAL RED LIST (2017)[8]	RSA RED LIST (2004)[2]	RSA LEGAL[3]	FS LEGAL[7]	
MACROSCELIDIDAE (Elephant shrews)								
Elephantulus myurus	Eastern Rock Elephant Shrew	4	LC (S)	LC	LC			
ERINACEIDAE (Hedgehog)								
Atelerix frontalis (frontalis)	Southern African Hedgehog	2	LC (S)	**NT**	**NT**		**PG**	
SORICIDAE (Shrews)								
Crocidura cyanea	Reddish-gray Musk Shrew	2	LC (S)	LC	**DD**			
Suncus varilla	Lesser Dwarf Shrew	2	LC (U)	LC	**DD**			
NYCTERIDAE (Slit-faced bats)								
Nycteris thebaica	Egyptian Slit-faced Bat	2	LC (U)	LC	LC			
RHINOLOPHIDAE (Horseshoe bats)								
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	2	LC (U)	LC	**NT**			
VESPERTILIONIDAE (House, pipistrelle, serotine & related bats)								
Miniopterus natalensis / shreibersii	Natal / Shreiber's Long-fingered Bat	3	LC (U)	LC	**NT**			
Neoromicia capensis	Cape Serotine	1	LC (S)	LC	LC			
Pipistrellus hesperidus	Dusky Pipistrelle	1						LC (U)
Scotophilus dinganii	Yellow-bellied House Bat	1						LC (U)
MOLOSSIDAE (Free-tailed & related bats)								
Tadarida aegyptiaca	Egyptian Free-tailed Bat	2	LC (U)	LC	LC			
LEPORIDAE (Hares & rabbits)								
Lepus capensis	Cape Hare	3	LC (D)	LC	LC		**OG**	
Lepus saxatilis	Scrub Hare	1	LC (D)	LC	LC		**OG**	
SCIURIDAE (Squirrels)								
Xerus inauris	South African Ground Squirrel	1	LC (S)	LC	LC			
GLIRIDAE (Dormice)								
Graphiurus murinus	Forest African Dormouse	3	LC (S)	LC	LC			
PEDETIDAE (Spring Hare)								
Pedetes capensis	South African Spring Hare	2	LC (U)	LC	LC			
BATHYERGIDAE (Mole-rats)								
Cryptomys hottentotus	Southern African Mole-rat	1	LC (S)	LC	LC			

FAMILY[1]& SPECIES[2,4]	COMMON NAME[2,4]	LO	CONSERVATION STATUS					ATLAS[6]
			GLOBAL RED LIST[5]	REGIONAL RED LIST (2017)[8]	RSA RED LIST (2004)[2]	RSA LEGAL[3]	FS LEGAL[7]	
HYSTRICIDAE (Porcupine)								
Hystrix africaeaustralis	Cape Porcupine	1	LC (S)	LC	LC			
THRYONOMYIDAE (Cane Rat)								
Thryonomys swinderianus	Greater Cane Rat	2	LC (U)	LC	LC			
MURIDAE (Gerbils, rock mice, vlei rats & relatives)								
Aethomys namaquensis	Namaqua Rock Mouse	2	LC (S)	LC	LC			
Gerbilliscus brantsii	Highveld Gerbil	2	LC (U)	LC	LC			
Gerbilliscus leucogaster	Bushveld Gerbil	3	LC (S)	LC	**DD**			
Lemniscomys rosalia	Single-Striped Lemniscomys	2	LC (S)	LC	**DD**			
Mastomys coucha	Southern African Mastomys	1	LC (S)	LC	LC			
Mus orangiae	Free State Pygmy Mouse	2	LC (U)	NE	**DD**			
Otomys auratus / irroratus	Southern African Vlei Rat	2	LC (S)	**NT**	LC			
Rhabdomys pumilio	Xeric Four-striped Grass Rat	2	LC (S)	LC	LC			
NESOMYIDAE (Climbing & fat mice & relatives)								
Dendromus melanotis	Gray African Climbing Mouse	2	LC (S)	LC	LC			
Mystromys albicaudatus	African White-tailed Rat	2	**EN (D)**	**VU**	**EN**			
Saccostomus campestris	Southern African Pouched Mouse	2	LC (S)	LC	LC			
Steatomys krebsii	Kreb's African Fat Mouse	3	LC (S)	LC	LC			
CANIDAE (Dogs, foxes, jackals & relatives)								
Canis mesomelas	Black-backed Jackal	1	LC (S)	LC	LC			
Lycaon pictus	African wild dog		**EN (D)**	**EN**	**EN**	**EN**		1
Otocyon megalotis	Bat-eared Fox	2	LC (U)	LC	LC	**PS**	**PG**	
Vulpes chama	Cape Fox	2	LC (S)	LC	LC	**PS**		
MUSTELIDAE (Badger, otters, polecat & weasel)								
Aonyx capensis	African Clawless Otter	2	LC (S)	**NT**	LC			
Hydrictis maculicollis	Spotted-necked Otter	3	LC (D)	**VU**	**NT**			
Ictonyx striatus	Striped Polecat	2	LC (S)	LC	LC			
Mellivora capensis	Honey Badger	2	LC (D)	LC	**NT**			
Poecilogale albinucha	African Striped Weasel	2	LC (U)	**NT**	**DD**			
HERPESTIDAE (Meerkat & mongooses)								
Atilax paludinosus	Marsh Mongoose	2	LC (D)	LC	LC			
Cynictis penicillata	Yellow Mongoose	1	LC (S)	LC	LC			

FAMILY[1]& SPECIES[2,4]	COMMON NAME[2,4]	LO	CONSERVATION STATUS					ATLAS[6]
			GLOBAL RED LIST[5]	REGIONAL RED LIST (2017)[8]	RSA RED LIST (2004)[2]	RSA LEGAL[3]	FS LEGAL[7]	
Herpestes sanguineus	Slender Mongoose	1	LC (S)	LC	LC			
Ichneumia albicauda	White-tailed Mongoose	2	LC (S)	LC	LC			
Suricata suricatta	Meerkat	2	LC (U)	LC	LC			
VIVERRIDAE (Civet & genets)								
Civettictis civetta	African Civet	2	LC (U)	LC	LC			
Genetta genetta	Common Genet	3	LC (S)	LC	LC			
Genetta maculata	Common Large- / Rusty-spotted Genet	3	LC(U)	LC				
HYAENIDAE (Aardwolf & hyenas)								
Hyaena brunnea	Brown Hyena	2	**NT (D)**		**NT**	**PS**		
Proteles cristata	Aardwolf	2	LC (S)	LC	LC		**PG**	
FELIDAE (Cats)								
Caracal caracal	Caracal	2	LC (U)	LC	LC			
Felis nigripes	Black-footed Cat	2	**VU (D)**	**VU**	LC	**PS**		
Leptailurus serval	Serval	1	LC (S)	**NT**	**NT**	**PS**		
Felis silvestris	Wildcat	2	LC (D)	LC	LC			
ORYCTEROPODIDAE (Aardvark)								
Orycteropus afer	Aardvark	1	LC (U)	LC	LC	**PS**	**PG**	
PROCAVIIDAE (Hyraxes)								
Procavia capensis	Rock Hyrax	4	LC (U)	LC	LC			
EQUIDAE (Zebras)								
Equus quagga	Plains Zebra	1	LC (S)	LC	LC	PS*	**OG**	6
Equus zebra hartmannae	Hartmann's Zebra	5	**VU (U)***	**VU**	**EN**	**VU**	**OG**	2
SUIDAE (Hogs & pigs)								
Phacochoerus africanus	Common Warthog	4	LC (S)	LC	LC			2
GIRAFFIDAE (Giraffe)								
Giraffa camelopardalis	Giraffe	5					**OG**	5
BOVIDAE (Even-toed antelope)								
Aepyceros melampus	Impala	1	LC (S)	LC	LC		**OG**	10
Alcelaphus caama	Red Hartebeest	1	LC (D)	LC	LC	**PS**	**OG**	8
Antidorcas marsupialis	Springbok	1	LC (I)	LC	LC		**OG**	10
Connochaetes gnou	Black Wildebeest	1	LC (I)	LC	LC	**PS**	**OG**	6

