

# Terrestrial Ecology Specialist Report

## Volume 4, Annex E

Lesotho Highlands Development Authority

Contract LHDA No.: 6004

Document Date: 22 September 2017

Contract Name: Professional Services for the  
Environmental & Social Impact Assessment  
(ESIA) for the Polihali Western Access Corridor

Document Ref: P2W-6004-DFR-0004

**ECOREX**  
CONSULTING ECOLOGISTS





## Revision History

Version	Issue Date	Description of Changes
00	28 May 2017	First Draft for Client Review
01	7 July 2017	Second Draft for Client Review
02	22 September 2017	Final Report





# Abbreviations and Acronyms

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AoI	Area of Influence
AWD	Aircraft or Arianation Warning Devices
BFD	Bird Flight Diverters
BMP	Biodiversity Monitoring Plan
BPST	Bulk Power Supply and Telecommunications
CBD	Convention on Biological Diversity
CES	Coastal and Environmental Services
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CR	Critically Endangered
DAC	Drakensberg Alpine Centre (of endemism)
DNA	Deoxyribose Nucleic Acid
e.g.	for example
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EN	Endangered (relates to species on the IUCN Red Data Species List)
ERM	Environmental Resources Management Southern Africa (Pty) Ltd
ESIA	Environmental and Social Impact Assessment
ESIS	Environmental and Social Impact Statement
FSL	Full Supply Level
GIS	Geographic Information System
GPS	Geographic Positioning System
ha	hectar
ICM	Integrated Catchment Management
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
kp	Kilometre point
kV	kilovolts
KZN	KwaZulu-Natal
LC	Least Concern
LHDA	Lesotho Highlands Development Authority
LHWP	Lesotho Highlands Water Project
LVA	Loxton, Venn and Associates
m	meter
masl	Metres above sea level
MDTP	Maloti Drakensberg Transfrontier Project
MDTCA	Maloti Drakensberg Transfrontier Conservation Area
NDVI	Normalised Difference Vegetation Index
NT	Near Threatened (relates to species on the IUCN Red Data Species List)
PRAI	Polihali Reservoir and Associated Infrastructure
PS	Performance Standard
PWAC	Polihalo Western Access Corridor
PWAR	Polihali Western Access Road
RAP	Resettlement Action Plan
RD	Roads Directorate
RMA	Range Management Area
SABONET	Southern African Biodiversity Network
SCP	Systematic Conservation Planning
UNCCD	United Nations Convention to Combat Desertification
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USAID	United States Agency for International Development
VU	Vulnerable (relates to species on the IUCN Red Data Species List)
WCS	Wetland Consulting Services
WHS	World Heritage Site



# Glossary of Technical Terms

Technical Term	Definition
Biodiversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.
Biodiversity Offset	Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from development plans or projects after appropriate prevention and mitigation measures have been taken.
Critical Habitat	Areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered (CR) and/or Endangered (EN) species; (ii) habitat of significant importance to endemic and / or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and / or unique ecosystems; and/or (v) areas associated with key evolutionary processes (see IFC PS6, Paragraph 16).
Critically Endangered	A taxon is Critically Endangered (CR) when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by IUCN criteria ( <a href="http://www.iucnredlist.org">www.iucnredlist.org</a> )
Ecoregion	An ecoregion is defined as a "relatively large unit of land or water containing a characteristic set of natural communities that share a large majority of their species, dynamics, and environmental conditions".
Ecosystem Services	Defined as the benefits that people obtain from nature. These are typically divided into four categories. <ul style="list-style-type: none"><li>• Provisioning services are the goods or products obtained from ecosystems, such as food, timber, medicines, fibre, and freshwater.</li><li>• Regulating services are the benefits obtained from an ecosystem's control of natural processes, such as climate, disease, erosion, water flows, and pollination, as well as protection from natural hazards.</li><li>• Cultural services are the nonmaterial benefits obtained from ecosystems, such as recreation, spiritual values, and aesthetic enjoyment.</li><li>• Supporting services are the natural processes that maintain the other ecosystem services, such as nutrient cycling and primary production.</li></ul>
Endangered	A taxon is Endangered (EN) when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by the IUCN criteria ( <a href="http://www.iucnredlist.org">www.iucnredlist.org</a> ) or provisionally assessed by an expert group.
Endemic	A species that has $\geq 95$ % of its global range inside the country or region of analysis (IFC PS6 GN79).
Fossorial	Animal that digs burrows.
Habitat	The environmental or ecological area in which an animal, plant species or other organism lives.
Invasive Aliens	Species are identified as invasive aliens when (i) they are non-native to an ecosystem, and (ii) their introduction is liable to cause environmental harm, or harm to human health and livelihoods, because they spread rapidly and have negative effects on native species through competition, predation, or disease. Invasive species can be flora, fauna, or other organisms (e.g. microbes) but generally refer to plants.
IUCN Red List	This list has been developed by the International Union for Conservation of Nature (IUCN) and details the global conservation status of a wide range of biological species. The Red List website is <a href="http://www.redlist.org">http://www.redlist.org</a> .

<b>Technical Term</b>	<b>Definition</b>
Project Area	The Area of Influence defined as the corridor along the PWAR and powerline within which the majority of project impacts are predicted to occur.
Modified Habitat	An area that may contain a large proportion of plant and/or animal species of non-native origin, and / or where human activity has substantially modified the primary ecological functions and species composition.
Natural Habitat	An area composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary functions and species composition.
Restricted Range	Restricted range species include those with ranges in the following criteria: endemic to a site or found globally at fewer than 10 sites; animal species having a distribution range less than 50 000 km <sup>2</sup> ; or bird species with a global breeding range less than 50 000 km <sup>2</sup> (IFC PS6)
Vulnerable	A taxon is Vulnerable (VU) when it is not Critically Endangered (CR) or Endangered (EN) but is facing a high risk of extinction in the wild in the medium-term future, as defined by the IUCN criteria ( <a href="http://www.iucnredlist.org">www.iucnredlist.org</a> ).

# Acknowledgements

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The following people are gratefully acknowledged for their roles in the project:

- Samuel Zwakala of the Mokhotlong Maloti Drakensberg Transfrontier Project (MDTP) office for assisting with field surveys;
- The Environmental Resources Management (ERM) team for arranging logistics;
- Grant Benn for preparing field mapping and report maps;
- Jessica Hughes for her review and inputs into this report; and
- George Sekonya for support with reporting.

The combination of Warren McClelland and Khotso Kobisi working together in the field was a successful partnership which enabled a mutually beneficial sharing of knowledge. Khotso contributed valuable plant identification skills and was able to bring local insight and understanding on the use of plants, while Warren shared his identification skills of flora and fauna, including reptiles.



# Non-Technical Summary

## Scope and Methods

This study covered the vegetation and flora, mammals and herpetofauna of the Polihali Western Access Corridor (PWAC) between Katse Reservoir and the proposed Polihali Reservoir. The approach taken was to undertake a detailed review of the existing relevant reports and databases and follow this up with a field survey targeting key areas or particular information gaps that had been identified. Fieldwork comprised vehicle- and foot-based surveys of all major vegetation communities and faunal habitats within a corridor of ~200 m along the eastern half of the route in late January/early February 2017 and along the western half of the PWAC in mid-April 2017. Information on natural resource usage by communities along the route was obtained through informal, *ad hoc* conversations with people seen using natural resources, as well as meetings with key community members knowledgeable on natural resource use along the PWAC. Data from previous reporting in the Project Area, from the Polihali Reservoir area and the current study were integrated to produce an assessment of the baseline status of the Project Area in the context of prevailing conditions and land use. The significance of potential direct and indirect impacts on flora, mammals and herpetofauna was assessed for construction and operation of the Polihali Western Access Road (PWAR) and Powerline.

## Route Selection

A route selection study was undertaken as an initial task of the study during which four route options between Katse and Polihali for the PWAC were compared on ecological, social, and technical and cost criteria in order to rank the options and recommend a preferred alternative. Terrestrial ecology criteria used to compare the route options were: i) the distance of road route traversing mountainous areas over 2800 m altitude as these high lying areas of Lesotho are important for localised endemic plants and herpetofauna in particular but also more important for remaining medium to large mammals; and ii) proximity of the proposed road to rivers and wetlands (i.e. mainly important for amphibians). Overall, the routes with the longest distance traversed at high altitude were the least preferred for ecological reasons. Route B was selected as the preferred corridor for the road and powerline as it offered the best compromise for reducing ecological risks and optimising social benefits, balanced with cost.

This terrestrial ecology baseline and impact assessment is therefore based on Route B as the selected PWAC along which the PWAR and powerline route is broadly aligned, although the powerline deviates in two stretches of the route for approximately 6.7 km in the east and 8 km in the west.

## Baseline Assessment – Key Findings

### ***Vegetation Communities***

Two broad vegetation associations were identified along the Polihali Western Access Corridor (PWAC), based on distinctive physiognomy and floristic composition:

- **Montane Grassland**  
This is the dominant vegetation association across the length of the PWAC and includes the important Rocky Ridges and Outcrops habitat and Seep Wetlands. Higher plateaus and ridges are dominated by grass species such as *Themeda triandra*, *Festuca caprina*, *F. scabra*, *Poa*

*binata*, *Merxmuellera disticha* and *Koeleria capensis*, and mountain slopes at lower altitudes being dominated by *Aristida* species, *Cymbopogon dieterlenii* and *Eragrostis* species.

- **Montane Shrubland**

This shrubland is associated with the highest mountain peaks and upper slopes and is more prominent along the alternative route Option C at altitudes of over 2800 metres above sea level (masl) than on the PWAR where it is only confined to short stretches at the high lying areas on the eastern and western sides of the Semenanyane valley. This community also includes the heavily grazed mountain slopes at the eastern end of the PWAR that have been invaded by woody shrubs as a result of overgrazing.

MDTP (2007) classified the lower-lying western and eastern thirds of the PWAR as “*Cymbopogon* spp. communities” and “Lower Foothills Lower Slope Grassland”, which was corroborated by field data. The higher slopes above the *Cymbopogon* communities are mapped as “*Themeda triandra* communities”, particularly between Ha Mei and Makhoaba Junction. While *Themeda triandra* is certainly present on these higher slopes and crests, the heavily grazed state of much of the grassland made it impossible to determine whether it is still a dominant species or not. The subalpine section of the PWAC between Makhoaba Junction and Ha Semphi is mapped as a mosaic of four vegetation types, namely “*Festuca caprina* dominated communities”, “*Merxmuellera macowanii* communities”, “Lesotho Highland Basalt Grassland” and “uKhahlamba Basalt Grassland”. *Festuca caprina* is a dominant and diagnostic species of the highest altitudes along the PWAC, as well as several *Merxmuellera* species, which supports the MDTP vegetation map, although the boundaries and extent of these communities were not clear in the field. uKhahlamba Basalt Grassland is confined to the basalt cliff zone along the Lesotho / KwaZulu-Natal border and is unlikely to be present in the Project Area. These areas should be merged with the Lesotho Highland Basalt Grassland vegetation type.

### ***Plant Species of Conservation Importance***

- Seven of the species recorded along the PWAC during this study are considered species of conservation concern. The most threatened of these species is *Boophone disticha*, which is classified as Endangered because of a high demand within the traditional medicine industry resulting in declining populations. However, this species is still relatively widespread in the country (*pers. obs.*) and does not meet the IUCN criteria for EN. Four species occurring along the PWAC have been classified as Vulnerable in Lesotho, two of which are endemic to Lesotho (*Aloe polyphylla*, *Jamesbrittenia lesutica*), and two which are widespread species in grasslands throughout Lesotho and South Africa (*Eucomis autumnalis*, *Dicoma anomala*). Two Near Threatened species, *Aristaloe aristata* and *Cotula paludosa*, were confirmed to occur just outside of the PWAC during fieldwork but are also potentially present on the route.
- The only individuals of *Aloe polyphylla* that were located along the PWAC were planted in villages such as Ha Salemon and Makhoaba. However, discussions with residents near Kosheteng revealed that wild plants are still present at the highest altitudes in the mountain tops above the Kosheteng sheep stud. These wild plants are unlikely to be directly impacted by the road construction but may be indirectly impacted through improved access to aloe sites for collectors and possibly through resettlement of villages.
- About 27% of the 254 plant species recorded along the PWAC during fieldwork are either strictly endemic (18 species) or near-endemic (52 species) to the Drakensberg Alpine Centre.



### **Important Plant Resources**

- The communities living along the PWAC are heavily dependent on plant resources, either as a source of grazing or browsing for their livestock, or directly for firewood or medicinal purposes. This is particularly relevant at the lower altitudes on either side of the route where population density is higher, but as resources dwindle the importance of plant resources in the higher-lying central part of the route will increase. Conversations with community members and direct observations of plant utilisation during fieldwork for this study and CES (2014a) provided a list of 102 plant species that occur within the general vicinity of the PWAC and are considered to be important resources for local communities. While CES (2014a) focused on an area on the eastern end of the PWAC, the information collected is relevant since most of the species listed in CES (2014a) are present within the PWAC. Interviews conducted in a social study (LHDA Contract 6001) to the east of the PWAC confirmed that the majority of resources harvested (56%) are used to supplement the communities' food supply; 30% of the wild plants collected are used for medicinal purposes, and 12% were used for other purposes such as fuel, construction and spiritual use. Similar usage patterns are likely to be present along the PWAC.

### **Mammals**

- Integration of data from CES (2014b), LVA (1993) and Du Plessis *et al.* (2014) produced a list of 25 mammal species confirmed to occur in the general vicinity of the Project Area, of which eight were recorded during this study along the PWAR.
- One Near Threatened mammal was confirmed to occur along the PWAR (African Clawless Otter) and another Near Threatened species was recorded in the high mountains along the transmission line route to the north (Grey Rhebok).
- Sloggett's Rat was the only mammal species recorded during fieldwork that is strictly endemic to the Drakensberg Mountains; individuals were seen at high altitude in the vicinity of the Mokhoaba River and junction; the distinctive subsoil runs of Sclater's Golden Mole, a Drakensberg near-endemic, were located at numerous sites at altitudes above 2600 masl.
- Very few fauna species are specifically protected under Lesotho legislation; two protected species were confirmed to occur within the Project Area (African Clawless Otter and Water Mongoose), and two species were confirmed to occur in the high mountains of the PWAC (Grey Rhebok).

### **Herpetofauna**

- Integration of data from CES (2014b), LVA (1993) and Harvey (2014) produced a list of 12 reptile species and nine amphibian species confirmed to occur in general vicinity of the Project Area, of which five reptiles and four amphibians were confirmed to occur along the PWAR.
- No Threatened or Near Threatened reptile or amphibian species were recorded during this survey and none are likely to occur within the PWAC.
- One frog species that is strictly endemic to the Drakensberg Mountains was confirmed to occur in the Project Area, namely Maluti River Frog, while no endemic reptiles were recorded.
- The only herpetofauna protected in Lesotho are monitor lizards (*Varanus* species) and chelonians (tortoises and terrapins), none of which have been recorded within the Project Area.

### **Current Ecological Status and Threats to Flora, Mammals and Herpetofauna**

- Much of the Project Area is under intense grazing and browsing pressure from livestock and most areas of arable land have been cultivated. Severe overgrazing on shallow soils of steep slopes in the eastern part of the PWAC, near the Senqu River valley has exposed soil to rain and wind, resulting in serious soil erosion in some areas. The intense grazing and browsing pressure has also resulted in reduced species richness and a change in floristic composition of grassland habitat, with increaser grass species dominating over climax grasses.
- Most indigenous mammals are considered to be under threat in Lesotho, particularly as a result of habitat degradation through uncontrolled burning and overgrazing of grassland and wetland habitat, but also through hunting by livestock herders and their dogs. Most of the habitat along the PWAR has been seriously impacted by overgrazing and grass cover is sparse in many areas. Herders and their dogs were frequently encountered during fieldwork, suggesting that the few mammal species that are present are under immense hunting pressure as well.
- The greatest threat to herpetofauna in the Project Area is likely to be habitat loss or degradation, particularly degradation of grassland, riparian and wetland habitats through severe overgrazing.

### **Key Potential Impacts**

Key potential impacts of the Polihali Western Access Corridor on flora, mammals and herpetofauna were identified and assessed, and are summarised below.

#### **Construction Phase**

- Clearance of ~190 ha of grassland and shrubland habitat for road and powerline construction, affecting known locations of four threatened species: *Boophone disticha*, *Jamesbrittenia lesutica*, *Eucomis autumnalis* and *Dicoma anomala*. The most important location of *E. autumnalis* and *B. disticha* was located between kp 7-9.
- Potential loss of spiral aloes planted in villages alongside the existing gravel road which may be affected by road widening or realignment. A number of mature spiral aloes were seen in several villages along the existing road (and which should be censused and relocated before construction).
- Loss of medicinal and other useful plants used by communities that occur within the road reserve, notably the same site with important threatened species between kp 7-9, as well as another site important for thatching / weaving grass near Ha Thene (kp 16), and a community botanical garden at Ha Semphi (kp 12).
- Site clearance and blasting will have localised impacts on fauna, particularly snakes, lizards and small burrowing animals that live in rock crevices that will suffer mortality during construction. However, all the species recorded and likely to occur along the PWAC are believed common and widely distributed.

#### **Operation Phase**

- Spread of alien invasive plant species that are introduced during construction activities is predicted to encroach along the road and into adjacent habitats where they may outcompete indigenous vegetation, decrease faunal habitat quality and reduce grazing availability.

- The new paved road and increased traffic will facilitate the increased harvesting and sale of wild spiral aloes to road users. Several spiral aloes and other aloes were seen cultivated in villages along the route and wild coloies are reported to occur in the higher mountains along the PWAC.
- Similarly, the new road will also increase pressure on other useful natural resources and may encourage outsiders to come to the area to collect or purchase medicinal or other plants, which may result in a decline in availability for local residents.

### Summary Impact Tables

#### Construction Phase

Impact of Site Clearance and Cut and Fill for Road and Powerline Construction on Vegetation and Flora				
Project Phase:	Construction Phase			
	Grassland and Rocky Habitats in Modified Habitats (Table 4.10 and Table 4.11) (Mostly low lying areas <2700 m)		Grassland and Rocky Habitats in Near-natural Habitats (Table 4.10 and Table 4.11) (Mostly subalpine zone >2700 m)	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct		Direct	
Magnitude	Medium	Small	Medium	Small
Sensitivity	Low	Low	Medium	Medium
Significance	Minor	Negligible	Moderate	Minor

Impact of Road Construction on Planted Spiral Aloe Populations		
Project Phase:	Construction Phase	
	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct	
Magnitude	Medium	Negligible
Sensitivity	High	High
Significance	Major	Negligible

Impact of Site Clearance for Construction of Road and Transmission Lines on Useful Natural Plant Resources in Infrastructure Footprint				
Project Phase:	Construction Phase			
	Grassland and Rocky Habitats in Modified Habitats (Table 4.10 and Table 4.11) (Mostly low lying areas <2700 m)		Grassland and Rocky Habitats in Near-natural Habitats (Table 4.10 and Table 4.11) (Mostly subalpine zone >2700 m)	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct		Direct	
Magnitude	Medium	Small	Medium	Small
Sensitivity	Medium	Medium	Medium	Medium
Significance	Moderate	Minor	Moderate	Minor

Impact of Site Clearance and Blasting on Mammal and Herpetofaunal Assemblages				
Project Phase:	Construction Phase			
	Grassland and Rocky Habitats in Modified Habitats (Table 4.10 and Table 4.11) (Mostly low lying areas <2700 m)		Grassland and Rocky Habitats in Near-natural Habitats (Table 4.10 and Table 4.11) (Mostly subalpine zone >2700 m)	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct		Direct	
Magnitude	Medium	Small	Medium	Small
Sensitivity	Medium	Medium	Medium	Medium
Significance	Moderate	Minor	Moderate	Minor

**Operation Phase**

Impact of Increased Spiral Aloe Collection and Sale		
Project Phase:	Operational Phase	
	Pre-Mitigation Impact	Residual Impact
Type of Impact	Indirect	
Magnitude	Large	Low
Sensitivity	High	High
Significance	Critical	Moderate

Impact of Increased Pressure on Natural Resources through Increased Access to Resources				
Project Phase:	Operational Phase			
	Grassland and Rocky Habitats in Modified Habitats (Table 4.10 and Table 4.11) (Mostly low lying areas <2700 m)		Grassland and Rocky Habitats in Near-natural Habitats (Table 4.10 and Table 4.11) (Mostly subalpine zone >2700 m)	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Indirect		Indirect	
Magnitude	Medium	Small	Medium	Small
Sensitivity	Low	Low	Medium	Medium
Significance	Minor	Negligible	Moderate	Minor

**Mitigation Measures**

The following measures are recommended in mitigation of negative impacts of the Polihali Western Access Corridor on flora, mammals and herpetofauna:

**Biodiversity Awareness and Training**

- Develop induction and training and awareness materials for biodiversity conservation and hold regular training sessions with contractor staff.

**Vegetation, Flora and Fauna Habitats**

- Minimise the footprint of site clearance and vehicles on terrestrial habitats and flora and fauna;

- Minimise spread of alien invasive plants through cleaning of vehicles, equipment, and regular monitoring and control measures to curb spread.

#### ***Spiral Aloe Census of Homesteads Requiring Resettlement***

- Spiral aloe census in households along the PWAR to quantify number of aloes that may be impacted by construction;
- Spiral aloe relocation with resettler households or to new colony or botanical garden; and
- Teaching of community members to propagate spiral aloes for legal sale to road users and for replanting into colonies.

#### ***Plant Search and Rescue and Establishment of Community Nurseries or Botanical Garden***

- Search and rescue of priority plants in road and powerline footprints by experienced field botanists;
- Establish community gardens in the Polihali Project Area to safeguard useful medicinal and other plants; and
- Consider potential for establishing a botanical garden in the Polihali or Mokhotlong area to safeguard threatened plant species; enhance Lesotho biodiversity awareness; and benefit communities through school groups and sale of plants.

#### ***Important Plant Resources***

- Identify presence of useful plant resources requiring relocation to nurseries prior to site clearance;
- Support harvesting of natural resources by local communities prior to site clearance;
- Create indigenous plant nurseries to be run by community members; and
- Use seeds and propagated plants in rehabilitation of project disturbed areas.

### **Other Recommendations**

Other recommendations include:

- The PWAC corridor should be included into the Integrated Catchment Management strategy for the LHWP Phase II with a focus on identifying opportunities to enhance grazing resources and reduce land use pressures to support biodiversity enhancement;
- The need to incorporate relevant long term biodiversity mitigation and monitoring measures presented in this report (such as measures to control spiral aloe harvesting) into the Biodiversity Management Plan for the LHWP Phase II; and
- Identification of opportunities for biodiversity offsets to compensate for the impacts of the PWAC, which should include the identification of some form of new protected areas along the PWAC (such as in the upper Liseleng and Semenanyane valleys) and their evaluation in the context of other offset requirements for the Polihali Reservoir. The evaluation should include consideration of the various biodiversity features that are affected by the PWAR and PRAI and which need to be identified in possible offset areas.

This should also include identifying other biodiversity features of importance in Lesotho (which may not be impacted by LHWP Phase II) that also warrant protection. Such evaluation should include identification of additional conservation actions that can be implemented to enhance or restore degraded habitats.



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# Section 1 Introduction

## 1.1 Background

This report is the terrestrial ecology specialist report that covers vegetation and flora, mammals and herpetofauna of the proposed road and powerline route of the Polihali Western Access Corridor (PWAC) which is required to facilitate construction of the Polihali Dam. Birds are reported on in a separate specialist study. The report has been compiled to provide inputs into the Environmental and Social Impact Assessment (ESIA) for the Polihali Western Access Corridor as outlined in Section 1.4.

## 1.2 Study Team

Team members involved in the compilation and review of this report are summarised in Table 1.1.

**Table 1.1 Authors and Contributors to this Report**

Aspect	Person	Organisation / Company	Qualifications
Mammals and Herpetofauna	Warren McClelland	Ecorex Consulting Ecologists	<ul style="list-style-type: none"><li>• National Diploma in Nature Conservation (1993)</li><li>• +15 years ecology consulting experience throughout sub-Saharan Africa</li></ul>
Vegetation	Khotso Kobisi	Independent	<ul style="list-style-type: none"><li>• Diploma in Agriculture</li><li>• Training in wetlands identification</li><li>• 20 years experience in rangeland, herbarium and field surveys in Lesotho</li></ul>
GIS Mapping & Analysis	Grant Benn	Geocline	<ul style="list-style-type: none"><li>• MSc Conservation Biology</li><li>• BSc Honours Zoology</li><li>• 16 years GIS experience</li></ul>
Field Assistants	Samuel Zwakala George Sekonya	DEA ERM	<ul style="list-style-type: none"><li>• MPhil in Environmental Science</li></ul>
Review	Jessica Hughes	ERM	<ul style="list-style-type: none"><li>• MSc in Zoology</li><li>• MPhil in Environmental Science</li><li>• 24 years consulting experience in EIA and Biodiversity, and Lesotho studies</li></ul>

## 1.3 Scope of Terrestrial Flora and Fauna Study

The scope of work for the terrestrial flora and fauna study required the following:

- Review available data and mapping of the PWAC to confirm priority field survey areas (and accessibility), including baseline and monitoring data from Phase 1 dams and mapping produced by the Maloti Drakensberg Transfrontier Park (MDTP) for the conservation priorities planning study (MDTP, 2007);
- Vegetation: undertake foot based surveys in representative habitats along the PWAC to confirm the habitat types and priority species present and which may potentially be affected by the road and powerline routes;
- Mammals and Herpetofauna: undertake a foot and vehicle-based field survey in representative habitats (e.g. along streams, seeps, rocky ridges, grassland) to record the presence of medium-large mammals and herpetofauna and their habitats in the PWAC Project area. Active

searches for mammals and amphibians were to include a combination of binocular-based surveys of slopes from vehicle or foot; turning over of rocks and scouring rock crevices for reptiles; and direct observation, acoustic listening, and netting along streams for amphibians. Evidence of the presence of priority or notable mammal and herpetofauna (e.g. scats, burrows, tracks, etc.) was to be recorded by Geographical Positioning System (GPS), photographed (where possible) and their habitats noted;

- Natural resource use: obtain information on species and use of natural resources from local informants encountered during field surveys, particularly herders and other local residents.
- Compile a specialist report that:
  - Describes the baseline status of flora and fauna in the project area in the context of prevailing conditions and trends;
  - Tabulates and maps the survey sites/areas, and location of priority species;
  - Provides photographs of representative habitats where surveys were conducted; and
  - Identifies and assesses the direct and indirect impacts of the Project (based on the Project Description provided in Section 1.4) for construction and operation phases.

