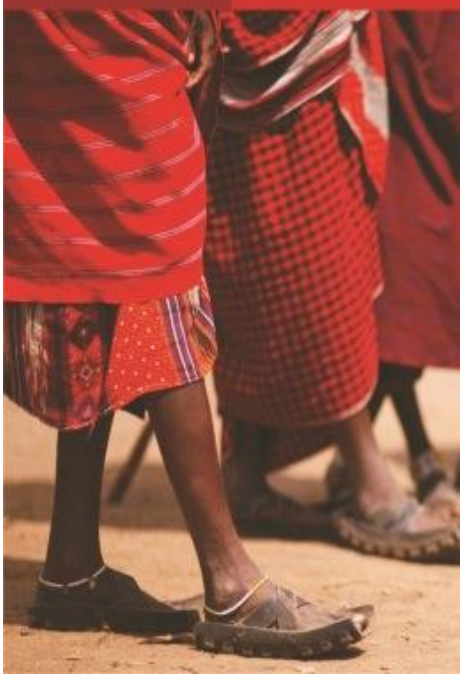


DIGBY WELLS
ENVIRONMENTAL

Flora and Fauna Assessment for the Proposed Klipspruit Extension: Weltevreden Project, Mpumalanga

Flora and Fauna Report

Project Number:

BHP2690

Prepared for:

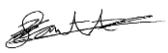
BHP Billiton Energy Coal South Africa (BECSA)

March 2015

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

This document has been prepared by Digby Wells Environmental.

Report Type:	**Flora and Fauna Report**
Project Name:	**Flora and Fauna Assessment for the Proposed Klipspruit Extension: Weltevreden Project, Mpumalanga**
Project Code:	**BHP2690**

Name	Responsibility	Signature	Date
Rudi Greffrath (Cert. Sci. Nat.)	Report Writer		2015/01/20
Brett Coutts	Reviewer		2015/01/26
Phil Patton (Pr.Sci.Nat)	Reviewer		2015/03/10

EXECUTIVE SUMMARY

Introduction

Digby Wells Environmental (Digby Wells) has been appointed by BHP Billiton Energy Coal South Africa Propriety Limited (BECSA) as the independent Environmental Assessment Practitioner (EAP) to conduct the Environmental Impact Assessment (EIA) according to the National Environmental Management Act (NEMA Act 107 of 1998), as well as associated specialist studies for the opencast development at the Klipspruit Extension Project: Weltevreden (KPSX: Weltevreden). This report details the fauna and flora component of the EIA process.

BECSA has identified coal reserves adjacent to its current Klipspruit Colliery at the proposed KPSX: Weltevreden area is situated approximately 25 km west of eMalahleni. This report also forms part of the mining right application currently being completed for BECSA by Digby Wells.

The activities proposed to occur on the KPSX: Weltevreden Project is specifically opencast mining, including the construction of offices and fuel bay, haul roads, PCDs, coal tip and conveyor belt, pipelines and clean and dirty water separation systems and water canals and a high mast radio communication tower.

Methodology

A literature review and desktop study were completed in order to determine the expected species composition or baseline conditions of the study area, before field work was conducted. Vegetation was then sampled with stratified random sampling and the use of the Braun Blanquet assessment in order to define vegetation communities which were then mapped. In addition, a species list was compiled listing all species recorded in the field survey with particular emphasis on dominant species, alien invasive species and Species of Special Concern (SSC).

The study area was traversed by vehicle and foot, noting the presence of animals on site or evidence of animal activity such as pellets, spoor, nests, burrows and droppings. Suitable microhabitats, such as reed beds and rocky outcrops, were investigated. Visual sightings and ecological indications were used to identify the larger mammal inhabitants of the study area; this includes scats, tracks and habitat such as burrows and dens. Scats found were collected (if required), photographed with a scale along with any tracks observed and identified

Sensitivity of the study site was determined based on available information on both National and Provincial level. In addition to the field survey, an assessment of the biodiversity value was also undertaken.

Study area

The project area is located in the Grassland Biome of South Africa. The study area is situated within an area vegetated by the Moist Sandy Highveld Grassland vegetation type according to Low & Rebelo (1998) with the most recent vegetation classification, classifying it as Eastern Highveld Grassland (Mucina & Rutherford 2006). The vegetation type is considered to be endangered nationally with none conserved and 55% altered, primarily by cultivation (Mucina & Rutherford 2006).

The study site can be divided into six main vegetation units: Grassland, Secondary grassland, Riparian areas, Alien tree stands, Rocky outcrops and Agricultural fields. The study area includes agricultural fields consisting of maize, buildings including farm houses and worker accommodation, alien invasive tree areas and roads. The study site is currently being used predominantly for commercial farming.

A total of 97 plant species were recorded on the study site. Of these, one is regarded as Species of Special Concern (SSC). Twenty-three invasive or alien species were recorded and categorised according to the Alien and Invasive Species Lists, 2014 (GN R599 in *GG* 37886 of 1 August 2014) of the NEMBA (Act 10 of 2004). Fifteen mammal species were recorded from the site, two species are protected. 65 bird species were recorded, four of which are protected, no reptiles and three amphibians were recorded, of which one amphibian is protected.

Sensitivity

Wetlands constitute High Sensitivity areas due to their role as process and habitat areas within the ecosystem. In addition, high sensitivity is given to areas designated as Threatened landscape features such as ridges, and those areas that were pristine or close to pristine with low or no anthropogenic impacts. Areas occurring within Highly Significant areas according to the C-Plan (2013) unless heavily degraded are also assigned a High Sensitivity.

Areas of medium sensitivity include those natural areas with some anthropogenic change or degradation, with high numbers of SSC and moderate rocky slopes.

Low sensitivity was assigned to areas completely transformed or heavily degraded, on relatively flat ground. The study area was found to be in different states of sensitivity, with the riparian and grassland areas designated as high and medium high respectively and alien trees being low sensitivity.

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1 Introduction

Biodiversity is defined, according the National Environmental Management Biodiversity Act No. 10 of 2004 (NEMBA), as "*the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems*". The NEMBA legislation upholds the country's commitment to the protection of South Africa's biological resources and it is imperative that development takes place in a sustainable way in order to achieve this.

Although 5.4% of South Africa's land surface area is currently formally conserved through the system of national and provincial protected areas, the protected area network is skewed towards certain biomes such as Grassland, in which the area of interest is located, leaving biomes such as Savanna and Succulent Karoo under-conserved (DEAT, 2005). Many of these under-conserved areas overlap with areas of high population density, high agricultural potential, mineral deposits and scenic beauty important for tourism. This can lead to conflict regarding decisions over land use allocations, for example, should land be used for mining or agricultural purposes. For this reason extensive consultation regarding land use changes is required, and areas considered irreplaceable for biodiversity conservation and important for ecosystem services, need to be set aside.

The faunal component of the Grassland biome is usually related directly to the vegetation types, which are in turn related to the soil types. Nutrient rich and nutrient poor soils produce different vegetation types, which support selective grazers and browsers. The grasslands of Mpumalanga are mainly divided into farms, which limits faunal movement and reduces the function of the ecosystem. Farms are commonly used for cultivation and livestock. As most of these farms are not managed for maintaining ecosystem function, but rather for maximum agricultural production, it is likely that the majority of the area is a modified ecosystem.

In many areas, especially in terrestrial ecosystems, it is not the direct use of biological resources that is threatening their sustainability, but rather indirect pressures such as changing land use and associated clearing of natural vegetation and habitat fragmentation. The Mpumalanga Province is rich in biodiversity; this is commonly attributed to its bio-geographical location and diverse topography.

The National Biodiversity Implementation Plan sets out the strategic objectives, outcomes and activities identified during the National Biodiversity Strategy and Action Plan (NBSAP) process. It identifies the leading agents and key partners for implementing the activities (DEAT, 2005). The plan consists of a goal and five strategic objectives (Table 1-1).

Table 1-1: Goal and strategic objectives of the National Biodiversity Implementation Plan

GOAL	**Conserve and manage terrestrial and aquatic biodiversity to ensure sustainable and equitable benefits to the people of South Africa, now and in the future.**
OBJECTIVE 1	Policy framework for biodiversity management.
OBJECTIVE 2	Institutional framework for biodiversity management.
OBJECTIVE 3	Integrated management of terrestrial and aquatic ecosystems.
OBJECTIVE 4	Sustainable use of biological resources.
OBJECTIVE 5	A network of conservation areas to conserve representative samples.

Under Strategic Objective 3, the various industries impacting on biodiversity are encouraged to develop and implement changes in operational procedures to minimise negative impacts on biodiversity and create sustainable practices. Industries mentioned include those related to agricultural, mining, forestry, fishing and property development. Under mining it states that relationships already exists between mining industry and biodiversity sectors and that these relationships should be further developed. Funds set aside for rehabilitation should be utilised to mitigate negative impacts on biodiversity and important biodiversity areas should be set aside and managed. The overall statement drives home that biodiversity is the responsibility of the industry and that practices should be carried out in a way that is responsible, sustainable and preserves biodiversity of the area. It also states that rehabilitation efforts should consider biodiversity.

The focus of this study is for the above mentioned strategic objectives to be the backbone of this investigation and subsequently to inform environmental management decisions on site. In order for this to be accomplished, the primary objective of this investigation is to characterise the flora and fauna present and to investigate the potential impacts of the proposed project on the vegetation and animal life in the study area, thereafter to provide reasonable and achievable mitigations to either reduce or eliminate impacts. Thereafter to suggest management measures that will mitigate the effects that construction and operation will have on the area, thereby striving for the attainment of the National Biodiversity Strategy goal. This report details field work findings of the KPSX: Weltevreden study area, as well as an in depth description of the study area and expected impacts.

BHP Billiton Energy Coal South Africa Propriety Limited (BECSA) is the holder of an approved Mining Right (Ref No. MP 30/5/1/2/2/125 MR) and Environmental Management Programme (EMPr) for Klipspruit Colliery (KPS), located near Ogies, Mpumalanga Province. The Klipspruit (KPS) EMPr was approved in 2003 in terms of Section 39 of the Minerals Act, 1991 (Act No. 50 of 1991) and in 2009 was subsequently updated to meet the requirements of the Mineral and Petroleum Resources Development Act, 2002 (Act No 28 of 2002) (MPRDA).

BECSA is proposing to extend the Life of Mine (LoM) of its operations by implementing the Klipspruit Extension (KPSX) Project which incorporates Klipspruit South (KPSX: South), as well as BECSA's three neighbouring Prospecting Rights to the north east, collectively referred to as Weltevreden (KPSX: Weltevreden). The Mining Right for KPS incorporates the Klipspruit Main Pit, the Smaldeel Mini-pit, Bankfontein and KPSX: South. The KPSX: Weltevreden Project will extend the KPS LoM by at least another twenty (20) years. The regional and local setting of KPSX: Weltevreden is depicted in Figure 4-1.

In addition to the approved EMPr, an application for a Water Use Licence Application (WULA) will be submitted to the Department of Water and Sanitation (DWS) for various water uses at KPSX: Weltevreden. An Integrated Water and Waste Management Plan (IWWMP) will be developed to manage the water resources and waste streams produced during the mining operations.

BECSA has applied for an amendment to the Mining Right and the Mining Work Programme for KPS in terms of the provisions of Section 102 of the MPRDA to incorporate the KPSX: Weltevreden resource. In addition, a Section 102 EIA/EMP Amendment Report will be submitted to the Department of Mineral Resources (DMR). The WULA will be submitted to the Department of Water and Sanitation (DWS) according to Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). In addition, environmental authorisation is required for listed activities triggered in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). This scoping report is compiled in support of the above mentioned environmental authorisation and will be submitted to the relevant competent authorities.

Digby Wells Environmental (Digby Wells) has been appointed by BECSA as the independent Environmental Assessment Practitioner (EAP) to conduct the Environmental Impact Assessment (EIA) according to the NEMA, as well as associated specialist studies for the opencast development at KPSX: Weltevreden, as well as the required Public Participation Process (PPP).

2 Terms of Reference

BECSA has identified coal reserves adjacent to its current Klipspruit Colliery at the proposed Klipspruit Extension Project area (KPSX: Weltevreden), situated approximately 25 km west of eMalahleni. This report is in support of the mining right application currently being completed for BECSA by Digby Wells Environmental.

The activities proposed to occur on the KPSX: Weltevreden Project area includes a combination of opencast mining, construction of offices and a fuel bay, haul roads, PCDs, coal tip and conveyor belt, pipelines and clean water canals and a high mast radio communication tower.

Digby Wells was commissioned by BECSA to complete a flora and fauna baseline assessment, including impact assessment and proposed mitigation measures of the Klipspruit Extension Project, also known as the Weltevreden study area. The agreed Terms of Reference (ToR) were in summary:

- Flora and fauna list of expected species for the area;
- Identification and description of habitats on site;
- Identification of flora and fauna on site;
- Sensitivity assessment and
- Impacts Assessment, as well as relevant mitigation and management measures.

3 Legislation

The legislation and best-practice guidelines that were considered for the purposes of this report include and are not limited to the following:

3.1 National

- Constitution of the Republic of South Africa Act (Act No.108 of 1996);
- National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA);
- National Environmental Management: Biodiversity Act 10 of 2004;
- National Environmental Management: Biodiversity Act 10, 2004: Threatened and Protected Species Regulations;
- National list of Ecosystems Threatened and in need of Protection under Section 52(1)(a) of the Biodiversity Act (GG 34809, GN 1002, 9 December 2011);
- National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003);
- The World Heritage Convention Act (1999);
- The Environment Conservation Act (ECA), 1989 (Act No. 73 of 1989), and;
- Minerals and Petroleum Resources Development Act, 2002.

- NEMBA (Act 10 of 2004). Alien and Invasive Species Lists, 2014 (GN R599 in *GG* 37886 of 1 August 2014).

3.2 Provincial

- Mpumalanga Tourism and Parks Agency (MTPA) minimum requirements.
- Mpumalanga Nature Conservation Act, 1999. (Act no. 10 of 1998) – Schedule eleven and twelve.

4 Study area

4.1 Locality

The project area lies various portions of the farms Hartebeeslaagte 325JS, Weltevreden 324JS, Tweefontein 238JS, Grootpan 7 IS and Wildebeesfontein 327JS (Figure 4-1). The study area is situated to the south-west of the town Witbank, north-east of the town Ogies, with the Phola settlement bordering on the western boundary. The majority of the surrounding properties are privately owned agricultural farms.

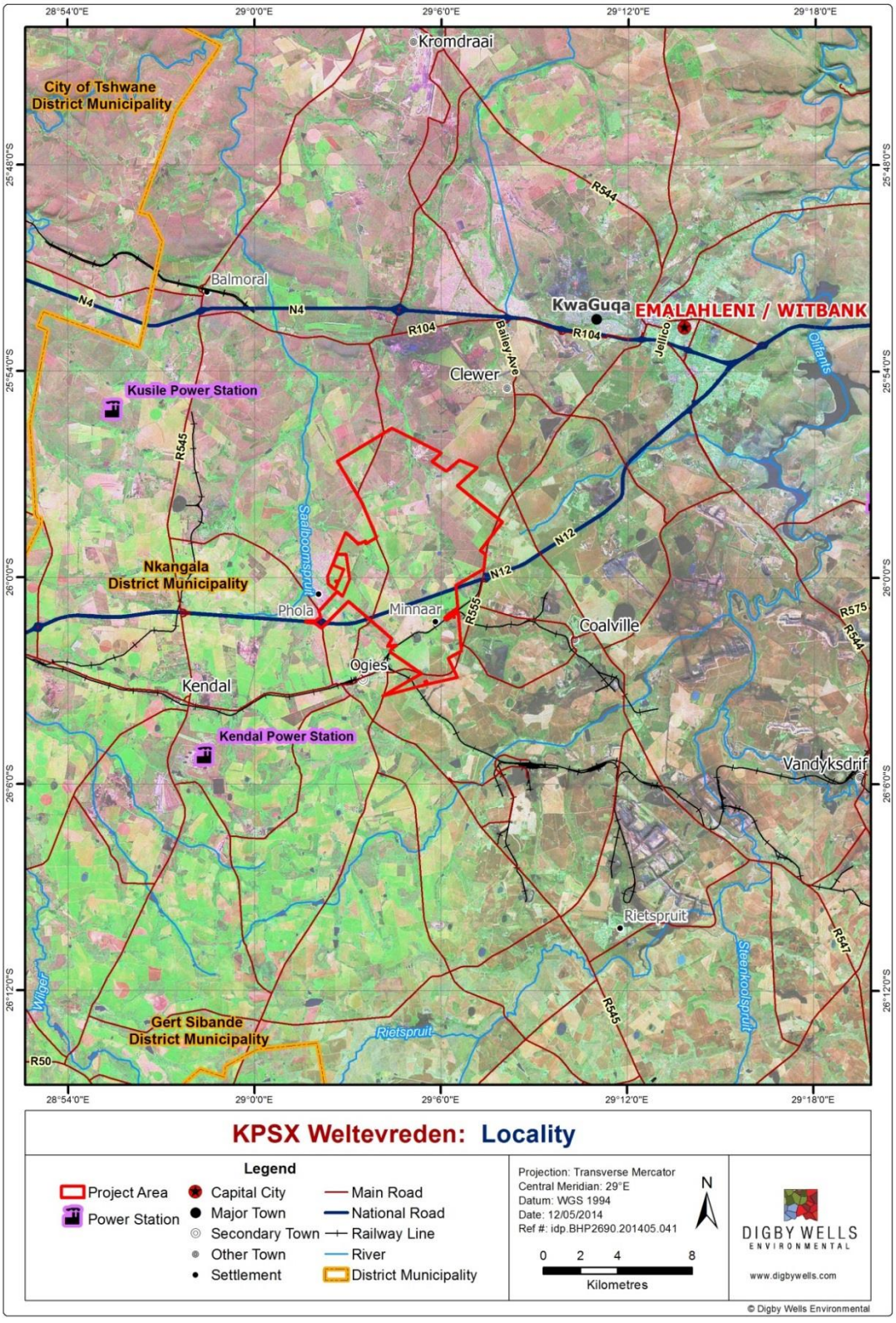


Figure 4-1: Locality of the study area within the regional setting

4.2 Regional vegetation

The study area is situated within the Moist Sandy Highveld Grassland and the according to Low & Rebelo (1998), with the most recent vegetation classification, classifying it as Eastern Highveld Grassland and Rand Highveld Grassland vegetation types (Mucina & Rutherford 2006). Both these vegetation types are considered to be nationally endangered with none conserved and some altered, primarily by cultivation.

The conservation status of this vegetation type is 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 is often heavily grazed.