FAMILY[1]& SPECIES[2,4]	COMMON NAME[2,4]	LO	CONSERVATION STATUS					ATLAS[6]
			GLOBAL RED LIST[5]	REGIONAL RED LIST (2017)[8]	RSA RED LIST (2004)[2]	RSA LEGAL[3]	FS LEGAL[7]	
Connochaetes taurinus taurinus	Blue Wildebeest	5	LC (S)	LC	LC	PS	OG	4
Damaliscus lunatus	Tsessebe	5	LC (D)	VU	EN	PS		3
Damaliscus pygargus phillipsi	Blesbok	1	LC (S)*	LC	LC	PS	OG	7
Hippotragus equinus	Roan Antelope	5	LC (D)	EN	VU	EN	PG	2
Hippotragus niger niger	Sable Antelope	1	LC (S)	VU	VU	VU	PG	5
Kobus ellipsiprymnus ellipsiprymnus	Waterbuck	1	LC (D)	LC	LC		OG	9
Kobus leche	Lechwe							7
Oreotragus oreotragus	Klipspringer	4	LC (S)	LC	LC		OG	
Oryx gazella	Gemsbok	1	LC (S)	LC	LC		OG	10
Ourebia ourebi	Oribi	5	LC (D)	End	EN	EN	PG	1
Pelea capreolus	Vaal Rhebok	5	LC (S)	NT	LC		OG	1
Raphicerus campestris	Steenbok	1	LC (S)	LC	LC		OG	9
Redunca arundinum	Southern Reedbuck	5	LC (S)	LC	LC		OG	5
Redunca fulvorufula	Mountain Reedbuck	4	LC (S)	EN	LC		OG	5
Sylvicapra grimmia	Bush Duiker	1	LC (S)	LC	LC		OG	9
Syncerus caffer	African Buffalo	5	LC (D)	LC	LC		OG	3
Tragelaphus angasii	Nyala	5	LC (S)	LC	LC			4
Tragelaphus oryx	Common Eland	1	LC (S)	LC	LC		OG	5
Tragelaphus scriptus	Bushbuck	5	LC (S)	LC	LC		OG	3
Tragelaphus strepsiceros	Greater Kudu	5	LC (S)	LC	LC		OG	4
Dama dama	Fallow Deer	5						6
Key								
Status: DD = Data Deficient; EN = Endangered; G = Game; LC = Least Concern; NIWA = Non-indigenous Wild Animal; NT = Near Threatened; OG = Ordinary Game; PG = Protected Game; PS = Protected Species; VU = Vulnerable								
Likelihood of Occurrence (LO): 1 = Present; 2 = High; 3 = Moderate; 4 = Low; 5 = Managed								
Sources: [1]Stuart & Stuart (2007); [2]Friedmann & Daly (2004); [3]ToPS List (2015); [4]Monadjem *et al.* (2010); [5]IUCN (2015-4); [6]MammalMAP (2017); [7]Free State Nature Conservation Ordinance (1969); [8]EWT & SANBI (In press)								

11.3. Appendix 3. Present and potentially occurring bird species

CATEGORY & SCIENTIFIC NAME	COMMON NAME	LO	CONSERVATION STAUS				ATLAS		
			GLOBAL	REGIONAL	RSA	FS LEGAL[3]	SABAP 2[4]	1	NSS

			RED LIST[1]	RED LIST[1]	LEGAL[2]		FP (RR%)	AP (RR%)	IR		RO
1. Ocean birds											
Chroicocephalus cirrocephalus	Grey-headed Gull	2	LC	LC	-	**PG Schedule 1 Section 2**					
Sterna caspia	Caspian Tern	3	LC	**VU**	-	**PG Schedule 1 Section 2**					
2. Inland water birds											
Anastomus lamelligerus	African Openbill	4	LC	LC	-	**PG Schedule 1 Section 2**					
Anhinga rufa	African Darter	1	LC	LC	-	**PG Schedule 1 Section 2**	11,1			x	73
Ardea cinerea	Grey Heron	1	LC	LC	-	**PG Schedule 1 Section 2**	11,1	100		x	63
Ardea goliath	Goliath Heron	2	LC	LC	-	**PG Schedule 1 Section 2**				x	
Ardea melanocephala	Black-headed Heron	1	LC	LC	-	**PG Schedule 1 Section 2**	77,8			x	7
Ardea purpurea	Purple Heron	2	LC	LC	-	**PG Schedule 1 Section 2**					
Ardeola ralloides	Squacco Heron	1	LC	LC	-	**PG Schedule 1 Section 2**					66
Bostrychia hagedash	Hadeda Ibis	1	LC	LC	-	**PG Schedule 1 Section 2**	66,7			x	18
Bubulcus ibis	Western Cattle Egret	1	LC	LC	-	**PG Schedule 1 Section 2**				x	60
Butorides striata	Green-backed Heron	4	LC	LC	-	**PG Schedule 1 Section 2**					
Chlidonias hybrida	Whiskered Tern	1	LC	LC	-	**PG Schedule 1 Section 2**	11,1			x	67
Chlidonias leucopterus	White-winged Tern	2	LC	LC	-	**PG Schedule 1 Section 2**				x	
Ciconia abdimii	Abdim's Stork	2	LC	**NT**	-	**PG Schedule 1 Section 2**				x	
Ciconia ciconia	White Stork	1	LC	LC	-	**PG Schedule 1 Section 2**					59
Egretta alba	Great Egret	1	LC	LC	-	**PG Schedule 1 Section 2**				x	75
Egretta ardesiaca	Black Heron	4	LC	LC	-	**PG Schedule 1 Section 2**					
Egretta garzetta	Little Egret	2	LC	LC	-	**PG Schedule 1 Section 2**				x	
Egretta intermedia	Yellow-billed Egret	2	LC	LC	-	**PG Schedule 1 Section 2**					
Glareola nordmanni	Black-winged Pratincole	1	**NT**	**NT**	-	**PG Schedule 1 Section 2**					47
Ixobrychus minutus	Little Bittern	4	LC	LC	-	**PG Schedule 1 Section 2**					
Mycteria ibis	Yellow-billed Stork	1	LC	**EN**	-	**PG Schedule 1 Section 2**				x	62
Nycticorax nycticorax	Black-crowned Night Heron	2	LC	LC	-	**PG Schedule 1 Section 2**					
Phalacrocorax africanus	Reed Cormorant	1	LC	LC	-					x	87
Phalacrocorax lucidus	White-breasted Cormorant	1	LC	LC	-					x	70
Phoenicopterus roseus	Greater Flamingo	2	LC	**NT**	-	**PG Schedule 1 Section 2**				x	
Platalea alba	African Spoonbill	2	LC	LC	-	**PG Schedule 1 Section 2**				x	
Plegadis falcinellus	Glossy Ibis	1	LC	LC	-	**PG Schedule 1 Section 2**	11,1			x	76
Scopus umbretta	Hamerkop	2	LC	LC	-	**PG Schedule 1 Section 2**				x	