## 1.4 Project Description and Location

Components included in this assessment of the Polihali Western Access Corridor (PWAC)<sup>1</sup> are summarised below and in Table 1.2 and Table 1.3. The routing is shown in Figure 1.1:

- Polihali Western Access Road (PWAR) that:
  - Comprises a new, paved road link between the A8 in the vicinity of Ha Seshote to the Polihali Reservoir in the vicinity of Tloha-Re-Bue;
    - Shall be designed in accordance with the Lesotho Roads Directorate (RD) standards for a Class A road (as a minimum) and the Phase II Agreement, with due regard to the heavy traffic expected during construction;
    - Has paved junctions to local access roads where required; and
    - Includes associated road infrastructure such as drainage, culverts and bridge structures. A total of three main bridge structures are required for the crossing of the Matsoku, Liseleng and Semenanyane Rivers, and several culverts across the smaller streams traversed by the road.
- Bulk Power Supply and Telecommunications (BPT) Infrastructure (transmission lines and substations) that includes:
  - Upgrade of electrical infrastructure from the existing substation near Ha Lejone to Matsoku Intake substation;
  - New 132kV powerline from the Matsoku Intake substation to a new Polihali substation to supply the Phase II construction sites including the Polihali Dam, tunnel intake, and associated camp and office facilities;
  - Re-alignment of the existing powerline along the A1 that crosses the Khubelu and Senqu Rivers where there is potential inundation of existing electrical infrastructure due to reservoir impoundment; and

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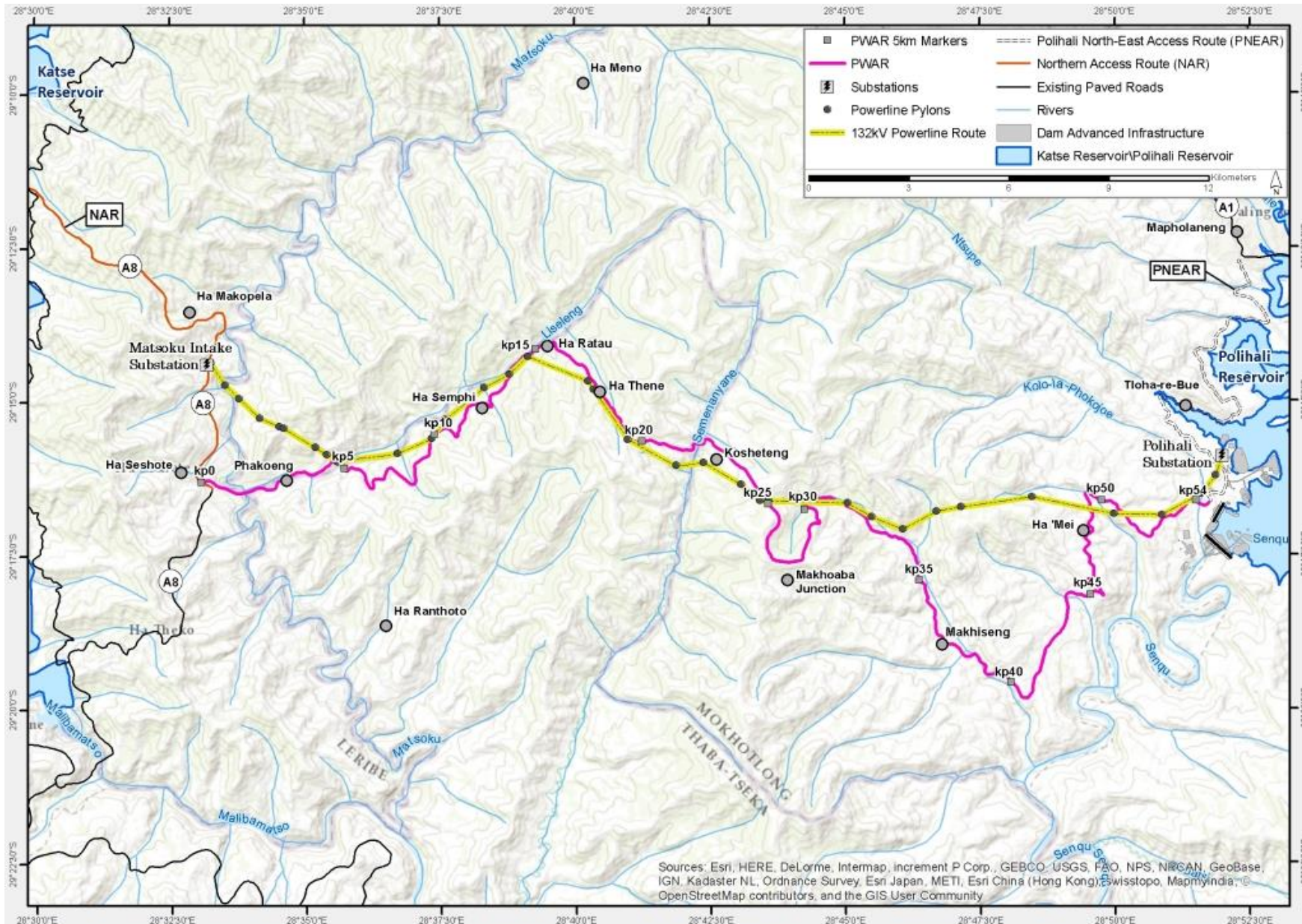
<sup>1</sup> The infrastructure corridor is referred to as the PWAC. The BPST infrastructure ('Power and Telecoms') primarily follows the alignment of the PWAR although the powerline deviates from the PWAR in some locations (see Figure 1.1).

- A telecommunications component that entails the provision of the required levels of telecommunications infrastructure to provide voice and data facilities (including teleconference) to the Phase II project areas.

Note: A separate ESIA for the PRAI covers the BPST components for the realignment of the powerline along the A1 over the Khubelu and Senqu Rivers; and the new substation and telecommunications mast near the Polihali infrastructure area. The western construction camp for the PWAC falls under a separate EMP



Figure 1.1 PWAR and Powerline Route



**Table 1.2 Summary Description of PWAR Design Specifications**

Feature	Description
Route	Ha Seshote to Polihali via Ha Ratau-Makhoaba Junction and Ha Mei.
Class	Class A Road
Length	54.3 km
Total Width	10 m comprising two 3.5 m lanes and 0.5 -1 m shoulder (0.5 m in restricted areas) and a 1 m side drain. Extra climbing lanes to be located where required.
Servitude	30 m road reserve (15 m from centre line) and 60 m building restriction area (no new building zone).
Land Requirements:	Total ~170 ha comprising: 164 ha for 30 m road reserve; and 5-6 ha for construction camp and site / works areas at bridges.
<b>Bridges and Culverts</b>	
Bridges	3 major bridges: <ul style="list-style-type: none"> <li>• Matsoku River – 60 m length at km 1.3 (3 spans 20 m length);</li> <li>• Semenanyane River – 90 m at km 21.8 (5 spans of 12-20 m length);</li> <li>• Makhoaba River – 80 m at km 37.6 (4 spans of ~20 m length).</li> </ul>
Culverts	18 culverts across streams with catchments varying from 1-38 km <sup>2</sup> .
<b>Construction Requirements</b>	
Volume of Cut and Fill	950,000 m <sup>3</sup> of each (balanced).
Blasting	Blasting required at rock embankments to widen road, at bridge locations, and at quarries and borrow pits.
Duration of construction	20 months, split into two tenders. Scheduled to start in October 2018.
Resettlement and compensation	Some households will require resettlement and compensation for loss of arable land and resources. Compensation and resettlement requirements and implementation are being handled by separate Resettlement Action Plan (RAP) consultants in accordance with the LHDA's compensation policy.

**Table 1.3 Summary Description of BPST Powerline Design Specifications**

Feature	Specifications
Route	Matsoku substation to new substation at Masakong (near Polihali).
Power supply	132 kV
Length of powerline	35.4 km
Pylons	106 pylons, including 33 deviation point pylons.
Land requirements	~18 ha permanent land required for pylons, local tower access tracks; ~120 ha temporary land (including 1.1 ha for laydown sites; 112 ha for 132kV servitude, and 7 ha for 33kV servitudes).
Access tracks	~42.5 km of access tracks for installation and maintenance of pylons.
Servitude Width	31 m (15.5 m each side of centre line).
Servitude Restrictions	No house structures are permitted within the powerline servitude. Graves may remain in the servitude provided no damage is caused during construction or maintenance. Arable land is permitted at owners' risk.
Bird protection measures	<ul style="list-style-type: none"> <li>• Bird Flight Diverters (BFDs) on the entire 132 kV line;</li> <li>• BFDs on sections of the existing Ha-Lejone-Matsoku line to be refurbished (where feasible);</li> <li>• Aircraft or Aviation Warning Devices (AWDs) on four sections of the line at high altitude across ridgelines;</li> <li>• Anti-perching Devices or Bird Guards on cross-arms above vertical insulators to reduce electrocution and flashover risk; and</li> <li>• Minimum of 1800 mm phase to phase or phase to earth clearance.</li> </ul>
Resettlement and compensation	Powerline construction will require compensation for loss of arable land within the servitude, and some temporary loss for works areas. Compensation and resettlement requirements and implementation are being handled by separate RAP consultants in accordance with LHDA's compensation policy.

Note: the specifications contained in Table 1.2 and Table 1.3 form the basis of this assessment.

## 1.5 Assessment of Alternatives

### 1.5.1 Routes Considered

Four route options for the PWAC were assessed as part of a route selection phase of work for this study (Figure 1.2). The routes had previously been assessed mainly on technical, cost and social grounds by Barry and Partners (2014a,b) and SMEC (2016). Since little attention had been given to ecological considerations of the four routes in the earlier studies, the scope of work for this Project required a route selection study with a focus on the ecological and social aspects of the four routes. Ecological and social criteria were identified that could be spatially identified and represented to compare the routes, as reported in the route selection report (ERM, 2017: P2W-6004-0002). In relation to terrestrial ecology the criteria related to: i) the distance of road route traversing mountainous areas over 2800 m in altitude (as these high lying areas of Lesotho are important for localised endemic plants and herpetofauna in particular but are also important for remaining medium to large mammals); and ii) proximity of the proposed road to rivers and wetlands (i.e. mainly important for amphibians). Overall, the routes with the longest distance traversed at high altitude were the least preferred for ecological reasons.

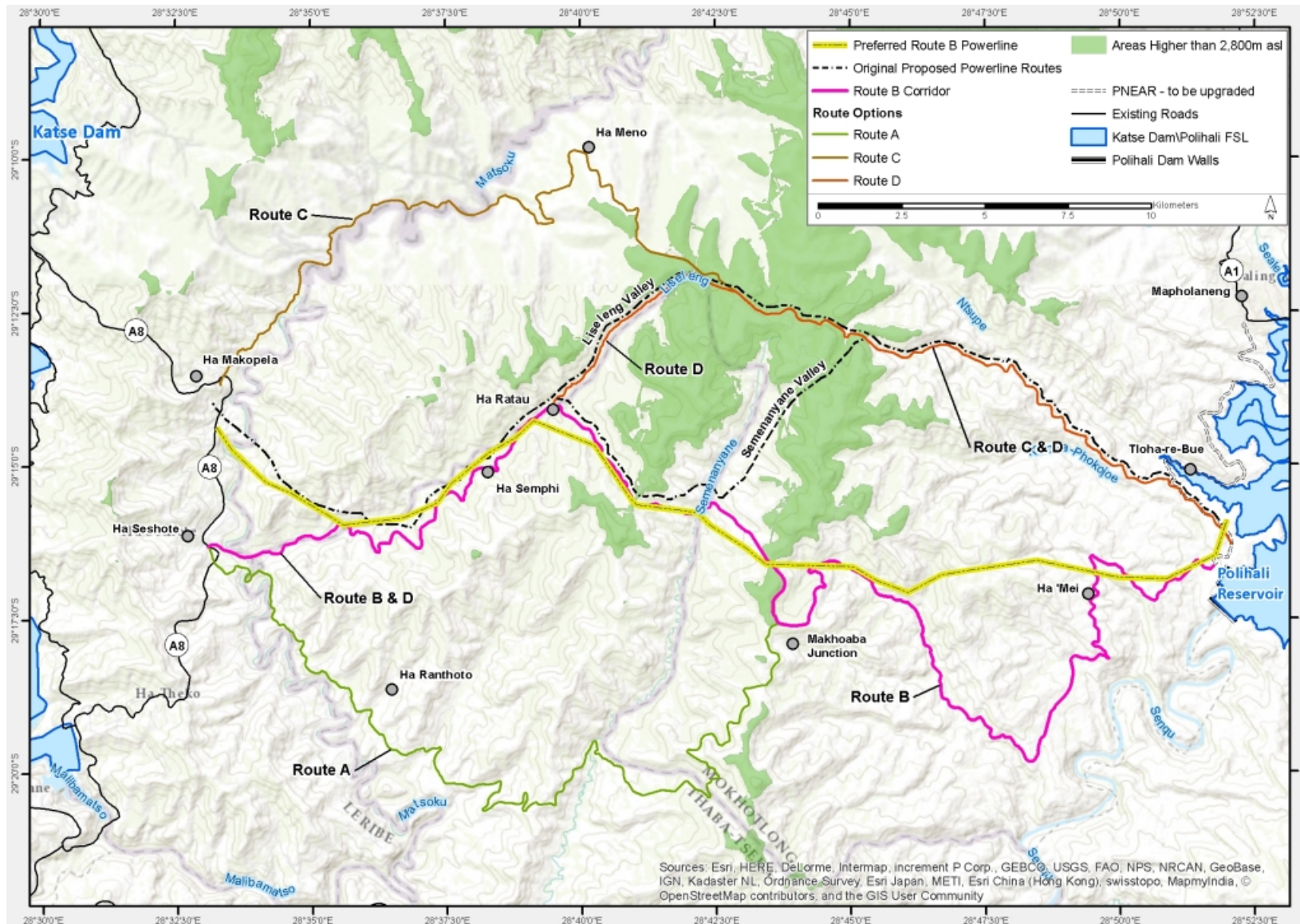
The route selection study conducted by the engineers (Barry and Partners, 2014a,b; SMEC, 2016) preferred Route C, and later Route D, based on the shorter distance and lower cost for both the powerline and road. However, the route selection study and some initial field surveys for birds, flora and fauna confirmed some significant ecological constraints of Route C and D, mainly related to high powerline collision risks to birds, particularly in the high altitude areas of the routes (shown in Green in Figure 1.2). A number of high priority birds, including Bearded Vulture, Cape Vulture, Black Stork and Bald Ibis amongst others occurred in higher density and abundance along Route C. In addition, Routes C and D were confirmed to have fewer social benefits as they served fewer villages than either Route B or A. Route B was selected as the preferred corridor for the road and powerline as it offered the best compromise for reducing ecological risks and optimising social benefits, balanced with cost.

### 1.5.2 Realignments

The specialist studies have been undertaken concurrently with the engineering design process which has provided the opportunity for the ecology (and social) team to input into identifying constraints of the proposed PWAR and powerline alignments, and to allow for some realignments to avoid sensitive areas. Realignment of the routes in certain places has allowed for avoidance of certain sensitive sections of route and thereby has fulfilled the most important and first step of the mitigation hierarchy. A summary of all realignments to the original proposed routing of the PWAR and powerline are contained in Table 1.4. This has lessened the severity of some of the impacts on sensitive ecological and social receptors.



**Figure 1.2 Powerline and Road Options Assessed During the Route Selection Study**



Note: PWAR Route D comprises the western section of Route B (pink); the Liseng valley link and eastern half of Route C (brown); Route C comprises the entire northern route (brown). The Semenanyane Valley (dashed black line) was an optional route for the powerline.

**Table 1.4 Summary of Road and Powerline Realignments**

Marker	Nearest villages / landmark	Reason for realignment	Outcome
PWAR			
kp 0-1.3	Ha Sesote - Phakoeng	<b>School proximity - safety / nuisance:</b> The original road was close to a school, dividing mission and school, and posing a high safety risk and noise disturbance.	Avoided
kp 7-9	Ha Salemone – Ha Tlelase	<b>Wetland and priority plants:</b> The original route passed through two seasonal Seep wetlands with localised and protected plant species including <i>Boophone disticha</i> (Vulnerable) and <i>Eucomis autumnalis</i> (Vulnerable) (Talukdar, 2002). See Section 4.2.3 on priority plant species.	Largely avoided
kp 15-17.4	Ha Ratau	<b>School / village division:</b> The original route passed between the village and the school and posed a high safety risk and noise disturbance. Road rerouted below school. <b>Important Fen (wetland) with deep peat:</b> The original route crossed the top end of the fen posing a high risk of flow concentration and erosion of the system and loss of peat.	Avoided
kp 19.5-20.7	Saddle to west of Semenanyane valley between Ha Thene and Kosheteng	<b>Wetlands including Seeps with springs and peat.</b> The original route passed through moist slopes above a Valleyhead fen wetland with artesian springs, posing a significant risk to this system. The PWAR was rerouted to follow the existing track south of this wetland.	Largely avoided
kp 22-24.7	Kosheteng	<b>Wetland water supply and social nuisance:</b> The original route passed at eye level along the slope to the north of the village above a linear wetland (fen) system that supplies the village with water. The PWAR was rerouted to a new river crossing point on the Semenanyane River, and up the back (north) side of the slope.	Avoided
kp 26-31	Makhoaba Junction	<b>Wetland, arable and grazing land:</b> The option of a shorter route cutting along a lower contour below the Makhoaba junction was considered as it was 2 km shorter. The team recommended the road should follow the existing track at the top of the watershed to avoid wetlands and rangelands in the valley and to retain the existing junction point.	Existing route to be used, 2 km longer
kp 36-37.6	Makhiseng	<b>Arable land:</b> The original route deviated from the existing dirt road and passed across arable land above the Makhoaba village. This was considered to be an unnecessary loss of important arable land.	Minimised (arable land loss)
Powerline			
kp 15-17 (TP 14-16)	Ha Sekila – Ha Sekolopata	<b>Visual:</b> A pylon was placed on a prominent ridgeline above Ha Ratau, but was repositioned into a lower saddle to reduce its prominence in the landscape.	Largely avoided
kp 20.3-21.1 (TP 17-19)	Saddle to west of Semenanyane valley between Ha Thene and Kosheteng	<b>Visual:</b> The original route crossed the PWAR several times in the western side of the scenic Semenanyane River valley. The powerline was realigned to minimise visual intrusion from the PWAR.	Largely avoided
kp 25 (TP 22)	Crest of ridge above Kosheteng to Makhoaba loop.	<b>Visual:</b> The original route had a pylon located on the crest of the ridge above Kosheteng at the change in watershed to the east. The powerline route was adjusted on the crest to minimise interference with the watershed.	Largely avoided

# Section 2 Legal and Policy Framework

## 2.1 Legislation and Policies

### 2.1.1 Lesotho Legislation Specific to Biodiversity

Legislation of specific relevance to biodiversity protection is summarised in Table 2.1.

**Table 2.1 Legislation Relevant to Biodiversity**

Legislation	Requirements
Lesotho Environment Act No.10 of 2008	<p>The Environment Act, 2008 provides a framework environmental law for the implementation of the National Environmental Policy. It sets out the principles of environmental management in Part II, Section 3(2) of the Act, which include:</p> <ul style="list-style-type: none"> <li>• To reclaim lost ecosystems where possible and reverse the degradation of natural resources;</li> <li>• To ensure that waste generation is minimised and safely disposed of;</li> <li>• To prevent interference with the climate and adverse disturbances of the atmosphere and take compensatory measures for any unavoidable interference;</li> <li>• To require prior environmental impact assessment of proposed projects or activities which are likely to have adverse effects on the environment or natural resources; and</li> <li>• To ensure that appropriate measures are taken to prevent soil erosion.</li> </ul> <p>Relevant specific environmental protection provisions under Part IX of the Act include:</p> <ul style="list-style-type: none"> <li>• Identification and protection of areas;</li> <li>• Re-forestation and afforestation of hilly and mountainous areas;</li> <li>• Protection of river, river banks and wetlands;</li> <li>• Conservation of biological diversity;</li> <li>• Conservation of biological resources;</li> <li>• Management of rangelands; and</li> <li>• Management of dangerous materials, hazardous waste and toxic chemicals.</li> </ul> <p>The Environmental Act specifies the need for an environmental licence that must be obtained for certain types of projects and activities prior to construction of the development. A list of these types of developments is provided in Part A of the First Schedule of the Act. It specifically includes projects or activities that affect any of the following biodiversity-linked areas or features which have been demarcated as such by central or local authority:</p> <ul style="list-style-type: none"> <li>17 a) Streams and river channels and their banks;</li> <li>17 b) Floodplains and wetlands;</li> <li>17 k) Landscapes;</li> <li>17 m) <b>Biotic assemblages;</b></li> <li>17 n) <b>Habitat of Red Data Book species;</b></li> <li>17 p) Aquifers and aquifer recharge areas;</li> <li>17 q) Areas with a high natural water table;</li> <li>17 s) Unstable soil;</li> <li>17 t) <b>Natural resource areas;</b></li> <li>17 w) Areas or sites of outstanding natural beauty;</li> <li>17 y) Areas or sites of specific scientific interest;</li> <li>17 bb) Bird migration sites.</li> </ul> <p>Requires guidelines to be prepared for prohibiting or controlling alien species, and specifies that no alien plant species may be introduced into rivers, riverbanks or wetlands, and that forestry related activities are prohibited from propagating alien invasive species.</p>

Legislation	Requirements
Historical Monuments, Relics, Fauna and Flora Act No 41 of 1967	<ul style="list-style-type: none"> <li>• No person may destroy or damage or remove from its original habitat or export from Lesotho any flora or fauna proclaimed under Section 8 as protected without the written consent of the commission;</li> <li>• Protected flora and fauna include tortoises, terrapins, cranes, storks and herons, hamerkop, birds of prey and egrets. Amendments in 2004 and 2006 have listed additional protected flora species.</li> </ul> <p><b>Note:</b> provisions for the protection of historical monuments and archaeology have been superseded by the new Heritage Act.</p>
Weeds Eradication Act No. 18 of 1969	Requires all persons occupying land to eradicate all weeds on that land, and that custodians of the land are responsible for the eradication of weeds on unoccupied or unallocated land. This act is also supported by requirements under the Environmental Act 10 of 2008.
Range Management Regulations of 1980 and National Rangelands Resources Management Policy Action Plan 2015	Regulates all aspects pertaining to the management of rangelands.  <i>Management of rangelands in a sustainable manner is recognised as being a primary means to enhance biodiversity protection in Lesotho.</i>

### 2.1.2 Protected Species

The Historical Monuments, Relics, Fauna and Flora Act (No. 41 of 1967) is the primary legislation dealing with the protection of flora and fauna in Lesotho, and provides the relevant authority with the power to designate protected species of flora and fauna. Such a list was provided in the Proclamation of Monuments, Relics, Fauna and Flora (LN No. 36 of 1969), and subsequent amendments in Legal Notices No. 93 of 2004 and No. 38 of 2006, which designated the species of flora and fauna (mammals, reptiles) in Box 2.1 as protected:



**Box 2.1 Protected Flora and Fauna of Lesotho****Protected Fauna (mammals, reptiles )**

All antelope species (mefuta eohle ea linyamatsana, liphofu, litsephe le matsa)  
 All baboons and monkeys (litsoene le likhabo)  
 Bushpig and warthog (mefuta eohle ea likolobe, le likolobemoru)  
 Antbear, pangolin and honey badger (mefuta eohle ea lithakali, likhaha le lisele)  
 All porcupines and hedgehogs ( linoko le lihlong)  
 Springhares (litsipho le litsipjoane)  
 All otters and mongooses (mefuta ea liqibi, matobi ka bosamane le lehlahare)  
 All leguaans (mefuta ea lipolometsi le kang qamo le phathakaile)  
 All tortoises and terrapins (mefuta ea likhulu le khulu-ea-metsi).

**Protected Flora**

All aloes with particular reference to *Aloe polyphylla*, including its seeds and flowers  
 All bamboos (*Leqala*)  
 All *Protea* species (*Sekila*)  
 Wild Olive (*Mohloare*)  
 All *Cussonia* species (*Motšetše*)  
*Rhus\* burchelli* (*Mokhoamphiri*)  
 All *Celastraceae* species (e.g. *Gymnosporia*) (*Sefeamaeba*)  
*Ilex mitis* (*Phukhu*)  
 All *Heteromorpha* species (*Monkhoane*)  
 All *Euclea* species (*Mohlakola*)  
 All *Grewia* species (*Lesika*)  
 All *Buddleja* species (*Lelora*)  
 All *Gladiolus* species (*Mefuta ea khahla*)  
*Rhamnus prinoides*  
*Bulbine narcissifolia*  
*Mentha aquatica* and *M.longifolia*  
*Dianthus basuticus*  
*Tulbaghia* species  
*Pachycarpus* species

\* *Rhus burchelli* now called *Searsii burchelli*

Note: the authors of this report believe that some of the listed species are not worthy of protected status as they are widespread and reasonably common. These include all *Buddleja* species (*Lelora*); *Gladiolus* species (*Mefuta ea khahla*); *Rhamnus prinoides*; *Mentha aquatica* and *M.longifolia*; *Dianthus basuticus*; and *Tulbaghia* species.