Eastern Highveld Grassland occurs in the Mpumalanga and Gauteng Provinces: It occurs in the plains between Belfast in the east and the eastern side of Johannesburg in the west and extending southwards to Bethal, Ermelo and west of Piet Retief. Altitude ranges from 1 520m to 1 780m, but also declines as low as 1 300m (Mucina & Rutherford, 2006).

Eastern Highveld Grassland is considered endangered. Only a very small fraction is conserved in statutory reserves (Nooitgedacht Dam and Jericho Dam Nature Reserves) and in private reserves (Holkranse, Kransbank, Morgenstond). Some 44% is transformed primarily by cultivation, plantations, mines, urbanisation and by building of dams. Cultivation may have had a more extensive impact, indicated by land-cover data. No serious alien invasions are reported, but Black Wattle (*Acacia mearnsii)* can become dominant in disturbed areas. Erosion is very low (Mucina & Rutherford, 2006).

Important taxa:

Grass: *Abildgaardia ovata, Andropogon appendiculatus, A. schirensis, Aristida aequiglumis, A. bipartita, A. congesta, A. junciformis, A. stipitata, Brachiaria serrata, Bulbostylis contexta, Chloris virgata, Cymbopogon caesius, C. pospischilii, Cynodon dactylon, Digitaria diagonalis, D. monodactyla, D. ternata, D. tricholaenoides, Diheteropogon amplectens, Elionurus muticus, Eragrostis capensis, E. chloromelas, E. curvula, E. plana, E. racemosa, Harpochloa falx, Heteropogon contortus, Hyparrhenia hirta, Koeleria capensis, Microchloa caffra, Panicum coloratum, P. natalense, Setaria incrassate, S. nigrirostris, S. sphacelata, Themeda triandra, Tristachya biseriata, T. rehmannii;*

Herbs: *Acalypha penduncularis, A. wilmsii, Berkheya insignis, B. pinnatifida, B. setifera, Crabbea acaulis, Cynoglossum hispidium, Dicoma anomala, Haplocarpha scaposa, Helichrysum caespititium, H. nudifolium, H. rugulosum, Hermannia coccocarpa, H. depressa, H. transvaalensis, Ipomoea crassipes, I. oblongata, Jamesbrittenia silenoides, Pelargonium luridium, Pentanisia prunelloides, Peucedanum magalismontanum, Pseudognaphalium luteo-album, Rhynchosia effuse, Salvia repens, Schistostephium crataegifolium, Sonchus nanus, Vernonia natalensis, V. oligocephala, Wahlenbergia undulata;*

Herbaceous Climber: *Rhynchosia totta;*

Succulent: *Aloe greatheadii var davyana;*

Shrub: *Anthospermum rigidium, Chaetacanthus costatus, Diospyros austro-africana, D. lycoides, Euphorbia striata, Helichrysum melanacme, Gnidia burchellii, G. capitata, Polygala uncinata, Rhus bicolour;* and

Geophytic Herbs: *Boophane disticha, Eucomis autumnalis, Hypoxis villosa, Zantedeschia albomaculata*

Rand Highveld Grassland occurs in Gauteng, North-West, Free State and Mpumalanga Provinces. In areas between rocky ridges from Pretoria to Witbank, extending onto ridges of the Stoffberg and Roosenekal regions as well as west of Krugersdorp centered in the vicinity of Derby and Potchefstroom, extending southwards and northeastwards form there. Altitude ranges from 1 300m to 1 635m, but reaches 1 760m in places (Mucina & Rutherford, 2006).

Rand Highveld Grassland is considered endangered. It is poorly conserved (only 1%). Small patches are protected in statutory reserves (Kwaggavoetpad, Van Riebeeck Park, Bronkhorstspruit, and Boskop Dam Nature Reserve) and in private conservation areas (e.g. Doornkop, Zemvelo, Rhenosterpoort and Mpopomeni). Almost half has been transformed mostly by cultivation, plantations, urbanisation or dam building. Cultivation may also have had an impact on an additional portion of surface area of the unit where old lands are currently classified as grasslands in land cover classifications and poor land management has led to degradation of significant portions of the remainder of this unit. Scattered aliens (most prominently *Acacia mearnsii*) occur in about 7% of this unit. Only about 7% has been subjected to moderate to high erosion levels (Mucina & Rutherford, 2006).

Important taxa:

Graminoids: *Ctenium concinnum, Cynodon dactylon, Digitaria monodactyla, Diheteropogon amplectens, Eragrostis chloromelas, Heteropogon contortus,*

Loudetia simplex, Monocymbium ceresiiforme, Panicum natalense, Schizachyrium sanguineum, Setaria sphacelata, Themede triandra, Trachypogon spicatus, Trisachya biseriata, T. rehmannii, Andropogon schirensis, Aristida aequiglumis, A. congesta, A. junciformis subsp. *galpinii, Bewsia biflora, Brachiaria nigropedata, B serrata, Bulbostylis burchellii, Cymbopogon caesius, Digitaria tricholaenoides, Elionurus muticus, Eragrostis capensis, E. curvula, E. gummiflua, E. palna, E. racemosa, Hyparrhenia hirta, Melinis nerviglumis, M. repens* subsp. *repens, Microchloa caffra, Setaria nigrirostris, Sporobolus pectinatus, Trichoneura grandiglumis, Urelyrum agropyroides*

Herbs: *Acanthospermum australe, Justicia analgalloides, Pollichia campestris, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Helichrysum caespititium, H. nudifolium* var. *nudifolium, H rugulosum, Impomoea crassipes, Kohautia amatymbica, Lactuca inermis, Macledium zeyheri* subsp. *argyrophylum, Nidorella hottentotica, Oldenlandia herbacea, Rotheca hirsuta, Selago densiflora, Senecio coronatus, Sonchus dregeanus, Vernonia oligocephala, Xerophyta retinervis*

Geophytic Herbs: *Boophone disticha, Cheilanthes hirta, Haemanthus humilis* subsp. *humilis, Hypozis rigidula var. pilossisima, Ledebouria ovatifolia Oxalis corniculata*

Succulent Herb: *Aloe greatheadii* var. *davyana*

Low shrubs: *Anthospermum rigidum* subsp. *pumilum, Indigofera comosa, Rhus magalismontana, Stoebe plumosa*

Succulent Shrub: *Lopholaena coriifolia, Geoxylic Suffrutex*, *Elephantorrhiza elephantine.*

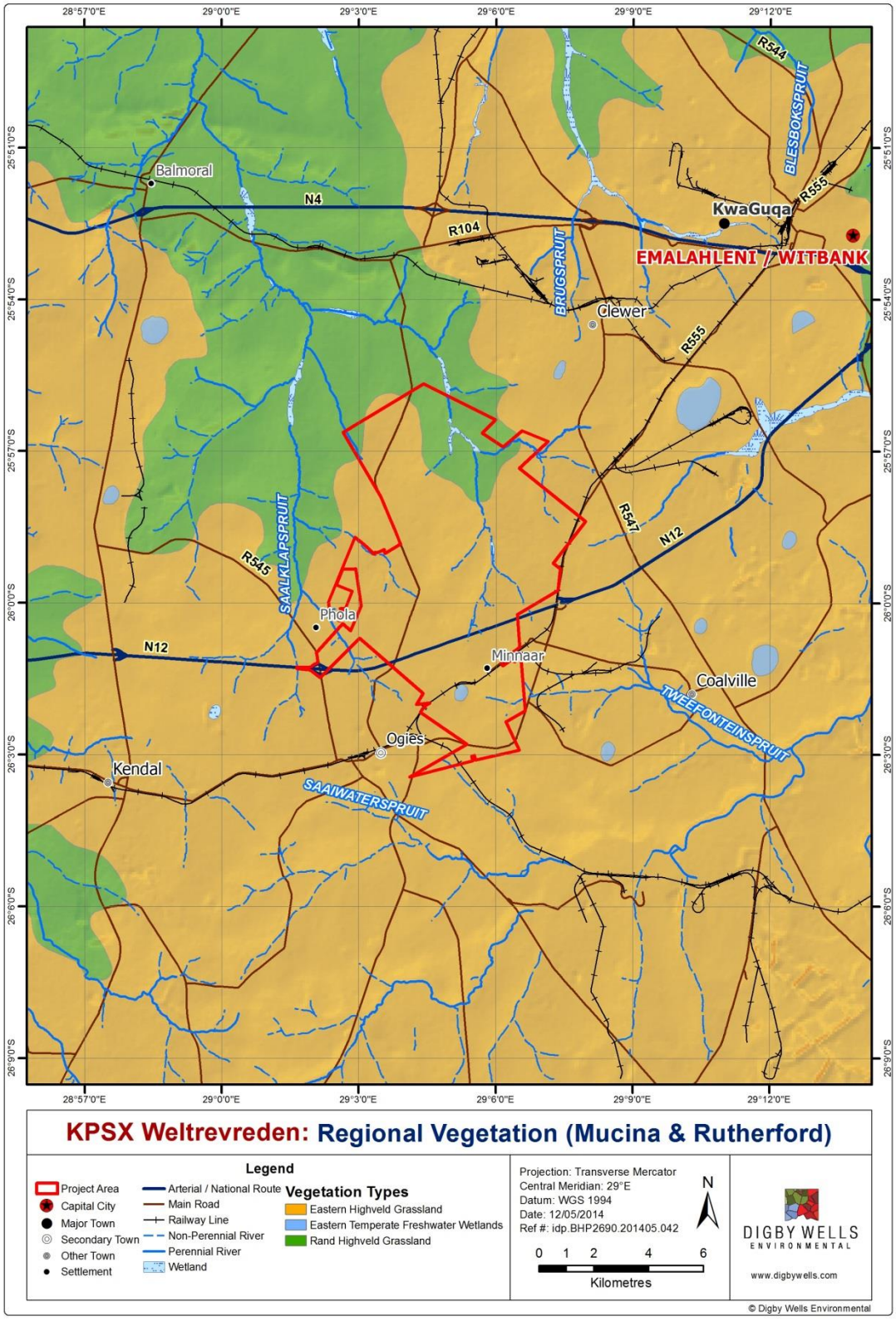


Figure 4-2: Regional vegetation types (Mucina and Rutherford 2006).

5 Methodology

5.1 Flora

The flora assessment was comprised of both a desktop and a field investigation component.

5.1.1 Desktop Assessment

The desktop component involved the generation of a checklist of expected flora for the site utilising the three databases listed below. Potential Species of Species Concern (SSC) were listed, whereby the national red-data lists, as well as the provincially protected plants list were consulted.

The regional vegetation for the greater study area was accessed (Mucina and Rutherford, 2006) and broad preliminary habitats were identified using aerial imagery, to be ground-truthed when field studies commenced. The following literature and databases were consulted in order to achieve this:

- PRECIS (Pretoria Computerised Information System). This plant taxonomy database provides information for species that occur in southern Africa and follows the format of Germishuizen and Meyer, 2003. The database is accessed on the Plants Of Southern Africa (POSA) website and is updated every two months (posa.sanbi.org);
- Mpumalanga Nature Conservation Act, 1999. (Act no. 10 of 1998) – Schedule eleven and twelve: protected plant species and,
- Vegetation Map of Southern Africa (Mucina and Rutherford, 2006).

5.1.2 Field Investigation

A site visit was conducted from the 25th to the 29th of August 2014 for the dry season, and 13th to the 16th of January 2015 for the wet season. Methodology for the study was stratified random sampling: after broad habitats were delineated on aerial imagery, sample plots were used to determine vegetation distribution in the field. The Braun-Blanquet methodology was employed in grassland areas, using an approximate area of 100 m^2.

The Braun-Blanquet floristic-sociological approach recognises units by the floristic composition and abundance. This methodology is easier and quicker to use than the alternative point-survey or wheel-point methodology, results in a reliable estimate of cover abundance and it is the most widely used approach for vegetation studies.

The Braun-Blanquet method incorporates seven cover-abundance categories as listed in Table 5-1. A general species list was also compiled from random traversing through the site.

For grassland areas, species were recorded for random sample plots throughout the site, where dominance, composition and structure were recorded.

Table 5-1: Braun-Blanquet analysis cover abundance

Cover Abundance	Category
One or few individuals.	r
Occasional and less than 5% of total plot area.	+
Abundant and with very low cover, or less abundant but higher cover; in any case less than 5% cover of total plot area.	1
Very abundant and less than 5%, or 5-25% cover, of a total plot area: ▪ 2m – Very abundant ▪ 2a – 5-12.5 % cover, irrespective of number of individuals ▪ 2b – 12.5-25% cover, irrespective of number of individuals	2

5.2 Fauna

As with the flora component, the faunal study included a desktop assessment prior to field studies. This phase is important as expected habitats are identified that require special attention when field investigations take place.

5.2.1 Desktop Assessment

Probability lists were generated for the following animal groups, all information obtained can be found in the accompanying scoping report:

- For birds, the South African Bird Atlas Project 2 (SABAP 2) was accessed for expected species lists for the area (2529 CC and 2629 AA);
- For mammals, information about species habitat requirements and distribution was obtained from Friedman & Daly (2004). Lists from previous studies for the area were recorded;
- For reptiles, information about the distribution of species is available online on the South African Reptile Conservation Atlas (SARCA) (2010);
- For amphibians, information about the distribution of species is found on FrogMAP on the Animal Demography Unit website (http://vmus.adu.org.za). Species habitat and taxonomy data was accessed from du Preez and Carruthers (2009) and

- For butterflies, species distribution maps are published online by the South African Butterfly Conservation Atlas (SABCA, 2010).

5.2.2 Field investigation

The study area was traversed by vehicle and foot, noting the presence of animals on site or evidence of animal activity, such as droppings, pellets, spoor, nests and burrows.. Suitable microhabitats, such as rocky outcrops, were investigated. Visual sightings and ecological indications were used to identify the larger mammal inhabitants of the study area; this includes scats, tracks and habitat such as burrows and dens. Scats found were collected (if required), photographed with a scale along with any tracks observed and identified.

- For birds, all opportunistic sightings were recorded and particular attention was focused on those habitats within the project area that have a higher propensity to harbour greater species diversity. Birds were recorded by both call and sight and their identification was confirmed using the guides: Sinclair *et al*. (2012) and Robert's Birds (2009).
- For mammals, opportunistic sightings were recorded for small and large mammals. Small mammals were sampled using Sherman traps, placed strategically at intervals within the properties and areas that would potentially harbour animal activity (eg.: rocky outcrops in the vicinity of the riparian habitats (Figure 5-1). Traps were baited and left for 24-hour intervals. The following field guides were used for identification purposes:
  - Mammals of Southern Africa (Smithers, 1993);
  - The Mammals of the Southern African Sub-region (Skinner & Chimimba, 2005);
  - Red Data Book of the Mammals of South Africa (Friedman & Daly 2004) and
  - The Kingdon field guide to African Mammals (Kingdon, 1997).
- For herpetofauna (reptiles and amphibians), direct and opportunistic observations were completed along trails or paths within the project area. Any herpetofauna species seen or heard along such paths or trails within the project area was identified and recorded. Another method used was refuge examinations using visual scanning of terrains to record smaller herpetofaunal species which often conceal themselves under rocks and in fallen logs, rotten tree stumps, in leaf litter, rodent burrows, ponds, old termite mounds, etc. Amphibians and reptiles observed by people residing in the study area were also recorded. For all frog and snake species, target species were studied from existing literature in order to assess their preferred receiving habitat and whether the site was suitable enough to harbour them. Different species have different seasonal and daily peaks of activity based on their biology and the weather. To increase the likelihood of detecting target species, one should conduct surveys at the time of year and day when those species are most likely to be active

and during weather conditions favouring activity. The following field guides were used for identification purposes:

- Branch (2001) Snakes and Other Reptiles of Southern Africa ;
- Caruthers (2009) Frogs and Frogging in Southern Africa, for frog calls;
- Du Preez and Caruthers A Complete guide to the frogs of South Africa, (2009).

- For invertebrates, butterflies were photographed and identified using Woodhall (2005).

Figure 5-1: Examples of a Sherman traps positioned on site

5.2.3 Study Limitations

The following limitations were encountered during this study:

- Field investigations did not include a night survey, for safety reasons, therefore nocturnal species (specifically bat and owl species) were not recorded.

6 Findings

6.1 Flora

6.1.1 Expected flora

Vegetation expected to occur on site can be deduced from the regional vegetation data as well as the species recorded to occur within the Quarter Degree Square (QDS) in which the study area is found. The former provides an indication of the reference state of the vegetation, whereas the latter represents the species lists that have been recorded during field surveys for the national listings.

The study area falls within one of South Africa's nine plant biomes (Mucina and Rutherford 2006), namely Grassland.

A total of 323 plant species have been recorded in the expected species lists for the 2529 CC and 2629 AA according to PRECIS, in which the study site occurs. Thirty four species of conservation significance can be expected in the QDS grids.

6.1.2 Vegetation communities

Vegetation communities were delineated based on similarity of species composition and habitat. A large proportion of the study area had been altered from its natural state due to current and historical land use (Figure 6-1). Owing to the effects of fragmentation, as well as the impacts of grazing cattle, especially close to the Phola community, much of the remaining natural vegetation on site had been altered and infested with alien plant species. Further to this, heavy grazing results in a loss of palatable species and an increase in non-palatable ones. This decreases the carrying capacity of the veld and increases the likelihood of alien vegetation taking over the landscape. The agricultural areas cover the largest proportion of the study area (52%), with Grassland being second with (28%). The high sensitive areas are affected the least, with 1 and 3% (Table 6-1).