CATEGORY & SCIENTIFIC NAME	COMMON NAME	LO	CONSERVATION STAUS				ATLAS				
							SABAP 2[4]			SABAP 1	NSS
			GLOBAL RED LIST[1]	REGIONAL RED LIST[1]	RSA LEGAL[2]	FS LEGAL[3]	FP (RR%)	AP (RR%)	IR		RO
Threskiornis aethiopicus	African Sacred Ibis	2	LC	LC	-	PG Schedule 1 Section 2				x	
3. Ducks & wading birds											
Actitis hypoleucos	Common Sandpiper	2	LC	LC	-	PG Schedule 1 Section 2				x	
Alopochen aegyptiaca	Egyptian Goose	1	LC	LC	-	PG Schedule 1 Section 2	44,4			x	29
Amaurornis flavirostra	Black Crake	2	LC	LC	-	PG Schedule 1 Section 2					
Anas capensis	Cape Teal	2	LC	LC	-	PG Schedule 1 Section 2					
Anas erythrorhyncha	Red-billed Teal	1	LC	LC	-	OG Schedule 2 Section 3				x	65
Anas hottentota	Hottentot Teal	1	LC	LC	-	PG Schedule 1 Section 2					64
Anas smithii	Cape Shoveler	1	LC	LC	-	PG Schedule 1 Section 2					68
Anas sparsa	African Black Duck	2	LC	LC	-	PG Schedule 1 Section 2					
Anas undulata	Yellow-billed Duck	1	LC	LC	-	OG Schedule 2 Section 3				x	45
Calidris ferruginea	Curlew Sandpiper	2	NT	LC	-	PG Schedule 1 Section 2				x	
Calidris minuta	Little Stint	2	LC	LC	-	PG Schedule 1 Section 2				x	
Charadrius hiaticula	Common Ringed Plover	2	LC	LC	-	PG Schedule 1 Section 2					
Charadrius pallidus	Chestnut-banded Plover	3	NT	NT	-	PG Schedule 1 Section 2					
Charadrius pecuarius	Kittlitz's Plover	1	LC	LC	-	PG Schedule 1 Section 2	11,1			x	5
Charadrius tricollaris	Three-banded Plover	1	LC	LC	-	PG Schedule 1 Section 2	33,3			x	4
Dendrocygna bicolor	Fulvous Whistling Duck	2	LC	LC	-	PG Schedule 1 Section 2					
Dendrocygna viduata	White-faced Whistling Duck	1	LC	LC	-	PG Schedule 1 Section 2					44
Fulica cristata	Red-knobbed coot	1	LC	LC	-	OG Schedule 2 Section 3				x	72
Gallinago nigripennis	African Snipe	2	LC	LC	-	PG Schedule 1 Section 2					
Gallinula chloropus	Common Moorhen	1	LC	LC	-	PG Schedule 1 Section 2				x	83
Himantopus himantopus	Black-winged Stilt	1	LC	LC	-	PG Schedule 1 Section 2				x	85
Netta erythrophthalma	Southern Pochard	2	LC	LC	-	PG Schedule 1 Section 2					
Oxyura maccoa	Maccoa Duck	2	NT	NT	-	PG Schedule 1 Section 2					
Philomachus pugnax	Ruff	2	LC	LC	-	PG Schedule 1 Section 2					
Plectropterus gambensis	Spur-winged Goose	1	LC	LC	-	OG Schedule 2 Section 3				x	46
Podiceps cristatus	Great Crested Grebe	3	LC	LC	-	PG Schedule 1 Section 2					
Podiceps nigricollis	Black-necked Grebe	3	LC	LC	-	PG Schedule 1 Section 2					
Porphyrio madagascariensis	African (Purple) Swamphen	2	LC	LC	-	PG Schedule 1 Section 2					

CATEGORY & SCIENTIFIC NAME	COMMON NAME	LO	CONSERVATION STAUS				ATLAS				
			GLOBAL RED LIST[1]	REGIONAL RED LIST[1]	RSA LEGAL[2]	FS LEGAL[3]	SABAP 2[4]			SABAP 1	NSS
							FP (RR%)	AP (RR%)	IR		RO
Recurvirostra avosetta	Pied Avocet	2	LC	LC	-	PG Schedule 1 Section 2				x	
Tachybaptus ruficollis	Little Grebe	2	LC	LC	-	PG Schedule 1 Section 2				x	
Tadorna cana	South African Shelduck	1	LC	LC	-	OG Schedule 2 Section 3				x	77
Thalassornis leuconotus	White-backed Duck	2	LC	LC	-	PG Schedule 1 Section 2					
Tringa glareola	Wood Sandpiper	2	LC	LC	-	PG Schedule 1 Section 2				x	
Tringa nebularia	Common Greenshank	2	LC	LC	-	PG Schedule 1 Section 2					
Tringa stagnatilis	Marsh Sandpiper	1	LC	LC	-	PG Schedule 1 Section 2				x	84
Vanellus armatus	Blacksmith Lapwing	1	LC	LC	-	PG Schedule 1 Section 2				x	28
Vanellus coronatus	Crowned Lapwing	1	LC	LC	-	PG Schedule 1 Section 2	77,8			x	11
4. Large terrestrial birds											
Afrotis afraoides	Northern Black Korhaan	1	LC	LC	-	PG Schedule 1 Section 2				x	82
Anthropoides paradiseus	Blue Crane	3	VU	NT	PS	OG Schedule 2 Section 3				x	
Burhinus capensis	Spotted Thick-knee	1	LC	LC	-	PG Schedule 1 Section 2	11,1			x	22
Coturnix coturnix	Common Quail	1	LC	LC	-	OG Schedule 2 Section 3					38
Cursorius rufus	Burchell's Courser	3	LC	VU	-	PG Schedule 1 Section 2					
Cursorius temminckii	Temminck's Courser	1	LC	LC	-	PG Schedule 1 Section 2					14
Eupodotis caerulescens	Blue Korhaan	1*	NT	LC	-	PG Schedule 1 Section 2				x	
Numida meleagris	Helmeted Guineafowl	1	LC	LC	-	OG Schedule 2 Section 3	88,9	100		x	8
Ortygospiza fuscocrissa	African Quailfinch	1	LC	LC	-	PG Schedule 1 Section 2	44,4			x	23
Pternistis natalensis	Natal Spurfowl	2	LC	LC	-	OG Schedule 2 Section 3					
Pternistis swainsonii	Swainson's Spurfowl	1	LC	LC	-	OG Schedule 2 Section 3	44,4			x	31
Rhinoptilus africanus	Double-banded Courser	1	LC	LC	-	PG Schedule 1 Section 2				x	56
Rhinoptilus chalcopterus	Bronze-winged Courser	3	LC	LC	-	PG Schedule 1 Section 2					
Sagittarius serpentarius	Secretarybird	2	VU	VU	-	PG Schedule 1 Section 2				x	
Scleroptila gutturalis	Orange River Francolin	2	LC	LC	-	OG Schedule 2 Section 3					
Struthio camelus	Common Ostrich	1	LC	LC	-		33,3			x	71
5. Raptors											
Aquila verreauxii	Verreauxs' Eagle	2	LC	VU	-	PG Schedule 1 Section 2					
Buteo buteo	Common Buzzard	1	LC	LC	-	PG Schedule 1 Section 2				x	9
Buteo rufofuscus	Jackal Buzzard	2	LC	LC	-	PG Schedule 1 Section 2				x	

CATEGORY & SCIENTIFIC NAME	COMMON NAME	LO	CONSERVATION STAUS				ATLAS				
			GLOBAL RED LIST[1]	REGIONAL RED LIST[1]	RSA LEGAL[2]	FS LEGAL[3]	SABAP 2[4]			SABAP 1	NSS
							FP (RR%)	AP (RR%)	IR		RO
Circus macrourus	Pallid Harrier	2	NT	NT	-	PG Schedule 1 Section 2				x	
Circus maurus	Harrier, Black	3	VU	EN	-	PG Schedule 1 Section 2				x	
Circus ranivorus	African Marsh Harrier	2	LC	EN	-	PG Schedule 1 Section 2					
Elanus caeruleus	Black-shouldered Kite	2	LC	LC	-	PG Schedule 1 Section 2				x	
Falco amurensis	Amur Falcon	1	LC	LC	-	PG Schedule 1 Section 2	44,4			x	48
Falco biarmicus	Lanner Falcon	2	LC	VU	-	PG Schedule 1 Section 2					
Falco naumanni	Lesser Kestrel	1	LC	LC	-	PG Schedule 1 Section 2	55,6			x	2
Falco rupicoloides	Greater Kestrel	3	LC	LC	-	PG Schedule 1 Section 2				x	
Falco rupicolus	Rock Kestrel	2	LC	LC	-	PG Schedule 1 Section 2				x	
Falco vespertinus	Red-footed Falcon	3	NT	NT	-	PG Schedule 1 Section 2					
Haliaeetus vocifer	African Fish Eagle	1	LC	LC	-	PG Schedule 1 Section 2					86
Melierax canorus	Pale Chanting Goshawk	2	LC	LC	-	PG Schedule 1 Section 2				x	
Melierax gabar	Gabar Goshawk	4	LC	LC	-	PG Schedule 1 Section 2					
Milvus aegyptius	Yellow-billed Kite	2	LC	LC	-	PG Schedule 1 Section 2				x	
Pernis apivorus	European Honey Buzzard	2	LC	LC	-	PG Schedule 1 Section 2					
Polemaetus bellicosus	Martial Eagle	2	VU	EN	EN	PG Schedule 1 Section 2					
6. Owls & nightjars											
Asio capensis	Marsh Owl	1	LC	LC	-	PG Schedule 1 Section 2	11,1			x	57
Bubo africanus	Spotted Eagle-Owl	2	LC	LC	-	PG Schedule 1 Section 2					
Caprimulgus rufigena	Rufous-cheeked Nightjar	2	LC	LC	-	PG Schedule 1 Section 2					
Tyto alba	Western Barn Owl	2	LC	LC	-	PG Schedule 1 Section 2				x	
Tyto capensis	African Grass-owl	1*	LC	VU	-	PG Schedule 1 Section 2					
7. Sandgrouse, doves etc											
Centropus burchellii	Burchell's Coucal	3	LC	LC	-	PG Schedule 1 Section 2				x	
Chrysococcyx caprius	Diederik Cuckoo	1	LC	LC	-	PG Schedule 1 Section 2	11,1			x	33
Chrysococcyx klaas	Klaas's Cuckoo	2	LC	LC	-	PG Schedule 1 Section 2					
Clamator jacobinus	Jacobin Cuckoo	3	LC	LC	-	PG Schedule 1 Section 2				x	
Columba guinea	Speckled Pigeon	1	LC	LC	-					x	81
Columba livia	Rock Dove	1	LC	LC	-	PG Schedule 1 Section 2				x	74
Cuculus solitarius	Red-chested Cuckoo	2	LC	LC	-	PG Schedule 1 Section 2				x	
Oena capensis	Namaqua Dove	1	LC	LC	-	PG Schedule 1 Section 2				x	37