## 2.2 Relevant Initiatives

Relevant initiatives in Lesotho that support biodiversity protection are summarised in Table 2.2.

**Table 2.2 Initiatives Relevant to Flora and Fauna Protection**

Initiative	Summary
Maloti Drakensberg Transfrontier Project (MDTP)	<p>A bilateral project from 2004-2012 between Lesotho and South Africa aimed at the conservation of biodiversity along Maloti mountains and Drakensberg range. The initiative was targeted at the assessment, mapping and documentation of unique biodiversity that still exists and their threats. Establishment and capacitating different stakeholders was the major achievement of the project for sustainability of natural resources along Maloti - Drakensberg mountain range and covered the entire Lesotho Highlands. Government Ministries were also capacitated and played a leading role in bilateral steering committees so that there would be a continuity of project activities post its lifespan. A key focus in Lesotho was on improving rangeland management in order to support biodiversity protection.</p> <p>Current MDTP focus is on protection and management of the Sehlabathebe National Park</p>

Initiative	Summary
	and ongoing vulture monitoring.
SABONET plant list	The Southern African Biodiversity Network (SABONET) project was initiated in 1999 with the main purpose of computerising herbarium specimens. In Lesotho it based on three herbaria: Roma, Maseru and Sehlabathebe, with the purpose of additional live plant collection and preparing herbarium specimens throughout the country. Live plants were planted at Roma Herbarium while plant specimens were computerised for future reference. SABONET conducted a survey of <i>Thamnocalamus tessellates (Leqala)</i> sites in the lowlands, foothills and part of Senqu river valley. Several people were trained and publications produced under the initiative, including a Checklist of Lesotho Grasses and a Preliminary Checklist of the Plants of Lesotho.

Note: this excludes wetland protection initiatives that are dealt with in the separate specialist wetland report.

## 2.3 International Conventions

International conventions that Lesotho has ratified and which are relevant to biodiversity are summarised in Table 2.3:

**Table 2.3 International Conventions Relevant to the Project**

International Convention	Key Provisions and Relevance to Lesotho
Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar)	Requires “commitments from its member countries to maintain the ecological character of their Wetlands of International Importance”.  <i>No Ramsar site is located in the vicinity of the Project.</i>
Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);	Requires signatories to ensure that international trade in specimens of wild animals and plants does not threaten their survival.  <i>Spiral aloe is a CITES Appendix 1 listed species which is an endemic and endangered species in Lesotho that is targeted for trade. Natural colonies occur in the broader project area but replanted aloes occur in villages some of which may be affected by the project, while the road may facilitate increased sale of wild specimens.</i>
Convention on Biological Diversity (CBD) (1993)	CBD is dedicated to promoting sustainable development taking into consideration the underpinning principles of balancing social needs with ecosystems protection. It requires signatories to report and demonstrate progress towards protection of biodiversity through preparation of National Biodiversity Strategic Action Plans and progress reports.
Africa Convention on Conservation of Nature and Natural Resources (15/09/1968)	The fundamental principle of this Convention requires the Contracting States to adopt measures to ensure conservation, utilization and development of soil, water, flora and faunal resources in accordance with scientific principles and with due regard to the best interests of the people.  <i>This convention establishes the species that the signatory states need to protect and establishes that protected areas need to be managed through planning on a scientific basis. It also requires signatories to take steps to combat soil erosion, protect water resources and flora and fauna. Protected species listed relevant to Lesotho include Oribi, Reedbuck and Mountain Reedbuck which shall not be hunted without a permit.</i>

International Convention	Key Provisions and Relevance to Lesotho
United Nations Convention to Combat Desertification (UNCCD)	<p>The Convention to Combat Desertification aims to reverse and prevent desertification/land degradation.</p> <p><i>Overutilization of natural resources by communities dependent on these natural resources has led to extensive land degradation in the PRAI Area of Influence. Land degradation affects the wetlands of the area both directly through erosion and degradation of wetland habitat, and indirectly through changing catchment characteristics, specifically increasing runoff.</i></p>
World Heritage Convention (UNESCO).	<p>Requires signatories to promote cooperation among nations to protect heritage of outstanding universal value and to protect globally important biodiversity and cultural heritage.</p> <p><i>The project area is not within any designated World Heritage Sites (WHS). Sehlabathe National Park is a UNESCO WHS designated as such in 2012.</i></p>

## 2.4 International Good Practice

### 2.4.1 Performance Standard 6 (PS6): Biodiversity Conservation and Sustainable Management of Living Natural Resources

For biodiversity, international good practice typically refers to the IFC standards, specifically:

- Performance Standard 6 (PS6) – Biodiversity Conservation and Sustainable Management of Living Natural Resources.

PS6 is the primary standard concerned with biodiversity and ecosystem services. PS6 recognises that the protection and conservation of biodiversity, the maintenance of ecosystem services and the management of living natural resources are fundamental to sustainable development. The IFC standards contained in PS6 are based on the Convention on Biological Diversity (CBD). The objectives of PS6 are stated as:

- To protect and conserve biodiversity;
- To maintain the benefits from ecosystem services; and
- To promote the sustainable management of living natural resources through the adoption of practices that integrates conservation needs and development priorities.

To achieve these objectives, PS6 contains guidelines that cover the protection and conservation of biodiversity (refer to [www.ifc.org](http://www.ifc.org) for the full guidance notes for PS6).

PS6 specifies consideration of the following aspects of biodiversity assessment and management:

- Direct and indirect project-related impacts on biodiversity and ecosystem services and identification of any significant residual impacts;
- Assessment of affected habitat as Modified versus Natural Habitat;
- Evaluation of affected habitat as Critical Habitat using defined criteria;
- Assessment of ecosystem services (a component of defining Critical Habitat);
- Assessment of the impact on legally protected and internationally recognised areas;
- Adoption of the mitigation hierarchy of avoid-mitigate-rehabilitate-offset;
- Outlines the applicability of biodiversity offsets;
- Specifies consideration of alien vegetation; and
- Defines the role of stakeholder engagement in developing biodiversity management plans.





# Section 3 Approach and Methods

## 3.1 Introduction

### 3.1.1 Objectives

The objectives of the terrestrial flora and fauna field survey were to focus on confirming priority species of flora and fauna in representative habitats that may be impacted by the Project. This, together with other available information on flora and fauna for the broader Project Area, was required to provide the basis for impact identification and assessment of powerline and road construction, and operation, on flora and fauna. In addition, feasible and practical mitigation and monitoring measures were required to be identified and described together with any additional recommendations to enhance biodiversity protection in the Project Area.

### 3.1.2 Approach

The approach to the study was based on:

- Review of previous flora and fauna data (including mapping) from the Lesotho Highlands, and specifically the Katse and Polihali catchments in order to pre-identify features and areas of interest, and to inform the selection of representative areas for field work;
- Maximal overlap of team members in the field to facilitate knowledge and data sharing, and skills transfer. This included partnering the terrestrial flora and fauna ecologists;
- Scheduling fieldwork to coincide with the summer period to enhance identification of plant species during the flowering season, and optimal fauna species diversity and abundance;
- Integrated terrestrial flora and fauna reporting to streamline reporting and minimise data gaps;
- Realistic identification and assessment of project impacts that draws upon previous experience and monitoring results of Phase 1 dams; and
- Presentation of realistic and practical mitigation and monitoring measures that build on tried and tested approaches that have been successfully applied in Lesotho or on similar projects in similar settings.

### 3.1.3 Methods and Activities

The methods and activities undertaken include:

- **Data review and gap analysis** - available data for the project area were assembled and reviewed during the Inception Phase to identify gaps as the basis for confirming additional survey focus areas (see Section 3.2);
- **Field surveys (summer)** – field surveys by the terrestrial ecologist (Warren McClelland) and botanist (Khotso Kobisi) were undertaken between 1<sup>st</sup> and 4<sup>th</sup> February 2017 (eastern half) and by Khotso Kobisi from 12<sup>th</sup> to 16<sup>th</sup> April 2017 (western half) to collect data on mammals, herpetofauna, and flora and their habitats within a ~500 m wide corridor along the PWAR (see Section 3.3.2);

- **Data assembly and mapping** – flora and fauna field data were collated into Excel spreadsheets; GPS coordinates of survey areas and priority species were mapped in a Geographical Information System (GIS), and photographs collated;
- **Baseline reporting** – the flora and fauna baseline data were collated into the integrated terrestrial ecology report as the basis for the assessment of impacts;
- **Impact assessment and mitigation** – impacts of the project on flora and fauna were identified for:
  - a) the infrastructure components, comprising the footprint of the road and powerline servitude, and proposed quarries and borrow pits; and
  - b) operation of the road and powerline.
- **Monitoring** - requirements for monitoring specific biodiversity aspects are specified; and
- **Recommendations** - additional management measures for enhancing biodiversity protection are recommended.

### 3.1.4 Assumptions and Limitations

The following assumptions and limitations applied to this study:

#### 1. Road access

Road access along the existing PWAR is poor and comprises dirt roads and tracks, some of which proved impassable during the early February survey period and required considerable time for travel. This meant that some stretches of the full road and powerline were not walked and areas with extensive settlement or fields were viewed from various vantage points to confirm their biodiversity value. Focus was placed on checking areas of grassland and rocky habitats within the 500 m corridor along the PWAC. Additional data were provided by the wetlands team from their survey between 18<sup>th</sup> and 25<sup>th</sup> April 2017. However, despite these access constraints, the survey achieved sufficient coverage of representative areas of the road and powerline footprint for a robust assessment of the potential impacts.

#### 2. Quarries and Borrow pits

Quarry and borrow pit locations had not been finalised at the time of the field surveys and will be confirmed following geotechnical surveys. However, a number of proposed locations along the PWAR were visited, most of which were in degraded areas of low biodiversity value. Once geotechnical surveys have been conducted and borrow pit and quarries confirmed, it is recommended a rapid botanical reconnaissance is done to confirm biodiversity sensitivities to their development with a focus on sites in more intact areas of the PWAR (e.g. Makhoaba Pass).

#### 3. Drought conditions and overgrazing

Prevailing drought conditions over the last few years as a result of lower than normal rainfall, has exacerbated land use pressures resulting in worsened degradation of rangelands, and reduced diversity and abundance of biodiversity. Although the problem is worse in the Polihali Reservoir area than along much of the PWAC, the results of the flora and fauna surveys are not considered fully representative of conditions that may pertain during normal or high rainfall years. Therefore, the baseline conditions recorded during the surveys are not considered a sufficient baseline against which future monitoring can be compared. Should future monitoring of biodiversity along the PWAC be considered, it will require additional baseline data to be gathered and this should be correlated with rainfall.

#### 4. Species identification

Severe overgrazing by livestock has resulted in large areas of grassland having limited vegetation cover, particularly the lower lying parts of the route in the vicinity of villages. The part of the PWAR between kp 42 and 53 is particularly heavily grazed (Figure 4.14). In addition, the follow up surveys were conducted late in the summer season (in April 2017) and it is possible that some flowering species, particularly geophytes, were overlooked (either because of being browsed or having already flowered). Most geophytes can only be positively identified if in flower.

#### 5. Mammals and Herpetofauna

No pitfall trapping was undertaken for small mammals or reptiles or amphibians. It is believed that such intensive surveys are not warranted for the linear road and powerline corridors and because no localised threatened species are known to occur along the route that would be at risk from the project construction.

#### 6. Birds

Birds (avian fauna) are covered under a separate bird study by Avisense.

## 3.2 Review of Previous Data

### 3.2.1 Relevant Data

The team has a wealth of studies relevant to the broader Project Area. However, no previous studies for either Katse Dam (on the west) or the proposed Polihali Dam (on the east) covers the PWAC, although baseline and monitoring studies for both these areas do provide useful contextual data

Relevant flora and fauna reports consulted for this study are listed in Box 3.1. Other references are listed in Section 8.

#### **Box 3.1 List of Relevant Data Consulted for This Study**

CES. 2014a. LHWP Polihali Dam: Baseline Flora Survey. LHDA Contract No. 6002.

CES. 2014b. LHWP Polihali Dam: Baseline Fauna Survey. LHDA Contract No. 6002.

Barker *et al.* 2014. Phase 1 Biological Resources Monitoring: Flora of the Katse Dam Catchment. LHDA Contract No. 1273. Report for Anchor Consultants.

Du Plessis *et al.* 2014. Phase 1 Biological Resources Monitoring: Mammals of the Katse Dam Catchment. LHDA Contract No. 1273.

Harvey. 2014. Phase 1 Biological Resources Monitoring: Herpetofauna of the Katse Dam Catchment. LHDA Contract No. 1273. Report for Anchor Consultants.

Turpie *et al.* 2014. Phase 1 Biological Resource Monitoring: Katse Catchment Land Cover Change Analysis 1991-2013. Report for Anchor Consultants.

MDTP. 2007. Degradation Mapping and Veld Assessment Report. Project for Maluti Drakensberg Transfrontier Project (Lesotho Highlands).

AfriDev. 1996-2000. Annual biological monitoring of Katse. LHDA Contract No. 615.

Database sources that were used to supplement data contained in the listed reports were:

- Global Biodiversity Information Facility (<http://www.gbif.org>);
- Virtual Museum of the Animal Demography Unit (<http://vmus.adu.org.za>); and
- Plants of Southern Africa (<http://newposa.sanbi.org/sanbi/Explore>).

### 3.2.2 Vegetation and Flora

Sources of available information on vegetation and flora relevant to the PWAC area are summarised below and reviewed in the Baseline Chapter, Section 4.2.1.

#### 3.2.2.1 Mucina and Rutherford (2006)

Mapping prepared by Mucina and Rutherford for Southern African was reviewed for the PWAC project area as context for understanding the vegetation types of the project area. The entire PWAC is mapped as Lesotho Highlands Basalt Grassland (Figure 4.1).

#### 3.2.2.2 CES (2014) Baseline Vegetation Surveys

CES (2014a) conducted three surveys for the Polihali Reservoir at the eastern end of the PWAC in November 2013, January and February 2014 over 29 days in total. A stratified random approach was used to locate 80 x 50 m transects in pre-mapped vegetation land cover types (categorised into seven classes) in the catchment. A total of 15 transects out of the 80 transects were in the inundation area but only one transect was located near the eastern end of the PWAC (transect 18). Transect locations and derived mapping are shown in Figure 4.2.

#### 3.2.2.3 MDTP (2007) Historic Vegetation Mapping

Detailed vegetation mapping of the Highlands was prepared in the early 1980s under a United States Agency for International Development (USAID) funded rangeland inventory programme. Vegetation types were mapped onto 1:50,000 maps using aerial imagery and extensive ground-truthing. The mapping was digitised and ground-truthed during a systematic conservation planning (SCP) study for the MDTP (MDTP, 2007). This 'historic' mapping was reviewed and compared with baseline data collected along the PWAC (see Section 4.2.1.2 and Figure 4.3).

#### 3.2.2.4 Katse Phase 1 Studies

A baseline survey of flora and vegetation communities within the Katse catchment area was conducted by Loxton, Venn and Associates in 1992 (LVA, 1993). Four major vegetation belts were identified, within which seven vegetation communities were defined (Table 4.1). Forty 50-m - transects were sampled in a representative selection of vegetation communities across the Katse catchment, in which 554 plant species were recorded. Barker *et al.* (2014) conducted follow-up surveys in February 2014, surveying 37 of the 40 plots from LVA (1993). This study provided an updated baseline for the Katse catchment and provided a recent assessment of the state of vegetation and species composition. Areas overlapping with the PWAC were reviewed and used to summarise change in land cover over time.

### 3.2.3 Mammals and Herpetofauna

#### 3.2.3.1 Polihali Reservoir Area

Three 10-day faunal surveys were undertaken by CES (2014b), one of which was in the dry season (October 2013) and two of which were in the summer (wet season) (January and March 2014). The wet season surveys corresponded with the period of maximal faunal activity for most groups, particularly amphibians, reptiles and migratory birds. All habitats present in the region were sampled. Most faunal observations were made visually with the aid of binoculars, and special attention was paid to cliff faces used by breeding birds. Nocturnal visits were made to several

wetland sites to record amphibian activity. Small mammals were trapped during the March 2014 survey using Sherman traps placed in linear arrays of 10 traps each. Trap arrays were placed next to natural features such as rivers or rock outcrops, and were checked twice daily, in the morning and evening. Single voucher specimens and Deoxyribose Nucleic Acid (DNA) samples were retained for each species, and all additional specimens were released at the trapping site. Five small mammal species were recorded in the Sherman traps and six other species were recorded incidentally during fieldwork, either through visual observation or indirect evidence such as spoor or dung. Funnel and drift trap arrays were erected for sampling reptiles and amphibians. Each trap array comprised a 'Y' shaped arrangement of three shade-cloth drift fences, each 10 m long and with double-ended funnel traps placed on each side at mid-length. Trap arrays were checked twice daily, in the morning and evening. Voucher specimens and DNA samples were retained for each species, and all surplus specimens were released at the trapping site. The arrays were left in place for six days and nights, and resulted in the capture of three amphibian species and a single reptile species. An additional three amphibian species and five reptile species were collected during active searching of suitable habitat and during nocturnal surveys.

### 3.2.3.2 Katse Reservoir Area

Loxton, Venn and Associates conducted mammal surveys in the Katse catchment area for Phase 1A of the Lesotho Highlands Water Project (LHWP) during 1991/92 (LVA, 1993). Fieldwork focused on three areas in the catchment, namely the Upper Bokong Valley, Ha Poli/Ha Lejone and Katse. Small mammal trapping took place along fixed traplines and signs of mammals were searched for along walked transects. Surveys were conducted in March 1991, September/October 1991, December 1991 and January 1992. Du Plessis *et al.*, (2014) provided an updated assessment of the mammal fauna of the Katse catchment area, surveying the same areas that were sampled by LVA (1993), and using the same combination of trapping and walking transects. Fourteen traplines were located, comprising seven in the Upper Bokong Valley, four in the Ha Lejone/Ha Poli area and two in the Katse area. Each trapline was 250 m in length and contained 50 wooden-based snap traps spaced ~5 m apart. Seven species were collected in traplines during January / February 2014 fieldwork, with four species collected in the Upper Bokong Valley and in the Ha Lejone/Ha Poli area, and only two species were recorded in the Katse area.

Loxton, Venn and Associates conducted herpetological surveys in the Katse catchment area for Phase 1A of the LHWP during four trips in 1991 and 1992 (LVA, 1993). Amphibians were surveyed at 43 sites within and around the Katse reservoir, and reptiles at 18 sites. Survey effort was recorded as 30 person-days for amphibians and 48 person-days for reptiles, during which time seven amphibian and ten reptile species were recorded. Harvey (2014) provided an updated assessment of the herpetofauna for the Katse catchment area and conducted additional fieldwork from 28<sup>th</sup> January to 4<sup>th</sup> February 2014. A representative proportion of the original survey sites were sampled in each of the main habitats surveyed by LVA (1993). Survey methods comprised active searching, which included overturning rocks and clumps of dead vegetation and searching within rocky outcrops, sweep-netting for adult and larval amphibians, acoustic surveys, and nocturnal searches. Nine amphibian species were recorded, including two species not located by LVA (1993), and seven reptile species, which included one species not recorded during the 1991-1992 surveys.

## 3.3 Surveys and Data Analysis

### 3.3.1 Sampling Sites / Areas

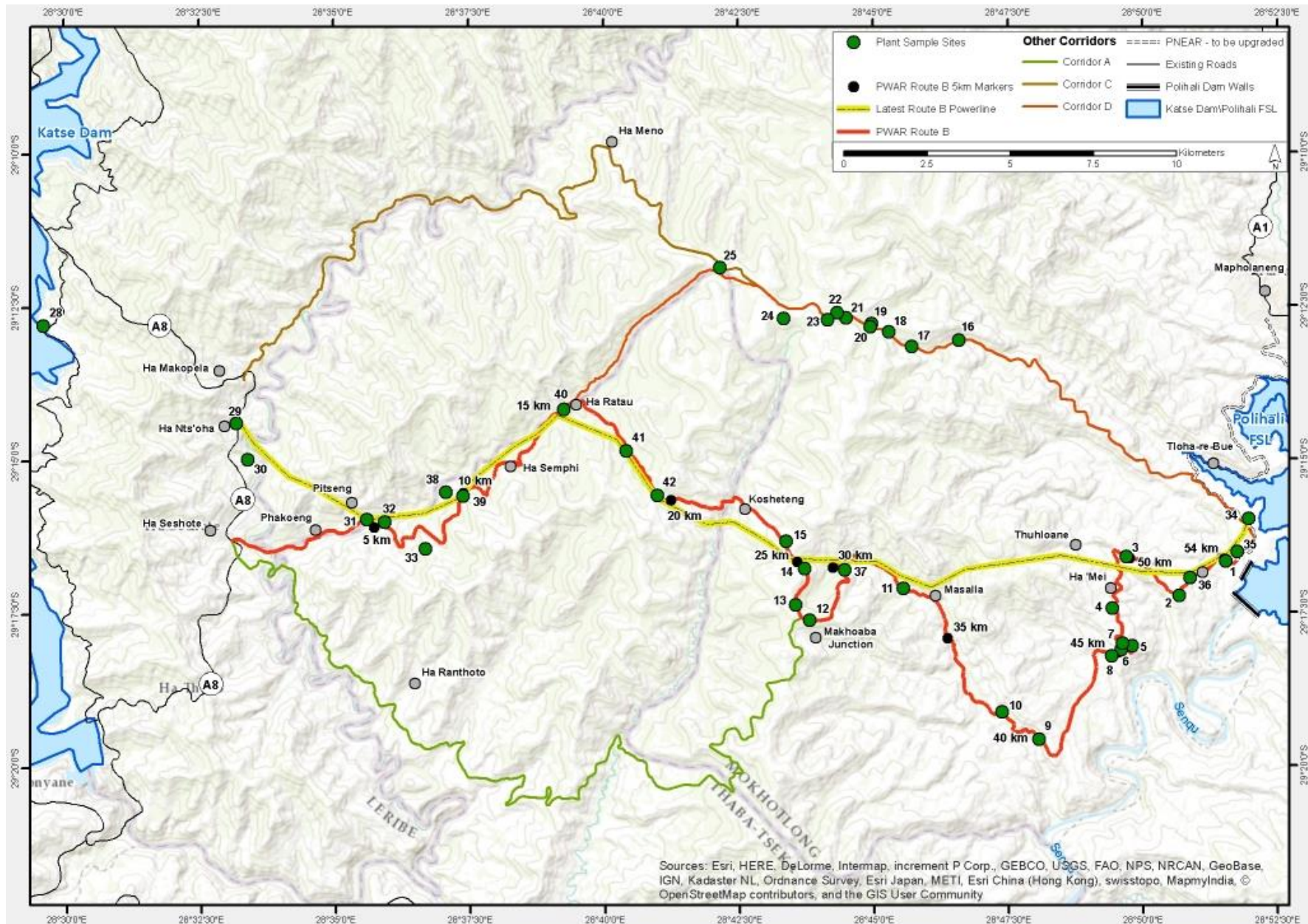
The length of the PWAC was sampled in two trips, the eastern half from 1<sup>st</sup> to 4<sup>th</sup> February 2017 and the western half from 12<sup>th</sup> to 16<sup>th</sup> April 2017. A total of 42 sampling sites were surveyed in representative habitats along the PWAR and Powerline route, including ten locations in sub-alpine habitats along the proposed transmission line following Route Option C (Table 3.1 and Figure 3.1).