Table 6-1: Percentage of vegetation types/land use in the study area

Description	Sensitivity	Total Area (ha)	Percentage
Agricultural Fields	Low	3765.9	52%
Alien Vegetation	Low	433.9	6%
Grassland	High / Medium	2076.5	28%
Ridge / Rocky Outcrop	High	41.3	1%
Riparian Areas	High	198.3	3%
Sand Mining	Low	133.4	2%
Secondary Grassland	High / Medium	655.4	9%
Total		**7304.8**	**100%**

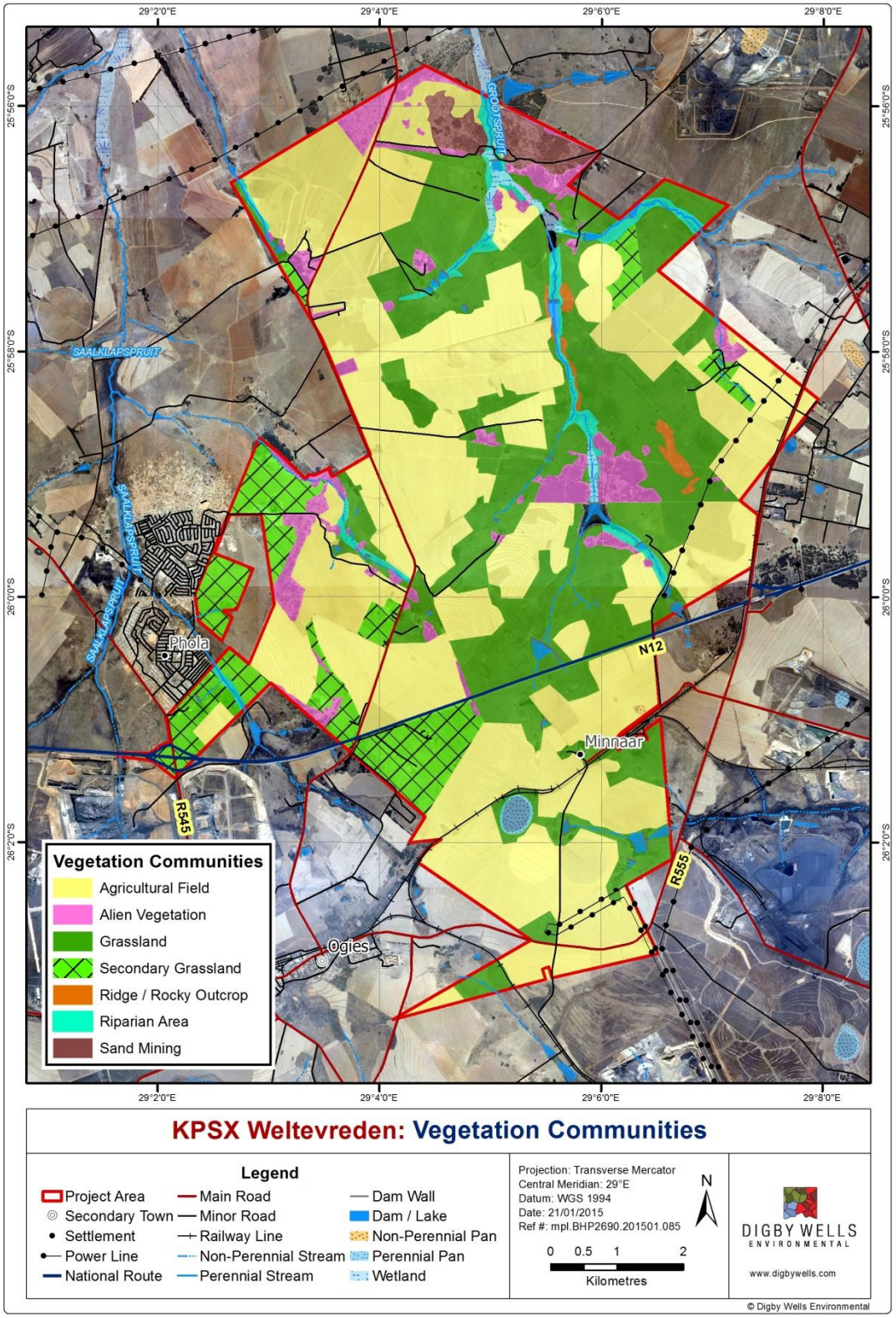


Figure 6-1: Vegetation communities of the Weltevreden extension project

6.1.2.1 Rocky Outcrops

Rocky outcrops/Ridges are a sensitive landscape as determined by the MTPA, as per the minimum requirements set forth by Parks Board. Reasons for the protection of these outcrops are that they provide habitat for plant and animal species that is not impacted on by agriculture due to the unsuitable rocky nature of these outcrops for ploughing.

Ridges as biodiversity hotspots and future refuges

Varied topography is recognised as one of the most powerful influences contributing to the high biodiversity of southern Africa. The interplay between topography and climate over a long period of time has led to the evolution of a rich biodiversity (Samways & Hatton, 2000). Landscapes composed of spatially heterogeneous abiotic conditions provide a greater diversity of potential niches for plants and animals than do homogeneous landscapes. The richness and diversity of flora has been found to be significantly higher in sites with high geomorphological heterogeneity and it can reasonably be assumed that associated faunal communities will also be significantly more diverse in spatially heterogeneous environments (Burnett *et al.*, 1998). Ridges are characterised by high spatial heterogeneity due to the range of differing aspects (north, south, east, west and variations thereof), slopes and altitudes all resulting in differing soil (e.g. depth, moisture, temperature, drainage, nutrient content), light and hydrological conditions. The temperature and humidity regimes of microsites vary on both a seasonal and daily basis (Samways & Hatton, 2000). Moist cool aspects are more conducive to leaching of nutrients than warmer drier slopes (Lowrey & Wright, 1987). Variation in aspect, soil drainage (Burnett *et al.*, 1998) and elevation/altitude (Primack, 1995) have been found to be especially important predictors of biodiversity. It follows that ridges will be characterised by a particularly high biodiversity, as such their protection will contribute significantly to the conservation of biodiversity. The diversity of plant communities on ridges can easily be observed, with grassland communities associated with the crests of hills and the southern slopes while woody species grow on warmer northern aspects (Lowrey & Wright, 1987) as well as on protected areas on southern slopes and on rocky outcrops (Grobler, 2000).

The rocky outcrops vegetation type was limited to the hillslopes of the Saalklapspruit River and Grootspruit River just above various wetland features that are evident throughout the river and riparian habitats. These exposed rocky areas were found to harbour a variety of epilithic (growing on the surface of rock) plant species that are characteristic of rocky habitats. Floral growth forms such as herbs, sedges and reeds were all represented. Trees were absent with the exception of shrubs that prefer this habitat type. Grasses was found on the periphery of the rocky outcrops and these most often were grassland species pioneer subclimax and climax species were found in equal numbers.

Observed plants including woody plants: Blue Bush (*Diospyros lycoides)* and an understorey layer comprised of grasses: mostly *Hyparrhenia hirta* (Common Thatching Grass), *Themeda triandra* (Red Grass) and *Cymbopogon excavatus* (Common Turpentine Grass); and forbs: *Cleome maculata*, *Crassula obovata and Frithia humulis (**EN**)*.

Figure 6-2: Landscape examples of the *Diospyros lycioides – Hyparrhenia hirta* Rocky Outcrops

6.1.2.2 Riparian areas

The wetland/riparian vegetation type is composed of typical riparian plant species which are adapted to permanent or perennial saturation. This includes *Schoenoplectus* and *Cyperus* species as well as a number of wet grasses, such as Cotton Wool Grass (*Imperata cylindrica*), Rye Grass (*Lolium perenne*), Rescue Grass (*Bromus catharticus*) and swamp couch Grass (*Cynodon dactylon*).

Other forb species present include Edging lobelia (*Lobelia erinus*) and, as a result of the dams which have been constructed and grazing and trampling by livestock this vegetation type has been impacted. Additionally Cotton Wool Grass (*Imperata cylindrica*) patches occur in the study area, indicating surface water seep points. These water seep points are seen as areas where diversity will differ from the surrounding vegetation. This vegetation type and typical species are illustrated in Figure 6-3 below.

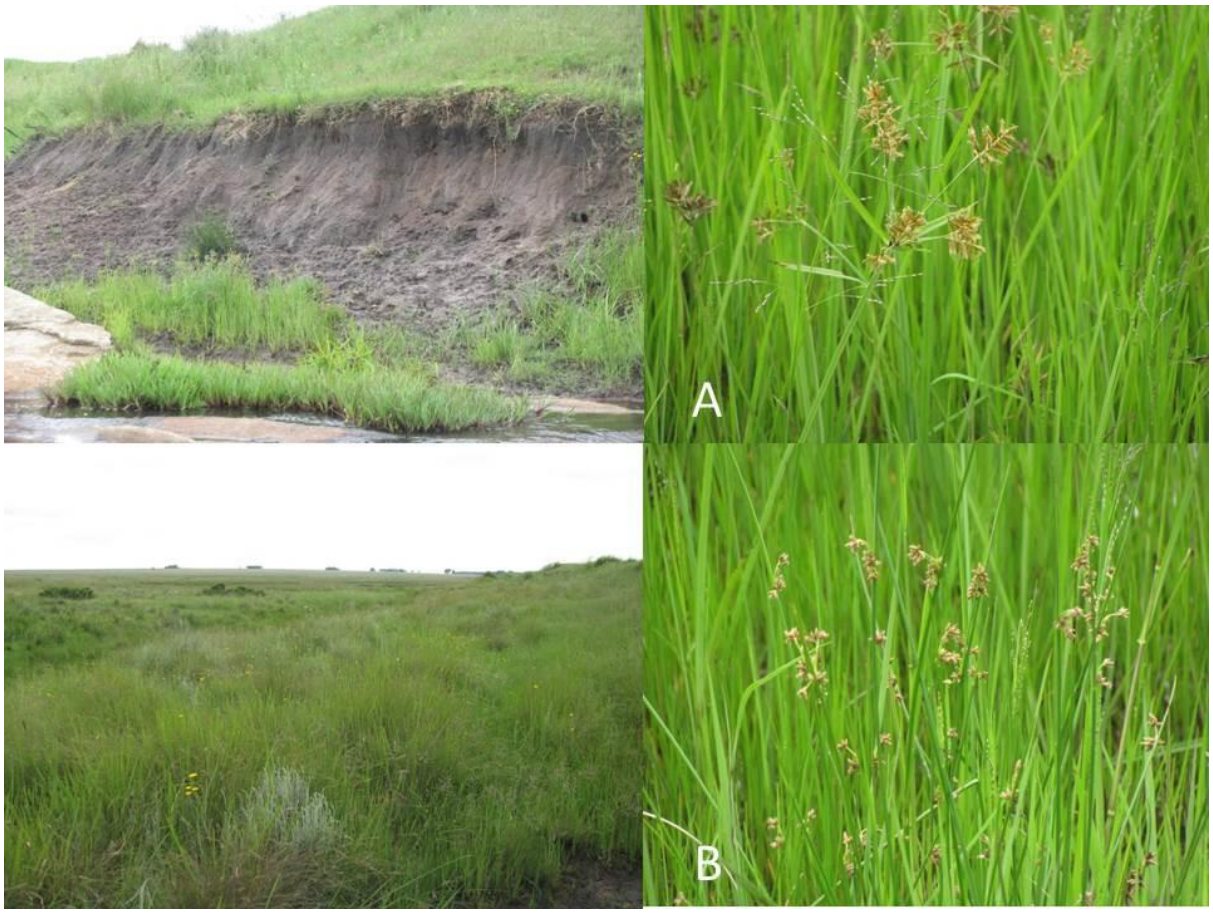


Figure 6-3: Riparian landscapes and Vegetation within the Weltevreden Study Area; A: *Pycreus macranthus*, B: *Schoenoplectus sp.*

6.1.2.3 Agricultural fields

The agricultural fields are comprised of Maize *(Zea mays)*. These areas have been colonised by problem plants on the periphery such as Yellow Nut Sedge (*Cyperus esculentus*) White Mexican Poppy (*Argemone ochroleuca*). This vegetation type and typical species are illustrated in Figure 6-4 below.

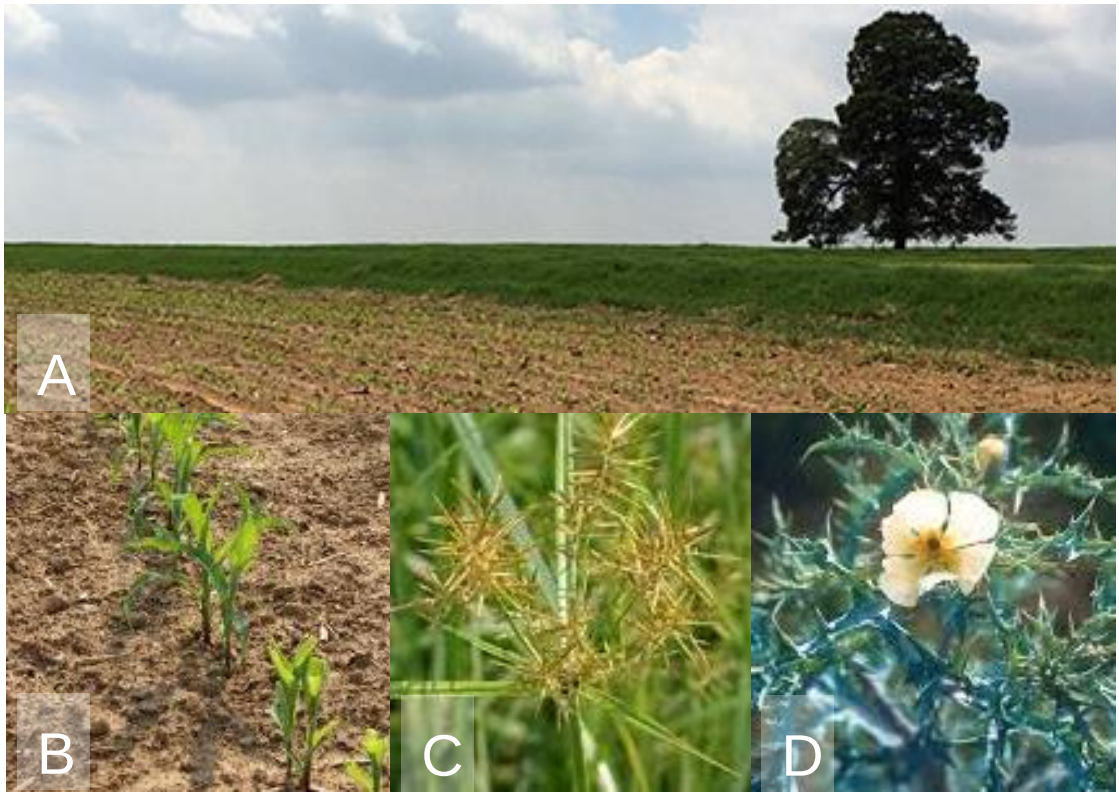


Figure 6-4: A, View of Agricultural fields within the Weltevreden Study Area, B. Mielies (*Zea mays*), C. Yellow Nut Sedge (*Cyperus esculentus*) and D. White Mexican Poppy (*Argemone ochroleuca)*

Due to the high levels of transformation and disturbance, areas of cultivated land are not considered natural habitat and therefore have a low ecological integrity. When left fallow these areas also tend to be readily encroached by various NEMBA listed invasive plants. No medicinal, endemic, Red Data or protected species were recorded in the cultivated lands and the probability of such species occurring in this vegetation community is considered low. Accordingly, the conservation importance of cultivated land is considered low.

6.1.2.4 Grassland

The grassland unit was identified as the original or primary vegetation type in the area. The grasslands have formed and are maintained as a result of natural factors such as fire periodic grazing and frost, all of which are important in not allowing trees to start dominating the area, thereby creating a savanna landscape. The grassland habitat type identified at the project site was the remaining grassland after the majority of the area was utilized for agricultural activities predominantly maize farming. The effects of the anthropogenic activities, in the form of declining habitat, are a major threat to these grassland areas of the study site and the province as a whole. The grassland was encountered on relatively flat rolling hill slopes, with the majority of the very flat and agriculturally suitable areas used for maize farming. The ecological integrity and sensitivity was found to be high, and the grasslands are seen as very important with regards to its biodiversity maintenance function.

The grass layer was largely dominated by Gum Grass (*Eragrostis gummiflua)*, Weeping Love grass (*E. curvula*), Common Thatch grass (*Hyparrhenia hirta*) forbs present were, Small white albuca (*Albuca setosa*), *Dianthus basuticus,* Giant Bell flower *(Wahlenbergia grandiflora)* and Chironia (*Chironia purpurascens*). Few alien invasives were encountered however Pompom weed (*Campuloclinium macrocephalum*) and Bankrupt Bush (*Seriphium plumosum*). No trees were encountered in this vegetation type.

6.1.2.4.1 Secondary Grassland

The secondary grassland vegetation type is composed of original grassland vegetation, which has been largely impacted on/transformed previously by agricultural activities (specifically grazing). The grass layer is dominated by Weeping Love Grass (*Eragrostis curvula)* and Tough Love Grass (*Eragrostis plana)*. Forbs present include *Pelargonium luridium, Nemesia fruticans, Monopsis decipiens*. Alien and invasive vegetation includes White Flower Mexican Poppy (*Argemone ochroleuca),* Yellow Nut Sedge *(Cyperus esculentus), Sticky Nightshade (Solanum sisimbriifolium).* This vegetation type and typical species are illustrated in Figure 6-5 below.

Figure 6-5: Secondary Grassland within the Weltevreden Study Area; A. View of grassland vegetation type, B. *Eulophia ovalis*, C. *Pelargonium luridum*, D. *Monopsis decipiens* and E. *Nemesia fruticans*

Much of the Secondary Grasslands have been impacted upon by grazing, however in consideration of the broader landscape matrix, this vegetation type provides valuable natural grassland habitat for both flora and fauna. The ecological integrity of this vegetation community varies according to the specific disturbance. No Red Data/protected flora species were recorded in this vegetation type. The suitability of the Secondary Grassland vegetation community as habitat for other Red Data and/or protected species of both flora and fauna is not regarded as high and accordingly, the conservation importance of these areas is regarded to be moderate.

6.1.2.5 Exotic tree stands

Stands of Exotic Trees including Red River Gum (*Eucalyptus camaldulensis)* and Black Wattle (*Acacia mearnsii*) are found within the study area. These tree stands are believed to have been historically planted to provide timber or screening for the farmhouses. They are regarded to be a highly disturbed vegetation community. Infestations have occurred along the water courses. Little vegetation is supported below the tree canopy. No Red Data, protected or medicinal species were recorded in this community and the probability of occurrence of such species is considered low. The conservation importance of these areas is therefore considered low. A full assessment of the alien invasive species encountered on the study area is provided in Section 6.1.3 below.

Figure 6-6: Alien Vegetation within the Weltevreden Study Area; A. Red River Gum (*Eucalyptus camaldulensis*), B. Black Wattle (*Acacia mearnsii*), C. Black Wattle (*Acacia mearnsii*)

6.1.3 Alien plant species

Invasion by destructive alien plant species erodes the natural capital of ecosystems, compromises their stability and is a growing problem in South Africa (Richardson and van Wilgen 2004). Alien invasion for the Weltevreden study area was extensive and well-established, including alien bushclumps of <6m in height, as well as an abundance of alien shrubs and forbs. Stands of Exotic Trees including Red River Gum (*Eucalyptus camaldulensis) Populus x canescense* (Grey poplar) and Black Wattle (*Acacia mearnsii*) are found throughout the study area. These trees were historically planted as wind breaks, known as screening, by local farmers around farm houses. These fast colonising plants have

since spread and are now found in various locations across the study area, including watercourses. Little vegetation is supported in the ground beneath these trees. The conservation importance of these areas is therefore considered low. A management plan and monitoring programme is recommended to control these plants.

Alien species in South Africa are categorised according to the Alien and Invasive Species Lists, 2014 (GN R599 in *GG* 37886 of 1 August 2014) of the NEMBA (Act 10 of 2004).