CATEGORY & SCIENTIFIC NAME	COMMON NAME	LO	CONSERVATION STAUS				ATLAS				
			GLOBAL RED LIST[1]	REGIONAL RED LIST[1]	RSA LEGAL[2]	FS LEGAL[3]	SABAP 2[4]			SABAP 1	NSS
							FP (RR%)	AP (RR%)	IR		RO
Pterocles namaqua	Namaqua Sandgrouse	3	LC	LC	-	PG Schedule 1 Section 2					
Streptopelia capicola	Cape Turtle Dove	1	LC	LC	-		77,8			x	42
Streptopelia semitorquata	Red-eyed Dove	2	LC	LC	-	PG Schedule 1 Section 2				x	
Streptopelia senegalensis	Laughing Dove	1	LC	LC	-		88,9			x	40
8. Aerial feeders, etc											
Alcedo cristata	Malachite Kingfisher	2	LC	LC	-	PG Schedule 1 Section 2					
Apus affinis	Little Swift	1	LC	LC	-	PG Schedule 1 Section 2	33,3			x	1
Apus apus	Common Swift	2	LC	LC	-	PG Schedule 1 Section 2				x	
Apus barbatus	African Black Swift	2	LC	LC	-	PG Schedule 1 Section 2					
Apus caffer	White-rumped Swift	1	LC	LC	-	PG Schedule 1 Section 2				x	80
Apus horus	Horus Swift	4	LC	LC	-	PG Schedule 1 Section 2				x	
Cecropis cucullata	Greater Striped Swallow	2	LC	LC	-	PG Schedule 1 Section 2					
Cecropis cucullata	Swallow, Greater Striped	3	LC	LC	-	PG Schedule 1 Section 2					
Cecropis semirufa	Red-breasted Swallow	2	LC	LC	-	PG Schedule 1 Section 2				x	
Ceryle rudis	Pied Kingfisher	2	LC	LC	-	PG Schedule 1 Section 2				x	
Colius colius	White-backed Mousebird	2	LC	LC	-					x	
Colius striatus	Speckled Mousebird	1	LC	LC	-					x	36
Coracias caudatus	Lilac-breasted Roller	3	LC	LC	-	PG Schedule 1 Section 2					
Coracias garrulus	European Roller	2	LC	NT	-	PG Schedule 1 Section 2				x	
Cypsiurus parvus	African Palm Swift	4	LC	LC	-	PG Schedule 1 Section 2					
Delichon urbicum	Common House Martin	2	LC	LC	-	PG Schedule 1 Section 2					
Dendropicos fuscescens	Cardinal Woodpecker	2	LC	LC	-	PG Schedule 1 Section 2				x	
Halcyon albiventris	Brown-hooded Kingfisher	3	LC	LC	-	PG Schedule 1 Section 2					
Hirundo albigularis	White-throated Swallow	2	LC	LC	-	PG Schedule 1 Section 2				x	
Hirundo fuligula	Rock Martin	4	LC	LC	-	PG Schedule 1 Section 2				x	
Hirundo rustica	Barn Swallow	1	LC	LC	-	PG Schedule 1 Section 2	22,2			x	17
Indicator indicator	Greater Honeyguide	3	LC	LC	-	PG Schedule 1 Section 2					
Indicator minor	Lesser Honeyguide	3	LC	LC	-	PG Schedule 1 Section 2					
Jynx ruficollis	Red-throated Wryneck	2	LC	LC	-	PG Schedule 1 Section 2					
Lybius torquatus	Black-collared Barbet	2	LC	LC	-	PG Schedule 1 Section 2				x	

CATEGORY & SCIENTIFIC NAME	COMMON NAME	LO	CONSERVATION STAUS				ATLAS				
			GLOBAL RED LIST[1]	REGIONAL RED LIST[1]	RSA LEGAL[2]	FS LEGAL[3]	SABAP 2[4]			SABAP 1	NSS
							FP (RR%)	AP (RR%)	IR		RO
Megaceryle maxima	Giant Kingfisher	2	LC	LC	-	PG Schedule 1 Section 2					
Merops apiaster	European Bee-eater	1	LC	LC	-	PG Schedule 1 Section 2				x	79
Merops bullockoides	White-fronted Bee-eater	2	LC	LC	-	PG Schedule 1 Section 2				x	
Petrochelidon spilodera	South African Cliff Swallow	1	LC	LC	-	PG Schedule 1 Section 2				x	25
Phoeniculus purpureus	Green Wood-hoopoe	2	LC	LC	-	PG Schedule 1 Section 2				x	
Rhinopomastus cyanomelas	Common Scimitarbill	2	LC	LC	-	PG Schedule 1 Section 2				x	
Riparia paludicola	Brown-throated Martin	1	LC	LC	-	PG Schedule 1 Section 2				x	88
Tachymarptis melba	Alpine Swift	3	LC	LC	-	PG Schedule 1 Section 2					
Trachyphonus vaillantii	Crested Barbet	2	LC	LC	-	PG Schedule 1 Section 2				x	
Tricholaema leucomelas	Acacia Pied Barbet	1	LC	LC	-	PG Schedule 1 Section 2				x	78
Upupa africana	African Hoopoe	2	LC	LC	-	PG Schedule 1 Section 2				x	
Urocolius indicus	Red-faced Mousebird	1	LC	LC	-					x	52
9. Cryptic & elusive insect-eaters											
Acrocephalus arundinaceus	Great Reed Warbler	2	LC	LC	-	PG Schedule 1 Section 2					
Acrocephalus baeticatus	African Reed Warbler	2	LC	LC	-	PG Schedule 1 Section 2					
Acrocephalus gracilirostris	Lesser Swamp Warbler	2	LC	LC	-	PG Schedule 1 Section 2					
Anthus cinnamomeus	African Pipit	2	LC	LC	-	PG Schedule 1 Section 2				x	
Anthus leucophrys	Plain-backed Pipit	2	LC	LC	-	PG Schedule 1 Section 2					
Anthus similis	Long-billed Pipit	2	LC	LC	-	PG Schedule 1 Section 2					
Anthus vaalensis	Buffy Pipit	2	LC	LC	-	PG Schedule 1 Section 2					
Bradypterus baboecala	Little Rush Warbler	3	LC	LC	-	PG Schedule 1 Section 2					
Calandrella cinerea	Red-capped Lark	1	LC	LC	-	PG Schedule 1 Section 2	66,7			x	16
Calendulauda sabota	Sabota Lark	2	LC	LC	-	PG Schedule 1 Section 2				x	
Certhilauda semitorquata	Eastern Long-billed Lark	2	LC	LC	-	PG Schedule 1 Section 2				x	
Chersomanes albofasciata	Spike-heeled Lark	2	LC	LC	-	PG Schedule 1 Section 2				x	
Cisticola aridulus	Desert Cisticola	1	LC	LC	-	PG Schedule 1 Section 2					54
Cisticola ayresii	Wing-snapping Cisticola	1	LC	LC	-	PG Schedule 1 Section 2					26
Cisticola fulvicapilla	Neddicky	1	LC	LC	-	PG Schedule 1 Section 2				x	53
Cisticola juncidis	Zitting Cisticola	1	LC	LC	-	PG Schedule 1 Section 2				x	19