**Table 3.1 Sample Sites along the PWAC**

Map No.	Date Surveyed	GPS Coordinates						Location
		Latitude			Longitude			
		Degrees	Minutes	Seconds	Degrees	Minutes	Seconds	
1	Feb 2017	29	16	40.16	28	51	32.15	Route B PWAR
2	Feb 2017	29	17	13.88	28	50	40.26	Route B PWAR
3	Feb 2017	29	16	35.52	28	49	41.12	Route B PWAR
4	Feb 2017	29	17	25.97	28	49	25.94	Route B PWAR
5	Feb 2017	29	18	2.84	28	49	47.54	Route B PWAR
6	Feb 2017	29	18	6.24	28	49	35.77	Route B PWAR
7	Feb 2017	29	18	0.29	28	49	37.18	Route B PWAR
8	Feb 2017	29	18	12.7	28	49	24.99	Route B PWAR
9	Feb 2017	29	19	33.92	28	48	3.64	Route B PWAR
10	Feb 2017	29	19	7.17	28	47	22.83	Route B PWAR
11	Feb 2017	29	17	6.51	28	45	32.62	Route B PWAR
12	Feb 2017	29	17	37.5	28	43	48.57	Route B PWAR
13	Feb 2017	29	17	22.32	28	43	32.59	Route B PWAR
14	Feb 2017	29	16	47.08	28	43	42.72	Route B PWAR/Powerline
15	Feb 2017	29	16	20.1	28	43	21.99	Route B PWAR/Powerline
16	Feb 2017	29	13	3.7	28	46	34.83	Route C Option
17	Feb 2017	29	13	9.75	28	45	42.87	Route C Option
18	Feb 2017	29	12	55.16	28	45	17.34	Route C Option
19	Feb 2017	29	12	47.36	28	44	57.91	Route C Option
20	Feb 2017	29	12	50.32	28	44	56.64	Route C Option
21	Feb 2017	29	12	41.66	28	44	29.78	Route C Option
22	Feb 2017	29	12	36.44	28	44	19.73	Route C Option
23	Feb 2017	29	12	43.54	28	44	9.35	Route C Option
24	Feb 2017	29	12	41.88	28	43	20.18	Route C Option
25	Feb 2017	29	11	52.13	28	42	9.47	Route C Option
26	Apr 2017	29	6	29.9	28	29	32.6	Lejone Power Substation
27	Apr 2017	29	9	53.7	28	28	50.9	Katse Intake Substation
28	Apr 2017	29	12	47.2	28	29	35.5	Matsoku Outlet Tunnel
29	Apr 2017	29	14	23	28	33	9.8	Matsoku Substation
30	Apr 2017	29	14	58.9	28	33	22.7	Route B Powerline
31	Apr 2017	29	15	57.6	28	35	35.5	Route B Powerline
32	Apr 2017	29	16	0	28	35	55.3	Route B PWAR/Powerline
33	Apr 2017	29	16	26.3	28	36	40.3	Route B PWAR
34	Apr 2017	29	15	58.2	28	51	57.9	PWAC New Substation
35	Apr 2017	29	16	31.1	28	51	44.9	Route B PWAR
36	Apr 2017	29	16	56.2	28	50	52.4	Route B PWAR / Powerline
37	Apr 2017	29	16	48.4	28	44	27.8	Route B PWAR / Powerline
38	Apr 2017	29	15	31.2	28	37	3.2	Route B Powerline
39	Apr 2017	29	15	35.1	28	37	22.7	Route B PWAR/Powerline
40	Apr 2017	29	14	10.4	28	39	15	Route B PWAR
41	Apr 2017	29	14	51.1	28	40	24.7	Route B PWAR/Powerline
42	Apr 2017	29	15	34.9	28	40	58.8	Route B PWAR/Powerline



Figure 3.1 Location of Flora and Fauna Transects within the PWAC



### 3.3.2 Natural Resource Use

No focussed natural resource use surveys were undertaken for this study. However, information on natural resource use was obtained as follows:

- During the social data gathering surveys in Focus Group Meetings held in villages along the route; and
- From discussions with local informants encountered during the field survey.

In addition, the botanist (K Kobisi) interviewed a representative of Makhiseng village (on Makhoaba River) on the 3<sup>rd</sup> February 2017 during natural resource use surveys for the ESIA of the PRAI.

Local informants encountered during field surveys were questioned about the use, location, distribution and abundance of spiral aloes. In particular, such discussions were held with people in or near Ha Tsetsane, Ha Salemone, Ha Semphi, and near the Makhoaba River.

### 3.3.3 Field Survey Methods

#### 3.3.3.1 Vegetation and Flora

All visible and identifiable plants were recorded during foot-based transects, with the focus placed on locating species of conservation importance and confirming vegetation communities along the PWAC. Searches were located in areas where the likelihood of finding priority species was optimal, e.g. in less degraded grassland areas; along dolerite outcrops, cliff edges or rocky slopes. Species of uncertain identification were photographed and collected for identification each evening using available literature. Alien species occurring in the Project Area were recorded and photographs of representative individuals taken.

Data on natural resource use were obtained as described in Section 3.3.2 above.

#### 3.3.3.2 Mammals

Mammal sampling was limited to visual observations and collection of evidence such as spoor and dung along the flora transects with a focus on the eastern half of the route. No trapping of small mammals was undertaken due to the low density and diversity of small mammals expected to occur given the widespread degradation and population pressures, and the low risk posed to these fauna from the road and powerline. Additional data from the Katse side were sourced from previous baseline and monitoring data around the Katse reservoir (LVA, 1993; Du Plessis *et al.*, 2014).

#### 3.3.3.3 Herpetofauna

Herpetofaunal sampling took place through active searching of likely reptile and amphibian habitat while walking the flora transects with a focus on the eastern half of the route. This included turning over rocks, examining cracks and crevices in cliff faces, and sitting quietly and waiting for reptiles to sun themselves on exposed rock surfaces. Where possible, reptiles and frogs were caught by hand and photographs of key identification features taken. No pitfall trapping of reptiles or amphibians was undertaken. Additional data from the Katse side were sourced from previous baseline and monitoring data around the Katse reservoir (LVA, 1993; Harvey, 2014).

### 3.3.4 Data Entry and Analysis

Survey transects, and plant and fauna species recorded in the field were recorded with a GPS, photographed if they were of conservation significance, and noted in a field log book. All species and locality data were entered into Excel spreadsheets and plotted in GIS to prepare maps. Raw data are supplied in a separate Excel database.



### 3.4 Impact Assessment Methodology

Impacts were assessed in accordance with the standard impact assessment methodology provided by ERM and the ratings provided in Table 3.2, which are described in more detail in Chapter 3 of the ESIS. The impact significance matrix table allows for impacts of large magnitude on highly sensitive receptors or resources (e.g. endangered/critically endangered species or habitats) to be categorised as Critical, which aligns with critical habitat triggers used by IFC PS6 (IFC, 2012a, b).

A category of Very High sensitivity has been added to enable better differentiation of different portions of the route for ecology risks, where required.

**Table 3.2 Impact Significance Rating Matrix**

Evaluation of Significance		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	Medium	High / Very High
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Critical
	Positive Impacts			
	Positive	Minor	Moderate	Major

Magnitude ratings are derived from a combination of the assessed extent and duration of an impact, and scale and frequency, where impacts can be quantitatively calculated or modelled, e.g. where a percentage of a habitat or species loss can be determined. Where major unplanned events (i.e. ones which cannot be reasonably foreseen to occur (e.g. an oil spill or dam tailings break), the likelihood of the event occurring is also factored into the assignment of magnitude.

Sensitivity ratings were assigned based on the biodiversity importance of the vegetation or faunal receptors (i.e. threatened status or other values such as ecological condition or functional value) and taking into consideration their vulnerability and resilience to the particular impact assessed.

Significance ratings are assigned for impacts before mitigation is applied ('pre-mitigation') and after mitigation has been applied ('residual')<sup>2</sup>.

<sup>2</sup> Residual impact ratings are often referred to as post-mitigation ratings elsewhere but are considered the same in this report.



# Section 4 Baseline Environment

## 4.1 Area of Influence

The potential Area of Influence (Aoi) of the proposed PWAC (referred to in this report as the Project Area) on terrestrial flora and fauna comprises:

- The terrestrial habitats within the footprints (direct impact) of:
  - The ~10 m wide road that will be cleared for construction along a distance of 54.5 km and the immediately adjacent areas affected by rock cutting, spoil deposition, dust and temporary access requirements within a ~30 m wide servitude, and laydown areas estimated at a total of ~170 ha;
  - The pylons and road access tracks required for construction of the 34.5 km powerline, estimated at 18 ha in total for construction of pylons; laydown areas, substation expansions, and access tracks; and
  - Quarries and borrow pits (not confirmed or quantified yet).
- Adjacent habitats along the PWAC that will be impacted by increased human settlement and cultivation that may be encouraged and facilitated by the new road access (induced impact).

## 4.2 Vegetation and Flora

### 4.2.1 Global and Regional Context

#### 4.2.1.1 Terrestrial Ecoregions

At a global scale, three of the world's terrestrial ecoregions are represented in Lesotho, namely Highveld Grasslands (in the drier west), Drakensberg Montane Grasslands, Woodlands and Forests (across much of Lesotho), and Drakensberg Alti-montane Grasslands and Woodlands (along the border with KwaZulu-Natal (KZN))<sup>3</sup>. The western and eastern thirds of the PWAC are located in the Drakensberg Montane Grasslands, Woodlands and Forests ecoregion, which is the ecoregion comprising most of the Drakensberg Mountain range between 1800 and 2500 masl in KZN, Lesotho and the eastern Free State. The higher-lying central part of the PWAC lies within the Drakensberg Alti-montane Grasslands and Woodlands ecoregion, which is the alpine part of the Drakensberg Mountains above 2500 masl.

#### 4.2.1.2 National Vegetation Types

Four sources of information have been reviewed on vegetation type mapping for the PWAC. These are:

- 1 Mucina and Rutherford (2006) mapping of the Southern African region
- 2 CES (2014) mapping of the Polihali Reservoir Project Area
- 3 Rangeland Inventory (1983) mapping of vegetation types
- 4 LHWP Phase 1a (Katse) vegetation transects

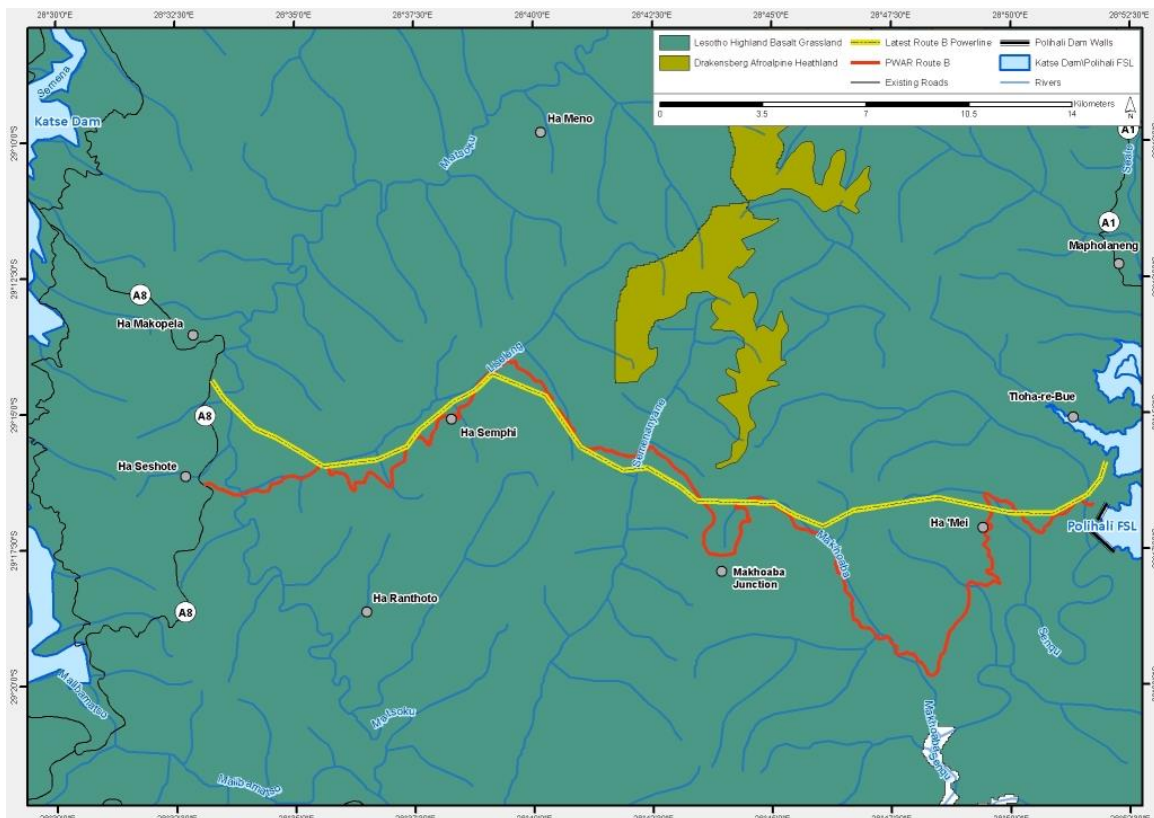
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<sup>3</sup> [www.worldwildlife.org/ecoregions/at1003](http://www.worldwildlife.org/ecoregions/at1003). Accessed 13 March 2017

## 1. Mucina and Rutherford Vegetation Types

Mucina and Rutherford (2006) describe eleven vegetation types for Lesotho, most of which are grassland / shrubland formations (nine vegetation types), and two of which are wetlands (Lesotho Mires, Drakensberg Wetlands). Lesotho Highland Basalt Grassland covers the majority of the PWAC, while Drakensberg Afroalpine Heathland is present in the mountains to the north of the PWAC (Figure 4.1). Senqu Montane Shrubland is present in the Senqu River valley to the south of the PWAC. Lesotho Highland Basalt Grassland is the dominant vegetation type on the high basalt plateau of central and eastern Lesotho, also occurring in eastern Free State and north-eastern Eastern Cape, as well as marginally into KwaZulu-Natal. The predominant terrain is rugged, comprising numerous high peaks and plateaus, between which are deeply incised valleys, such as the Senqu and Khubelu River valleys. Vegetation is closed, short grassland with *Festuca caprina* dominant at higher altitudes and *Themeda triandra* more prominent at medium to low altitudes. Disturbed areas are characterised by low shrubland dominated by *Chrysocoma ciliata* and *Pentzia cooperi*. Lesotho Highland Basalt Grassland has a high proportion of species endemic to the Drakensberg Mountains, such as *Berkheya cirsiifolia*, *Diascia anastreptera*, *Glumicalyx lesuticus*, *Helichrysum basalticum*, *Heliophila alpina*, *Lobelia galpinii* and *Eucomis schiffii*. In addition, there are a number of species that are endemic to this vegetation type, including *Argyrobolium summomontanum*, *Helichrysum nimbicola*, *Lessertia dykei*, *Polygala erubescens*, *Gladiolus saundersii*, *Jamesbrittenia lesutica* and *Aloe polyphylla*. The vegetation type has been classified as Least Threatened by Mucina and Rutherford (2006).

**Figure 4.1 Vegetation Types in the PWAC Project Area (Mucina and Rutherford, 2006)**



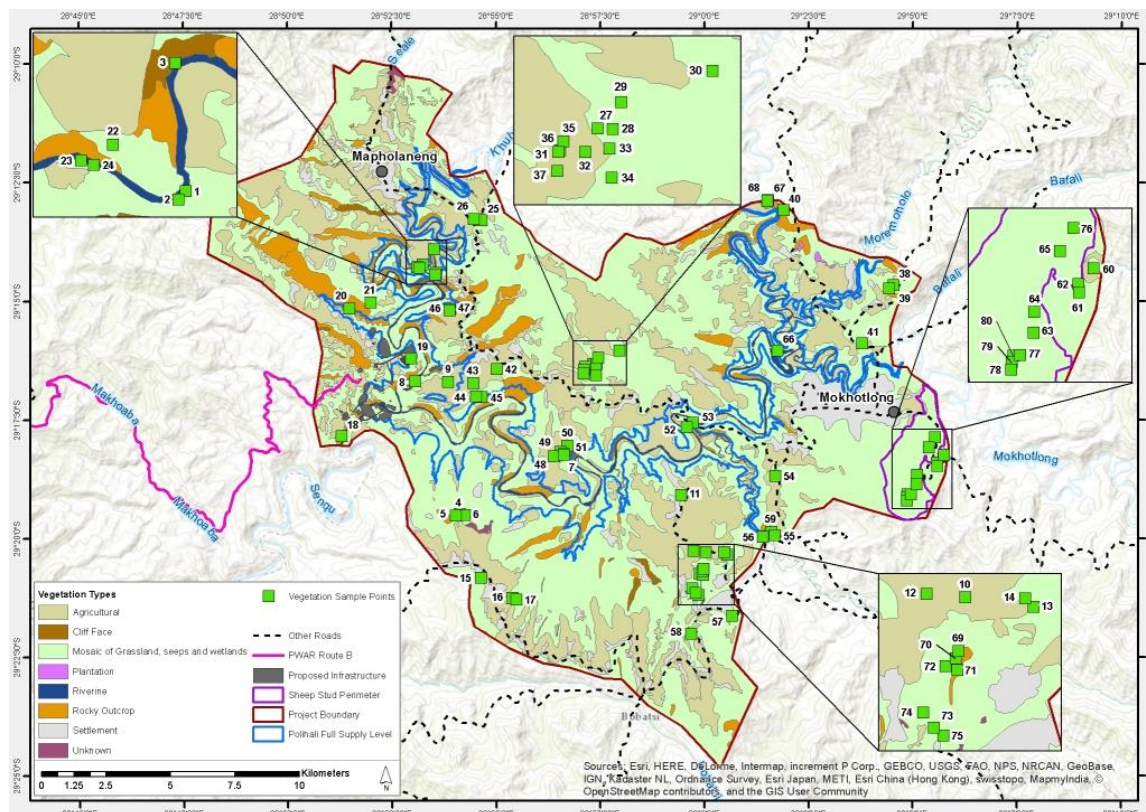
## 2. CES Vegetation Mapping

Land cover / vegetation type mapping for the Polihali Reservoir Project Area by CES (2014) distinguished grassland, seeps and wetlands; cliffs; rocky outcrops; woodland; riverine; agriculture, and water. Different grassland communities were not distinguished. Only a small portion of the CES mapped area covers the easternmost end of the PWAC.

The CES (2014a) study recorded four flora species of conservation concern, all listed as Vulnerable on the Lesotho Red Data list, none of which are considered threatened by IUCN and none of which were recorded in the transect (18) near the PWAR. These are *Jamesbrittania lesutica*; *Urginea saniensis*; *Aloe polyphylla* and *Dicoma anomala*. *Aloe polyphylla* (Spiral Aloe) was only recorded planted near households. No wild spiral aloe plants were found in the Polihali Reservoir area.

The broad vegetation communities described and mapped in CES (2014a) correspond broadly with the lower altitudes along the eastern quarter of the PWAC. The subalpine communities along the central part of the PWAC fell outside of the area surveyed by CES and include different vegetation communities such as subalpine dwarf shrubland and high-altitude seep wetlands.

**Figure 4.2 Vegetation Types in the PRAI Project Area and Overlapping the PWAR (CES, 2014)**



## 3. Rangeland Inventory Mapping

The vegetation ('ecological units') mapping prepared for the whole country under the Rangeland Inventory in the early 1980s (see Section 3.2.2.3) identified 47 vegetation type across the Lesotho Highlands of which six classes fall along the PWAC Project Area (Figure 4.3).

The lower-lying western and eastern thirds of the PWAC have been mapped as "*Cymbopogon sp.* communities" and "Lower Foothills Lower Slope Grassland", which was corroborated by field data for this study. The steeper, warmer slopes at these altitudes are dominated by species such as



*Cymbopogon dieterlenii*, while the more gentle slopes and crests are dominated by shorter species such as *Aristida congesta*. The higher slopes above the *Cymbopogon* communities are mapped as “*Themeda triandra* communities”, particularly between Ha Mei and Makhoaba Junction. While *Themeda triandra* is certainly present on these higher slopes and crests, the heavily grazed state of much of the grassland made it impossible to determine whether it is still a dominant species or not. The subalpine section of the PWAC between Makhoaba Junction and Ha Semphi is mapped as a mosaic of four vegetation types, namely “*Festuca caprina* dominated communities”, “*Merxmuellera macowanii* communities”, “Lesotho Highland Basalt Grassland” and “uKhahlamba Basalt Grassland”. *Festuca caprina* is a dominant and diagnostic species of the highest altitudes along the PWAC, as well as several *Merxmuellera* species, which supports the MDTP vegetation map, although the boundaries and extent of these communities are not easily defined in the field. The vegetation class mapped as uKhahlamba Basalt Grassland (shown in Figure 4.3 to occur in a small area of the route (light green in map)) is mis-mapped as it is generally confined to the basalt cliff zone along the Lesotho / KwaZulu-Natal border and is unlikely to be present in the PWAC Project Area. This area should be merged with the Lesotho Highland Basalt Grassland vegetation type.

#### 4. Katse Basin Vegetation Transects and Land Cover Mapping

Vegetation transects were done in the Katse Catchment by Barker *et al.* (2014) at plots sampled during previous annual monitoring surveys between 1996 and 2000 by AfriDev. Vegetation types identified in the Katse Catchment during baseline sampling in the early 1990s are summarised in Table 4.1.

**Table 4.1 Vegetation Types identified within the Katse Catchment (LVA, 1993)**

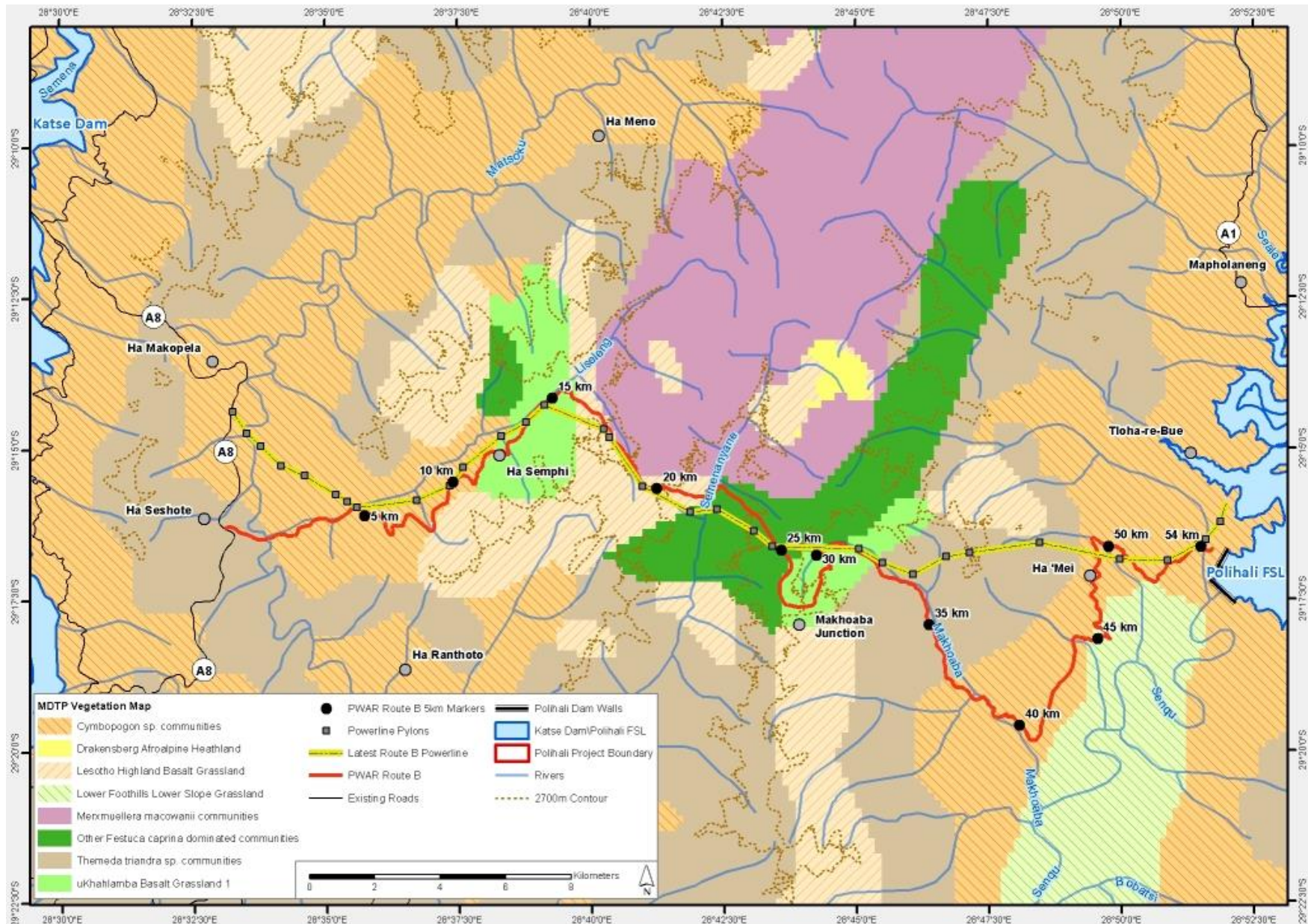
Vegetation Belt	Vegetation Community
Temperate Alpine Belt	<i>Merxmuellera</i> temperate grassland
	<i>Merxmuellera disticha</i> / <i>Festuca caprina</i> temperate grassland
Temperate / Subtropical Alpine Belt	<i>Merxmuellera disticha</i> / <i>Themeda triandra</i> mixed grassland
	<i>Merxmuellera disticha</i> / <i>Harporchloa falx</i> mixed grassland
Subtropical Subalpine Belt	<i>Themeda triandra</i> / <i>Eragrostis curvula</i> subtropical grassland
Subtropical Montane Belt	<i>Catalepis gracilis</i> subtropical grassland
	<i>Cymbopogon plurinodis</i> subtropical grassland

Comparison of 1991/2 and 2014 vegetation transect data produced the following conclusions:

- Flora comprised a suite of species that are common in the long term, as well as a suite of species that show a short-term turn-over that may be related to factors such as fire or grazing history;
- Frequency of shrubby species has remained relatively stable within the surveyed vegetation plots;
- Relative abundance of the more palatable decreaser grasses diminished by 4.3%, and the less palatable increaser grasses decreased by 2.4%;
- Amount of bare ground in transects increased by 32%, implying that plant density has been reduced, probably as a consequence of inappropriate land use practices (overgrazing in particular, and the associated effect of trampling);
- A number of invasive alien species had become locally common, most notably *Salix fragilis* and *Rosa rubiginosa*, as well as an indigenous pioneer species, *Artemisia afra*; and
- No populations of the spiral aloe (*Aloe polyphylla*) were located, but two populations of the rare *Euryops inops* were found.

This trend in vegetation cover is mirrored by the results of the remote sensing derived classification for three years (1993, 2005 and 2013) over a 20-year period as discussed in Section 4.2.1.3.

Figure 4.3 'Historic' (1983) Vegetation Types (Ecological Units) from Rangeland Inventory (MDTP, 2007)



#### 4.2.1.3 Land Degradation

Remote-sensing derived land cover mapping (Turpie *et al.*, 2014) that was done for the LHWP Phase 1 areas overlaps approximately two thirds of the PWAC alignment. This was used to extrapolate relevant information to provide historical context to the vegetation and range condition of the PWAC. The land cover data from LHWP Phase 1 were used to understand the baseline trends in land cover changes within the 30 m Road Reserve of the PWAR. Results are summarised in Table 4.2 and Figure 4.4.