The national list of invasive plant species listed in NEMBA represents the following categories:

- Category 1a: Species requiring compulsory control;
- Category 1b: Invasive species controlled by an invasive species management programme;
- Category 2: Invasive species controlled by area, and
- Category 3: Invasive species controlled by activity.

Certain species have different alien invasive categories for different provinces in South Africa. Table 6-2 lists the alien species identified on site as well as their respective alien categories.

Table 6-2: Alien plant species listed for the study site

Species (Category)	English Name	Growth form	Grass	Riparian	Rocky	Agric land	Alien clumps
Acacia mearnsii (2)	Black Wattle	Tree					x
Agave sisalana (2)	Sisal	Succulent				x	x
Asclepias fruticosa	Shrubby milkweed	Shrub	x	x			
Bidens pilosa	Common Blackjack	Herb	x		x		x
Bromus catharticus	Rescue grass	Grass	x	x			x
Campuloclinium macrocephalum(1b)	Pompom weed	Herb	x		x		
Cirsium vulgare (1b)	Scottish thistle	Herb	x				x
Conyza albida	Tall fleabane	Herb	x	x	x		
Cyperus esculentus	Yellow Nut Sedge	Sedge		x			
Datura stramomium (1b)	Common thorn apple	Herb	x	x		x	
Eucalyptus camuldensis (1b)	Red River Gum	Tree					x
Oenothera rosea	Rose evening primrose	Herb	x		x	x	x
Paspalum urvillei	Vasey Grass	Grass				x	x

Species (Category)	English Name	Growth form	Grass	Riparian	Rocky	Agric land	Alien clumps
Persicaria lapathifolia	Spotted Knotweed	Herb		x			
Populus x canescens(2)	Grey Poplar	Tree		x			x
Salix babylonica	Weeping Willow	Tree		x			
Schkuhria pinnata	Dwarf marigold	Shrub	x		x		
Seriphium plumosum	Bankrupt Bush	Shrub	x			x	
Solanum mauritianum(1b)	Bugweed	Shrub	x		x		x
Solanum sisymbrifolium(1b)	Wild Tomato	Shrublet	x				
Tagetes minuta	Tall Khaki Weed	Herb	x			x	x
Taraxacum officinale	Dandelion	Herb	x				
Verbena bonariensis (1b)	Tall Verbena	Shrub	x			x	x

6.2 Fauna

6.2.1 Avifauna

The habitat of the proposed mining and surrounding area generally includes mesic Highveld grassland dominated by agriculture (Maize production and grazing). A total of 65 bird species were observed over the field work time, these species are marked as bold in the regional South African Bird Atlasing Project (SABAP2) list depicted in Appendix C.

During the site visit a number of species were observed, the southern central areas which were predominated by agricultural fields and farm roads included species such as Redeyed Dove (*Streptopelia semitorquata*), Laughing Dove (*Spilopelia senegalensis),* Cape Turtle Dove (*Streptopelia capicola*), Common Fiscal (*Lanius collaris*), Cape Sparrow (*Passer melanurus*), Neddicky (*Cisticola fulvicapilla*), Swainsons Spurfowl (*Pternistis swainsonii*), Helmeted Guineafowl (*Numida meleagris*), Black Shouldered Kite (E*lanus axillaris)* and large numbers of Feral Pigeons *(Columba livia domestica).* Throughout the more natural grassland vegetation type of the central southern section of the study area a Grass Owl (*Tyto capensis*) was observed within the wetland habitat. This species is considered Vulnerable in South Africa according to The Red Data Book of Birds of South Africa, Lesotho and Swaziland, with between 1 000 and 5 000 birds remaining in this country (Barnes, 2000). The species has a general distribution in the south-western region of South Africa and Lesotho, and the combined pressure from mining, development, fire mismanagement, land clearing for agriculture, overgrazing, afforestation and road kill are the major issues and concern relating to the reduced numbers of this species. This species has not been previously recorded in the pentads relating to QDS 2629AA and QDS 2529CC according to both SABAP1 and SABAP2.

Although not seen on the days of the site visit, a number of birds of prey should be present periodically throughout the year and would in all likelihood include Red Data summer migrants species such as Pallid Harrier (*Circus macrourus*) and Montagu's Harrier (*Circus pygargus)*. These species do however prefer the less impacted grassland areas to sustain their preferred prey species.

The grasslands and agricultural fields of the study area harbour a number of typical highveld endemics. These included several White Storks along with widow, weaver and bishop species (within the wetter areas). A number of African Quailfinch's (*Ortygospiza fuscocrissa*) were observed within the grasslands – these species generally feed on the seeds of the wetter grass species and are renowned wetland indicators. African Pipit (*Anthus cinnamomeus*) and Cape Longclaw (*Macronyx capensis*) were observed throughout the property – although there is enough nesting habitat for the more endangered lark and pipit species in the general area it must be noted that any explosives, increased traffic loads and earth movement will negatively impact on the breeding of all lark and pipit species, however this is usually not a permanent impact. The grassland area is also ideal habitat for quail and button-quail species although these species are highly nomadic and were not identified during the site investigation. The altitude and species type of the grassland suggests that the area could be home to some endemic and endangered lark and pipit species such as Rudd's Lark (*Heteromirafra ruddi*) and Botha's Larks (*Spizocorys fringillaris*) (which has been observed in the area according to the SABAP1 records.

A number of water birds were identified within the open water of the farm dams in the northern section of Weltevreden these included Sacred Ibis (*Threskiornis aethiopicus*), Red-knobbed Coot (*Fulica cristata*), African Snipe (*Gallinago nigripennis*), Grey Heron (*Ardea cinerea)*, Black-headed Heron (*Ardea melanocephala*), Egyptian Goose (*Alopochen aegyptiaca)*, Spurwinged Goose (*Plectropterus gambensis*) Yellowbilled Duck (*Anas undulata*), White-faced Duck (*Dendrocygna viduata*), Great White Egret *(Ardea alba)*, Cattle Egret (*Bubulcus ibis*), Common Sandpiper (*Actitis hypoleucos*)and Three-banded Plover (*Charadrius tricollaris*). The dam in the southern section was home to Greater flamingos (*Phoenicopterus roseus*) this observation was made during both site visits. During the summer months all areas of standing water within and adjacent to the proposed site will contain a number of wading and water species along with vagrants and due to the close proximity of a larger pan systems in the surrounding vicinity a number of birds will be observed flying from one destination to the other. Appendix C is a complete bird list for the greater area of Weltevreden property (including the list in **bold** that was observed during the site investigation), although the habitat on the site could not cater for a number of species on this list, it presents an idea of what is and can be found in the vicinity.

It is very likely that any disturbance to the area will impact the birdlife within all habitats of the property. The wetlands and natural grassland areas are the most sensitive and there is a concern that any mining will have a negative impact on the quality of the water and a possible de-watering effect that would impact on the wetland system permanently. It is proposed that should any disturbance occur within the property that the two most sensitive

habitats are conserved and managed accordingly. It is also highly recommended that a detailed faunal monitoring system is implemented to assist in the mitigation of disturbance.

Appendix C is a complete bird list for the greater area of Witbank/eMalahleni, although the habitat on the site could not cater for a number of species on this list, it presents an idea of what was historically found and what can currently be found in the vicinity. A few of these species are illustrated in Figure 6-7 below.

Figure 6-7: Avifauna species which occur within the Weltevreden Study Area African A. Grass Owl *(Tyto capensis)* (Fred Miranda), B. White Stork *(Ciconia ciconia)* (Boris Belchev), C. African Snipe *(Gallingo nigripennis)* (Jean-Louis Lemoigne)

Figure 6-8: Greater Flamingo's (*Phoenicopterus roseus*) (Hardaker 2012).

6.2.2 Mammals

Actual sightings, spoor, calls, dung and burrow sites were used to establish the presence of animals on the proposed project site. The evidence of dung and spoor suggests that animals were present in the area although very few were recorded during the surveys. The observations of local land owners were used to supplement the findings of the mammal survey. Three rodents were caught in the Sherman traps, some of the traps had been disturbed possibly from larger species or cattle. These species were Swamp Musk Shrew, (*Crocidura mariquensis)* Striped Mouse (*Rhabdomys pumilio)* and Multimammate Mouse (*Mastomys natalensis)*. All of these rodent species are listed as least concern. The large number of burrows seen in the general project area means that there is a dense population

of rodents, particularly of multimammate mice. Despite the high numbers, there is a low diversity of species. Therefore, there is a high abundance of small mammals but a low diversity (large number of small mammals, however limited to a few species), leading to a relatively low biodiversity of small mammals; however, relatively high numbers may be important in adding to avian, amphibian and the reptilian diversity, as they are a potentially valuable food source. However, during the field survey it was found that farmers poison these rodents. Evidence of blue (treated) mielie kernels and dead rodents were evident during specifically the dry season survey. These dead rodents can poison birds of prey and other predators.

The majority of the farms in the area are involved in agriculture and cattle grazing and the local farmers were able to give an indication on a number of larger mammal species that are found in the area. Mammal activity is most prominent in the Grassland habitat, although it was found that small mammal activity will is high in the other habitat types present as well. Species recorded from the study area include Cape Clawless Otter (*Aonyx capensis*), Common Duiker (*Sylvicapra grimmia*) and Striped Polecat (*Ictonyx striatus*), African Civet (*Civettictis civetta*), South African Hedgehog (*Atelerix frontalis*), Scrub hare (*Lepus saxatilis*), Serval (*Felis serval*), Large-spotted Genet *(Genetta tigrina*), *Lutra maculicollis* (Spotted necked otter), Blesbok (*Damaliscus dorcas phillipsi*), *Galerella sanguinea* (Slender mongoose), Water Mongoose (*Atilax paludinosus*) and Yellow mongoose (*Cynictis penicillata*) were recorded during field investigations. The more common faunal species observed on site can be seen in Figure 6-9.

The Common Duiker (*S. grimmia*) was found in the Grassland vegetation type. These small antelope flourish in a range of different habitats in woodlands, grasslands and savanna (Kingdon 1997). They benefit from reduced predation and patches of low secondary growth, even in urban areas.

Cape Clawless Otter (*Aonyx capensis*) was observed by the central pan, in the Natural Grassland, located on the central northern section of the study area. Signs of this species were also identified on the eastern section of the site, within the grassland system and associated streams (Figure 6-9). This species range extends across the African continent, from Senegal to Ethiopia and south to South Africa. A variety of habitats are preferred, ranging from semi-arid, open plains to rainforests. Their front paws are completely clawless with minimal webbing, giving them an appearance very similar to human hands. They use their incredibly dexterous paws to grab prey such as molluscs and crustaceans.

The Striped polecat (*Ictonyx striatus)* is nocturnal, hunting mostly at night. During the day it will burrow into the undergrowth or sleep in the burrows of other animals. Most often striped polecats are found in habitats with large ungulate populations, because of the lower level of shrub that often accompanies the presence of these grazers. In this case the large assemblages of cows perform the function of these large ungulates. The striped polecat was found run over by a vehicle.

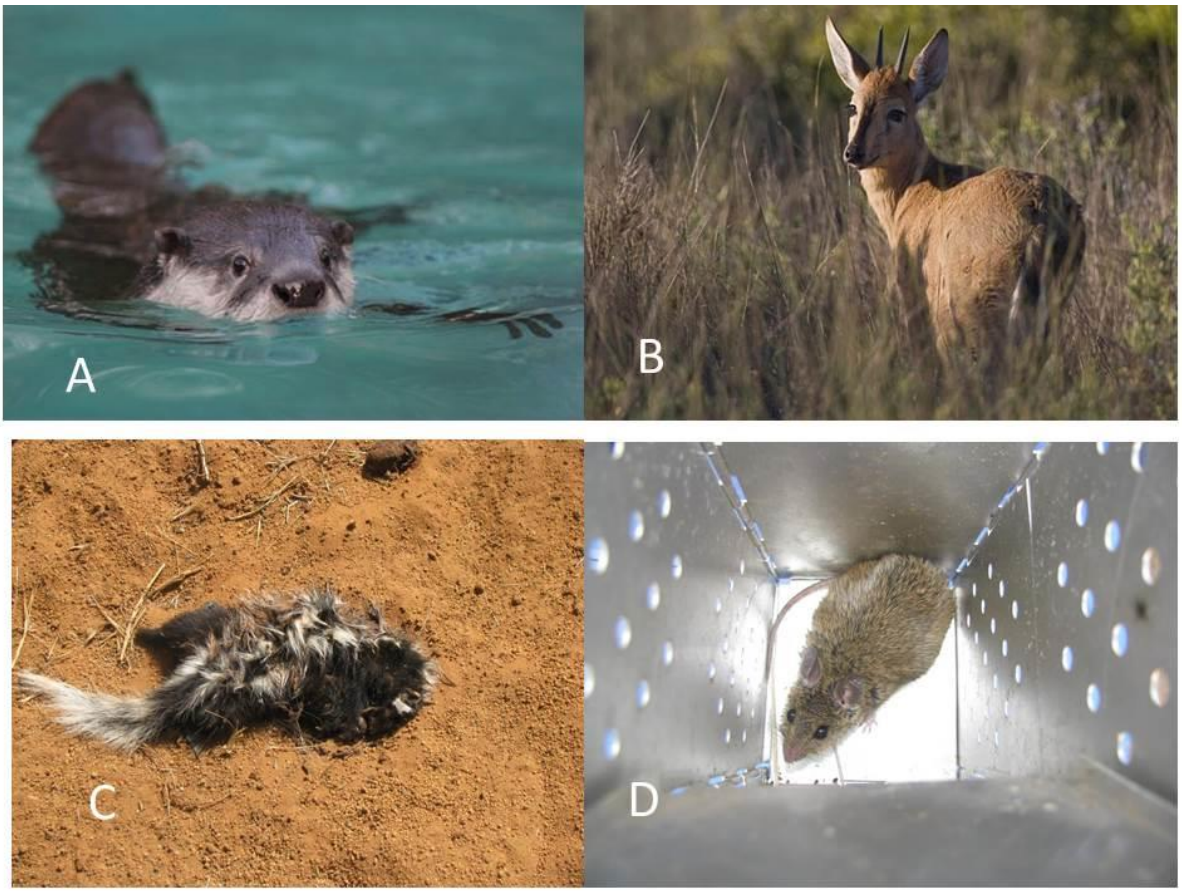


Figure 6-9: A: Cape Clawless Otter (*Aonyx capensis*); B: Common Duiker (*Sylvicapra grimmia*), C, Striped polecat (*Ictonyx striatus),* Multimammate Mouse *(Mastomys natalensis)*

6.2.3 Herpetofauna

Amphibians are viewed to be good indicators of change to the whole ecosystem because they are sensitive to changes in the aquatic and terrestrial environments. Most species of amphibians are dependent on the aquatic environment for reproduction (Duellman and Trueb 1986). Additionally, amphibians are sensitive to water quality and Ultra-violet (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 should provide a number of different species of amphibians, however actual site observations were low.

According to Carruthers (2001), frogs occur throughout every habitat type in 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 study area further niche differentiation is encountered by means of geographic location, this differentiation includes, banks of pans, open water, inundated grasses, rocky outcrops, reed beds, trees, rivers and open ground. Three frog species were identified on site, namely: the Clicking Stream Frog (*Strongylopus grayii*), Giant Bullfrog *(Pyxicephalus adspersus)* and Common River Frog (*Amietia angolensis*) (as represented in Figure 6-10 and Figure 6-11.

Giant Bullfrog *(Pyxicephalus adspersus):* This species is considered to be Near Threatened (NT) and protected under Mpumalanga Nature Conservation Act 10 of 1998, Protected Schedule 2, it is the largest amphibian found in Southern Africa. In Mpumalanga and Gauteng, the males reach a snout-vent length of 245mm and a mass of 1.4kg (Branch, 2001). In contrast to most other frogs, males are larger than females. Although the Giant Bullfrog is widely distributed in the atlas region, it occurs in the north eastern region of the Western Cape, central and southern region of the Eastern Cape, eastern section of the Northern Cape, Free State, Gauteng, Limpopo and a few localities in Mpumalanga along the Highveld region close to the project site.

The preferred habitat is also varied but importantly it breeds in seasonal, shallow, grassy pans in flat open areas but also utilises non-permanent vleis and shallow water on the margins of waterholes and dams.

Adult bullfrogs spend the dry periods in burrows, usually at depths of between 0.5 and 1m depending on the type and humidity of the soil and generally feed on prey such as small birds, lizards, rodents, snakes, insects, crabs and even other frogs. Birds are the major predators of bullfrogs, Records include species such as African and Western March Harriers, Marsh Owl, and the larger egrets (Great White, Yellow Billed and Little) all feeding on this species. Many of these species were observed during the field survey in December 2014.

It has been reported that the Giant Bullfrog numbers are declining in all provinces but particularly Gauteng and Mpumalanga. The juvenile bullfrogs were observed on the dirt road that crosses the N12.

The Common River Frog or Angola River Frog (Not threatened) is a widespread and common species occurring mainly on the eastern half of South Africa. However, care needs to be taken when identifying this species as it may be confused with the Cape River Frog (*A. fusigula*) or even the rarer Drakensberg Frog *(A. dracomontana).* It is highly unlikely that neither of these species would have a distribution overlapping the Weltevreden project site. This species tolerates some habitat disturbance and is frequently associated with human habitation, taking up residence in ditches and ponds often where reed or aquatic vegetation is present. The adults spend most of the day floating amongst the vegetation or basking on rocks at the water's edge. They are skittish and will move quickly from any disturbance with a single jump into the closest deep water area. Breeding takes place all year round, although they are common they are very susceptible to acid pollution and is have been proven that mining has impacted on this species.

Figure 6-10: Giant Bullfrog *(Pyxicephalus adspersus)*

Figure 6-11: A: Clicking Stream Frog (*Strongylopus grayii)*; B: Common River Frog (*Amietia angolensis*)

6.2.4 Invertebrates

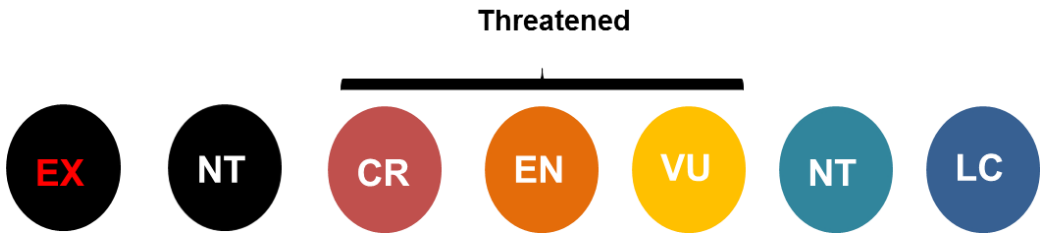
Insects are the most abundant macroscopic organisms in terrestrial and aquatic habitats (Picker et al. 2004). Human threats pose significant threats to insect populations. Threats to butterflies in South Africa include: the establishment of alien invasive vegetation, changing fire regimes (either increased or reduced frequency), agricultural activities, urbanisation, plantation forestry, increased grazing and road construction (Ball 2006).