CATEGORY & SCIENTIFIC NAME	COMMON NAME	LO	CONSERVATION STAUS				ATLAS				
			GLOBAL RED LIST[1]	REGIONAL RED LIST[1]	RSA LEGAL[2]	FS LEGAL[3]	SABAP 2[4]			SABAP 1	NSS
							FP (RR%)	AP (RR%)	IR		RO
Cisticola textrix	Cloud Cisticola	2	LC	LC	-	PG Schedule 1 Section 2				x	
Cisticola tinniens	Levaillant's Cisticola	1	LC	LC	-	PG Schedule 1 Section 2				x	49
Eremomela icteropygialis	Yellow-bellied Eremomela	2	LC	LC	-	PG Schedule 1 Section 2					
Eremopterix leucotis	Chestnut-backed Sparrow-lark	2	LC	LC	-	PG Schedule 1 Section 2				x	
Eremopterix verticalis	Grey-backed Sparrow-lark	4	LC	LC	-	PG Schedule 1 Section 2					
Hippolais icterina	Icterine Warbler	4	LC	LC	-	PG Schedule 1 Section 2					
Macronyx capensis	Cape Longclaw	2	LC	LC	-	PG Schedule 1 Section 2				x	
Malcorus pectoralis	Rufous-eared Warbler	4	LC	LC	-	PG Schedule 1 Section 2					
Mirafra africana	Rufous-naped Lark	1	LC	LC	-	PG Schedule 1 Section 2	44,4			x	32
Mirafra cheniana	Melodious Lark	1	NT	LC	-	PG Schedule 1 Section 2					27
Mirafra fasciolata	Eastern clapper Lark	1	LC	LC	-	PG Schedule 1 Section 2	44,4			x	20
Motacilla aguimp	African Pied Wagtail	3	LC	LC	-	PG Schedule 1 Section 2				x	
Motacilla capensis	Cape Wagtail	1	LC	LC	-	PG Schedule 1 Section 2	77,8			x	12
Phylloscopus trochilus	Willow Warbler	2	LC	LC	-	PG Schedule 1 Section 2					
Prinia flavicans	Black-chested Prinia	2	LC	LC	-	PG Schedule 1 Section 2				x	
Prinia maculosa	Karoo Prinia	3	LC	LC	-	PG Schedule 1 Section 2					
Pycnonotus nigricans	African Red-eyed Bulbul	2	LC	LC	-					x	
Pycnonotus tricolor	Dark-capped Bulbul	2	LC	LC	-						
Sphenoeacus afer	Cape Grassbird	2	LC	LC	-	PG Schedule 1 Section 2					
Spizocorys conirostris	Pink-billed Lark	2	LC	LC	-	PG Schedule 1 Section 2					
Sylvia borin	Garden Warbler	4	LC	LC	-	PG Schedule 1 Section 2					
Sylvietta rufescens	Long-billed crombec	1	LC	LC	-	PG Schedule 1 Section 2					55
10. Regular insect-eaters											
Acridotheres tristis	Common Myna	3			-					x	
Anthoscopus minutus	Cape Penduline-Tit	3	LC	LC	-	PG Schedule 1 Section 2					
Batis pririt	Pririt Batis	2	LC	LC	-	PG Schedule 1 Section 2					
Cercomela familiaris	Familiar Chat	2	LC	LC	-	PG Schedule 1 Section 2				x	
Cercomela sinuata	Sickle-winged Chat	2	LC	LC	-	PG Schedule 1 Section 2					
Corvus albus	Pied Crow	2	LC	LC	-					x	
Corvus capensis	Crow, Cape	3	LC	LC	-					x	

CATEGORY & SCIENTIFIC NAME	COMMON NAME	LO	CONSERVATION STAUS				ATLAS				
			GLOBAL RED LIST[1]	REGIONAL RED LIST[1]	RSA LEGAL[2]	FS LEGAL[3]	SABAP 2[4]			SABAP 1	NSS
							FP (RR%)	AP (RR%)	IR		RO
Cossypha caffra	Cape Robin-Chat	2	LC	LC	-	PG Schedule 1 Section 2				x	
Creatophora cinerea	Wattled Starling	3	LC	LC	-	PG Schedule 1 Section 2				x	
Dicrurus adsimilis	Fork-tailed Drongo	2	LC	LC	-	PG Schedule 1 Section 2				x	
Dryoscopus cubla	Black-backed Puffback	2	LC	LC	-	PG Schedule 1 Section 2					
Erythropygia coryphoeus	Karoo Scrub Robin	2	LC	LC	-	PG Schedule 1 Section 2					
Erythropygia paena	Kalahari Scrub Robin	1	LC	LC	-	PG Schedule 1 Section 2				x	30
Lamprotornis bicolor	Pied Starling	2	LC	LC	-					x	
Lamprotornis nitens	Cape Glossy Starling	1	LC	LC	-	PG Schedule 1 Section 2				x	41
Lanius collaris	Southern (Common) Fiscal	1	LC	LC	-	PG Schedule 1 Section 2				x	58
Lanius collurio	Red-backed Shrike	2	LC	LC	-	PG Schedule 1 Section 2				x	
Lanius minor	Lesser Grey Shrike	2	LC	LC	-	PG Schedule 1 Section 2					
Muscicapa striata	Spotted flycatcher	2	LC	LC	-	PG Schedule 1 Section 2				x	
Myrmecocichla formicivora	Ant-eating Chat	1	LC	LC	-	PG Schedule 1 Section 2	66,7			x	21
Nilaus afer	Brubru	3	LC	LC	-	PG Schedule 1 Section 2					
Oenanthe monticola	Mountain Wheatear	2	LC	LC	-	PG Schedule 1 Section 2				x	
Oenanthe pileata	Capped Wheatear	1	LC	LC	-	PG Schedule 1 Section 2			1	x	24
Onychognathus morio	Red-winged Starling	2	LC	LC	-					x	
Parus cinerascens	Ashy Tit	2	LC	LC	-	PG Schedule 1 Section 2					
Saxicola torquatus	African StoneChat	1	LC	LC	-	PG Schedule 1 Section 2	55,6	100		x	69
Sigelus silens	Fiscal Flycatcher	2	LC	LC	-	PG Schedule 1 Section 2				x	
Stenostira scita	Fairy Flycatcher	2	LC	LC	-	PG Schedule 1 Section 2					
Sturnus vulgaris	Common Starling	3			-	PG Schedule 1 Section 2					
Sylvia communis	Whitethroat, Common	4	LC	LC	-	PG Schedule 1 Section 2				x	
Sylvia subcaerulea	Chestnut-vented Tit-Babbler	1	LC	LC	-	PG Schedule 1 Section 2	22,2			x	51
Tchagra australis	Brown-crowned Tchagra	3	LC	LC	-	PG Schedule 1 Section 2				x	
Tchagra senegalus	Black-crowned Tchagra	2	LC	LC	-	PG Schedule 1 Section 2					
Telophorus zeylonus	Bokmakierie	3	LC	LC	-	PG Schedule 1 Section 2				x	
Terpsiphone viridis	African Paradise Flycatcher	2	LC	LC	-	PG Schedule 1 Section 2					
Thamnolaea cinnamomeiventris	Mocking Cliff Chat	2	LC	LC	-	PG Schedule 1 Section 2				x	
Turdus smithi	Karoo Thrush	2	LC	LC	-	PG Schedule 1 Section 2				x	