Changes in land cover along the PWAC showed a decrease in good quality grasslands (NDVI class 1) from 34% to 21%, while the area of degraded grassland increased from 7% to 14% (Level 4), and from 3% to 7% for the most degraded class (Level 5). The area of cultivated land doubled over this 20 year period from 7% to 15%. Interestingly, the extent of increase in short shrubs along the PWAC did not significantly increase but it is expected that the extent of this type may have increased more in areas further away from the PWAC. The most significant changes were seen in the last 8 years from 2005 to 2013, as can be seen at a glance by the extent of yellow areas in Figure 4.5.

**Table 4.2 Land Cover Extent in the PWAR (30-m Road Reserve) in 1993, 2005 and 2013**

LandCover Class	1993 Area (ha)	%	2005 Area (ha)	%	2013 Area (ha)	%
<i>Leucosidea</i> (Tall woody) Communities	11.79	0	52.74	0	54.72	0
<b>NDVI Level1 high (Pristine)</b>	<b>3 853.80</b>	<b>34</b>	<b>3 652.47</b>	<b>32</b>	<b>2 367.00</b>	<b>21</b>
NDVI Level 2	2 853.81	25	2 712.15	24	2 181.06	19
NDVI Level 3	1 757.97	15	1 748.25	15	1 984.59	17
<b>NDVI Level 4</b>	<b>854.82</b>	<b>7</b>	<b>818.19</b>	<b>7</b>	<b>1 464.57</b>	<b>13</b>
<b>NDVI Level 5 low (Degraded)</b>	<b>399.87</b>	<b>3</b>	<b>378.81</b>	<b>3</b>	<b>787.50</b>	<b>7</b>
Ridgelines	701.10	6	702.36	6	698.49	6
Short Shrub ( <i>Chrysocoma</i> )	43.11	0	62.37	1	99.09	1
<b>Subsistence Farming</b>	<b>829.98</b>	<b>7</b>	<b>1 227.60</b>	<b>11</b>	<b>1 713.87</b>	<b>15</b>
Wetlands	131.49	1	118.62	1	112.50	1
		100		0		100

**Figure 4.4 Change in Extent of Land Cover and Vegetation Classes along the PWAC**  
(derived from Remote Sensing Based Mapping for Katse Reservoir Catchment by Turpie *et al.*, 2014)

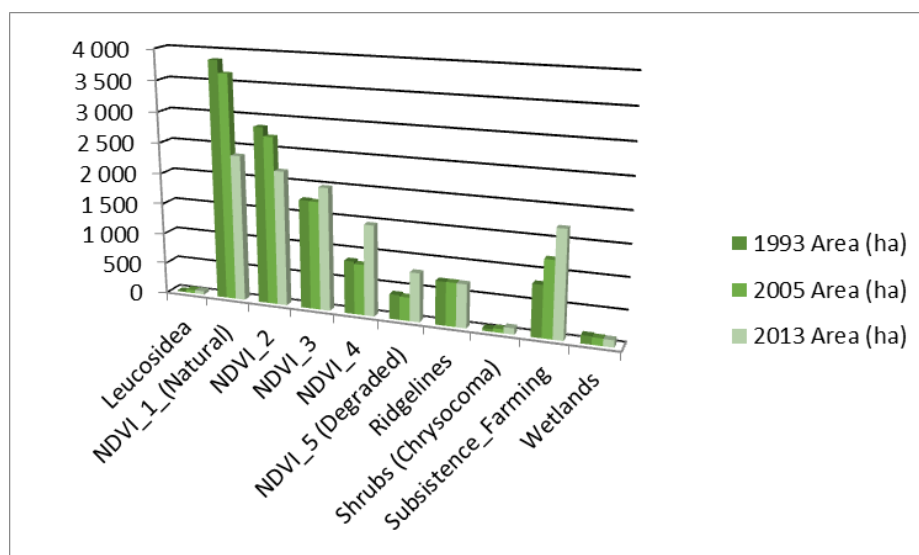
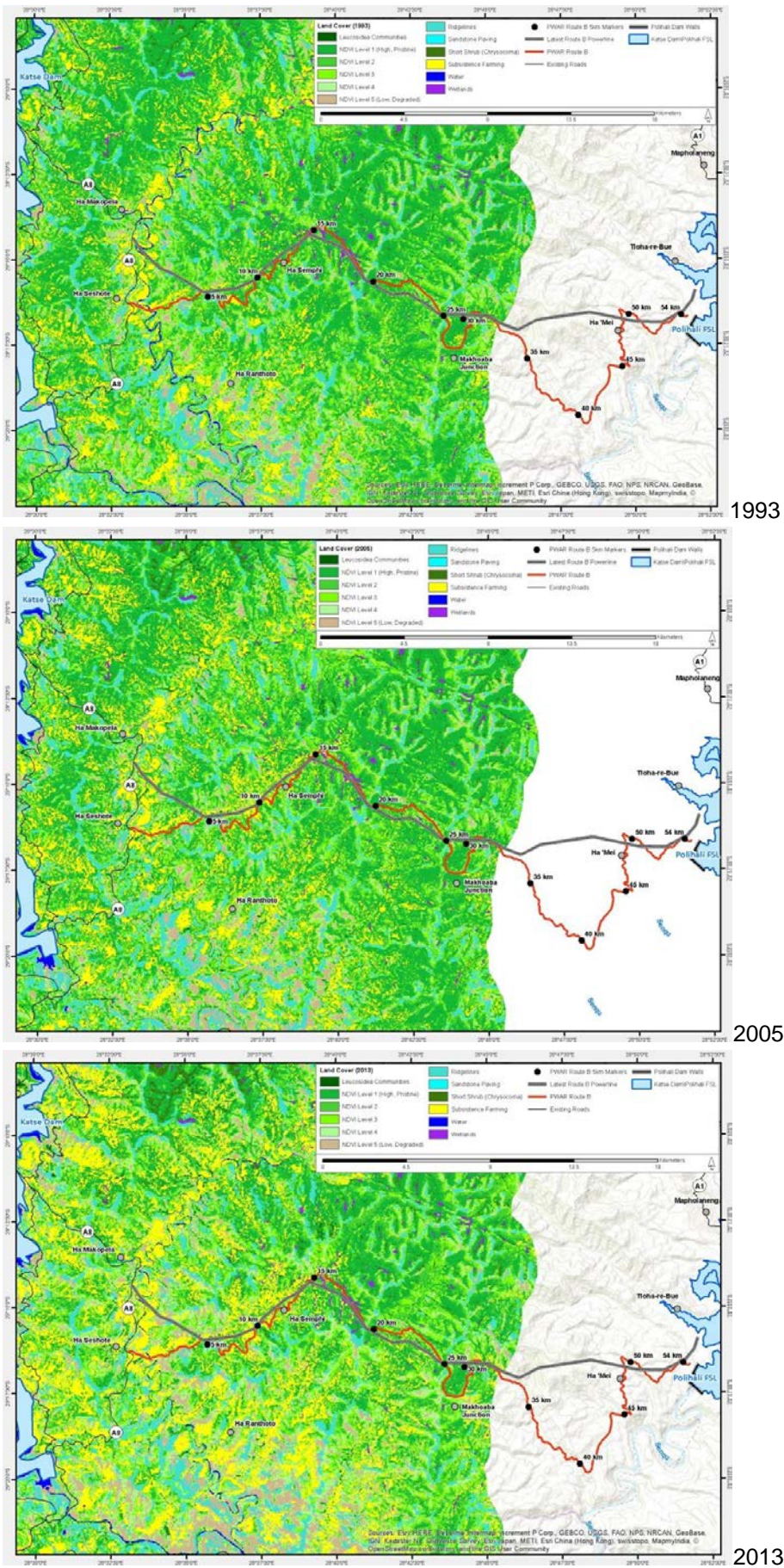




Figure 4.5 Land Cover Mapping for 1993, 2005 and 2013 (Turpie *et al.*, 2014)



#### 4.2.1.4 Centres of Endemism

The Project Area is situated within the Drakensberg Alpine Centre (DAC) of plant endemism (Van Wyk and Smith, 2001; Carbutt and Edwards, 2004, 2006). This centre of plant endemism covers approximately 40,000 km<sup>2</sup> of the Drakensberg Mountain Range in Lesotho and South Africa, and comprises six floristic regions (Hilliard and Burtt, 1987), with the alpine region of the Lesotho Maloti Mountains and KwaZulu-Natal Drakensberg summit being the region in which the Project Area is situated. The DAC has the fourth richest flora of any regional centre of endemism in South Africa; with an estimated 2618 species of vascular plants present (Carbutt and Edwards, 2006).

Approximately 13% of the plant species occurring in the DAC are strictly endemic to the region and 24% are near-endemic, which is a high level of endemism relative to some other centres of endemism in South Africa (Carbutt and Edwards, 2004). Less than 6% of the DAC is currently conserved, mostly in the uKhahlamba-Drakensberg Park in KwaZulu-Natal, and despite the Lesotho Maloti Mountains dominating much of the DAC, only 3% of the conserved land in the DAC falls within this region, such as the Sehlabathebe National Park (Carbutt and Edwards, 2006).

#### 4.2.1.5 Priority and Protected Areas

Conservation priority areas and protected areas of Lesotho in relation to the Project Area are shown in Figure 4.6 and Figure 4.7 and summarised in Table 4.3. None of the formally designated protected areas lie close to the Project Area.

The PWAC lies at a considerable distance to any of the conservation priority nodes identified by the systematic conservation planning process for the MDTP (Figure 4.6). It is also located to the west of the Maloti Drakensberg Transfrontier Conservation Area (MDTCA), an area defined along the border with South Africa as a priority for improved rangeland management and biodiversity conservation (Figure 4.7). The most important priority areas identified by the MDTP for enhanced protection are located along the escarpment border with South Africa and therefore are located quite some distance from the PWAC. However, no conservation actions are focussed on this area as yet. In the absence of further funding, the MDTP is currently mainly focussed on the Sehlabathebe National Park which remains Lesotho's flagship protected area and which is designated as part of the Drakensberg Ukhahlamba World Heritage Site. Any future rangeland and biodiversity conservation activities in these upper catchment areas would benefit and enhance the Polihali reservoir, particularly given the seriously degraded state of most of the catchment wetlands and rangelands, and would help to attenuate runoff and sedimentation. The upper catchment areas should be the focus of future conservation actions under broader conservation initiatives in the region.

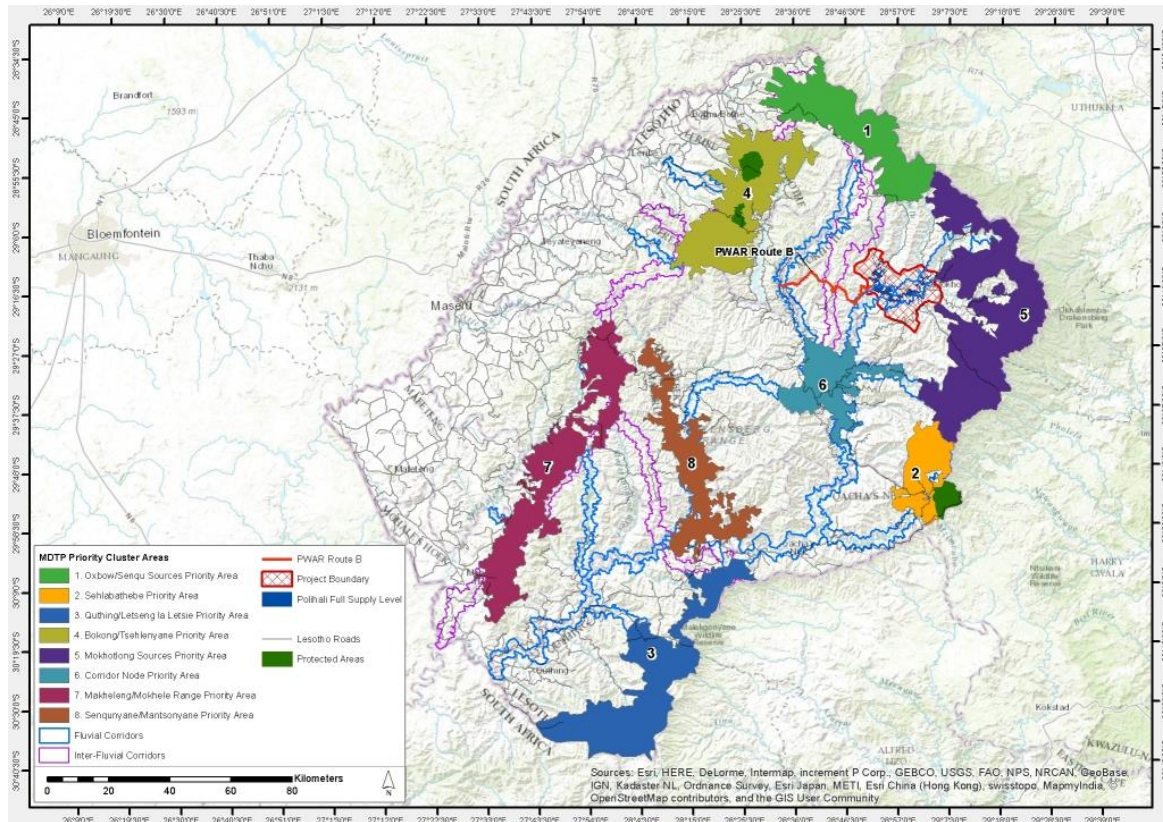
**Table 4.3 Protected Areas of Lesotho**

Name	Size <sup>4</sup>	IUCN Class
Sehlabathebe National Park	6475 ha	II
Tsehlanyane Nature Reserve	5300 ha	II
Bokong Nature Reserve	1972 ha	II
Lets'eng la Letsie (Ramsar site)	434 ha	VI
Range Management Areas (total)	~185,684 ha	VI
Mokhotlong/Sanqebethu Range Management Area (RMA)	52 000 ha	VI

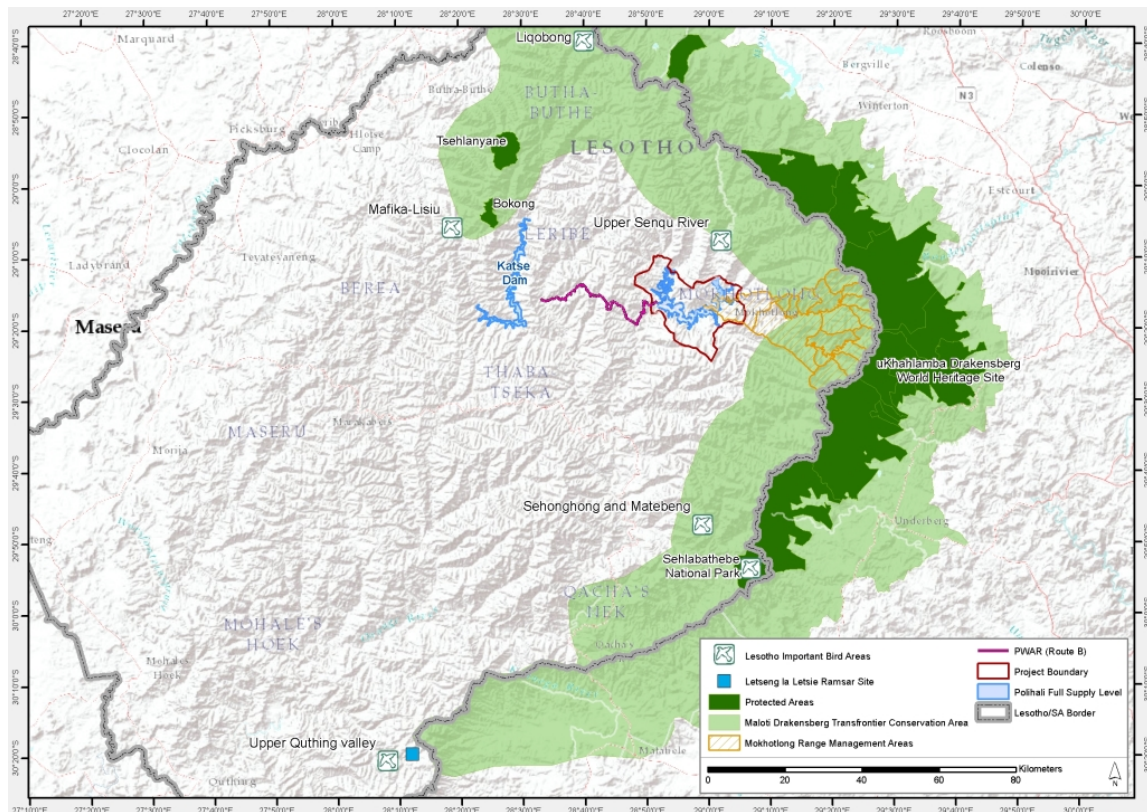
<sup>4</sup> Areas obtained from Lesotho Biodiversity Strategy and Action Plan for Sehlabathebe, Tsehlanyane, Bokong and RMAs (NES, 2000) and may not be accurate.



**Figure 4.6 Conservation Priority Areas of Lesotho in Relation to the Project Area (MDTP, 2007)**



**Figure 4.7 Protected Areas of Lesotho in Relation to the Project Area**



## 4.2.2 Description of Vegetation Types

Two broad vegetation associations are present along the PWAC, based on distinctive physiognomy and floristic composition, described below.

### 4.2.2.1 Montane Grassland

This is the dominant vegetation association across most of the length of the PWAC. Vegetation structure is low closed grassland at higher altitudes where grazing has been less severe, and open to sparse grassland in heavily overgrazed areas at lower altitudes or on very steep slopes. Key drivers of species composition in grasslands in the Phase 1 areas are altitude and aspect according to Barker *et al.* (2014). The impact of altitude is evident along the PWAC with the higher plateaus and ridges being dominated by grass species such as *Themeda triandra*, *Festuca caprina*, *F. scabra*, *Poa binata*, *Merxmullera disticha* and *Koeleria capensis*, and mountain slopes at lower altitudes being dominated by *Aristida* species, *Cymbopogon dieterlenii* and *Eragrostis* species. Another key driver of species composition in the grasslands along the PWAC is grazing pressure. Grass species that decrease when heavily grazed (Decreasers), such as *Themeda triandra*, *Eragrostis capensis* and *Helictotrichon turgidulum*, are more evident in the high-lying areas that are only seasonally grazed, while species that increase when heavily grazed (Increasers) such *Aristida congesta*, *A. diffusa*, *Eragrostis curvula* and *E. chloromelas* are more prominent at lower altitudes where grassland is grazed throughout the year. While grass species diversity is relatively high in Montane Grassland along the PWAC, the diversity of forbs and geophytes is even higher although no species are clearly dominant. Forb species observed during fieldwork included *Scabiosa columbaria*, *Alepidea thodei*, *Dianthus basuticus*, *Felicia muricata*, *Helichrysum aureum* and *Arctotis arctoides*, while geophytes included *Gladiolus permeabilis*, *Dipcadi gracillimum* and *Dierama* species.

An important habitat for plants embedded within the Montane Grassland vegetation association is Rocky Ridges and Outcrops. These areas have a distinct flora that is dominated by succulents such as *Euphorbia clavarioides*, *Crassula natalensis* and *Delosperma hirta*, dwarf shrubs such as *Lobelia galpinii* and *Searsia divaricata*, and small, xerophytic ferns such as *Mohria vestita* and *Cheilanthes eckloniana*. A number of geophytes appear to be restricted to these rocky outcrops as well, including the endemic *Eucomis schiffii*, as well as *Haemanthus humilis* and *Bulbine narcissifolia*.

Seep wetlands are another habitat that is embedded in Montane Grassland but this is dealt with in a separate wetlands specialist report (WCS, 2017: P2W-6004-DFR-0005).

### 4.2.2.2 Montane Shrubland

Montane Shrubland is associated with the highest mountain peaks and upper slopes, and is more prominent along the PWAC Option C route at altitudes of over 2800 masl than on the selected Route B, although small patches are present in the central parts of the PWAC. At lower altitudes, another form of dwarf shrubland is present on steep, heavily grazed mountain slopes at the eastern end of the PWAC near the Polihali Reservoir. Vegetation structure is low, open to closed shrubland with a relatively sparse grass understory. *Helichrysum trilineatum*, *Chrysocoma ciliata* and *Pentzia cooperi* are dominant species at higher altitudes, often forming dense stands, while *Euryops tysonii* is more prominent in heavily grazed slopes at lower altitudes.

Representative vegetation types in the PWAC Project Area are shown in Figure 4.8.



**Figure 4.8 Photographs of Representative Habitat Types Along the PWAC**



Photo 1. Cultivated fields and willow trees along Liseleng River valley (kp 3.5)



Photo 2. Poplar woodlot along Liseleng River at kp5



Photo 3. *Festuca caprina* grassland in Liseleng River valley near Ha Sekolopata (kp 18) (high altitude 2600m)





Photo 4 Wetland (valley head fen) at Ha Sekolopata (kp 16.5) with *Festuca* dominated grassland (~2500m)

Photo 5. Seep zone habitat



Photo 6. Subalpine shrub vegetation kp 21 (~2800m) – view down to Semenanyane River



Photo 7. Makhoaba River valley (kp 41) (~2050m)

Photo 8. Rocky habitat



Photo 10. Liseleng River with *Merxmuellera disticha* (high altitude; kp 16 (~2500m)

Photo 11 Example of good grassland cover habitat at Ha Ratau (high altitude) kp 17



## 4.2.3 Species of Conservation Importance

### 4.2.3.1 Species of Conservation Concern (threatened, near threatened)

Seven of the species recorded along the PWAC during this study are considered species of conservation concern as defined by Raimondo *et al.*, (2009) and as assessed by Talukdar, 2002 (Table 4.4). Each of these species is dealt with in more detail below and photos of selected species are displayed in Figure 4.9. The most threatened of these species according to Talukdar (2002) is *Boophane disticha*, which is classified as Endangered because of a high demand within the traditional medicine industry resulting in declining populations. However, this species is still relatively widespread in the country (*pers. obs.*) and does not meet the IUCN criteria for EN. Four species occurring along the PWAC have been classified as Vulnerable in Lesotho (Talukdar, 2002), two of which are endemic to Lesotho (*Aloe polyphylla*, *Jamesbrittenia lesutica*), and two which are widespread species in grasslands throughout Lesotho and South Africa (*Eucomis autumnalis*, *Dicoma anomala*). Two Near Threatened species, *Aristaloe aristata* and *Cotula paludosa*, were confirmed to occur just outside of the PWAC during fieldwork but are also potentially present on the route (Figure 4.10).

#### ***Aloe polyphylla* (Vulnerable)**

This iconic Maloti Mountain species is endemic to Lesotho and is a very popular horticultural collection. Overcollecting has resulted in populations declining and even disappearing at certain sites and it has thus been classified as Vulnerable. The only individuals of this species that were located along the PWAC were planted in villages such as Ha Salemone and Makhoaba. However, discussions with residents near Kosheteng revealed that wild plants are still present at the highest altitudes in the mountain tops above the Kosheteng sheep stud. These plants are unlikely to be directly impacted by the road construction but may be indirectly impacted through improved access to aloe sites for collectors.

#### ***Aristaloe aristata* (Near Threatened)**

This small aloe was found planted in villages such as Ha Salemone, but was not located along the PWAC during fieldwork. However, a small population was discovered in rocky habitat along the Khubelu River just to the east of the eastern end of the PWAC within the PRAI footprint. Since suitable habitat is present along the PWAC it is likely to be present at other localities. *Aristaloe aristata* is listed as a near-endemic of the DAC by Carbutt and Edwards (2006). It is widely collected in Lesotho and populations have been documented as declining (Talukdar, 2002).

#### ***Boophane disticha* (Endangered)**

*Boophane disticha*, which is called “*Leshoma*” in Sesotho, grows on dry rocky north-east facing slopes from the foothills to the mountains. Fairly large numbers of this plant were located at kp 7-8 in a complex of sheetrock seepage systems and terrestrial rocky habitat, but this was the only site along the PWAC at which this distinctive species was recorded. *Boophane disticha* is relatively widespread in Lesotho but it is heavily collected by traditional healers resulting in population declines in some areas. It is declared protected by Ministry of Tourism Environment and Culture (MTEC) under Legal Notice, No.36 of 1969 as amended by Legal Notice, No. 39 of 2004 and No. 38 of 2006.