During the field survey three species were identified within the Study Area. This is not regarded to be a true reflection of the existing species numbers. Signs of these species are illustrated in Figure 6-12 below.

Figure 6-12: Invertebrate species which occur within the Weltevreden Study Area; A, Brown veined white Butterfly (*Belenois aurota*), B, African Monarch (*Danaus chrysippus*) and C, Spotted Maize Beetle (*Astylus atromaculatus*)

6.3 Species of Special Concern

The International Union of Conservation Networks (IUCN) is the international authority for Red Data species. In South Africa, the Threatened Species Programme (TSP) undertakes this role, in collaboration with SANBI. SSC for the purpose of this report, include any Red Data, Nationally Protected and Provincially Protected species recorded on site. The Red Data listed flora and fauna species are identified on site were classified according to the following categories:



- Extinct (EX) – No known individuals remaining;
- Extinct in the Wild (EW) – Known only to survive in captivity, or as a naturalized population outside its historic range;
- Critically Endangered (CR) – Extremely high risk of extinction in the wild;
- Endangered (EN) – High risk of extinction in the wild;
- Vulnerable (VU) – High risk of endangerment in the wild;
- Near Threatened (NT) – Likely to become endangered in the near future;
- Least Concern (LC) – Lowest risk. Does not qualify for a more at risk category. Widespread and abundant taxa are included in this category;
- Data Deficient (DD) – Not enough data to make an assessment of its risk of extinction and
- Not Evaluated (NE) – Has not yet been evaluated against the criteria.

The SSC that were encountered during the field assessments are depicted in Figure 6-13, all these species were encountered in the Riparian, Wetland, Rocky outcrop or Grassland vegetation types.

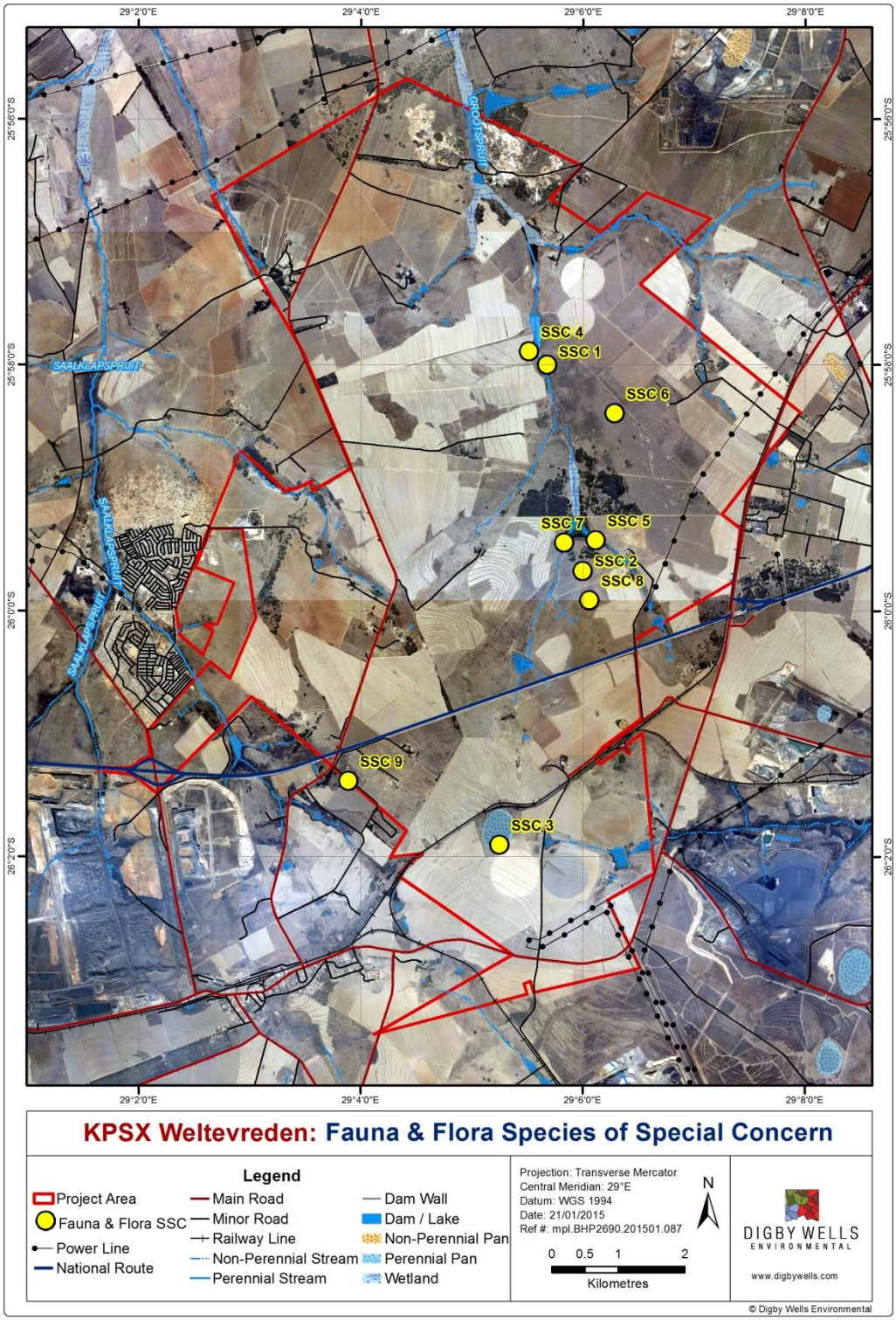


Figure 6-13: Fauna and Flora SSC

6.3.1 Flora SSC

An assessment to determine the presence of any RDL (Red Data Listed) plant species, as well as suitable habitat to support any such species, was undertaken. The complete PRECIS (Pretoria Computer Information Systems) red data plant list for the grid reference (2629AA and 2529CC) was enquired from SANBI (South African National Biodiversity Institute). From this list the potential species of special concern was identified, one of which was *Frithia humulis*. The plant Fairy elephants foot *(Frithia humulis)* (EN) was encountered on the Weltevreden study area, Figure 6-14, displays this species. *Frithia humilis* occurs in association with sandstone outcrops.

One Orange Listed species, namely *Hypoxis hemerocallidae*, scattered throughout the subject property. Any *H. hemerocallidae* species encountered during mining activities should be rescued and relocated to areas with increased sensitivity such as wetland/riparian zones with associated buffers.

Figure 6-14: Plant SSC encountered for the Weltevreden study area, *Frithia humulis*

Five other protected species had also been recorded in the area according to PRECIS: *Boophane disticha, Crinum bulbispermum, Eucomis autumnalis, Gladiolus dalenii and Gladiolus crassifolius.* It should be noted that all of the species from the genus *Gladiolus* are protected*. Boophane disticha, Gladiolus crassifolius and Gladiolus dalenii* grow in grassland often in rocky places. *Crinum bulbispermum* prefers moist grassland habitat, usually along rivers and *vleis. Eucomis autumnalis* grows in grassland, particularly moist places and rocky

ridges. The preferred habitat types of these protected species coincide with the designated sensitive areas of the study site. It is therefore important that recommendations presented in this report be followed as far as possible.

6.3.1.1 Medicinal Plants

Ethnobotany is a branch of botany that places focus on the use of plants for medicines and other practical purposes. The use of native plants for ethnobotanical uses can be detrimental to populations that are overexploited.

South Africa has a rich diversity of medicinal plants that not only have a global significance, but also have a cultural and historical role (van Wyk *et al.* 2009). There is a rapidly growing concern for conservation of medicinal plants that are dwindling in number due to illegal harvesting (Institute of Natural Resources 2003). This is particularly apparent in rural areas where medicinal plants are overexploited by traditional doctors. Table 6-3 represents the medicinal species recorded on site. Fourteen medicinal plants have been identified.

Table 6-3: Medicinal plants identified on site and their uses (van Wyk *et al.* 2009)

Scientific Name	Common Name	Form
Becium obovatum	Cat's Whiskers	Herb
Commelina africana	Yellow Commelina	Herb
Cyperus esculentus	Yellow Nut Sedge	Sedge
Euphorbia striata	Milkweed/Spurge	Herb
Helichrysum aureonitens	Golden everlasting	Herb
Ipomoa crassipes	Leafy flowered Ipomoa	Herb
Kohautia amatymbica	Tremble tops	Herb
Ledebouria cooperi	Cooper's Squill	Bulb/Herb
Ledebouria ovatifolia	-	Bulb/Herb
Monopsis decipiens	Butterfly Lobelia	Herb
Pelargonium luridum	Stalk-flowered Pelargonium	Herb
Senecio inornatus	-	Herb
Typha capensis	Bulrush	Reed
Vernonia oligocephala	Bicoloured-leaved Vernonia	Herb

6.3.2 Fauna SSC

Three mammal SSC were recorded on site. Additional SSC may occur on site and their absence during this investigation does not infer that they do not occur at all.

One amphibian species of potential concern was encountered, this species is Nationally protected, and designated as Near Threatened.

One bird SSC of international concern and four birds of national conservation concern were recorded for the Weltevreden site (as represented in Table 6-4). Twenty six protected bird species have the potential to occur on site (Appendix A). Four of these were recorded and an additional five have a high likelihood of being present due to favourable habitat being present.

Table 6-4: Fauna species SSC list for the study area

Full Name	*Scientific Name*	Global Red List Status_2013	South Africa Status_2014	Identified on site
Avifauna				
Botha's Lark*	*Spizocorys fringillaris*	EN	EN	
Rudd's Lark*	*Heteromirafra ruddi*	VU	CR	
Greater flamingos	*Phoenicopterus roseus*	LC	VU	x
African Grass-Owl	*Tyto capensis*	LC	VU	x
Montagu's harrier	*Circus pygargus*	LC	VU	
Secretarybird	*Sagittarius serpentarius*	VU	NT	x
African Snipe	*Gallinago nigripennis*	LC	VU	x
Pallid Harrier	*Circus macrourus*	NT	NT	
White stork	*Ciconia ciconia*	LC	NT	
Mammals				
Serval	*Leptailurus serval*	LC	NT	x
Spotted necked otter	*Lutra maculicollis*	LC	-	x
South African Hedgehog	*Atelerix frontalis*	LC	NT	x
Amphibians				
Giant Bullfrog	*Pyxicephalus adspersus*	LC	NT	x

*denotes endemic species

7 Impact assessment

Table 7-2 describes the various activities associated with the phases of mining proposed for the Weltevreden Mine. Associated with these activities are several impacts, which are described in the section below. The aim of the Impact Assessment is to strive to avoid damage or loss of ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (DEA, 2013). The infrastructure layout upon which the impact assessment is based is depicted in Figure 7-1. Offsets to compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate. The mitigation hierarchy is described in Table 7-1.

Table 7-1: Mitigation hierarchy

	**Avoid or Prevent**	Refers to considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts on biodiversity, associated ecosystem services and people. This is the best option, but is not always possible. Where environmental and social factors give rise to unacceptable negative impacts, mining should not take place. In such cases, it is unlikely to be possible or appropriate to rely on the later steps in the mitigation.
	Minimise	Refers to considering alternatives in the project location, sitting, scale, layout, technology and phasing that would minimise impacts on biodiversity, associated ecosystem services. In cases where there are environmental constraints, every effort should be made to minimise impacts.
	Rehabilitate	Refers to rehabilitation of areas where impacts are unavoidable and measures are provided to return impacted areas to near natural state or an agreed land use after mine closure.
	Offset	Refers to measures over and above rehabilitation to compensate for the residual negative impacts on biodiversity after every effort has been made to minimise and then rehabilitate the impacts. Biodiversity offsets can provide a mechanism to compensate for significant residual impacts on biodiversity.

Table 7-2: Activity table

Activity No.	Activity
Construction Phase	
1	The recruitment, procurement and employment of construction workers, engineers and contractors.
2	The transportation of construction material to the Project site via national, provincial and local roads.
3	Storage of fuel, lubricant and explosives in temporary facilities for the duration of the construction phase. These substances are classified as hazardous in terms of the Hazardous Substances Act, 1973 (Act No. 15 of 1973) and will be managed accordingly.
4	Site clearance and topsoil removal prior to the commencement of physical construction activities, as well as the open pit mining. This activity refers to the conversion of undeveloped, vacant land into industrial use.
5	Construction of surface infrastructure will take place, including the offices and fuel bay, haul roads, PCDs, coal tip and conveyor belt, pipelines and clean water canals and a high mast radio communication tower.
6	The construction of stockpiles, including topsoil, overburden and discard and emergency coal stockpiles.
7	The establishment of the initial boxcut and access ramps to the open pit mining areas.
Operational Phase	
8	Limited employment of skilled and unskilled labour will be required for the operation of the mine and support infrastructure.
9	Storage of fuel in diesel tanks, as well as lubricant and explosives in facilities for the duration of Project. These substances are classified as hazardous in terms of the Hazardous Substances Act, 1973 (Act No. 15 of 1973) and will be managed accordingly.
10	Drilling and blasting of the overburden rock for easy removal by excavators and dump trucks.
11	Coal removal by truck and shovel methods from the exposed coal seams. The coal is removed with shovels and transported to the plant by conveyor belt by trucks.
12	Vehicular activity on the proposed haul roads. Mining equipment will utilise the haul roads to access open pit areas, as well as to transport coal from the opencast pit to the plant and conveyor belt. The haul road will consist of wetland and stream crossings.
13	Mine water, or dirty water that is located within the opencast pits will need to be diverted by channels and berms to the PCDs to prevent clean water resources from being contaminated. Pipelines will pump the dirty water from the KPSX: Weltevreden PCDs to the KPS PCD.
14	Use of conveyor belts to transport the coal to the stockpiles at the KPS plant.

Activity No.	Activity
15	The PCDs will store all dirty water that has come into contact with the opencast pit, overburden stockpiles or emergency coal stockpile.
16	Operation and maintenance of the stockpiles, including topsoil, overburden and discard and ROM coal stockpiles.
17	Waste and sewage generation and disposal. All domestic, industrial and hazardous waste is produced during the mining process. Waste includes cans, plastics, used tyres and oil which must be disposed of in an appropriate manner by a contractor at a licensed waste disposal site. Sewage produced from the office buildings and ablutions will be treated at a sewage plant, septic tank or French drain system.
18	Concurrent replacement of overburden and topsoil and the re-vegetation of mined out strips. The mined strip will be backfilled with the overburden and compacted. Subsequently, the topsoil will be placed on top of the overburden and the area will be vegetated.
Decommissioning Phase	
19	Retrenchment of mine employees and staff will take place following the cessation of the mining operations and coal beneficiation activities.
20	Demolition of infrastructure will take place and includes the PCDs, haul roads, coal tip and conveyor belts, pipelines, high mast radio communication tower, fuel bay and mine offices and workshop.
21	Removal of fuel, lubricant and explosives will be required following the cessation of the mining activities to ensure that there is no health and safety risk to the environment and to people.
22	Final replacement of overburden and topsoil and the establishment of vegetation on the final open cast void. Overburden will be backfilled into the final void and compacted. Subsequently, topsoil will placed and the area vegetated.
23	Waste handling of scrap metal and used oil as a result of the Decommissioning Phase will be undertaken.
Post-closure Phase	
24	Post-closure monitoring and rehabilitation will determine the level of success of the rehabilitation, as well as to identify any additional measures that have to be undertaken to ensure that the mining area is restored to an adequate state. Monitoring will include surface water, groundwater, soil fertility and erosion, natural vegetation and alien invasive species and dust generation from the coal discard dumps.

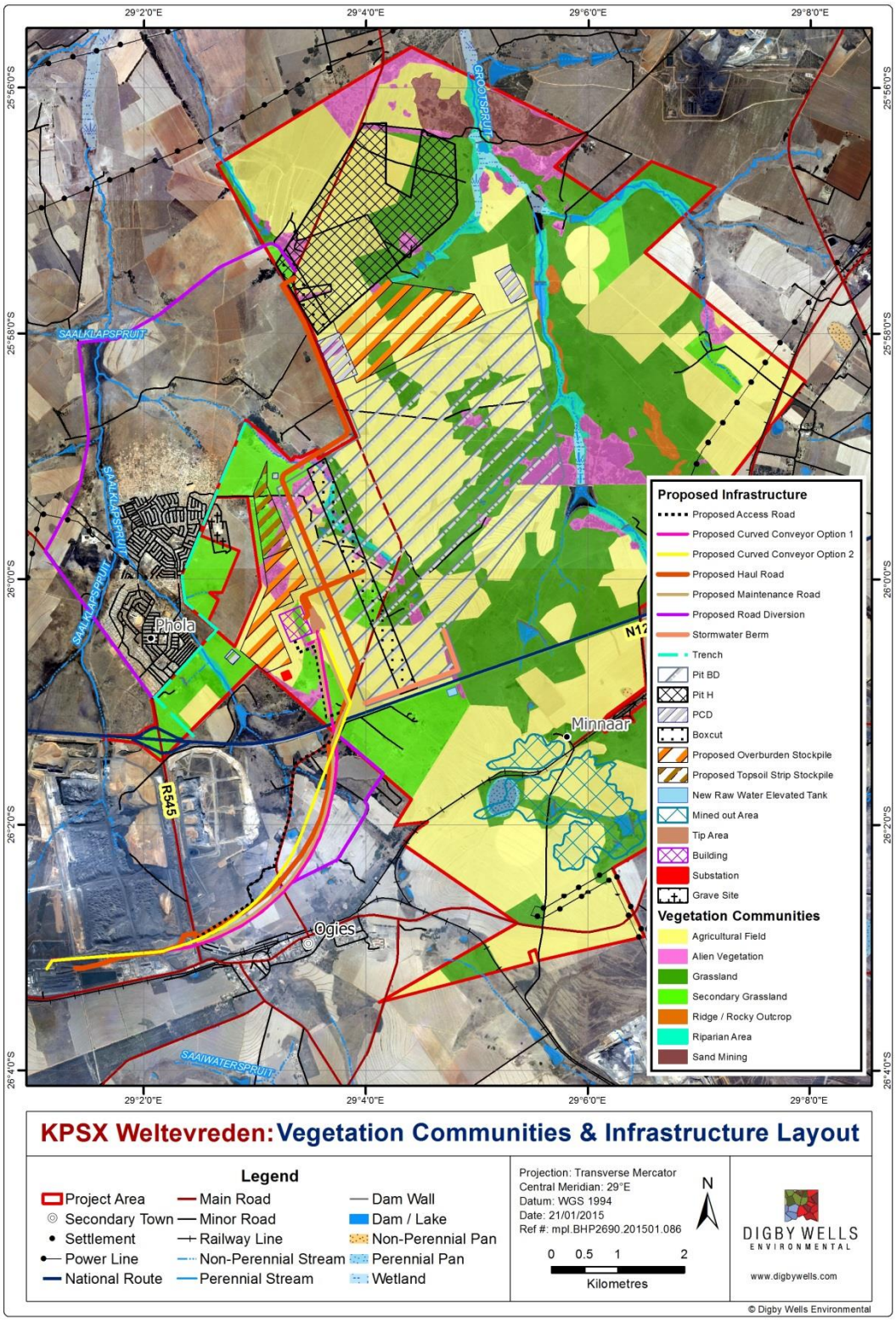


Figure 7-1: Vegetation communities and Infrastructure layout

The six vegetation types delineated during field work are all affected by infrastructure placement with the exception of Rocky outcrops, the area in ha to be affected and the percentage of the vegetation type that this represents are tabulated below in Table 7-3. Sand mining land use was not included as it was a small are in the north of the project area. The vegetation types affected the most are the agricultural fields and alien vegetation types, with the grassland only third and secondary grassland after that. Mitigation measures are suggested to minimize the impacts on the natural systems.