CATEGORY & SCIENTIFIC NAME	COMMON NAME	LO	CONSERVATION STAUS				ATLAS				
			GLOBAL RED LIST[1]	REGIONAL RED LIST[1]	RSA LEGAL[2]	FS LEGAL[3]	SABAP 2[4]			SABAP 1	NSS
							FP (RR%)	AP (RR%)	IR		RO
11. Oxpeckers & nectar feeders											
Chalcomitra amethystina	Amethyst Sunbird	2	LC	LC	-	PG Schedule 1 Section 2					
Cinnyris talatala	White-bellied Sunbird	2	LC	LC	-	PG Schedule 1 Section 2				x	
Nectarinia famosa	Sunbird, Malachite	4	LC	LC	-	PG Schedule 1 Section 2				x	
Zosterops pallidus	Orange River White-eye	2	LC	LC	-	PG Schedule 1 Section 2				x	
Zosterops virens	Cape White-eye	2	LC	LC	-	PG Schedule 1 Section 2				x	
12. Seed-eaters											
Amadina erythrocephala	Red-headed Finch	2	LC	LC	-	PG Schedule 1 Section 2				x	
Crithagra albogularis	White-throated Canary	2	LC	LC	-	PG Schedule 1 Section 2					
Crithagra atrogularis	Black-throated Canary	1	LC	LC	-	PG Schedule 1 Section 2	88,9			x	35
Crithagra flaviventris	Yellow Canary	1	LC	LC	-	PG Schedule 1 Section 2				x	61
Emberiza capensis	Cape Bunting	2	LC	LC	-	PG Schedule 1 Section 2					
Emberiza flaviventris	Golden-breasted Bunting	3	LC	LC	-	PG Schedule 1 Section 2					
Emberiza impetuani	Lark-like Bunting	4	LC	LC	-	PG Schedule 1 Section 2					
Emberiza tahapisi	Cinnamon-breasted Bunting	2	LC	LC	-	PG Schedule 1 Section 2				x	
Estrilda astrild	Common Waxbill	2	LC	LC	-	PG Schedule 1 Section 2					
Estrilda erythronotos	Black-faced Waxbill	3	LC	LC	-	PG Schedule 1 Section 2					
Euplectes afer	Yellow-crowned Bishop	1	LC	LC	-					x	3
Euplectes albonotatus	White-winged Widowbird	2	LC	LC	-					x	
Euplectes ardens	Red-collared Widowbird	2	LC	LC	-					x	
Euplectes orix	Southern Red Bishop	1	LC	LC	-					x	13
Euplectes progne	Long-tailed Widowbird	1	LC	LC	-		55,6			x	15
Lagonosticta senegala	Red-billed Firefinch	2	LC	LC	-	PG Schedule 1 Section 2				x	
Passer diffusus	Southern Grey-headed Sparrow	2	LC	LC	-	PG Schedule 1 Section 2				x	
Passer domesticus	House Sparrow	2			-					x	
Passer melanurus	Cape Sparrow	1	LC	LC	-		88,9			x	43
Plocepasser mahali	White-browed Sparrow-Weaver	1	LC	LC	-		100			x	6
Ploceus capensis	Cape Weaver	2	LC	LC	-						

CATEGORY & SCIENTIFIC NAME	COMMON NAME	LO	CONSERVATION STAUS				ATLAS				
			GLOBAL RED LIST[1]	REGIONAL RED LIST[1]	RSA LEGAL[2]	FS LEGAL[3]	SABAP 2[4]			SABAP 1	NSS
							FP (RR%)	AP (RR%)	IR		RO
Ploceus velatus	Southern Masked Weaver	1	LC	LC	-		100			x	34
Pytilia melba	Green-winged Pytilia	1	LC	LC	-	**PG Schedule 1 Section 2**	11,1			x	50
Quelea quelea	Red-billed Quelea	1	LC	LC	-		66,7			x	10
Serinus canicollis	Canary, Cape	3	LC	LC	-	**PG Schedule 1 Section 2**				x	
Sporopipes squamifrons	Finch, Scaly-feathered	3	LC	LC	-					x	
Uraeginthus angolensis	Blue Waxbill	2	LC	LC	-	**PG Schedule 1 Section 2**				x	
Uraeginthus granatinus	Violet-eared Waxbill	2	LC	LC	-	**PG Schedule 1 Section 2**					
Vidua chalybeata	Village Indigobird	2	LC	LC	-	**PG Schedule 1 Section 2**				x	
Vidua macroura	Pin-tailed Whydah	1	LC	LC	-	**PG Schedule 1 Section 2**	55,6			x	39
Vidua paradisaea	Long-tailed Paradise Whydah	2	LC	LC	-	**PG Schedule 1 Section 2**				x	
Vidua regia	Shaft-tailed Whydah	2	LC	LC	-	**PG Schedule 1 Section 2**				x	
Key											
Status: EN = Endangered; LC = Least Concern; NT = Near Threatened; PG = Protected Game; PS = Protected Species; VU = Vulnerable											
Likelihood of Occurrence (LO): 1 = Present; 1* = Present (recorded by Digby Wells 2013); 2 = High; 3 = Moderate; 4 = Low											
Sources: [1]Taylor *et al.* (2015); [2]ToPS (2015); [3]Free State Nature Conservation Ordinance (1969); [4]SABAP 2 (2017)											

11.4. Appendix 4. Present and potentially occurring reptile species

FAMILY & SPECIES[1]	COMMON NAME[1]	LO	CONSERVATION STATUS				ATLAS[4]
			GLOBAL RED LIST[3]	SA RED LIST[1]	RSA LEGAL[2]	FS LEGAL[5]	
AGAMIDAE (Agamas)							
Agama aculeata distanti	Distant's Ground Agama	2		1LC			
Agama atra	Southern Rock Agama	4		1LC			
AMPHISBAENIDAE (Worm lizards)							
Monopeltis capensis	Cape Worm Lizard	3		1LC			
COLUBRIDAE (Typical snakes)							
Crotaphopeltis hotamboeia	Red-lipped Snake	2		2LC			
Dasypeltis scabra	Rhombic Egg-eater	2	LC (U)	2LC			
CORDYLIDAE (Crag, flat & girdled lizards)							
Smaug giganteus	Giant Dragon Lizard	4	**VU**	**1VU End**	**VU**	**PG**	
ELAPIDAE (Cobras, mambas & relatives)							
Elapsoidea sundevallii media	Highveld Garter Snake	2		1LC			2
Hemachatus haemachatus	Rinkhals	2	LC (S)	1LC			
GEKKONIDAE (Geckos)							
Lygodactylus capensis capensis	Common Dwarf Gecko	3		1LC			
Pachydactylus capensis	Cape Gecko	2		2LC			
Pachydactylus mariquensis	Marico Gecko	4		1LC End			
GERRHOSAURIDAE (Plated lizards & seps)							
Gerrhosaurus flavigularis	Yellow-throated Plated Lizard	2		2LC			
LACERTIDAE (Typical lizards)							
Nucras holubi	Holub's Sandveld Lizard	2		2LC			
Nucras intertexta	Spotted Sandveld Lizard	2		2LC			
Pedioplanis burchelli	Burchell's Sand Lizard	3		1LC End			
Pedioplanis lineoocellata lineoocellata	Spotted Sand Lizard	3		2LC			
LAMPROPHIIDAE (Lamprophid snakes)							
Aparallactus capensis	Black-headed Centipede-eater	2	LC (S)	2LC			
Boaedon capensis	Brown House Snake	2		2LC			
Homoroselaps dorsalis	Striped Harlequin Snake	3	**NT**	1LC End			
Homoroselaps lacteus	Spotted Harlequin Snake	2		1LC			
Lamprophis aurora	Aurora House Snake	2	LC (D)	1LC			
Lycodonomorphus rufulus	Brown Water Snake	2		1LC			
Lycophidion capense capense	Cape Wolf Snake	2		2LC			