#### ***Cotula paludosa* (Near Threatened)**

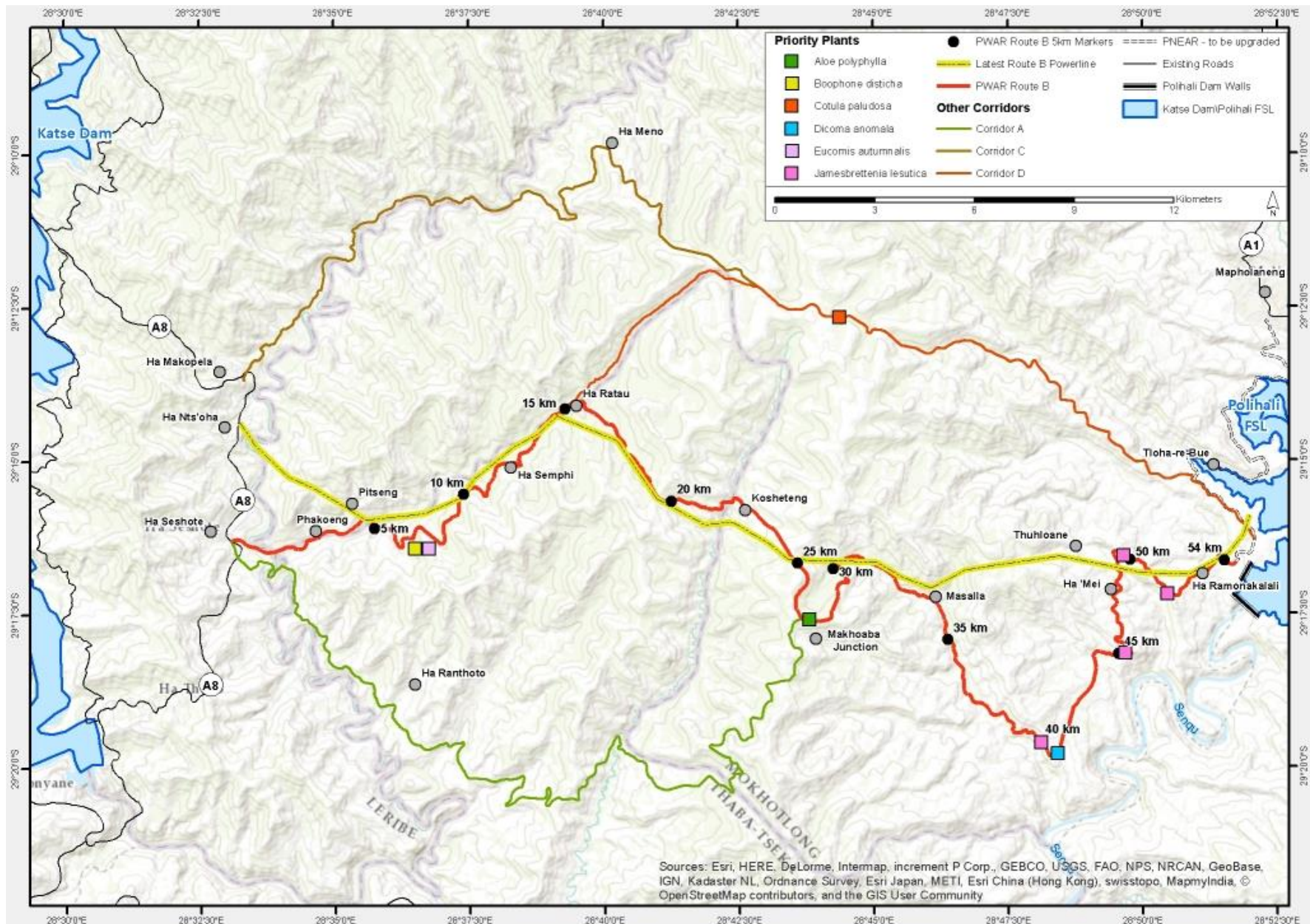
*Cotula paludosa* is a high-altitude seep specialist that is strictly endemic to the DAC (Carbutt and Edwards, 2006). Suitable habitat is present along the PWAC but the species was only located at a large wetland system along the transmission line route to the north of the PWAC, and at a site west of the Polihali Reservoir during fieldwork for that project.

**Table 4.4 Species of Plants of Conservation Concern**

Taxon	Sesotho Name (where known)	Growth Form	Red Data Status	DAC Endemic	Preferred Habitat	kp reading / Location	Abundance
<b>Asteraceae</b>							
<i>Cotula paludosa</i>		Forb	Near Threatened	Strict	Hillslope seeps, fens	Not confirmed along PWAC; found above Ha Mokone adjacent PRAI and along transmission line route	Locally common
<i>Dicoma anomala</i>	Hloenya	Forb	Vulnerable	Not endemic	Rocky grassland on hillslopes and plateaus	kp 7-8, 41	Common
<b>Amaryllidaceae</b>							
<i>Boophane disticha</i>	Leshoma	Geophyte	Endangered	Not endemic	Rocky scrub in valleys or on hillslopes	kp 7-8	Uncommon
<b>Asphodelaceae</b>							
<i>Aristaloe aristata</i>	Lekhalana	Succulent	Near Threatened	Near	Rocky scrub in valleys or on hillslopes	Not confirmed along PWAC; found along Khubelu River adjacent to eastern end of PWAC	Uncommon
<i>Aloe polyphylla</i>		Succulent	Vulnerable	Near	Rocky scrub in valleys or on hillslopes >2000m	Several villages along the route (Ha Salemone to Mokhoaba); reported to still occur in mountain tops above Kosheteng sheep shed at kp 24	Uncommon
<b>Hyacinthaceae</b>							
<i>Eucomis autumnalis</i>		Geophyte	Vulnerable	not endemic	Grassland on gentle slopes and plateaus, edges of hillslope seeps	kp 7-8	Scarce
<b>Scrophulariaceae</b>							
<i>Jamesbrittenia lesutica</i>		Forb	Vulnerable	Strict	Rocky grassland and dwarf shrubland on steep slopes	kp 50, 45-46, 40	Fairly common



Figure 4.9 Locations of Conservation Priority Plant Species Recorded along the PWAC





***Dicoma anomala* (Vulnerable)**

*Dicoma anomala* is a widespread and common species in the grassland biome in South Africa and Lesotho, and was frequently encountered in rocky grassland on hillslopes and mountain tops throughout the Project Area. It was assessed as Vulnerable in Talukdar (2002), but possibly in error, as population size, extent of occurrence and area of occupancy do not meet the thresholds for threatened status. Reassessment of this species under IUCN criteria is likely to result in a status of Least Concern, which is its status in neighbouring South Africa.

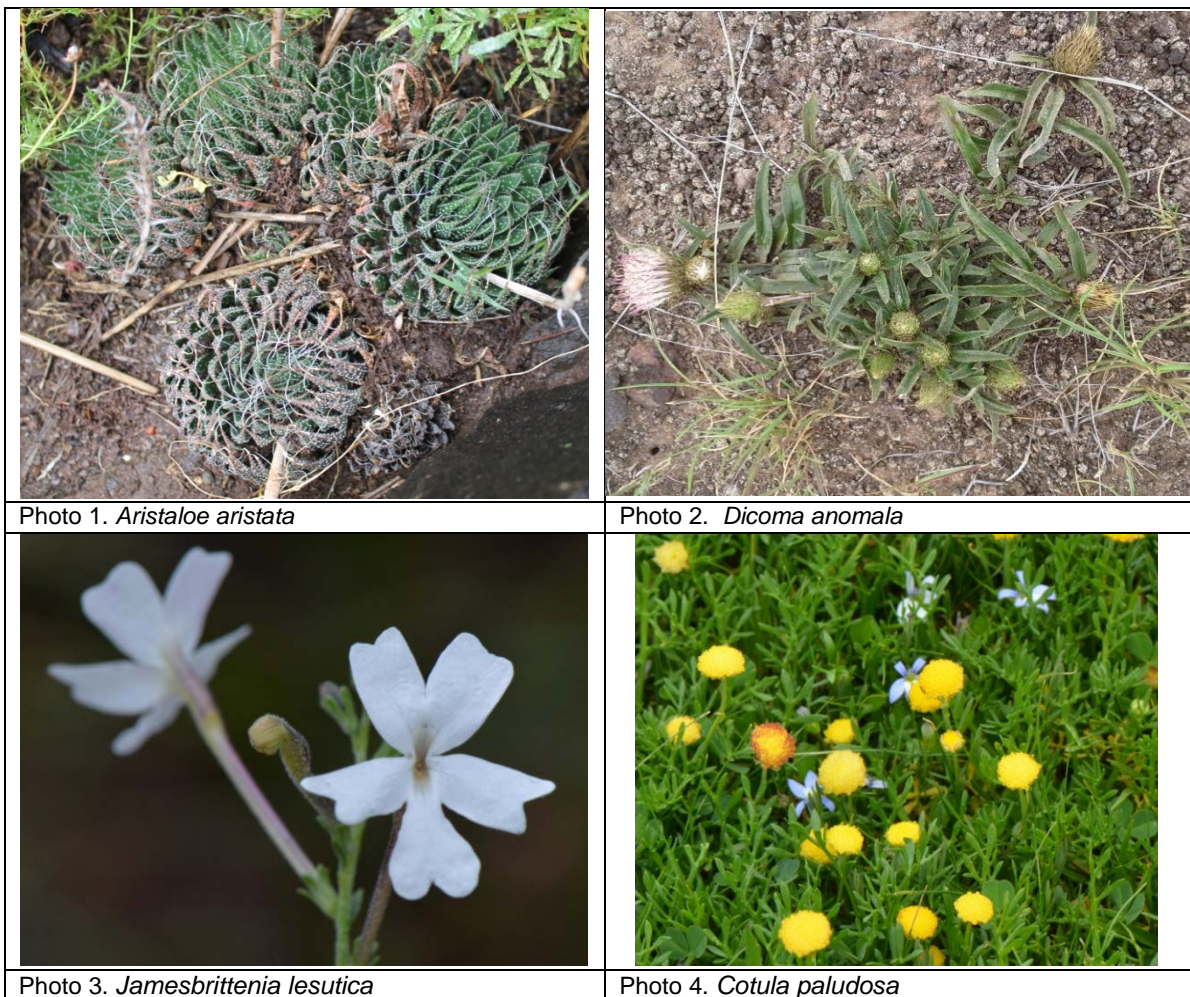
***Eucomis autumnalis* (Vulnerable)**

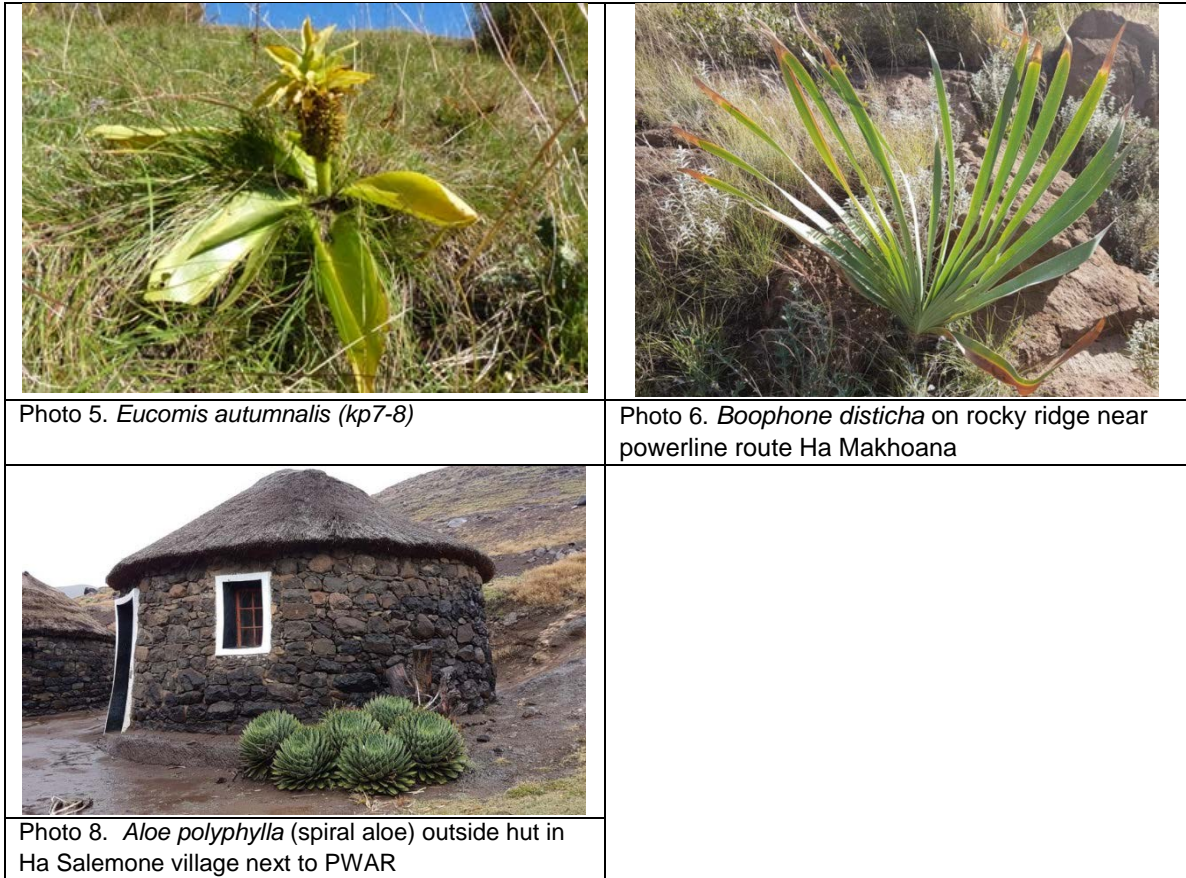
The pineapple flower is a widespread grassland geophyte in South African and Lesotho. A single population was located in the same complex of sheetrock seepage systems and terrestrial rocky habitat that *Boophone disticha* was found in at kp 7-8 of the PWAR. It is a widely used medicinal plant that has been heavily harvested throughout its range and populations are declining in South Africa and Lesotho (Williams *et al.*, 2008).

***Jamesbrittenia lesutica* (Vulnerable)**

This attractive species is endemic to the Mokhotlong district in eastern Lesotho and is therefore strictly endemic to the DAC (Carbutt and Edwards, 2006; Talukdar, 2002). It was found to be fairly widespread and relatively common in rocky grassland and dwarf shrubland on mountain slopes along the eastern half of the PWAC.

**Figure 4.10 Representative Species of Conservation Concern**





Source: Photo 1, 2, 6: K Kobisi 2017; Photo 3 & 5: W McClelland; Photo 4: G Marneweck; Photo 7: J Hughes

#### 4.2.3.2 Species Endemic or Near-Endemic to the Drakensberg Alpine Centre

About 334 species are endemic and 595 species near-endemic to the DAC (Carbutt and Edwards, 2006). About 27% of the 254 plant species recorded along the PWAR during fieldwork are either strictly endemic (18 species) or near-endemic (52 species) to the DAC (Appendix 2). One of the strict endemics, *Jamesbrittenia lesutica*, has a very restricted range within the DAC and is currently believed to be confined to parts of Mokhotlong District. Two species are considered endemic to Lesotho, namely *Aloe polyphylla* and *Relhania dieterlenii*. Five plant families contribute three or more strict / near endemic species in the Project Area, with the largest contribution from Asteraceae (19 species) and Scrophulariaceae (13 species) (Table 4.5). The family Asteraceae also has 69% of the strict endemics found in the Project Area. Photos of select endemic or near endemic plant species confirmed to occur in the Project Area are displayed in Figure 4.11.

**Table 4.5 Plant Families with the Most Endemic and Near-Endemic Plant Species in the Project Area**

Family	Strict Endemics	Near Endemics	Total
Asteraceae	7	12	19
Scrophulariaceae	5	8	13
Geraniaceae	0	3	3
Iridaceae	1	1	2
Poaceae	0	6	6



Figure 4.11 Photos of Some Endemic and Near-Endemic Species Occurring in the Project Area



Photo 1. *Delosperma lavisiae*



Photo 2. *Gladiolus saundersii*



Photo 3. *Alepidea thodei*



Photo 4. *Eucomis schiffii*



Photo 5. *Delosperma hirtum*



Photo 6. *Helichrysum basalticum*

Source: W McClelland 2017

#### 4.2.4 Community Use of Vegetation and Flora

The communities living along the PWAC are heavily dependent on plant resources, either as a source of grazing or browsing for their livestock, or directly for firewood or medicinal purposes. This is particularly relevant at the lower altitudes on either side of the route where population density is higher, but as resources dwindle the importance of plant resources in the higher-lying central part of the route will increase. Conversations with community members and direct observations of plant utilisation during fieldwork for this study, as well as data from CES (2014a) provided a list of 102 plant species that occur within the general vicinity of the PWAC and are considered to be important resources for local communities (Appendix 3).

Three areas of importance for medicinal plants were located during the cultural heritage survey for this study (MM&A, 2017: P2W-6004-DFR-0005). An extensive grassy slope and wetland area between kp 7-9 near Ha Salemone is important for a number of medicinal plants including *Boophone disticha*, *Eucoma autumnalis*, and *Pelargonium sidoides* (kp 7-9). A community botanical garden at a homestead in Ha Semphi (kp 12) was recorded as having several medicinal plants and an extensive area of sedge (*Ficinia gracilis* or 'Roro') was located at Ha Thene (kp16).

Firewood is particularly scarce on the hillslopes and people travel some distance to access this resource. Important species as a source of fuel are *Searsia divaricata*, *Salix* species, *Diospyros austro-africana*, *Euryops tysonii* and *Helichrysum trilineatum*. Examples of species used are shown in Figure 4.12.

Surveys in the Polihali Reservoir area (CES, 2014a) indicated that many high-altitude plants are prized by traditional healers for medicinal purposes, and healers from lower altitudes will either travel to collect the plants themselves, or trade with collectors from these higher altitudes. A survey by CES with a herbalist confirmed that most plants are collected in the Mokhotlong area with only a few collected from neighbouring areas although some herbalists were said to travel to KwaZulu-Natal for certain plants. The herbalist indicated that collection sites were dependent on habitats where plants are found and accessibility, and most plants were widespread and not difficult to find, with most found up the main river valleys. Some villagers grow their own plants for medicinal use.

Species mentioned as being used included *Aristaloe aristata*, *Bulbine narcissifolia*, *Gomphocarpus fruticosus*, *Lessertia depressa* and *Datura stramonium*. Some species are used on a daily basis, such as *Passerina montana* (used for fire wood) and *Juncus* sp. (used to make brooms, hats and baskets) and species such as *Artemesia afra* that are used to treat common illness such as flu, headaches and stomach aches. *Berkheya cirsiifolia* and *Silla nervosa* are used to take care of livestock and a number of species are used for spiritual and magical purposes. The herbalist explained that a number of the species used play a significant role in the local people's lives, as they still have a strong belief in communicating with their ancestors. For example, the connection with the ancestors is maintained by burning species such as *Helichrysum splendidum* (pheefo). This is a frequent occurrence for traditional healers, diviners and herbalist who are expected to have a constant connection with the ancestors.

Of the 60 species recorded as used by CES (2014a), 30 were identified as important medicinal plants, including treatment of a range of ailments such as sores, ulcers, headaches, cramps, muscular pains and headaches to being used as sedatives and for increasing virility. Nineteen species were important for spiritual purposes such as lucky charms to increase wealth, protective charms against black magic, bad spirits and lightning and cleanses for ridding oneself of black magic. Three species were identified as important food species, three were identified as being used for household items such as brushing teeth and the making of items such as baskets and hats and five species served a dual use such as being important for both medicinal and spiritual use.



Figure 4.12 Examples of Resources Used by Local Community Members



Photo 1. *Populus canescens* (Poplars) for firewood



Photo 2. Wood and dung for fuel



Photo 3. Berries of Rosaceae (alien) (sold)



Photo 4. *Helichrysum* for fuel

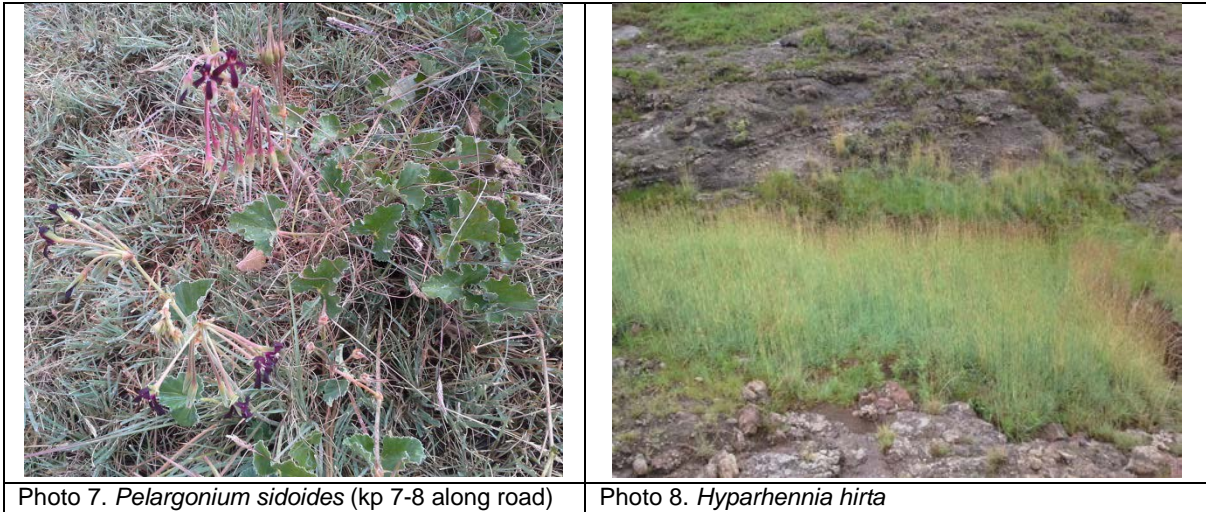


Photo 5. *Pelargonium bowkeri*



Photo 6. *Bulbine narcissifolia*





Source: K Kobisi 2017

#### 4.2.5 Alien Invasive Species

A report on invasive alien species in Lesotho (unreferenced in CES, 2014) lists 65 invasive plant species, of which 51 are terrestrial species and 14 are aquatic species. The International Union for the Conservation of Nature (IUCN) defines alien invasive species as “*animals, plants or other organisms introduced by man into places out of their natural range of distribution, where they become established and disperse, generating a negative impact on the local ecosystem and species.*”

Thirty invasive alien plant species are present within the Project Area, including *Salsola kali*, *Bidens formosa*, *Rosa rubiginosa*, *Echium plantagineum*, *Xanthium strumarium*, *X. spinosum* and *Salix fragilis*. Of these *Salsola kali*, *Echium plantagineum* and *Bidens formosa* are particularly prominent at the edges of cultivated fields, while *Salsola kali* has also invaded many old or active fields and has become a serious problem in some areas. *Salix fragilis*, *S. babylonica* and *Populus alba* are well established in places along the rivers and streams of the PWAC, although all three species are commonly harvested for firewood, which does limit their capacity to spread along the rivers. Disturbed sites such as roadsides, riverbanks and edges of homesteads are key areas which are invaded by alien plant species. A wide variety of dispersal agents contribute to the spread of invasive alien species in the Project Area, such as vehicles, particularly during earthworks for road maintenance, livestock, birds, rodents, insects, wind and water.

Despite legislation to control alien plants (e.g. the Weeds Eradication Act (Act 18 of 1969) and the Environmental Act (Act 10 of 2008), no guideline documents on the eradication of alien invasive species in Lesotho have been produced to date and it appears that the problem of invasive alien species is not actively managed.

Examples of alien and pioneer plants seen along the PWAC are shown in Figure 4.13.



Figure 4.13 Alien Invasive Plant Species Recorded in Project Area







 A photograph of a spiny cocklebur plant with dark green, lanceolate leaves and numerous sharp spines. The plant is growing in a grassy area with some rocks.	 A close-up photograph of a tumbleweed plant with thin, green, branching stems and small, needle-like leaves. The plant is densely packed.
<p>Photo 1. Spiny Cocklebur <i>Xanthium spinosum</i></p>	<p>Photo 2. Tumbleweed <i>Salsola kali</i></p>
 A photograph of a common dodder plant, showing a dense network of bright yellow, thread-like stems that are parasitic on other plants.	 A photograph of a cosmos plant with several bright pink flowers. The plant is growing in a field of dry, brown grass with mountains in the background.
<p>Photo 3. Common Dodder <i>Cuscuta campestris</i></p>	<p>Photo 4. Cosmos <i>Bidens formosa</i> in fields</p>
 A photograph of a large cocklebur plant with large, green, heart-shaped leaves and a prominent, spiny, yellowish-green seed head. The plant is growing in a grassy area.	 A photograph of a blue echium plant with many small, bright blue flowers. The plant has a dense, bushy appearance with green foliage.
<p>Photo 5. Large Cocklebur <i>Xanthium strumarium</i></p>	<p>Photo 6. Blue Echium <i>Echium vulgare</i></p>





Photo 7. *Datura stramonium* (along roadside in Makhoaba valley)



Photo 8. *Salsola kali* (Makhoaba valley roadside) (kp 35-42)



Photo 9. *Gomphostigma fruticososa* (pioneer) (kp 52)



Photo 10. *Rosa rubiginosa* (kp



Photo 11. Roadside alien species *Salsola kali* (kp 35-42)

Source: K Kobisi 2017 (Photos 1-7) J Hughes (Photo 8-11)



### 4.2.6 Threats to Habitats and Flora Species

The entire Project Area is under intense grazing and browsing pressure from livestock and most areas of arable land have been cultivated. Severe overgrazing on shallow soils of steep slopes particularly in the easternmost parts near the Senqu River valley has exposed soil to rain and wind, resulting in serious soil erosion in areas closest to the Polihal Dam site, which are located in a 'rain shadow'. The intense grazing and browsing pressure has also resulted in reduced species richness and a change in floristic composition of grassland habitat, with increaser grasses, such as *Aristida* and *Eragrostis* species, dominating over climax grasses such as *Themeda* and *Festuca*. Harvesting of indigenous woody shrubs for firewood is another threat to habitats in the Project Area, particularly the hillsides near villages. Main species targeted for fuel include *Chrysocoma ciliata*, *Euryops tysonii*, *Artemisia afra*, *Inulanthera thodei*, *Rhus divaricata*, *Rhus erosa*, *Pentzia cooperi*, *Rhamnus prinoides*, *Felicia filifolia* and other *Rhus* species. Further, the recent and ongoing drought has contributed to the increased grazing and human pressures on natural plants for food and medicinal purposes. The change in land cover condition along the PWAC as a result of these threats is further discussed in Section 4.2.1.2.

**Figure 4.14 Threats to Habitats and Flora**



Photo 3. Degraded wetland with gully erosion from overgrazing (kp 19.5) (2650m)



Photo 3. Photo 3. Heavily degraded grassland closer to the Senqu Valley after leaving Makhoaba valley (typical of kp 42 to 53)

Source: Photo 1: K Kobisi 2017; Photo 2: J Hughes.