Table 7-3: Percentage of each vegetation unit affected by infrastructure

Description	Area affected by infrastructure (ha).	Percentage of veg type affected by infrastructure.
Agricultural Fields	1635.3	43%
Alien Vegetation	145.0	33%
Grassland	615.2	30%
Ridge / Rocky Outcrop	0	0%
Riparian Areas	14.8	8%
Secondary Grassland	86.6	13%

7.1 Construction Phase

Activity No. 4: *Site clearing and topsoil removal*.					
Criteria	**Details / Discussion**				
Description of impact	The existing vegetation within the proposed area of development will be impacted on as the existing vegetation (Mostly grassland) will be removed to facilitate the construction of mine and related infrastructure. Pit H will only affect grassland and agricultural areas, the overburden stockpile will impact on grassland and riparian areas, the PCD will only impact on the agricultural habitat type, Pit BD will impact grassland and riparian areas, the boxcut will impact on riparian areas and grasslands, the topsoil stockpile will impact on the grassland only, the overburden stockpile will impact on alien vegetation and agricultural areas and the curved conveyor belt option will impact on the secondary grassland and alien vegetation habitat types. The exact impact on each vegetation type is explained in Table 7-3. The placement of the infrastructure will include the continuous and complete removal of vegetation on the footprint of the areas mentioned above. The partial degradation of natural vegetation and habitat for animal life has already taken place within the surrounding environment due to current land use practices such as agricultural and mining activities. The destruction of the areas grassland, secondary grassland, and riparian areas will result in the permanent reduction of natural habitat of reptiles, birds, frogs, insects and mammals present within the areas, this is of specific concern as SSC mammals, birds and amphibians were encountered. The potential impact on the rocky ridges habitat type will be of special concern as these are sensitive habitats, and one plant SSC was encountered here. The impact will be site specific in extent with impacts likely to occur on site. The severity of the impact was determined to be high.				
Mitigation required	▪ Limit degradation and destruction of natural environment to designated project areas by keeping the footprint of the disturbed area to the minimum and within designated areas only. Re-vegetate open areas to limit erosion. ▪ Avoid known areas of faunal and floral SSC as indicated on the relevant map. ▪ Avoid sensitive landscapes such as wetlands and ridges that were encountered on site. ▪ Restrict nationally restricted alien invasive plant recruitment by ensuring the removal of vegetation during construction and operation will be minimised thereby reducing the risk of open areas occurring. ▪ Maintain top soil biological activity by soils stockpiling without compaction to keep the seed bank viable if topsoil is replaced within a year. This viable seedbank will create an excellent basis for rehabilitated areas where these soils are used.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	4	6	5	6	90
Post-Mitigation	3	3	3	4	36

Activity No. 5, 6, 7: *Construction of surface infrastructure*					
Criteria	**Details / Discussion**				
Description of impact	The construction of surface infrastructure such as haul roads, pipes, storm water diversion berms (including transportation of materials & stockpiling), and other infrastructure will increase the favourable habitat for alien invasive plant species to establish themselves, primarily due to open/cleared ground being available to the very efficient establishment strategies of alien invasive plant species. The area designated for surface infrastructure will no longer allow for seepage of surface water into underground aquifers due to the hardening of surfaces. The infiltration will increase the surface water runoff, which in turn will increase erosion that will lead to loss of topsoil, which is detrimental to plant species.				
Mitigation required	▪ Limit areas suitable for alien invasive recruitment by removal of vegetation during construction of infrastructure will be minimised to reduce the risk of open areas occurring. ▪ Limit erosion by making use of permeable materials for pavements and walk-ways. Introduce a storm water management programme and create flower beds below the street level.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	2	5	3	5	50
Post-Mitigation	2	3	3	5	40

7.2 Operational Phase

Activity No. 12: *Vehicular activity on haul roads, use of hall roads*					
Criteria	**Details / Discussion**				
Description of impact	Vehicular activity could impact on fauna SSC in terms of road deaths, the evidence of road deaths were evident during field work. Furthermore, the vehicular activity will result in the creation of soil based dust which will increase the deposits these materials on plant leaves, blocking stomata and inhibiting evapotranspiration. Natural dust will be created from use of the haul road and ash dust will be created during transport by haul trucks. This will impact on the vegetation health and availability as food items as well as inhibit the ability of the plants units to provide ecological services.				
Mitigation required	▪ Prevent excess dust creation that could inhibit plant growth by wetting of the haul roads to suppress dust creation as well as cover haul trucks to prevent dust emissions during transport. ▪ To avoid animal deaths specific speed limits must be adhered to by all mining vehicles.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*

Pre-Mitigation	5	5	6	5	80
Post-Mitigation	3	3	3	4	36

Activity No. 18: The replacement of overburden and topsoil					
Criteria	**Details / Discussion**				
Description of impact	This may be considered to be a positive impact if implemented properly. The replacement of overburden and topsoil throughout the concurrent rehabilitation during the operational phase may result in the reduction of available space for alien invasive species, soil erosion and soil compaction, associated with top soil storage areas. This activity will create favourable habitat for indigenous plant species, and promote rehabilitation efforts.				
Mitigation required	▪ Reduce areas available for alien infestation by restoring disturbed areas to natural habitat. ▪ Implementation of an alien invasive management program is imperative to reduce the risk of these plant species infesting the mine area.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Enhancement	1	2	2	2	+10
Post-Enhancement	4	5	4	4	+39

7.3 Decommissioning Phase

Activity No. : Removal of infrastructure	
Criteria	**Details / Discussion**
Description of impact	The demolition and removal of infrastructure may result in impacts to vegetation, as large machinery is needed for removal of infrastructure. Of concern here is the destruction of vegetation, creation of favourable habitat for fast growing invasive species and ground compaction. Also of concern are the possible spillages from infrastructure holding hazardous material. These spillages and leaks may be considered for infrastructure such as sewerage and waste facilities, toxicant, pollutant and fuel storage infrastructure and general vehicle use. In the event that this infrastructure is not demolished properly and with caution, resulting spillages and leaks would impact on vegetation and soil quality. The demolition of infrastructure may require vehicles making use of non-designated areas, special care must be taken not to destroy rehabilitated areas.
Mitigation required	▪ Avoid spillage of hazardous materials, thereby protecting vegetation and soil. The correct and careful handling of the infrastructure housing pollutants and toxicants to prevent spillages and leaks.

	▪ Avoid destruction of vegetation, the creation of favourable habitat for fast growing invasive plants and ground compaction, by forcing vehicles to make use of existing roads and designated areas. Avoid rehabilitated and natural habitat areas as far as possible. ▪ The implemented alien invasive control program must be adhered to carefully.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	2	2	4	4	32
Post-Mitigation	2	2	3	4	28

Activity No. 22: *Rehabilitation (spreading of soil, re-vegetation & profiling/contouring)*					
Criteria	**Details / Discussion**				
Description of impact	This may be considered to be a positive impact if implemented properly. The replacement of overburden and topsoil throughout the life of mine as well as the final replacement during the decommissioning phase may result in the restoration of the natural vegetation.				
Mitigation required	▪ The footprint of the area disturbed by the mining operation will have topsoil and overburden replaced to restore the vegetation cover, through proper rehabilitation. ▪ Limit the erosion potential of exposed areas by re-vegetation. ▪ Re-vegetated areas will form seepage areas which will help aid infiltration.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Enhancement	1	1	2	2	+8
Post-Enhancement	4	5	4	5	+65

7.4 Post-Closure Phase

Activity No. 24: *Post-closure monitoring and rehabilitation*					
Criteria	**Details / Discussion**				
Description of impact	This activity will commence only after closure has taken place, furthermore this activity will be on-going after operations in the area has stopped.				
Mitigation required	▪ Direct rehabilitation efforts by ensuring correct measures are employed for a variety of rehabilitation projects ▪ Avoid erosion, alien invasive species establishment, by monitoring rehab outcome to ensure open areas are eliminated.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-	1	1	2	2	+8

Enhancement					
Post-Enhancement	4	5	4	5	+65

8 Cumulative Impacts

When determining the impacts of a development such as this, one needs to consider cumulative impacts. Cumulative impacts take into account impacts of current land use and land use change in the broader area. Ideally, all development should take place within a predefined Strategic Environmental Assessment which defines no-go and conservation areas as well as allowing for development such as housing, roads, agriculture and mining. In the absence of such a strategic plan, one can look at the surrounding activity and land use and determine to a certain extent, the overall impacts in the region with the addition of the proposed mine.

There are currently several mines surrounding the Weltevreden extension study site, most of these are coal mines (See Figure 8-1). These mining areas are directly adjacent to the Weltevreden project site and will have a high cumulative impact on the area as a whole. The construction of yet another mine in the area can be seen to have serious impacts on ecosystem function. The proposed Weltevreden extension is a surface mine, and therefore it will add to the general environmental degradation caused by the numerous mines in the area in conjunction with other land uses (agriculture, residential development and cattle farming).

The opportunity exists for the proposed Weltevreden extension to contribute quite substantially to the conservation in the region. Conservation of as much of the natural land in the area, and the creation of corridors linking other natural areas would aid in conservation of ecosystems, flora and fauna. If this is achieved (permanently, not just over the life of the mine), then the mine itself will have a net positive impact. The proposed mine would have essentially provided their own offsets, especially if the wetland areas and associated grassland is restored and managed as a conservation and corridor area.

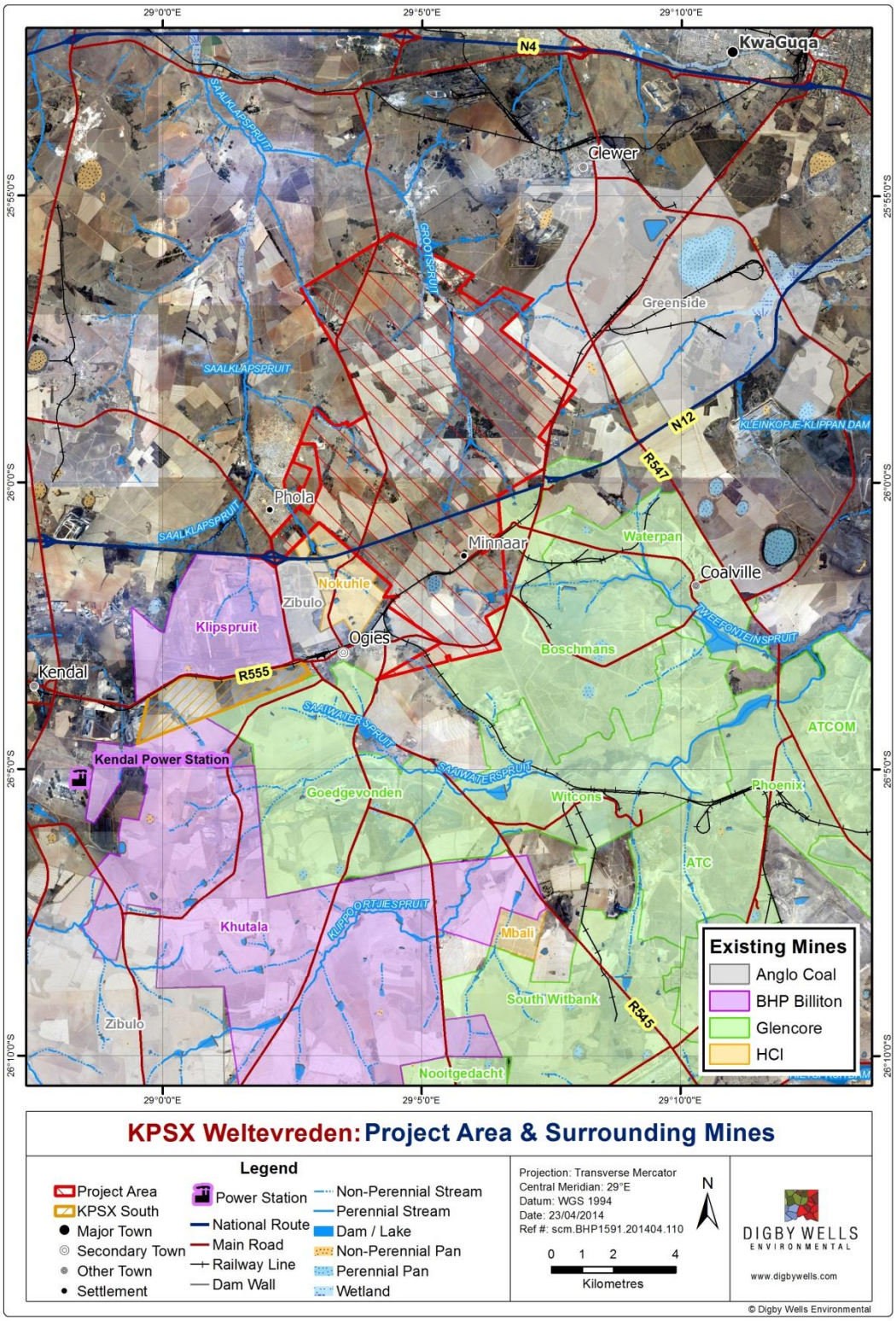


Figure 8-1: Map of the Weltevreden extension mine area and nearby existing and proposed mines

9 Mitigation Measures and Management Plan

Broad mitigation and management actions are described initially and then activity specific actions are described in this section. The mitigation measures are based on the sensitivity map (Figure 9-1) below. Areas designated as High and Medium/High are designated as such because of their function in the ecosystem and their ability to harbour plant and animal SSC, as was found during the field visits. Impact specific mitigation measures are discussed in the impact assessment section above. These mitigation measures will form an integral part of this mitigation and management plan.

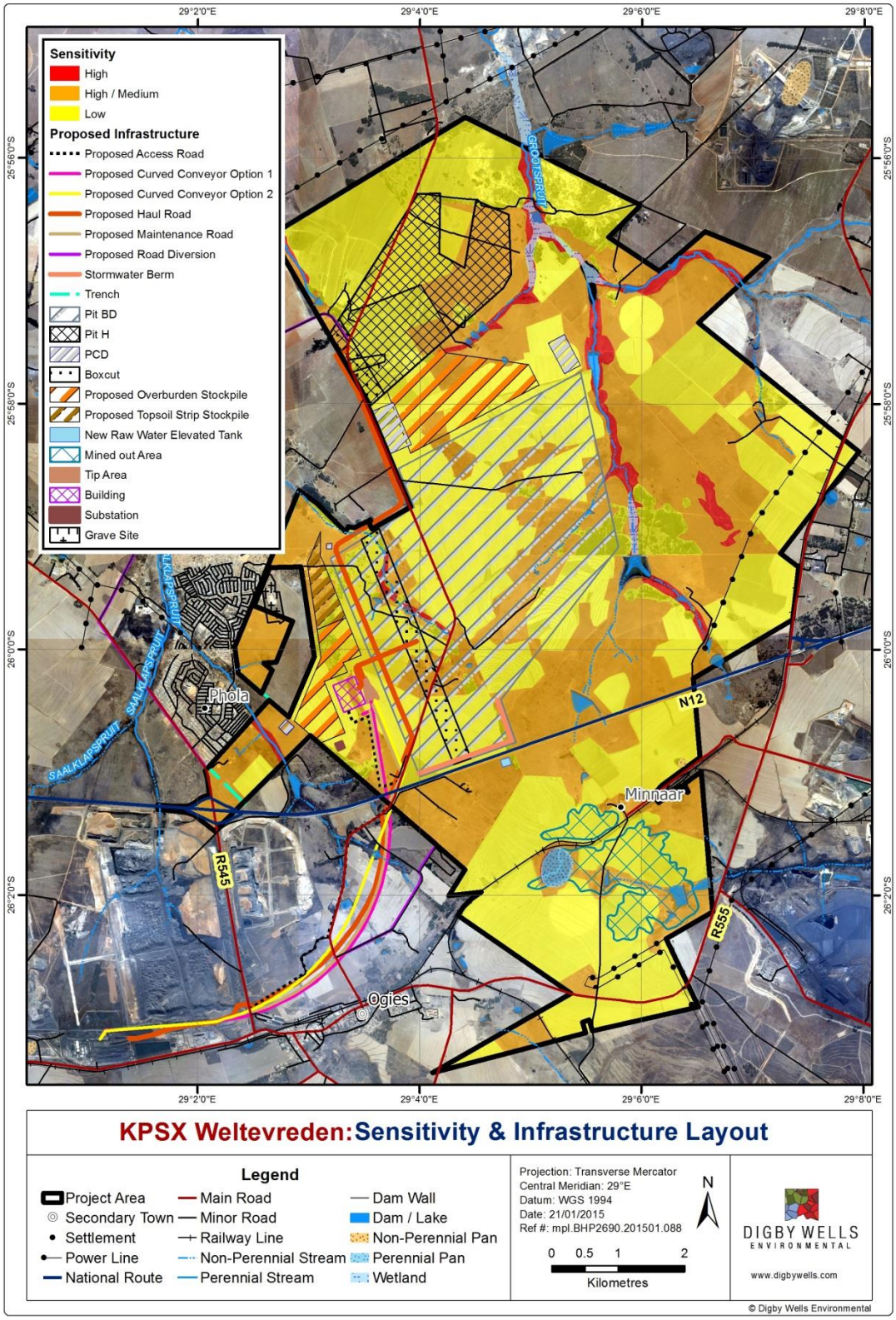


Figure 9-1: Sensitive areas of the Weltevreden Extension project

9.1 Avoid sensitive habitat (high sensitivity)

- Avoidance of the wetland and ridge areas and associated grasslands is strongly recommended. Any infrastructure placement must adhere to this. A monitoring plan must be adopted and adhered to strictly. The sensitive areas on the Weltevreden project area are the riparian areas, ridges with high sensitivity and grassland and secondary grassland as Medium high sensitivity. At this stage Pit BD and the Boxcut are planned to be on high sensitivity areas, specifically riparian/wetland areas. The buffers around these sensitive areas must also be adhered to which are 200m for ridge areas and 200m for wetland areas (please refer to the Wetland report).