FAMILY & SPECIES[1]	COMMON NAME[1]	LO	CONSERVATION STATUS				ATLAS[4]
			GLOBAL RED LIST[3]	SA RED LIST[1]	RSA LEGAL[2]	FS LEGAL[5]	
Prosymna sundevallii	Sundevall's Shovel-snout	2		1LC			
Psammophis crucifer	Cross-marked Grass Snake	2		1LC			
Psammophis trinasalis	Fork-marked Sand Snake	2		2LC			
Psammophylax rhombeatus rhombeatus	Spotted Grass Snake	2		2LC			
Pseudaspis cana	Mole Snake	2		2LC			
LEPTOTYPHLOPIDAE (Thread snakes)							
Leptotyphlops scutifrons conjunctus	Eastern Thread Snake	2		1LC			
PELOMEDUSIDAE (Terrapins)							
Pelomedusa subrufa	Marsh Terrapin	1		2LC			
SCINCIDAE (Skinks)							
Acontias gracilicauda	Thin-tailed Legless Skink	2	LC (U)	1LC			
Panaspis wahlbergii	Wahlberg's Snake-eyed Skink	2		LC			
Trachylepis capensis	Cape Skink	2		2LC			
Trachylepis punctatissima	Speckled Rock Skink	2	LC (S)	2LC			
Trachylepis punctulata	Speckled Sand Skink	3		2LC			
Trachylepis varia	Variable Skink	2		2LC			
TESTUDINIDAE (Tortoises)							
Psammobates oculifer	Serrated Tent Tortoise	4		1LC		**PG**	
Stigmochelys pardalis	Leopard Tortoise	1		1LC		**PG**	
TYPHLOPIDAE (Blind snakes)							
Afrotyphlops bibronii	Bibron's Blind Snake	3		1LC			
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake	2		2LC			
VARANIDAE (Monitors)							
Varanus albigularis albigularis	Rock Monitor	3		2LC			
Varanus niloticus	Water Monitor	3		2LC			
VIPERIDAE (Adders)							
Bitis arietans arietans	Puff Adder	2		2LC			

Key

Status: 1 = Global; 2 = Regional; LC = Least Concern; PS = Protected Species; VU = Vulnerable

Likelihood of Occurrence (LO): 1 = Present; 2 = High; 3 = Moderate; 5 = May occur as a managed population

Sources:[1]Bates *et al*. (2014); [2]ToPS List (2015); [3]IUCN (2015-4); [4]ReptileMAP (2017); [5]Free State Nature Conservation Ordinance (1969)

11.5. Appendix 5. Present and potentially occurring frog species

FAMILY[1,4] & SPECIES[4]	COMMON NAME[3]	CONSERVATION STATUS			LoO[3,5]	ATLAS (N)[3,5]
		GLOBAL RED LIST[2]	S.A. RED LIST[3]	RSA LEGAL[1]		
BUFONIDAE (True toads)						
Sclerophrys capensis	Raucous Toad	LC (D)	LC	-	2	
Sclerophrys gutturalis	Guttural Toad	LC (I)	LC	-	2	
Sclerophrys poweri	Power's Toad	LC (U)	LC	-	1	
HYPEROLIIDAE (Leaf-folding & reed frogs)						
Kassina senegalensis	Bubbling Kassina	LC (U)	LC	-	1	
Semnodactylus wealii	Rattling Frog	LC (U)	LC	-	4	
PIPIDAE (African clawed frogs)						
Xenopus laevis	Common Platanna	LC (I)	LC	-	1	
PYXICEPHALIDAE (Moss, river, sand & stream frogs)						
Amietia fuscigula	Cape River Frog	LC (S)	LC	-	2	
Amietia delalandii	Delalande's River Frog	LC (S)	LC	-	2	
Cacosternum boettgeri	Common Caco	LC (U)	LC	-	1	
Pyxicephalus adspersus	Giant Bullfrog	LC (D)	**NT**	-	2	
Strongylopus fasciatus	Striped Stream Frog	LC (U)	LC	-	4	
Tomopterna cryptotis	Tremolo Sand Frog	LC (S)	LC	-	2	
Tomopterna natalensis	Natal Sand Frog	LC (U)	LC	-	2	
Tomopterna tandyi	Tandy's Sand Frog	LC (U)	LC	-	1	
Key						
Status: LC = Least Concern; NT = Near Threatened; PS = Protected Species						
Likelihood of Occurrence (LO): 1 = Present; 2 = High; 4 = Low						
Sources: [1]ToPS List (2015); [2]IUCN (2015-4); [3]Minter *et al*. (2004); [4]Du Preez & Carruthers (2009); [5]FrogMAP (2017)						

11.6. Appendix 6. Present and potentially occurring butterfly species

SPECIES[1]	COMMON NAME[1]	LO	ATLAS[1,2]
HESPERIIDAE (Sandmen, skippers, sylphs & relatives)			
Borbo gemella	Twin Swift	3	
Coeliades forestan forestan	Striped Policeman	3	
Gegenes niso niso	Common Hottentot	3	
Gegenes pumilio gambica	Dark Hottentot	4	
Kedestes lepenula	Chequered Ranger	4	
Spialia asterodia	Star Sandman	3	
Spialia diomus ferax	Common Sandman	2	
Spialia mafa	Mafa Sandman	2	
Spialia nanus	Dwarf Sandman	4	
Spialia spio	Mountain Sandman	3	
LYCAENIDAE (Blues, coppers, opals & relatives)			
Aloeides damarensis damarensis	Damara Copper	3	
Aloeides henningi	Henning's Copper	2	
Aloeides pierus	Dull Copper	2	
Aloeides trimeni southeyae	Trimen's Copper	3	
Anthene livida livida	Pale Hairtail	2	
Azanus jesous	Topaz Babul Blue	2	
Azanus moriqua	Black-bordered Babul Blue	2	
Azanus ubaldus	Velvet-spotted Babul Blue	2	
Cacyreus marshalli	Common Geranium Bronze	2	
Chilades trochylus	Grass Jewel	2	
Cigaritis natalensis	Natal Bar	3	
Crudaria leroma	Silver Spotted Grey	2	
Cupidopsis jobates jobates	Tailed Meadow Blue	3	
Eicochrysops messapus messapus	Cupreous Blue	2	
Lampides boeticus	Pea Blue	2	
Lepidochrysops ortygia	Koppie Blue	2	
Lepidochrysops patricia	Patricia Blue	2	
Lepidochrysops plebeia plebeia	Twin-spot Blue	2	
Leptomyrina henningi henningi	Henning's Black-eye	2	
Leptomyrina lara	Cape Black-eye	3	
Leptotes pirithous pirithous	Common Zebra Blue	2	
Lycaena clarki	Eastern Sorrel Copper	2	
Oraidium barberae	Dwarf Blue	2	
Tarucus sybaris linearis	Dotted Blue	2	
Thestor basutus capeneri	Basuto Skolly	2	2
Zintha hintza hintza	Hintza Pierrot	2	
Zizeeria knysna knysna	African / Sooty Grass Blue	2	
Zizina otis antanossa	Dark / Clover Grass Blue	2	
NYMPHALIDAE (Acraeas, browns, charaxes & relatives)			
Acraea neobule neobule	Wandering Donkey Acraea	2	
Byblia ilithyia	Spotted Joker	3	
Catacroptera cloanthe cloanthe	Pirate	3	
Danaus chrysippus orientis	African Monarch, Plain Tiger	1	
Hypolimnas misippus	Common Diadem	1	
Junonia hierta cebrene	Yellow Pansy	1	
Junonia oenone oenone	Blue Pansy	2	

SPECIES[1]	COMMON NAME[1]	LO	ATLAS[1,2]
Junonia orithya madagascariensis	Eyed Pansy	2	
Phalanta phalantha aethiopica	African Leopard	4	
Precis archesia archesia	Garden Commodore	3	
Telchinia serena	Dancing Acraea	2	
Vanessa cardui	Painted Lady	2	
PAPILIONIDAE (Swallowtails, swordtails & relatives)			
Papilio demodocus demodocus	Citrus Swallowtail	1	
Papilio nireus lyaeus	Green-banded Swallowtail	2	
PIERIDAE (Tips, whites & relatives)			
Belenois aurota	Brown-veined White	1	1
Belenois creona severina	African Common White	2	
Catopsilia florella	African Migrant	1	
Colias electo electo	African Clouded Yellow	2	
Colotis evenina evenina	Orange Tip	2	
Eurema brigitta brigitta	Broad-bordered Grass Yellow	1	
Mylothris agathina agathina	Common Dotted Border	2	
Pinacopteryx eriphia eriphia	Zebra White	2	
Pontia helice helice	Common Meadow White	2	
Teracolus subfasciatus	Lemon Traveller	3	
Key			
Likelihood of Occurrence (LoO): 1 = Present; 2 = High; 3 = Moderate; 4 = Low			
Sources:[1]Mecenero *et al.* (2013); [2]LepiMAP (2017)			