## 4.3 Mammals

### 4.3.1 Global and Regional Context

Three of the world's terrestrial ecoregions are represented in Lesotho, namely Highveld Grasslands, Drakensberg Montane Grasslands, Woodlands and Forests, and Drakensberg Alti-montane Grasslands and Woodlands<sup>5</sup>. The Project Area is situated within the Drakensberg Montane Grasslands, Woodlands and Forests ecoregion, which covers much of central and eastern Lesotho. Some of the large mammals known to occur in this ecoregion are Eland (*Taurotragus oryx*), Southern Reedbuck (*Redunca arundinum*), Mountain Reedbuck (*Redunca fulvorufula*), Grey Rhebok (*Pelea capreolus*), Black Wildebeest (*Connochaetes gnou*) and Oribi (*Ourebia ourebi*), although most of these have their strongholds in South Africa and are absent or very scarce in Lesotho. Two mammals are endemic to the ecoregion, namely Thin Mouse Shrew (*Myosorex tenuis*) and Gunning's Golden Mole (*Neamblysomus gunningi*), neither of which occur in Lesotho, while Natal Red Rock Hare (*Pronolagus crassicaudatus*) is near-endemic and does occur in eastern Lesotho.

The Lesotho Highlands also fall within what Rowe-Rowe and Taylor (1996) classify as the Montane Bioregion, which is the mountainous region above 1800 masl, most of which is located within Lesotho. They list 47 mammal species for this bioregion in KwaZulu-Natal, with the diagnostic species being Grey Rhebok, Sclater's Golden Mole (*Chlorotalpa sclateri*) and Sloggett's (Ice) Rat (*Otomys sloggetti*).

### 4.3.2 Mammal Habitats

Even though the topography in the Project Area is diverse, only two broad structural vegetation types are present (Figure 4.15). These form the following broad mammal habitats:

- **Dwarf Shrubland** – this habitat is prominent on some of the heavily grazed mountain slopes along the eastern third of the PWAC, particularly drier north- and west-facing slopes, and is also prominent above 2700 masl along the central part of the PWAC; low, microphyllous shrubs form a sparse to dense woody stratum, often on shallow, rocky soils; and
- **Grassland** – present throughout the Project Area, on mountain slopes and plateaus; almost all grassland has been heavily overgrazed. Important mammal microhabitats within grassland are rocky outcrops and cliffs, as well as seepage wetlands.

**Figure 4.15 Representative Habitat Types for Mammals**

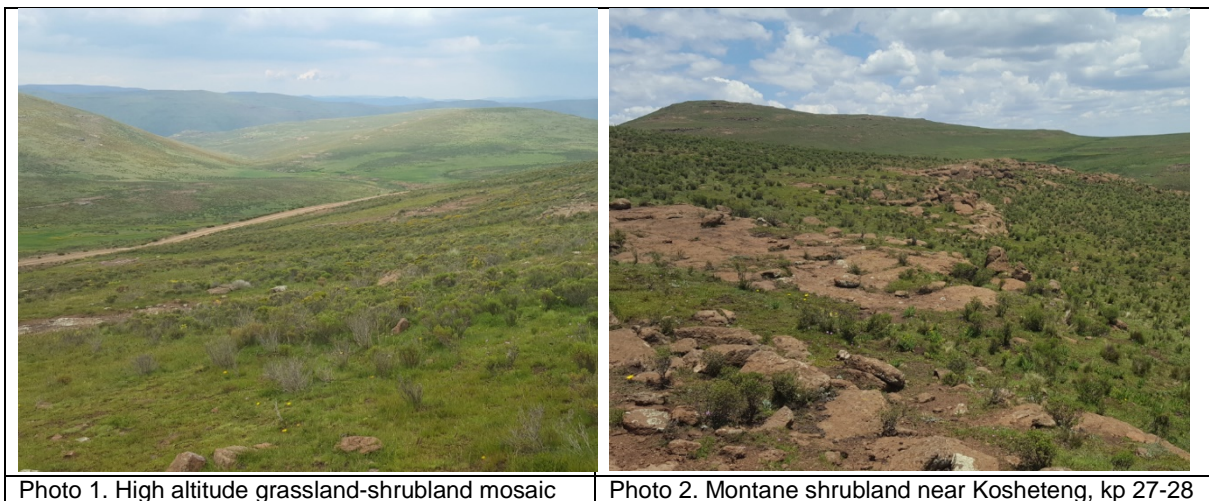






Photo 1. High altitude grassland-shrubland mosaic

Photo 2. Montane shrubland near Kosheteng, kp 27-28

<sup>5</sup> [www.worldwildlife.org/ecoregions/at1003](http://www.worldwildlife.org/ecoregions/at1003). Accessed 13 March 2017



(Route C)	
	
Photo 3. High-altitude wetland (powerline route)	Photo 4. Heavily overgrazed grassland at the eastern end of the PWAC (Khubelu valley)
	
Photo 5. Large rocky outcrop above Kosheteng sheep shed, kp 25	Photo 6. Montane grassland looking south down the Semenaryane valley

Source: W McClelland 2017

### 4.3.3 Mammal Species Diversity

Avenant (2007) provided an overview of the distribution and abundance of mammals in the Lesotho Highlands, and concluded that mammal species richness is low in Lesotho, and particularly so in the Lesotho Highlands. Some of the reasons given for this low diversity included the extreme climatic conditions at high altitudes, uniform topography and relatively homogeneous vegetation. Avenant (2007) states that 55 species are currently known from Lesotho, which is a reduction of about 30% in the number of species historically recorded in the country. However, Branch in CES (2014b) points out that Ambrose (1999) added 15-16 species to the 52 species listed by Lynch (1994), bringing the total to 67-68 species, although many of these are unlikely to occur in the Lesotho Highlands. Avenant (2007) found that carnivores, antelope and baboons usually only occur frequently far from human settlements, and usually on high plateaus. Both carnivores and small mammals were found to occur at highest densities in riverine vegetation.

No mammal surveys have been conducted along the PWAC prior to this study, although surveys in the Katse Catchment (LVA, 1993, Du Plessis *et al.*, 2014) are relevant to the western half of the PWAC and surveys conducted in the vicinity of the Polihali Reservoir (CES, 2014b) are relevant to the eastern half of the PWAC. According to CES (2014b) approximately 30 mammal species historically occurred in the general vicinity of the Polihali Reservoir, of which 17 have been confirmed from Mokhotlong (Lynch, 1994). Eleven mammal species were recorded during two surveys by CES (2014b), ten of which are likely to be present along the PWAC (Figure 4.6). LVA (1993) and Du Plessis *et al.* (2014) recorded 24 mammal species in the nearby Katse catchment area, nine of which have been confirmed to occur along the PWAC (Table 4.6).

### **Carnivores**

Three carnivore species were confirmed to occur within the Project Area during February 2017 fieldwork. Spoor of African Clawless Otter *Aonyx capensis* and Marsh Mongoose *Atilax paludinosus* were located along the Senqu River and at Matsoku weir (A.Jenkins, *pers. comm.*), and Black-backed Jackal (*Canis mesomelas*) was seen at high altitudes along Route C to the north of the PWAC. Four other small carnivores were confirmed to occur in the Katse catchment and are likely to be present along the PWAC, especially the higher-lying, remote central part of the route between Ha Ratau and Kosheteng, namely Caracal (*Caracal caracal*), Striped Polecat (*Ictonyx striatus*), Small Grey Mongoose (*Galerella pulverulenta*) and African Wild Cat (*Felis silvestris*). These species are likely to occur in very low numbers but no evidence of these was found.

### **Antelope**

Only one antelope species is likely to occur within the Project Area, namely Grey Rhebok (*Pelaea capreolus*). A family group of four Grey Rhebok were seen in a remote valley in the upper Liseleng / Semenanyane River during this study (see photos in Figure 4.16). A single Mountain Reedbuck was reportedly seen on a remote, high altitude (2714 m) peak to the east of the Polihali Reservoir during the CES survey (CES, 2014b), but this species possibly moves across to the Mokhotlong region from protected areas in nearby KwaZulu-Natal and is unlikely to occur anywhere within the PWAC.

### **Primates**

While no primates were confirmed to occur within the Project Area, Chacma Baboon (*Papio ursinus*) was reported to occur in low numbers in remote, high altitude areas (CES, 2014b) and may occur from time to time along the PWAC.

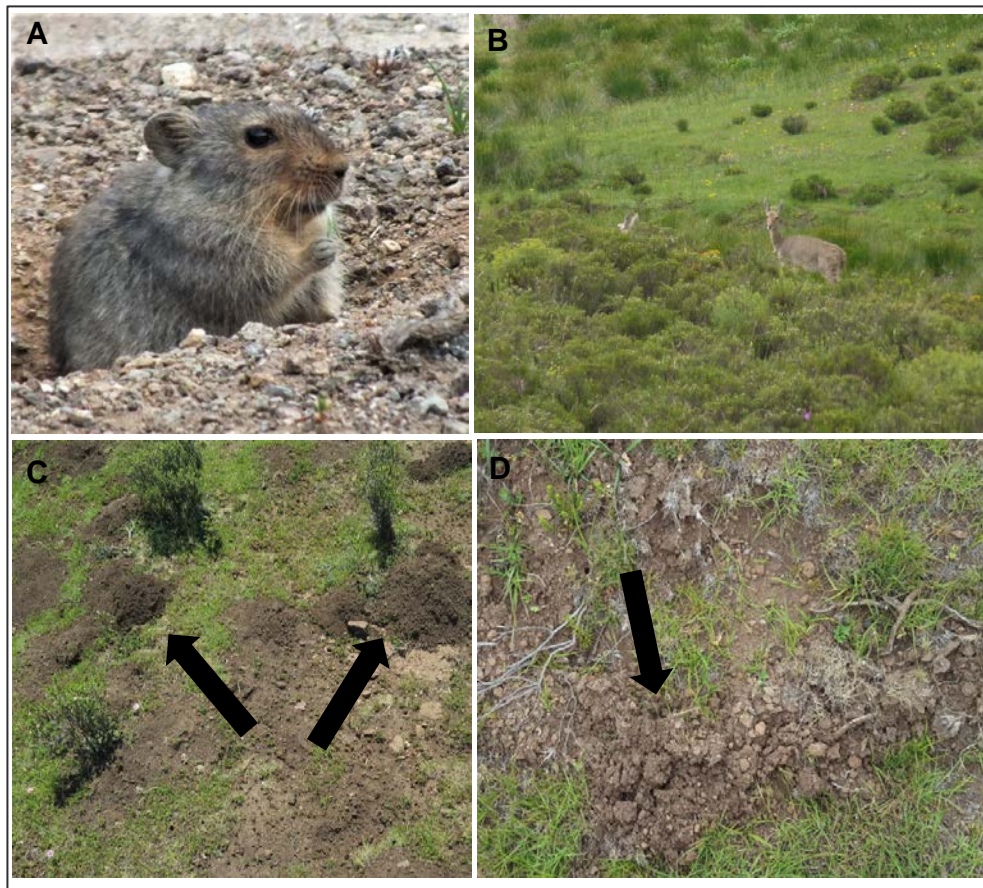
### **Small mammals**

This is the most diverse group of mammals within the Project Area. Incidental observations during fieldwork in February and April 2017 confirmed the presence of five small mammal species (Table 4.6). Soil mounds of Common Mole-rat (*Cryptomys hottentotus*) were regularly observed along the PWAC, particularly in deeper soils adjacent to or in seeps, Sloggett's Rat was seen at high altitude in the vicinity of the Makhoaba River and junction (J.Hughes, *pers. comm.*). The distinctive subsoil runs of Sclater's Golden Mole were located at numerous sites at altitudes above 2600 masl. Rock Hyrax (*Procavia capensis*) was observed in rocky outcrop habitat in the western part of the PWAC, and CES (2014b) recorded middens at seven sites within the vicinity of the Polihali Reservoir. Dung pellets of Scrub Hare (*Lepus saxatilis*) were found at a few sites at the eastern end of PWAC, although dung middens of a Red Rock Hare (*Pronolagus* species) were more frequent in the higher-lying central part of the route.

Small mammal trapping by CES (2014b) yielded three rodents (Striped Mouse *Rhabdomys pumilio*, Multi-mammate Mouse *Mastomys natalensis*, Grey Climbing Mouse *Dendromus melanotis*) and two shrew species (Forest Shrew *Myosorex varius*, Greater Musk Shrew *Crocidura flavescens*) while mammal trapping in the Katse catchment by LVA (1993) and Du Plessis *et al.* (2014) produced the above species as well as four more rodents (Grassland Vlei Rat *Otomys auratus*, Namaqua Rock Mouse *Micaelamys namaquensis*, Pygmy Mouse *Mus minutoides*, and White-tailed Rat *Mystromys albicaudatus*). The most significant of these species is White-tailed Rat, which is currently classified as Vulnerable (see Section 4.3.4).



**Figure 4.16 Photos of Selected Mammal Species Found Within or Adjacent to the PWAC Project Area**



A – Sloggett's Rat, B – Grey Rhebok, C – Common Mole-rat mounds, D – Golden mole sub-surface runs

**Table 4.6 Mammals Recorded in the General Vicinity of the PWAC**

Common Name / Scientific Name	IUCN Status	Endemic Status	Habitat Type	Area Recorded	Abundance in Project Area
Forest Shrew <i>Myosorex varius</i>	LC	Endemic to SA, Lesotho and Swaziland	Dense, moist grassland habitat, often next to streams or dams	East of the PWAC <sup>1</sup> ; west of the PWAC <sup>2</sup>	Uncertain
Greater Musk Shrew <i>Crocidura flavescens</i>	LC	Near-endemic to SA, Lesotho & Swaziland	Wide variety of habitat types	East of the PWAC <sup>1</sup> ; west of the PWAC <sup>2</sup>	Uncertain
Grey Climbing Mouse <i>Dendromus melanotis</i>	LC	Widespread	Various grassland types, sometimes associated with stands of tall grass	East of the PWAC <sup>1</sup> ; west of the PWAC <sup>2</sup>	Uncertain
Natal Multimammate Mouse <i>Mastomys natalensis</i>	LC	Widespread	Wide variety of habitat types	East of the PWAC <sup>1</sup> ; west of the PWAC <sup>2</sup>	Probably common
Striped Mouse <i>Rhodomys pumilio</i>	LC	Widespread	Wide variety of habitat types	East of the PWAC <sup>1</sup> ; west of the PWAC <sup>2</sup>	Probably common
Sloggett's Rat <i>Otomys sloggetti</i>	LC	Drakensberg endemic	High altitude shrubland and grassland; usually above 2600 masl	Higher lying areas along Makhoaba River valley	Fairly common



Common Name / Scientific Name	IUCN Status	Endemic Status	Habitat Type	Area Recorded	Abundance in Project Area
Vlei Rat <i>Otomys auratus</i>	NT	Widespread	Wetlands in grassland	West of the PWAC <sup>2</sup>	Uncertain
Namaqua Rock Mouse <i>Micaelamys namaquensis</i>	LC	Widespread	Wide variety of habitat types	West of the PWAC <sup>2</sup>	Uncertain
Pygmy Mouse <i>Mus minutoides</i>	LC	Widespread	Wide variety of habitat types	West of the PWAC <sup>2</sup>	Uncertain
White-tailed Rat <i>Mystromys albicaudatus</i>	VU	Endemic to South Africa and Lesotho	Grassland and shrubland areas	West of the PWAC <sup>3</sup>	Uncertain
Common Mole-rat <i>Cryptomys hottentotus</i>	LC	Widespread	Wide variety of habitat types	Higher lying areas along PWAC <sup>4</sup>	Fairly common
Cape Porcupine <i>Hystrix africaeaustralis</i>	LC	Widespread	Wide variety of habitat types	West of the PWAC <sup>2</sup>	Uncertain
Greater Cane-rat <i>Thryonomys swinderianus</i>	LC	Widespread	Tall areas of grass in grassland	West of the PWAC <sup>2</sup>	Uncertain
Rock Hyrax <i>Procavia capensis</i>	LC	Widespread	Cliffs and large dolerite outcrops	Isolated locations along PWAC <sup>4</sup>	Fairly common
Scrub Hare <i>Lepus saxatilis</i>	LC	Widespread	Wide variety of habitat types	Numerous sites along PWAC <sup>4</sup>	Fairly common
Rock rabbit sp. <i>Pronolagus sp.</i>	LC	Endemic to SA, Lesotho & Swaziland	Rocky outcrops in grassland	High mountains along PWAC <sup>4</sup>	Uncommon
Sclater's Golden Mole <i>Chlorotalpa sclateri</i>	LC	Drakensberg near-endemic	High altitude shrubland and grassland above 2500 masl	High mountains along PWAC <sup>4</sup>	Fairly common
African Clawless Otter <i>Aonyx capensis</i>	NT	Widespread	Rivers, streams	Matsoku weir <sup>4</sup>	Scarce
Water Mongoose <i>Atilax paludinosus</i>	LC	Widespread	Rivers, streams	Senqu River <sup>4</sup>	Scarce
Black-backed Jackal <i>Canis mesomelas</i>	LC	Widespread	Wide variety of habitat types	High mountains along PWAC	Scarce
Caracal <i>Caracal caracal</i>	LC	Widespread	Wide variety of habitat types	West of the PWAC <sup>2</sup>	Uncertain
Striped Polecat <i>Ictonyx striatus</i>	LC	Widespread	Wide variety of habitat types	West of the PWAC <sup>2</sup>	Uncertain
Small Grey Mongoose <i>Galerella pulverulenta</i>	LC	Near-endemic to SA, Lesotho and Namibia	Wide variety of habitat types	West of the PWAC <sup>2</sup>	Uncertain
African Wild Cat <i>Felis silvestris</i>	LC	Widespread	Wide variety of habitat types	West of the PWAC <sup>2</sup>	Uncertain
Grey Rhebok <i>Pelea capreolus</i>	NT	Endemic to SA, Lesotho and Swaziland	High altitude shrubland and grassland above 2500 masl	High mountains along PWAC <sup>4</sup>	Scarce

<sup>1</sup> = CES, 2014b; <sup>2</sup> = du Plessis, 2014; <sup>3</sup> = LVA, 1993; <sup>4</sup> = this study

### 4.3.4 Species of Conservation Importance

#### 4.3.4.1 Threatened and Near Threatened Species

Two Near Threatened (NT) mammal species have been confirmed to occur along the PWAC during this study. Spoor of African Clawless Otter was located at the Matsoku weir, and a small family group of Grey Rhebok was observed in high-altitude grassland at the head of the Semenanyane River valley. An additional NT species, Grassland Vlei Rat, was trapped at a number of sites within the Katse catchment by LVA (1993), but could not be relocated at the same sites by Du Plessis *et al.* (2014) during follow-up surveys. This species is likely to be rare along the PWAC, but if present; preferred habitat would be taller grassland adjacent to wetlands. According to Monadjem *et al.* (2016), four *Otomys* species occur in the Drakensberg Mountains and are clearly ecologically segregated according to altitude. *O. angoniensis* occurs on the lower slopes in savanna habitats, *O. auratus* and *O. laminatus* at mid-elevation in grasslands and *O. sloggetti* at the highest elevations in alpine heath and wetland habitats.

Two Vulnerable mammal species potentially occur within the vicinity of the Project Area, namely White-tailed Rat (*Mystromys albicaudatus*) and De Winton's Long-eared Bat (*Laephotis wintoni*). White-tailed Rat is known from a number of localities in Lesotho where it has been recorded in shrubland or grassland on black loamy soils with adequate vegetation cover (Coetzee and Monadjem, 2008). Individuals were trapped at two sites at Katse (upper Bokong valley, Ha Lejone) by LVA (1993), but Du Plessis *et al.* (2014) failed to relocate the species at the same sites. White-tailed Rat appears to specifically occur in grassland that is in an intermediate stage of succession between disturbed and climax, disappearing when grassland conditions change (Du Plessis *et al.*, 2014). Within southern Africa, De Winton's Long-eared Bat is confined to montane grasslands in Lesotho and north-eastern Free State (Monadjem *et al.*, 2010). Although its roosting habitat is unknown, it is assumed that De Winton's Long-eared Bat utilises crevices in rock faces, as do other *Laephotis* species. Such habitat is plentiful in the river valleys of the Project Area and roosts of this species may be present, but could not be confirmed.

Branch summarised the conservation status and habitats of bats in the Lesotho Highlands in CES (2014b), listing five Near Threatened and one Vulnerable bat species. However, the latest Red List mammal assessment (Child *et al.*, 2016) has downgraded these Near Threatened species to Least Concern, and upheld the Vulnerable status of De Winton's Long-eared Bat.

#### 4.3.4.2 Endemic or Near-endemic Species

Sloggett's Rat was the only mammal species recorded during fieldwork that is endemic to the Drakensberg Mountains. This species occurs from the Eastern Cape through Lesotho and western Kwazulu-Natal to south-western Mpumalanga, occurring in grassland and shrubland above 2000 masl, but more usually occurs above 2600 masl (Taylor, 2016). Mokotjomela *et al.* (2010) noted that populations of Sloggett's Rat are not currently under threat. Individuals were seen along the roadside at high altitude in the vicinity of the Makhoaba River and junction (J.Hughes, *pers. comm.*).

Sclater's Golden Mole is a Drakensberg near-endemic, also occurring in isolated mountain ranges in the Western Cape (Bronner and Bennett, 2016). The distinctive subsoil runs of Sclater's Golden Mole were located at numerous sites at altitudes above 2600 masl during February 2017 fieldwork.

#### 4.3.4.3 Protected Species

Of the protected species listed in the Historical Monuments, Relics, Fauna and Flora Act (Act No. 41 of 1967) (see Section 2.1.2) several species were confirmed to occur within the Project Area, namely African Clawless Otter, Water Mongoose, and Grey Rhebok.

Mammals of conservation importance are summarised in Table 4.7.

**Table 4.7 Mammal Species of Conservation Importance Confirmed Along the PWAC**

Common Name / Scientific Name	IUCN Status	Endemic status	Habitat Type	Area recorded	Abundance
Sloggett's Rat <i>Otomys sloggetti</i>	LC	Drakensberg endemic	High altitude shrubland and grassland; usually above 2600 masl	Higher lying areas along Makhoaba River valley	Fairly common
Sclater's Golden Mole <i>Chlorotalpa sclateri</i>	LC	Drakensberg near-endemic	High altitude shrubland and grassland above 2500 masl	High lying areas along PWAC <sup>4</sup>	Fairly common
African Clawless Otter <i>Aonyx capensis</i>	NT	Widespread	Rivers, streams	Matsoku weir & Senqu River	Scarce
Grey Rhebok <i>Pelea capreolus</i>	NT	Endemic to SA, Lesotho and Swaziland	High altitude shrubland and grassland above 2500 masl	High mountains along PWAC <sup>4</sup>	Scarce

### 4.3.5 Threats to Mammal Species

Most indigenous mammals are considered to be under threat in Lesotho, particularly as a result of habitat degradation through uncontrolled burning and overgrazing of grassland and wetland habitat, but also through hunting by livestock herders and their dogs. Du Plessis *et al.* (2014) considered dogs to be one of the major factors threatening small and larger mammals in the Lesotho Highlands. According to Avenant (2007) local Basotho people utilise most mammal species, either as food or for clothing and traditional medicine. Most of the habitat areas along the lower-lying eastern and western ends of the PWAC has been seriously impacted by overgrazing and grass cover is sparse in many areas. Herders and their dogs were frequently encountered during fieldwork, suggesting that the few mammal species that are present are under immense hunting pressure.

## 4.4 Herpetofauna

### 4.4.1 Global and Regional Context

The Drakensberg Montane Grassland, Woodland, and Forest ecoregion described in Section 4.2 is home to five endemic frog species, three of which occur in fast-flowing streams at high altitudes in Lesotho, namely Maluti River Frog (*Amietia vertebralis*), Phofung River Frog (*Amietia hymenopus*) and Natal Cascade Frog (*Hadromophryne natalensis*). Two endemic species occur at lower altitudes in KwaZulu-Natal but have not been recorded in Lesotho (Poynton's Caco *Cacosternum poyntoni*, Long-toed Tree Frog *Leptopelis xenodactylus*). Four reptile species are strictly endemic to this ecoregion, namely the poorly known Cream-spotted Mountain Snake (*Montaspis gilvamaculata*), Lang's Crag Lizard (*Pseudocordylus langi*), Cottrell's Mountain Lizard (*Tropidosaura cottrelli*) and Essex's Mountain Lizard (*T. essexi*), as well as numerous near-endemics such as Drakensberg Crag Lizard (*Pseudocordylus melanotus subviridis*), Drakensberg Flat Gecko (*Afroedura nivaria*) and Spiny Crag Lizard (*P. spinosus*). Minter *et al.* (2004) provide an overview of the zoogeographical affinities of the amphibian fauna of South Africa, Lesotho and Swaziland, and place eastern Lesotho within the Sweet Grasslands assemblage of the Central District, a species-poor assemblage with a relatively low proportion of endemics.