9.2 Rescue and relocation of flora and fauna

9.2.1 Flora

- Flora SSC should be avoided in any development, such as roads or powerlines. If this is not possible, the rescue of as many specimens as possible should occur. These species should be relocated to a nursery area, if the applicable permits have been obtained. Confirmation that flora SSC does occur on the property necessitates that this mitigation measure be followed very carefully.
- Cattle should be excluded from these areas (or managed correctly within them) and the invasive and problem plant species controlled. Restoration should also occur to restore Grass owl habitat as well as naturally occurring species of special concern.

9.2.2 Fauna

- Faunal SSC are expected to be affected by the mining activities, the impacts on habitat will occur and the faunal species associated with the habitat types will be adversely affected. Confirmation that fauna SSC does occur on the property necessitates that this mitigation measure be followed very carefully as habitat types frequented by these species will be adversely affected.
- Of specific concern here is the Grass owl and the Serval, South African Hedgehog and Giant bullfrog, as the habitat of these animals coincides with grassland and riparian areas which will be impacted on by certain mining infrastructure.
- Fauna will be positively impacted should the recommended corridor areas be implemented.

9.2.3 Biodiversity and Land Management Plan (BLMP)

A biodiversity and land management plan is recommended for the Weltevreden project area in order to effectively manage existing biodiversity. It is recommended that a competent person be placed to manage and monitor the state of the surrounding wetlands and grassland. The competent person will be responsible for implementing and monitoring the ecosystem health as well as managing the rehabilitation operations, where needed.

Adaptive management will then be applied to correct these negative trends; alien invasive plant species management plan should be considered.

10 Monitoring Programme

The on-site effects that the opencast mine will have on the flora of the area, such as possible ecosystem destruction can be quantified with continuous monitoring of natural areas on the project site. Such a monitoring program must concentrate on the fauna and flora SSC management specifically the Grass owl, Serval, South African Hedgehog and Giant Bullfrog populations. The other SSC on the area of interest must also be monitored, however these species are transient in nature and can move away from the area. Alien invasive species management must take place in the study area, the large infestations mapped on the property and encountered within other vegetation types pose a threat to natural occurring species.

A monitoring program will include seasonal assessments to identify areas where management will have to be applied. An alien invasive management program must also be developed, that will be utilised to control the spread and then eradicate all alien invasive species. Furthermore the management of the red data species will have to take place. Follow up surveys of the identified alien invasive problem areas will have to be conducted in order to adapt management plans to suit specific areas. Seasonal monitoring of the effects of the study area on flora and fauna in the general area must be conducted, this can be accomplished through information sharing with local land owners and surveys conducted on the surrounding farms. The major management measure to be employed with regards to the Red data species will be the set aside biodiversity corridor areas.

A monitoring program needs to evaluate the management actions on each of these components. The method of monitoring is the Braun Blanquet method, which is a specialised method designed specifically for vegetation survey/monitoring purposes.

- Monitoring must take place annually;
- Monitoring must be completed by qualified specialists;
- Adaptive management must applied;
- Monitoring during the wet season is essential; and
- Findings must be compared to previous years.

11 Recommendations and Knowledge Gaps

During the field assessment the identified grassland was seen as having a positive impact on the biodiversity in the area. This was primarily because of the diversity of plant and to a lesser extent animal species that were encountered here. It is recommended that a management plan be implemented which will firstly monitor fauna and flora present in the area (specifically SSC), and secondly devise management measures to enhance the status of the habitat present (and indirectly positively affecting SSC). Any destruction of the natural areas such as Grassland, rocky outcrops and riparian habitat types should be avoided. Land users such as farmers must be managed in such a way that biodiversity is enhanced, this

can be accomplished through declaring sensitive habitats no go areas where grazing and planting of crops are prohibited.

Monitoring of fauna and flora will indicate the effectiveness of any management measures employed. With the presence of riparian habitat, which is present in the study area, affording amphibians the opportunity to colonise a portion of the area, further studies in this regard is suggested. To summarise:

- Biodiversity Land Management Plan;
- Fauna and flora monitoring plan;
- Fauna and flora SSC monitoring; and
- Alien invasive management plan.

The opportunity to maintain or increase the ecological functioning of this area exists, thereby indirectly supporting the population of animal species possibly reliant on this area for services. By preserving any remaining grassland, rocky outcrops and wetland habitat types and removing the threats, the ecological functioning of the areas will be positively affected thereby increasing the suite of ecological services offered to animals, making the area an attractive option for animals to re-colonise

12 Conclusion

The area of study was found to be under pressure from surrounding land use, most notably, agriculture including maize and cattle farming. Despite these threats, it was found that the habitat related to the project area provided an ecological service to the plant and animal species encountered (including SSC) during the field survey and possibly to the plant and animal species that were identified during the desktop survey.

The area is either transformed or degraded, but wetlands and associated grasslands from important process and habitat areas. Grasslands also support some SSC. These areas are of conservation importance and the opportunity exists for BHP to conserve some biodiversity corridors maintaining ecosystem functionality and potentially having an overall positive impact on biodiversity.

It is the opinion of the specialist that mining may go ahead with the following conditions:

- Any surface infrastructure, such as roads and fences, should be located to an area of low sensitivity, this is already the case, except for the riparian and grassland vegetation types that will still be affected;
- The project area including all the wetland systems and the associated grasslands should be set aside as a biodiversity corridor and managed as a conservation area throughout the life of mine and beyond;
- All mitigation measures prescribed in this document will be adhered to strictly;

- Cattle should be excluded from these areas and invasive and problem plants actively controlled. Restoration of these areas should also be undertaken.

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Appendix A: Birds

Scientific Name	Common Name	IUCN Status
Tachybaptus ruficollis	**Little Grebe**	**Least Concern**
Phalacrocorax lucidus	Whitebreasted Cormorant	Least Concern
Phalacrocorax africanus	**Reed Cormorant**	**Least Concern**
Anhinga rufa	Darter	Least Concern
Ardea cinerea	**Grey Heron**	**Least Concern**
Ardea melanocephala	**Blackheaded Heron**	**Least Concern**
Ardea goliath	Goliath Heron	Least Concern
Ardea purpurea	Purple Heron	Least Concern
Egretta alba	**Great White Egret**	**Least Concern**
Egretta garzetta	Little Egret	Least Concern
Egretta intermedia	Yellowbilled Egret	Least Concern
Egretta ardesiaca	Black Egret	Least Concern
Bubulcus ibis	**Cattle Egret**	**Least Concern**
Ardeola ralloides	Squacco Heron	Least Concern
Butorides striatus	Greenbacked Heron	Least Concern
Nycticorax nycticorax	Blackcrowned Night Heron	Least Concern
Ixobrychus minutus	Little Bittern	Least Concern
Scopus umbretta	Hamerkop	Least Concern
Ciconia ciconia	**White Stork**	**Least Concern**
Ciconia nigra	Black Stork	Near Threatened
Ciconia abdimii	Abdim's Stork	Least Concern
Mycteria ibis	Yellowbilled Stork	Least Concern
Threskiornis aethiopicus	**Sacred Ibis**	**Least Concern**
Plegadis falcinellus	**Glossy Ibis**	**Least Concern**
Bostrychia hagedash	**Hadeda Ibis**	**Least Concern**
Platalea alba	African Spoonbill	Least Concern
Phoenicopterus ruber	**Greater Flamingo**	**Near Threatened**
Phoenicopterus minor	Lesser Flamingo	Near Threatened
Dendrocygna viduata	Whitefaced Duck	Least Concern
Dendrocygna bicolor	Fulvous Duck	Least Concern
Thalassornis leuconotus	Whitebacked Duck	Least Concern

Scientific Name	Common Name	IUCN Status
Alopochen aegyptiacus	**Egyptian Goose**	**Least Concern**
Tadorna cana	South African Shelduck	Least Concern
Anas undulata	**Yellowbilled Duck**	**Least Concern**
Anas sparsa	African Black Duck	Least Concern
Anas capensis	Cape Teal	Least Concern
Anas hottentota	Hottentot Teal	Least Concern
Anas erythrorhyncha	Redbilled Teal	Least Concern
Anas smithii	Cape Shoveller	Least Concern
Netta erythrophthalma	Southern Pochard	Least Concern
Plectropterus gambensis	**Spurwinged Goose**	**Least Concern**
Sagittarius serpentarius	Secretarybird	Vulnerable
Milvus migrans	Black Kite	Least Concern
Milvus aegyptius	Yellowbilled Kite	Least Concern
Elanus caeruleus	**Blackshouldered Kite**	**Least Concern**
Pernis apivorus	Honey Buzzard	Least Concern
Buteo vulpinus	**Steppe Buzzard**	**Least Concern**
Accipiter minullus	Little Sparrowhawk	Least Concern
Accipiter melanoleucus	Black Sparrowhawk	Least Concern
Accipiter badius	Little Banded Goshawk	Least Concern
Accipiter ovampensis	Ovambo Sparrowhawk	Least Concern
Melierax gabar	Gabar Goshawk	Least Concern
Circus ranivorus	African Marsh Harrier	Vulnerable
Circus pygargus	Montagu's Harrier	Least Concern
Circus macrourus	Pallid Harrier	Near threatened
Polyboroides typus	Gymnogene	Least Concern
Falco amurensis	Eastern Redfooted Kestrel	Least Concern
Falco rupicolis	Rock Kestrel	Least Concern
Falco rupicoloides	Greater Kestrel	Least Concern
Falco naumanni	Lesser Kestrel	Vulnerable
Scleroptila levaillantoides	Orange-river Francolin	Least Concern
Scleroptila levaillantii	Redwing Francolin	Least Concern

Scientific Name	Common Name	IUCN Status
Pternistis swainsonii	**Swainson's Spurfowl**	**Least Concern**
Coturnix coturnix	Common Quail	Least Concern
Coturnix delegorguei	Harlequin Quail	Least Concern
Numida meleagris	**Helmeted Guineafowl**	**Least Concern**
Turnix sylvatica	Kurrichane Buttonquail	Least Concern
Grus carunculatus	Wattled Crane	Vulnerable
Anthropoides paradisea	Blue Crane	Vulnerable
Rallus caerulescens	African Rail	Least Concern
Crex crex	Corncrake	Least Concern
Amaurornis flavirostris	Black Crake	Least Concern
Porzana pusilla	Baillon's Crake	Least Concern
Sarothrura rufa	Redchested Flufftail	Least Concern
Porphyrio madagascariensis	Purple Gallinule	Least Concern
Gallinula chloropus	**Common Moorhen**	**Least Concern**
Fulica cristata	**Redknobbed Coot**	**Least Concern**
Podica senegalensis	African Finfoot	Least Concern
Neotis denhami	Stanley's Bustard	Least Concern
Eupodotis barrowii	Whitebellied Korhaan	Vulnerable
Eupodotis caerulescens	Blue Korhaan	Near threatened
Actophilornis africanus	African Jacana	Least Concern
Charadrius hiaticula	Ringed Plover	Least Concern
Charadrius pecuarius	Kittlitz's Plover	Least Concern
Charadrius tricollaris	**Threebanded Plover**	**Least Concern**
Charadrius asiaticus	Caspian Plover	Least Concern
Vanellus coronatus	**Crowned Lapwing**	**Least Concern**
Vanellus melanopterus	Blackwinged Plover	Least Concern
Vanellus armatus	**Blacksmith Lapwing**	**Least Concern**
Vanellus senegallus	Wattled Plover	Least Concern
Arenaria interpres	Ruddy Turnstone	Least Concern
Actitis hypoleucos	Common Sandpiper	Least Concern
Tringa ochropus	Green Sandpiper	Least Concern

Scientific Name	Common Name	IUCN Status
Tringa glareola	Wood Sandpiper	Least Concern
Tringa stagnatilis	Marsh Sandpiper	Least Concern
Tringa nebularia	Greenshank	Least Concern
Calidris ferruginea	Curlew Sandpiper	Least Concern
Calidris minuta	Little Stint	Least Concern
Philomachus pugnax	Ruff	Least Concern
Gallinago nigripennis	**African Snipe**	**Least Concern**
Recurvirostra avosetta	Pied Avocet	Least Concern
Himantopus himantopus	Blackwinged Stilt	Least Concern
Burhinus capensis	**Spotted Dikkop**	**Least Concern**
Burhinus vermiculatus	Water Dikkop	Least Concern
Chlidonias hybridus	**Whiskered Tern**	**Least Concern**
Chlidonias leucopterus	Whitewinged Tern	Least Concern
Columba livia	**Feral Pigeon**	**Least Concern**
Columba guinea	Rock Pigeon	Least Concern
Columba arquatrix	Olive Pigeon	Least Concern
Streptopelia semitorquata	**Redeyed Dove**	**Least Concern**
Streptopelia capicola	**Cape Turtle Dove**	**Least Concern**
Streptopelia senegalensis	**Laughing Dove**	**Least Concern**
Oena capensis	Namaqua Dove	Least Concern
Treron calva	African Green Pigeon	Least Concern
Corythaixoides concolor	Grey Go away Bird	Least Concern
Cuculus canorus	Eurasian Cuckoo	Least Concern
Cuculus gularis	African Cuckoo	Least Concern
Cuculus solitarius	**Redchested Cuckoo**	**Least Concern**
Clamator jacobinus	Jacobin Cuckoo	Least Concern
Chrysococcyx klaas	Klaas's Cuckoo	Least Concern
Chrysococcyx caprius	**Diederik Cuckoo**	**Least Concern**
Centropus burchellii	Burchell's Coucal	Least Concern
Tyto alba	Barn Owl	Least Concern
Tyto capensis	**Grass Owl**	**Near threatened**

Scientific Name	Common Name	IUCN Status
Asio capensis	Marsh Owl	Least Concern
Bubo africanus	**Spotted Eagle Owl**	**Least Concern**
Caprimulgus europaeus	Eurasian Nightjar	Least Concern
Caprimulgus pectoralis	Fierynecked Nightjar	Least Concern
Caprimulgus tristigma	Freckled Nightjar	Least Concern
Apus apus	Eurasian Swift	Least Concern
Apus barbatus	Black Swift	Least Concern
Apus caffer	Whiterumped Swift	Least Concern
Apus horus	Horus Swift	Least Concern
Apus affinis	**Little Swift**	**Least Concern**
Tachymarptis melba	Alpine Swift	Least Concern
Cypsiurus parvus	Palm Swift	Least Concern
Colius striatus	Speckled Mousebird	Least Concern
Urocolius indicus	Redfaced Mousebird	Least Concern
Ceryle rudis	Pied Kingfisher	Least Concern
Megaceryle maxima	Giant Kingfisher	Least Concern
Alcedo semitorquata	Halfcollared Kingfisher	Near threatened
Alcedo cristata	Malachite Kingfisher	Least Concern
Halcyon senegalensis	Woodland Kingfisher	Least Concern
Halcyon albiventris	Brownhooded Kingfisher	Least Concern
Merops apiaster	Eurasian Bee-eater	Least Concern
Merops bullockoides	Whitefronted Bee-eater	Least Concern
Merops pusillus	Little Bee-eater	Least Concern
Coracias garrulus	Eurasian Roller	Near threatened
Upupa africana	African Hoopoe	Least Concern
Phoeniculus purpureus	Redbilled Woodhoopoe	Least Concern
Lybius torquatus	Blackcollared Barbet	Least Concern
Tricholaema leucomelas	Pied Barbet	Least Concern
Pogoniulus chrysoconus	Yellowfronted Tinker Barbet	Least Concern
Trachyphonus vaillantii	Crested Barbet	Least Concern
Indicator indicator	Greater Honeyguide	Least Concern

Scientific Name	Common Name	IUCN Status
Indicator minor	Lesser Honeyguide	Least Concern
Prodotiscus regulus	Sharpbilled Honeyguide	Least Concern
Geocolaptes olivaceus	Ground Woodpecker	Least Concern
Campethera abingoni	Golden tailed Woodpecker	Least Concern
Dendropicos fuscescens	Cardinal Woodpecker	Least Concern
Jynx ruficollis	Redthroated Wryneck	Least Concern
Mirafra africana	**Rufousnaped Lark**	**Least Concern**
Mirafra fasciolata	Eastern Clapper Lark	Least Concern
Mirafra rufocinnamomea	Flappet Lark	Least Concern
Calendulauda sabota	Sabota Lark	Least Concern
Heteromirafra ruddi	Bothas Lark	Endangered
Certhilauda semitorquata	Eastern Longbilled Lark	Least Concern
Chersomanes albofasciata	Spikeheeled Lark	Least Concern
Calandrella cinerea	**Redcapped Lark**	**Least Concern**
Spizocorys conirostris	Pinkbilled Lark	Least Concern
Hirundo rustica	**Barn Swallow**	**Least Concern**
Hirundo albigularis	**Whitethroated Swallow**	**Least Concern**
Hirundo dimidiata	Pearlbreasted Swallow	Least Concern
Hirundo semirufa	Redbreasted Swallow	Least Concern
Hirundo cucullata	**Greater Striped Swallow**	**Least Concern**
Hirundo spilodera	South African Cliff Swallow	Least Concern
Hirundo fuligula	Rock Martin	Least Concern
Delichon urbica	House Martin	Least Concern
Pseudhirundo griseopyga	Greyrumped Swallow	Least Concern
Riparia riparia	Sand Martin	Least Concern
Riparia paludicola	**Brownthroated Martin**	**Least Concern**
Riparia cincta	**Banded Martin**	**Least Concern**
Campephaga flava	Black Cuckooshrike	Least Concern
Dicrurus adsimilis	Forktailed Drongo	Least Concern
Oriolus larvatus	Blackheaded Oriole	Least Concern
Corvus capensis	Black Crow	Least Concern