11.7. Appendix 7. Present and potentially occurring odonata species

FAMILY &SPECIES[1]	COMMON NAME[1]	BIOTIC INDEX SCORE	LO
AESHNIDAE	**Hawkers**		
Anax imperator	Blue Emperor	1	2
COENAGRIONIDAE	**Pond damsels**		
Africallagma glaucum	Swamp Bluet	1	1
Africallagma sapphirinum	Sapphire Bluet	4	3
Ischnura senegalensis	Tropical / Marsh Bluetail	0	1
Pseudagrion citricola	Yellow-faced Sprite	3	4
Pseudagrion kersteni	Powder-faced / Kersten's Sprite	1	3
Pseudagrion salisburyense	Slate Sprite	1	2
GOMPHIDAE	**Clubtails**		
Ceratogomphus pictus	Common Thorntail	2	2
LESTIDAE	**Spreadwings**		
Lestes plagiatus	Highland Spreadwing	2	2
LIBELLULIDAE	**Skimmers**		
Crocothemis erythraea	Broad Scarlet	0	3
Crocothemis sanguinolenta	Little Scarlet	3	3
Orthetrum caffrum	Two-striped Skimmer	3	3
Orthetrum chrysostigma	Epaulet Skimmer	2	4
Pantala flavescens	Wandering Glider / Pantala	0	1
Sympetrum fonscolombii	Red-veined Darter / Nomad	0	2
Trithemis arteriosa	Red-veined Dropwing	0	3
Trithemis dorsalis	Highland / Round-hook Dropwing	0	3
PLATYCNEMIDIDAE	**Featherlegs**		
Elattoneura glauca	Common Threadtail	1	2
Key			
Likelihood of Occurrence (LO): 1 = Present; 2 = High; 3 = Moderate; 4 = Low			
Sources: Samways (2006); Samways (2008); OdonataMAP (2017)			

11.8. Appendix 8 Potentially occurring selected arachnid species

FAMILY& SPECIES[2,3,4]	CONSERVATION STATUS[1]		LO[2,3,4]
	RSA LEGAL[1]	FS LEGAL[4]	
BUTHIDAE (Fat-tailed scorpions)			
Uroplectes triangulifer			2
SCORPIONIDAE (Burrowing scorpions)			
Opistophthalmus carinatus			*2*
THERAPHOSIDAE (Baboon spiders)			
Harpactira hamiltoni	*	**	*2*
Harpactirella schwarzi	*	**	4
Key			
Status: * Listed as Protected under ToPS (2007); ** Listed as Protected under Free State Nature Conservation Ordinance			
Likelihood of Occurrence (LoO): 1 = Present; 2 = High; 3 = Moderate; 4 = Low			
Sources: [1]ToPS List (2015); [2]Leeming (2003); [3]ScorpionMAP (2017); [4]Dippenaar-Schoeman (2002)			

11.9. Appendix 9 List of BirdLasser records

CODE	SCIENTIFIC NAME	COMMON NAME	TIME
1	*Apus affinis*	Little Swift	11:45
2	*Falco naumanni*	Lesser Kestrel	12:40
3	*Euplectes afer*	Yellow-crowned Bishop	12:40
4	*Charadrius tricollaris*	Three-banded Plover	12:41
5	*Charadrius pecuarius*	Kittlitz's Plover	12:41
6	*Plocepasser mahali*	White-browed Sparrow-Weaver	12:42
7	*Ardea melanocephala*	Black-headed Heron	12:43
8	*Numida meleagris*	Helmeted Guineafowl	12:43
9	*Buteo buteo*	Common Buzzard	12:43
10	*Quelea quelea*	Red-billed Quelea	12:43
11	*Vanellus coronatus*	Crowned Lapwing	12:43
12	*Motacilla capensis*	Cape Wagtail	12:43
13	*Euplectes orix*	Southern Red Bishop	13:06
14	*Cursorius temminckii*	Temminck's Courser	13:06
15	*Euplectes progne*	Long-tailed Widowbird	13:08
16	*Calandrella cinerea*	Red-capped Lark	13:09
17	*Hirundo rustica*	Barn Swallow	13:09
18	*Bostrychia hagedash*	Hadeda Ibis	13:09
19	*Cisticola juncidis*	Zitting Cisticola	13:12
20	*Mirafra fasciolata*	Eastern Clapper Lark	13:17
21	*Myrmecocichla formicivora*	Ant-eating Chat	13:18
22	*Burhinus capensis*	Spotted Thick-knee	13:18
23	*Ortygospiza atricollis fuscocrissa*	African Quailfinch (spp)	13:23
24	*Oenanthe pileata*	Capped Wheatear	13:25
25	*Petrochelidon spilodera*	South African Cliff Swallow	13:26
26	*Cisticola ayresii*	Wing-snapping Cisticola	13:27
27	*Mirafra cheniana*	Melodious Lark	13:27
28	*Vanellus armatus*	Blacksmith Lapwing	13:29
29	*Alopochen aegyptiaca*	Egyptian Goose	13:29
30	*Cercotrichas paena*	Kalahari Scrub Robin	16:14
31	*Pternistis swainsonii*	Swainson's Spurfowl	16:15
32	*Mirafra africana*	Rufous-naped Lark	16:15
33	*Chrysococcyx caprius*	Diederik Cuckoo	16:15
34	*Ploceus velatus*	Southern Masked Weaver	16:29
35	*Crithagra atrogularis*	Black-throated Canary	16:43
36	*Colius striatus*	Speckled Mousebird	16:48
37	*Oena capensis*	Namaqua Dove	16:48
38	*Coturnix coturnix*	Common Quail	17:21
39	*Vidua macroura*	Pin-tailed Whydah	17:22
40	*Spilopelia senegalensis*	Laughing Dove	18:12
41	*Lamprotornis nitens*	Cape Glossy Starling	18:13
42	*Streptopelia capicola*	Cape Turtle Dove	18:13
43	*Passer melanurus*	Cape Sparrow	18:14
44	*Dendrocygna viduata*	White-faced Whistling Duck	08:00

CODE	SCIENTIFIC NAME	COMMON NAME	TIME
45	*Anas undulata*	Yellow-billed Duck	08:00
46	*Plectropterus gambensis*	Spur-winged Goose	11:12
47	*Glareola nordmanni*	Black-winged Pratincole	11:12
48	*Falco amurensis*	Amur Falcon	11:12
49	*Cisticola tinniens*	Levaillant's Cisticola	11:13
50	*Pytilia melba*	Green-winged Pytilia	13:23
51	*Sylvia subcaerulea*	Chestnut-vented Tit-Babbler	13:23
52	*Urocolius indicus*	Red-faced Mousebird	13:23
53	*Cisticola fulvicapilla*	Neddicky	13:27
54	*Cisticola aridulus*	Desert Cisticola	13:44
55	*Sylvietta rufescens*	Long-billed Crombec	13:44
56	*Rhinoptilus africanus*	Double-banded Courser	13:48
57	*Asio capensis*	Marsh Owl	13:53
58	*Lanius collaris*	Southern Fiscal	13:59
59	*Ciconia ciconia*	White Stork	14:05
60	*Bubulcus ibis*	Western Cattle Egret	17:21
61	*Crithagra flaviventris*	Yellow Canary	17:24
62	*Mycteria ibis*	Yellow-billed Stork	10:02
63	*Ardea cinerea*	Grey Heron	10:03
64	*Anas hottentota*	Hottentot Teal	10:17
65	*Anas erythrorhyncha*	Red-billed Teal	10:17
66	*Ardeola ralloides*	Squacco Heron	10:18
67	*Chlidonias hybrida*	Whiskered Tern	10:18
68	*Anas smithii*	Cape Shoveler	10:19
69	*Saxicola torquatus*	African Stonechat	10:19
70	*Phalacrocorax lucidus*	White-breasted Cormorant	10:20
71	*Struthio camelus*	Common Ostrich	10:40
72	*Fulica cristata*	Red-knobbed Coot	10:41
73	*Anhinga rufa*	African Darter	10:45
74	*Columba livia*	Rock Dove	10:45
75	*Ardea alba*	Great Egret	11:15
76	*Plegadis falcinellus*	Glossy Ibis	11:27