Scientific Name	Common Name	IUCN Status
Corvus albus	**Pied Crow**	**Least Concern**
Parus niger	Southern Black Tit	Least Concern
Pycnonotus tricolor	Blackeyed Bulbul	Least Concern
Turdus libonyanus	Kurrichane Thrush	Least Concern
Turdus olivaceus	Olive Thrush	Least Concern
Zoothera gurneyi	Orange Thrush	Least Concern
Psophocichla litsipsirupa	Groundscraper Thrush	Least Concern
Monticola rupestris	Cape Rockthrush	Least Concern
Monticola explorator	Sentinel Rockthrush	Least Concern
Oenanthe monticola	Mountain Chat	Least Concern
Oenanthe pileata	**Capped Wheatear**	**Least Concern**
Oenanthe bifasciata	Buffstreaked Chat	Least Concern
Cercomela familiaris	**Familiar Chat**	**Least Concern**
Thamnolaea cinnamomeiventris	Mocking Chat	Least Concern
Myrmecocichla formicivora	Anteating Chat	Least Concern
Saxicola torquata	**Stonechat**	**Least Concern**
Cossypha natalensis	Natal Robin	Least Concern
Cossypha caffra	Cape Robin	Least Concern
Parisoma subcaeruleum	Titbabbler	Least Concern
Hippolais icterina	Icterine Warbler	Least Concern
Acrocephalus arundinaceus	Great Reed Warbler	Least Concern
Acrocephalus baeticatus	African Marsh Warbler	Least Concern
Acrocephalus palustris	Eurasian Marsh Warbler	Least Concern
Acrocephalus schoenobaenus	Eurasian Sedge Warbler	Least Concern
Acrocephalus gracilirostris	Cape Reed Warbler	Least Concern
Chloropeta natalensis	Yellow Warbler	Least Concern
Bradypterus baboecala	African Sedge Warbler	Least Concern
Phylloscopus trochilus	Willow Warbler	Least Concern
Sylvietta rufescens	Longbilled Crombec	Least Concern
Sphenoeacus afer	Grassbird	Least Concern
Cisticola juncidis	**Zitting Cisticola**	**Least Concern**

Scientific Name	Common Name	IUCN Status
Cisticola aridulus	Desert Cisticola	Least Concern
Cisticola textrix	**Cloud Cisticola**	**Least Concern**
Cisticola ayresii	**Ayres' Cisticola**	**Least Concern**
Cisticola tinniens	**Levaillant's Cisticola**	**Least Concern**
Cisticola fulvicapillus	**Neddicky**	**Least Concern**
Prinia subflava	**Tawnyflanked Prinia**	**Least Concern**
Prinia flavicans	Blackchested Prinia	Least Concern
Prinia hypoxantha	Spotted Prinia	Least Concern
Muscicapa striata	Spotted Flycatcher	Least Concern
Muscicapa adusta	Dusky Flycatcher	Least Concern
Melaenornis pammelaina	Black Flycatcher	Least Concern
Sigelus silens	Fiscal Flycatcher	Least Concern
Terpsiphone viridis	Paradise Flycatcher	Least Concern
Motacilla capensis	**Cape Wagtail**	**Least Concern**
Anthus cinnamomeus	**African Pipit**	**Least Concern**
Anthus similis	Longbilled Pipit	Least Concern
Anthus leucophrys	Plainbacked Pipit	Least Concern
Anthus vaalensis	Buffy Pipit	Least Concern
Anthus lineiventris	Striped Pipit	Least Concern
Anthus chloris	Yellowbreasted Pipit	Least Concern
Macronyx capensis	**Cape Longclaw**	**Least Concern**
Lanius minor	Lesser Grey Shrike	Least Concern
Lanius collaris	Fiscal Shrike	Least Concern
Lanius collurio	Redbacked Shrike	Least Concern
Laniarius ferrugineus	Southern Boubou	Least Concern
Dryoscopus cubla	Puffback	Least Concern
Nilaus afer	Brubru	Least Concern
Telophorus zeylonus	Bokmakierie	Least Concern
Acridotheres tristis	**Indian Myna**	**Least Concern**
Spreo bicolor	**Pied Starling**	**Least Concern**
Creatophora cinerea	Wattled Starling	Least Concern

Scientific Name	Common Name	IUCN Status
Cinnyricinclus leucogaster	Plumcoloured Starling	Least Concern
Lamprotornis nitens	Glossy Starling	Least Concern
Onychognathus morio	Redwinged Starling	Least Concern
Buphagus erythrorhynchus	Redbilled Oxpecker	Least Concern
Cinnyris talatala	Whitebellied Sunbird	Least Concern
Chalcomitra amethystina	Black Sunbird	Least Concern
Zosterops virens	Cape White-eye	Least Concern
Plocepasser mahali	Whitebrowed Sparrowweaver	Least Concern
Passer domesticus	House Sparrow	Least Concern
Passer melanurus	Cape Sparrow	Least Concern
Passer diffusus	Southern Greyheaded Sparrow	Least Concern
Petronia superciliaris	Yellowthroated Sparrow	Least Concern
Amblyospiza albifrons	Thickbilled Weaver	Least Concern
Ploceus ocularis	Spectacled Weaver	Least Concern
Ploceus cucullatus	Spottedbacked Weaver	Least Concern
Ploceus capensis	Cape Weaver	Least Concern
Ploceus velatus	**Masked Weaver**	**Least Concern**
Ploceus xanthops	Golden Weaver	Least Concern
Anomalospiza imberbis	Cuckoofinch	Least Concern
Quelea quelea	**Redbilled Quelea**	**Least Concern**
Euplectes orix	**Red Bishop**	**Least Concern**
Euplectes afer	**Yellow-crowned Bishop**	**Least Concern**
Euplectes capensis	Yellowrumped Widow	Least Concern
Euplectes axillaris	Redshouldered Widow	Least Concern
Euplectes albonotatus	Whitewinged Widow	Least Concern
Euplectes ardens	Redcollared Widow	Least Concern
Euplectes progne	**Longtailed Widow**	**Least Concern**
Lagonosticta rubricata	Bluebilled Firefinch	Least Concern
Lagonosticta senegala	Redbilled Firefinch	Least Concern
Uraeginthus angolensis	Blue Waxbill	Least Concern
Estrilda astrild	**Common Waxbill**	**Least Concern**

Scientific Name	Common Name	IUCN Status
Estrilda melanotis	Swee Waxbill	Least Concern
Ortygospiza atricollis	Quail Finch	Least Concern
Amandava subflava	Orangebreasted Waxbill	Least Concern
Amadina fasciata	Cutthroat Finch	Least Concern
Amadina erythrocephala	Redheaded Finch	Least Concern
Lonchura cucullata	Bronze Mannikin	Least Concern
Vidua macroura	**Pintailed Whydah**	**Least Concern**
Vidua paradisaea	Paradise Whydah	Least Concern
Vidua funerea	Black Indigobird	Least Concern
Vidua chalybeata	Village Indigobird	Least Concern
Serinus mozambicus	**Yelloweyed Canary**	**Least Concern**
Serinus atrogularis	**Blackthroated Canary**	**Least Concern**
Serinus canicollis	Cape Canary	Least Concern
Serinus sulphuratus	Bully Canary	Least Concern
Serinus gularis	Streakyheaded Canary	Least Concern
Emberiza flaviventris	Goldenbreasted Bunting	Least Concern
Emberiza capensis	Cape Bunting	Least Concern
Emberiza tahapisi	Rock Bunting	Least Concern

Appendix B: Plant List

Scientific Name	Common Name	Ecological Status	Form
Acacia mearnsii	Black Wattle	Alien invasive	Tree
Agave sisalana	Sisal	Alien invasive	Succulent
Agrostis lachnantha	Bent grass	Increaser 2 - Pioneer	Grass
Albuca setosa	Small white albuca		Herb/Bulb
Alloteropsis semialata	Black-seed grass	Increaser 1 - Climax	Shrub
Aloe greatheadii var davyana		LC	Aloe
Ammocaris coranica		LC	Herb
Argemone ochroleuca	White flowered mexican poppy	Weed	Herb
Aristida congesta barbicolis	Spreading three awn	Pioneer Increase 2	Grass
Asclepias fruticosa	Shrubby milkweed	Weed	Shrub
Asparagus aethiopicus			Herb
Becium obovatum	Cat's Whiskers	Medicinal	Herb
Bidens pilosa	Common Blackjack	Alien invasive	Herb
Brachiaria serrata	Velvet Signal Grass	Decreaser - Climax	Grass
Bromus catharticus	Rescue grass	Weed	Grass
Campuloclinium macrocephalum	Pompom weed	Weed	Herb
Cheilanthes viridis			Fern/Herb
Chironia purpurascens	Chironia		Herb
Cirsium vulgare	Scottish thistle	Alien invasive	Herb
Cleome maculata			Herb
Commelina africana	Yellow Commelina	Medicinal	Herb
Conyza albida	Tall fleabane	Weed	Herb
Crassula capitella			Herb
Crassula obovata	Stonecrop		Herb
Cynodon dactylon	Couch Grass	Increaser 2 - Pioneer	Grass
Cyperus compressus			Sedge
Cyperus esculentus	Yellow Nut Sedge	Medicinal/Edible/Alien Invasive	Sedge
Cyperus obtusiflorus	White-flowered sedge		Sedge
Cyperus rupestris	Russet Rocket sedge		Sedge
Cyrtanthus breviflorus	Yellow Fire Lily		Bulb/Herb
Datura stramomium	Common thorn apple	Alien invasive	Herb
Dianthus basuticus			Herb
Digitaria diagonalis	Brown-seed finger grass	Climax Increaser 1	Grass
Digitaria eriantha	Common Finger Grass	Decreaser - Climax	Grass
Diospyros lycioides	Bluebush		Tree
Echinochloa colona	Jungle Rice	Pioneer Increaser 2	Grass
Eragrostis chloromelas	(Narrow) Curly Leaf	Increaser 2 - Subclimax to climax	Grass
Eragrostis curvula	Weeping Love Grass	Increaser 2 - Subclimax to climax	Grass
Eragrostis gummiflua	Gum Grass	Increaser 2 - Subclimax	Grass
Eragrostis nindensis	Whether love grass	Increaser 2 - Subclimax	Grass
Eragrostis plana	Tough love grass	Increaser 2 - Subclimax	Grass
Eragrostis pseudosclerantha	Footpath Love grass	Pioneer increaser 2	Grass
Eragrostis trichophora	Hairy Love Grass	Increaser 2 - Subclimax	Grass
Eucalyptus camuldensis	Red River Gum	Alien invasive	Tree

Eulophia ovalis	Eulophia		Herb
Euphorbia striata	Milkweed/Spurge	Medicinal	Herb
Frithia humulis		**EN, SA National red list**	Herb
Gomphocarpus physocarpus	Milkweed		Shrub
Harpochloa falx	Caterpillar Grass	Increaser 1 - Climax	Grass
Helichrysum aureonitens	Golden everlasting	Medicinal	Herb
Helichrysum caespititium			Herb
Helichrysum inornatum			Herb
Homeria pallida	Yellow Tulip		Bulb/Herb
Hyparrhenia hirta	Common Thatching Grass	Increaser 1 - Subclimax to climax	Grass
Hypoxis iridifolia			Herb
Imperata cylindrica	Cotton Wool Grass	Increaser 1	Grass
Indigofera comosa			Shrub
Ipomoa crassipes	Leafy flowered Ipomoa	Medicinal	Herb
Kohautia amatymbica	Tremble tops	Medicinal	Herb
Kyllinga alba	White Button Sedge		Herb
Ledebouria cooperi	Cooper's Squill	Medicinal	Bulb/Herb
Ledebouria ovatifolia		Medicinal	Bulb/Herb
Ledebouria revulata	Common squill		Bulb/Herb
Leersia hexandra	Wild Rice Grass		Grass
Lobelia erinus			Herb
Lotononis foliosa	Bookleaved Lotononis		Herb
Melinis repens	Natal Red Top	Increaser 2 - Pioneer to subclimax	Grass
Microchloa caffra	Pincushion grass	Increaser 2 - Pioneer	Grass
Monopsis decipiens	Butterfly Lobelia	Medicinal	Herb
Nemesia fruticans	Mauve Nemesia		Herb
Oenothera rosea	Rose evening primrose	Weed	Herb
Panicum natalense	Natal Panicum	Decreaser - Climax	Grass
Paspalum urvillei	Vasey Grass	Exotic	Grass
Pelargonium luridum	Stalk-flowered Pelargonium	Medicinal	Herb
Perotis patens	Cat's Tail	Increaser 2 - Pioneer to subclimax	Grass
Persicaria lapathifolia	Spotted Knotweed	Alien Invasive	Herb
Populus x canescens	Grey Poplar	Alien Invasive	Tree
Pycreus macranthus			Sedge
Salix babylonica	Weeping Willow	Exotic**	Tree
Schizachyrium sanguineum	Red Autumn Grass	Increaser 1 - Climax	Grass
Schkuhria pinnata	Dwarf marigold	Weed	Shrub
Senecio inornatus		Medicinal	Herb
Seriphium plumosum	Bankrupt Bush	Weed	Shrub
Setaria sphacelata var. sphacelata	Bristle Grass	Decreaser - Climax	Grass
Solanum mauritianum	Bugweed	Alien Invasive*	Shrub
Solanum sisymbrifolium	Wild Tomato	Alien Invasive*	Shrublet
Sporobolus africanus	Ratstail dropseed	Subclimax increaser 3	Grass
Sporobolus fimbriatus	Dropseed grass	Climax decreaser	Grass
Tagetes minuta	Tall Khaki Weed	Alien Invasive	Herb

Taraxacum officinale	Dandelion	Alien invasive	Herb
Themeda triandra	Red Grass	Decreaser - Climax	Grass
Trichoneura grandiglumis	Small Rolling Grass	Increaser 2 - Subclimax	Grass
Tristachya leucothrix	Hairy Trident Grass	Increaser 1 - Climax	Grass
Typha capensis	Bulrush	Medicinal	Reed
Verbena bonariensis	Tall Verbena	Alien invasive	Shrub
Vernonia oligocephala	Bicoloured-leaved Vernonia	Medicinal	Herb
Wahlenbergia grandiflora	Giant Bell flower		Herb

Appendix C: Curriculum Vitae

Mr. Rudolph Greffrath

Senior Fauna and Flora Specialist

Biophysical Department

Digby Wells Environmental

Education

- 2005: B-tech Degree in Nature Conservation, Nelson Mandela Metropolitan University (NMMU).
- 2001- 2004: National Diploma in Nature Conservation, Nelson Mandela Metropolitan University (NMMU).

Professional Registration

- South African Council for Natural Scientific Professions (Membership No. 200245/13);
- IAIA, International Association for Impact assessments;
- Botanical Society of South Africa;
- The Land Rehabilitation Society of Southern Africa, LARSA (Membership No. 0085);
- Grassland Society of Southern Africa.

Employment

- 2006 – Present: Digby Wells Environmental, Johannesburg, South Africa.
- 2002 - 2003: Shamwari Game Reserve, Eastern Cape, South Africa.
- 2001: Kop-Kop Geotechnical instrumentation specialists, Johannesburg, South Africa.

Experience

Rudi's current role is that of a fauna and flora specialist, in this capacity he is responsible for planning and conducting fauna and flora surveys/studies that are either completed in support of environmental authorisations or are focused specialist studies which meet local and international standards. In addition to this, Rudi is responsible for compiling Biodiversity Land Management Programs where different specialist studies are collated into a working document for clients in order to aid in pre or post mining management. He is also involved in rehabilitation studies which entail the planning, implementation and monitoring of vegetative rehabilitation in designated areas on mines. Rudi also fulfils the role of project manager for selected projects; here he manages national and international projects across Africa, specifically west, central and southern Africa, managing a multi-disciplinary team of specialists.

Rudi is also involved in the acquisition of permits for mines, this includes the planning of relocation strategies for protected and endangered plant species in areas where mines are to be established. This involves the planning and execution of data gathering surveys,

thereafter he manages the process involving relevant provincial and National authorities in order to obtain the specific permit that allows for a development to continue.

Information pertaining to the technical expertise of Rudi includes the following:

- 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 gold tailings reclamation and iron ore mining projects;
- Biodiversity Assessments including Mammalia, Avifauna, Herpetofauna and Arthropoda;
- Impact assessments based on the terrestrial environment;
- Biodiversity and Land Management Programs;
- Protected plant species management strategies planning and implementation;
- Monitoring of rehabilitation success through vegetation establishment;
- Rehabilitation planning;
- Environmental auditing of rehabilitated areas;
- Project management of ecological specialist studies;
- Planning and design of Rehabilitation off-set strategies.

Training

- Measurements of Biodiversity at the University of the Free State, led by Prof. M. T. Seaman. September 2008.
- Bird Identification course led by Ettiene Maraise November 2009.
- Introduction to VEGRAI and Eco-classification led by Dr. James Mackenzie December 2009.
- Dangerous snake handling and snake bite treatment with Mike Perry 2011.
- Rehabilitation of Mine impacted areas, with Fritz van Oudshoorn, Dr Wayne Truter and Gustav le Roux 2011.
- First aid Level 2, School of Emergency and Critical care, Netcare, 2013.

Projects

The following project list is indicative of Rudi's experience, providing insight into the various projects, roles and locations he has worked in.

Project	Location	Client	Main project features	Positions held	Activities performed
Mmamabula Energy Project (MEP).	Botswana	CIC energy	Construction of a railway, opencast	Senior Ecologist	Fauna and Flora surveys for the

			mine, wellfield, conveyors, addits, housing.		project features, including impact assessments, management plans. Alien eradication plans.
Tongan Biodiversity Land Management Plan	Ivory Coast	Randgold	Design, compilation and implementation of the BLMP	Ecologist, Project Manager	Fauna and Flora surveys for the BLMP, compilation of BLMP. Alien eradication plans.
Kibali Gold mine	DRC Congo	Randgold	Gold mine infrastructure	Senior Ecologist	Fauna and Flora surveys for the project features, including impact assessments, management plans.
Nzoro Hydroelectric station	DRC Congo	Randgold	Hydroelectric plant	Senior Ecologist	Fauna and Flora surveys for the project features, including impact assessments, management plans.
Loulo Biodiversity Land Management Plan	Mali	Randgold	Design, compilation and implementation of the BLMP	Ecologist, Project Manager	Fauna and Flora surveys for the project features, compilation of BLMP.
Koidu Diamond Mine	Sierra Leone	Koidu Resources	Construction of new open pit	Senior Ecologist	Fauna and Flora surveys for the project features, including impact assessments, management plans. Alien eradication plan.
Resource Generation	South Africa	Temo Coal	Coal mine/Railway Line	Senior Ecologist	Fauna and Flora surveys, Protected plant species management plans, Permitting and Rehabilitation design.

Impunzi Rehabilitation monitoring	South Africa	Glencore	Monitoring of rehabilitation success and suggested management measures	Flora specialist, Project manager	Vegetation surveys, rehabilitation monitoring. Alien eradication plan.

Publications

Biodiversity Action Plans for faunal habitat maintenance and expansion in mining. Poster presented at the 48th Annual Grassland Society of Southern Africa (GSSA) conference.