Even though the reptile fauna of Lesotho is poorly known, it is clear that diversity is low, particularly in the Lesotho Highlands in the east. Ambrose (2006) lists 45 reptiles for Lesotho, of which one species is now considered extinct in the country (Southern African Python *Python natalensis*). This number represents less than 8% of the species occurring in southern Africa. In addition, many species are also restricted to the lower, western part of the country. Bates and Haacke, 2003 documented 23 amphibian species for Lesotho, many of which are confined to the western

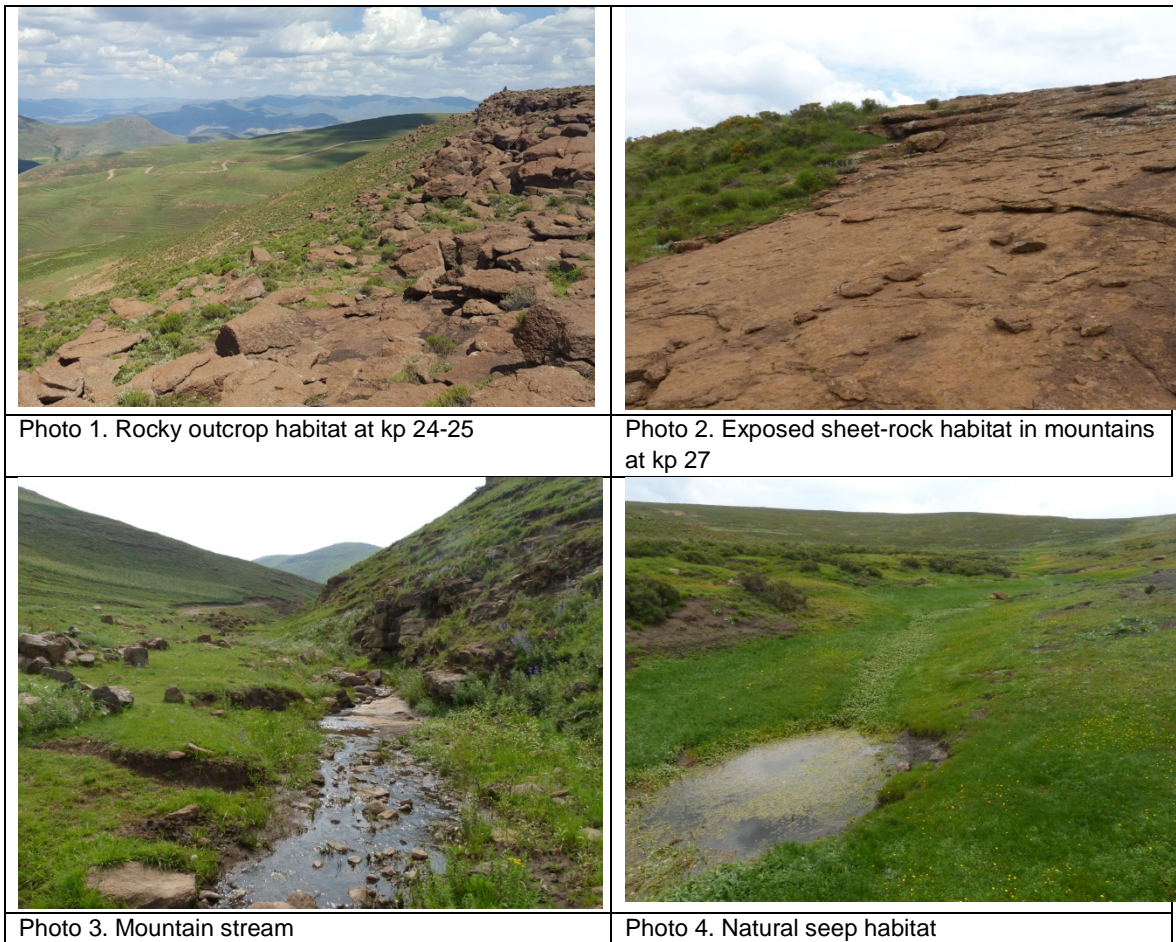
lowlands, listing only seven species for Mokhotlong district. Branch listed 10 species that potentially occur in the Lesotho Highlands, two of which have not been recorded in Mokhotlong District (Phofung River Frog and Natal Cascade Frog) and another which is poorly known within the district (Plaintive Rain Frog *Breviceps verrucosus*).

#### 4.4.2 Herpetofaunal Habitats

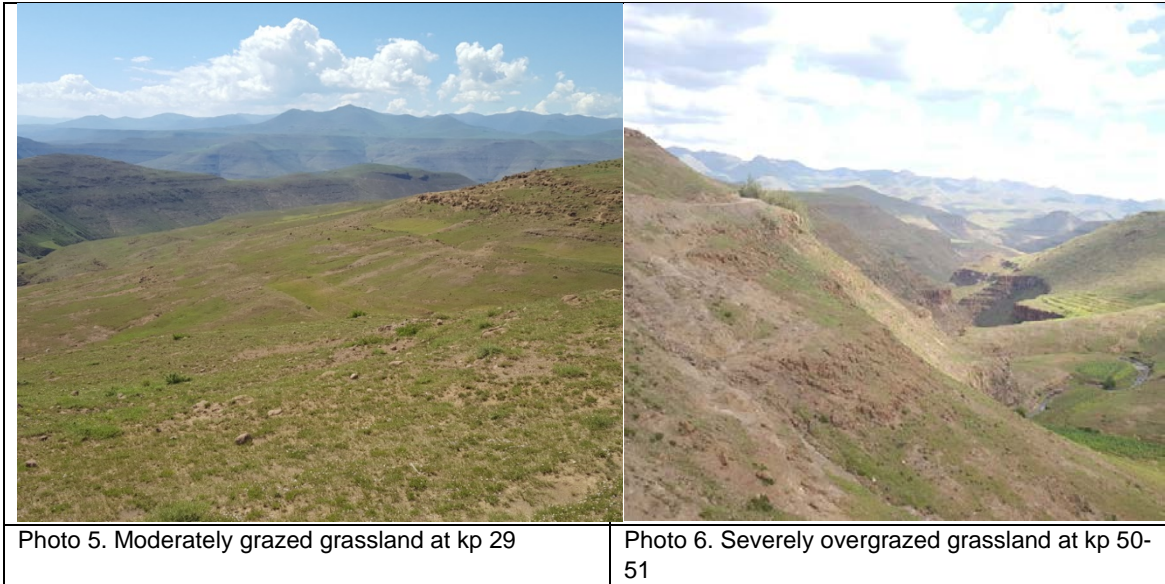
Examples of herpetofaunal habitats in the Project Area are shown in Figure 4.17. Important microhabitats for herpetofauna include:

- Cliffs and rocky outcrops – this is the most important microhabitat for reptiles in the Project Area, and three lizard species were apparently confined to rocky outcrops, namely Drakensberg Crag Lizard, Southern Rock Agama (*Agama atra*) and Speckled Mountain Skink (*Trachylepis punctatissima*);
- Seeps – this is an important microhabitat for amphibians such as Clicking Stream Frog (*Strongylopus grayii*); and
- Rivers and streams – this is the primary habitat for most of the amphibians in the Project Area, including the endemic Maluti River Frog and river frogs of the *Amietia queketti-poyntoni* complex.

**Figure 4.17 Representative Habitat Types for Herpetofauna**







Source: W McClelland, 2017

### 4.4.3 Herpetofauna Species Diversity

Even though the reptile fauna of Lesotho is poorly known, it is clear that diversity is low, particularly in the Lesotho Highlands in the east. Ambrose (2006) lists 45 reptiles for Lesotho, of which one species is now considered extinct (Southern African Python *Python natalensis*). This represents less than 8% of the species occurring in southern Africa. In addition, many species are also restricted to the lower, western part of the country. Branch (CES, 2014b) lists 14 reptile species for the Lesotho Highlands and recorded six species in the general vicinity of the Polihali Reservoir. Reptiles confirmed to occur during February and April 2017 fieldwork increase this total to nine reptile species in the vicinity of the eastern end of the PWAC, or 64% of the species known to occur in the Lesotho Highlands (Table 4.8).

Loxton, Venn and Associates (LVA) conducted herpetological surveys in the Katse catchment area for Phase 1A of the LHWP during four trips in 1991 and 1992 (LVA, 1993). Harvey, 2014 provided an updated assessment of the herpetofauna for the Katse catchment area and conducted additional surveys from 28<sup>th</sup> January to 4<sup>th</sup> February 2014. Although none of these surveys took place within the PWAC, the data are relevant to the western and central part of the PWAC. Nine amphibian species and 11 reptile species were confirmed to occur within the Katse catchment, all of which could occur within the PWAC (Table 4.8).

The most frequently encountered reptiles along the PWAC during February and April 2017 were lizard species. Southern Rock Agama and Burchell's Sand Lizard (*Pedioplanis burchellii*) were noticeably common in heavily grazed, lower-altitude grasslands in the eastern third of the route, while Drakensberg Crag Lizard and Speckled Mountain Skink were the most common lizard species above 2500 masl along the PWAC. This corresponds with the findings of Harvey (2014) who reported Speckled Mountain Skink and Drakensberg Crag Lizard to be the most common reptiles in the higher altitudes of the Katse catchment. An additional lizard species, Cape Skink (*Trachylepis capensis*) was caught in a trapline by CES (2014b) but was not encountered during the current study, while LVA (1993) recorded Essex's Mountain Lizard (*Tropidosaurus essexii*) at high altitude in the Katse catchment. Six snake species have been confirmed in the general vicinity of the Project Area. CES (2014b) caught a single Spotted House Snake (*Lamprophis guttatus*) in the Senqu River valley, which represented the second record of this species for Lesotho, and confirmed the presence of Puff Adder (*Bitis arietans*) and Rinkhals (*Hemachatus haemachatus*) during discussions with local residents. A single snake species was caught to the east of the PWAC during February 2017 fieldwork, namely Common Slugeater (*Duberria lutrix*). LVA (1993) and Harvey (2014) also confirmed the presence of two further snake species in the Katse catchment, namely Rhombic Skaapsteker (*Psammophylax rhombeatus*) and Cross-marked Grass Snake

(*Psammophis crucifer*). Photos of selected reptile species found during fieldwork are displayed in Figure 4.18.

Bates and Haacke (2003) documented 23 amphibian species for Lesotho, many of which are confined to the western lowlands, listing only seven species for Mokhotlong District. Branch listed ten species that potentially occur in the Lesotho Highlands, two of which have not been recorded in Mokhotlong District (Phofung River Frog, Natal Cascade Frog) and another which is poorly known within the district (Plaintive Rain Frog *Breviceps verrucosus*). LVA (1993) and Harvey (2014) recorded nine amphibian species in the nearby Katse catchment, including the three species mentioned above. All of these potentially occur in high-altitude parts of the PWAC. Five of the species recorded in Katse catchment were confirmed by CES (2104b) in the basin of the Polihali Reservoir. Four of these were located along the PWAC during Feb and April 2017 fieldwork, namely River Frogs of the *Amietia queketti-poyntoni* complex, Maluti River Frog, Cloud Toad (*Vandijkophrynus garipeensis nubicolus*) and Clicking Stream Frog (Table 4.8).

River frogs of the *Amietia queketti-poyntoni* complex were the most frequently encountered species in riverine habitat, occurring in perennial rivers and seasonal streams, while the Maluti River Frog was caught at several sites in the Senqu and Khubelu Rivers and is likely to occur in the smaller tributaries along the PWAC. Cloud Toad and Clicking Stream Frog are not confined to riparian systems and were found far from water on occasion.

**Table 4.8 Reptiles and Amphibians Confirmed to Occur in the General Vicinity of the PWAC, including the Polihali Reservoir Area**

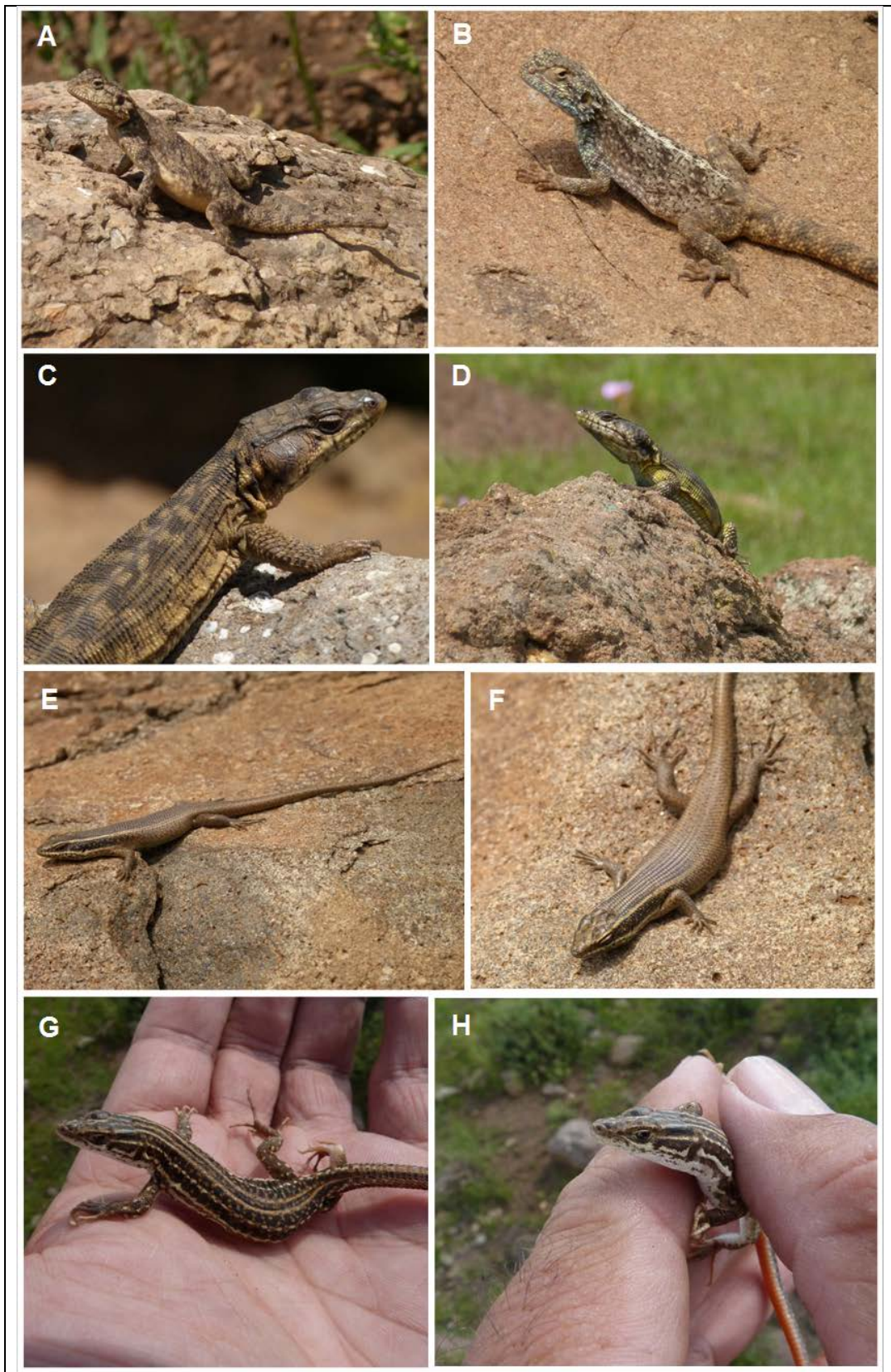
Common / Scientific Name	IUCN Status	Endemic status	Habitat Type	Area recorded	Abundance
Drakensberg Crag Lizard <i>Pseudocordylus melanotus subviridis</i>	LC	Drakensberg near-endemic	Rocky outcrops in grassland and shrubland, often on dolerite; at altitudes above 2200 masl	Numerous localities along PWAC, especially above 2600 masl	Common at preferred altitude of above 2600 masl
Southern Rock Agama <i>Agama Agama atra</i>	LC	Not endemic	Rocky outcrops and scree slopes in grassland and shrubland; wide range of altitudes	Numerous localities along PWAC, especially the lower-lying western and eastern thirds	The most common lizard species at lower altitudes
Cape Skink <i>Trachylepis capensis</i>	LC	Not endemic	Dolerite outcrops in grassland	Not recorded from PWAC; specimen caught near eastern end of PWAC <sup>1</sup> and in Katse catchment <sup>2</sup>	Uncommon, probably overlooked.
Speckled Mountain Skink <i>Trachylepis punctatissima</i>	LC	Not endemic	Rocky outcrops and scree slopes in grassland and shrubland; wide range of altitudes	Several sites along the PWAC, particularly at higher altitudes	Common at higher altitudes
Burchell's Sand Lizard <i>Pedioplanis burchelli</i>	LC	Not endemic	Rocky outcrops and scree slopes in grassland and shrubland; wide range of altitudes	Numerous localities in the lower lying degraded eastern half of the PWAC	Common throughout the PWAC, particularly at lower altitudes
Essex's Mountain Lizard <i>Tropidosaura essexi</i>	LC	Endemic to Drakensberg Mountains	Rocky outcrops at high altitudes, usually above 2800 masl	Not recorded from PWAC, but collected in the Katse catchment <sup>1</sup>	Uncertain; if present above 2800 masl
Puff Adder <i>Bitis arietans</i>	LC	Not endemic	Wide range of habitat types	Reported by local residents	Scarce



Common / Scientific Name	IUCN Status	Endemic status	Habitat Type	Area recorded	Abundance
Rhombic Skaapsteker <i>Psammophylax rhombeatus</i>	LC	Not endemic	Wide range of habitat types	Recorded in Katse catchment west of PWAC <sup>2,3</sup>	Uncertain
Cross-marked Grass Snake <i>Psammophis crucifer</i>	LC	Not endemic	Wide range of habitat types	Recorded in Katse catchment west of PWAC <sup>2,3</sup>	Uncertain
Common Slug-eater <i>Duberria lutrix</i>	LC	Not endemic	Wide range of habitat types	One locality south-east of Mokhotlong just above full supply level <sup>1</sup>	Uncommon, probably overlooked.
Rinkhals <i>Hemachatus haemachatus</i>	LC	Not endemic	Restricted to grassland habitat, often in association with rocky outcrops or wetlands	Reported by local residents	Scarce
Spotted Rock Snake <i>Lamprophis guttatus</i>	LC	Not endemic	Restricted to rocky areas in a variety of habitat types	Single specimen from Senqu River valley at eastern end of PWAC <sup>1</sup>	Scarce
River frog <i>Amietia delalandii</i> - <i>poyntonii</i> complex	LC	Not endemic	Prefers vegetated rivers and streams, usually relatively close to water	Many sites throughout the Polihali inundation area and at higher altitudes	Common
Maluti River Frog <i>Amietia vertebralis</i>	LC	Drakensberg endemic	Restricted to permanent rivers and streams, usually in close vicinity to water	Several sites within the Polihali inundation area, along Senqu and Khubelu Rivers	Fairly common
Phofung River Frog <i>Amietia hymenopus</i>	DD	Drakensberg endemic	High altitude streams	Recorded in Katse catchment west of PWAC <sup>3</sup>	Uncommon
Clicking Stream Frog <i>Strongylopus grayii</i>	LC	Not endemic	Wetlands in a wide variety of vegetation types	Found at two sites in mountains of the broader PWAC area	Uncommon, probably overlooked.
Cloud Toad <i>Vandijkophrynus garipeensis nubicolus</i>	LC	Drakensberg near-endemic	Short, open grassland in stony areas, sometimes near wetlands	Numerous localities within and above the Polihali inundation area	Common
Raucous Toad <i>Amietophrynus rangeri</i>	LC	Not endemic	Wide variety of aquatic habitats	Two sites within the Polihali inundation area	Probably fairly common
Natal Cascade Frog <i>Hadromophryne natalensis</i>	LC	Drakensberg endemic	Fast-flowing, rocky perennial rivers in forest and grassland	Recorded in Katse catchment west of PWAC <sup>2</sup>	Uncertain
Plaintive Rain Frog <i>Breviceps verrucosus</i>	LC	Not endemic	Forest, occasionally grassland	Recorded in Katse catchment west of PWAC <sup>3</sup>	Uncertain
Common Platanna <i>Xenopus laevis</i>	LC	Not endemic	Wide variety of aquatic habitats	Several sites within the Polihali inundation area	Fairly common

<sup>1</sup> = CES 2014b; <sup>2</sup> = LVA 1993; <sup>3</sup> = Harvey 2014

Figure 4.18 Photos of Selected Reptile Species Recorded in the PWAC Project Area



A & B – Southern Rock Agama, C & D – Drakensberg Crag Lizard, E & F – Montane Speckled Skink, G & H – Burchell's Sand Lizard

## 4.4.4 Species of Conservation Importance

### 4.4.4.1 Threatened and Near Threatened Species

No threatened or Near Threatened reptile or amphibian species were recorded during this survey and none are likely to occur along the PWAC.

Two Near Threatened reptiles are known to occur at high altitudes along the Lesotho / KwaZulu-Natal border, namely Cottrell's Mountain Lizard and Lang's Crag Lizard, although neither species is likely to occur within the Project Area. One Data Deficient frog species (Phofung River Frog) was confirmed to occur in high altitude streams in the Katse catchment by Harvey (2014), and potentially occurs in the Liseleng and Semenanyane River systems crossed by the PWAC. One Data Deficient reptile species (Cream-spotted Mountain Snake) occurs at higher altitudes to the east of the Project Area and is unlikely to be present in the Project Area.

### 4.4.4.2 Endemic or Near-endemic Species

Two frog species are strictly endemic to the Drakensberg Mountains, namely Maluti River Frog and Phofung River Frog. Both species are nearly endemic to Lesotho, occurring marginally into the Free State, KwaZulu-Natal and Eastern Cape provinces. Maluti River Frog was confirmed to occur in the PRAI Project Area at a number of sites along the Senqu and Khubelu Rivers (CES, 2014b), and the Phofung River Frog has been confirmed in the Katse catchment by Harvey (2014) as mentioned above.

Four reptile species are strictly endemic to the Drakensberg Mountains, namely Cream-spotted Mountain Snake, Lang's Crag Lizard, Cottrell's Mountain Lizard and Essex's Mountain Lizard. These species are confined to the high-altitude eastern edge of the Drakensberg Mountains along the Lesotho / KwaZulu-Natal border, and only Essex's Mountain Lizard has been recorded in the general vicinity of the PWAC, having been located in the Katse catchment by LVA (1993). The other three species are unlikely to be present at the altitudes represented within the PWAC. A number of reptile species are nearly endemic to the Drakensberg Mountains, such as Drakensberg Crag Lizard, Drakensberg Flat Gecko and Spiny Crag Lizard. The two near-endemics confirmed to occur within the Project Area were Drakensberg Crag Lizard, which was particularly common at higher altitudes, and Cloud Toad (Figure 4.18).

### 4.4.4.3 Protected Species

The only herpetofauna protected under the Historical Monuments, Relics, Fauna and Flora Act (Act No. 41 of 1967) are monitor lizards (*Varanus* species) and chelonians (tortoises and terrapins), none of which have been recorded within the Project Area during this study or by CES (2014b).

## 4.4.5 Threats to Herpetofauna

Discussions with locals concerning utilisation of reptiles and amphibians as food or for traditional medicine revealed that these were not utilised in any way, although all snakes were considered dangerous and were killed wherever possible (CES, 2014b). Dogs were regularly encountered, either in packs with livestock herders or singly, and it is likely that they hunt any small fauna that they find, but it is not certain how significant an impact or threat this is.

The greatest threat to herpetofauna along the PWAC is likely to be habitat loss or degradation, particularly degradation of grassland, wetland and stream habitats through severe overgrazing. Localised river pollution from point sources such as sheep dips may cause water quality linked impacts on amphibians, while diamond mines in the upstream Matsoku catchment may have water quality impacts on this system.

Even though a number of herpetofaunal species occur within microhabitats within grassland (such as dolerite outcrops), the ecological and structural integrity of the surrounding habitat is important for providing a food supply and cover safety from predation.



## 4.5 Habitat Status

The International Finance Corporation (IFC) has defined three categories of habitat status within IFC Performance Standard 6, namely Modified Habitat, Natural Habitat and Critical Habitat (IFC, 2012). These are described in the following sections.

### 4.5.1 Modified Habitat

Modified Habitat refers to areas that have a high proportion of non-native flora and fauna species, and / or habitat which has been substantially modified by human activity resulting in altered ecological functionality and species composition.

The main form of Modified Habitat within the PWAC Project Area comprise cultivated fields, which occur predominantly on footslopes, along river valleys and on lower-lying hill crests throughout the Project Area. Modified Habitats also include rural settlements, plantations of alien trees and highly degraded grasslands. The highest proportion of Modified Habitat tends to be in close proximity to highest human density in the Project Area.

### 4.5.2 Natural Habitat

Natural Habitat is defined as areas of viable assemblages of indigenous flora and fauna and / or areas where the primary ecological functions and species composition have not been significantly altered by human activity.

Grassland, along with river courses and wetlands, in reasonable to good condition comprise the primary Natural Habitats in the Project Area, especially grassland on steeper, rockier slopes where cultivation is not viable. Cliffs and rocky outcrops and high altitude shrublands are also significant types of Natural Habitat in the Project Area. Much of the grassland has been severely overgrazed, in some areas to the extent that ecological functionality has been compromised and species composition has been altered; these areas are classified as Modified Habitat.

### 4.5.3 Critical Habitat

Critical Habitat refers to areas of “high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes” (IFC, 2012).

None of the habitat within the Project Area fulfils any of the above criteria within the biodiversity components covered in this report, i.e. Flora, Mammals and Herpetofauna.

### 4.5.4 Summary of Habitat Status

Habitat status in terms of Modified and Near-natural Habitat along the PWAR and powerline are summarised in Table 4.9, Table 4.10 and Table 4.11, and Figure 4.19 and Figure 4.20.



**Table 4.9 Summary of Habitat Status along the PWAR and Powerline**

	PWAR			Powerline			Total Length	Total Area
	km	ha	%	km	ha	%	km	ha
Modified	30	88.5	55	22	12.4	62	54.5	170 ha (incl 164 ha for 30m road servitude and 6 ha for laydown / works and camp areas)
Near-natural	24.5	73.5	45	13.5	7.7	38	35.5	120 ha (temporary) (in 31.5 m powerline servitude;) ~18 ha (permanent) (in pylon & access road footprint)
<b>Total</b>	<b>54.5</b>	<b>162</b>	<b>100</b>	<b>35.5</b>	<b>20</b>	<b>100</b>		

Source: Total area estimated by design engineers (AECOM and Plantech)

**Table 4.10 Extent and Location of Habitat Status Classes along the PWAR**

PWAR stretch (km)	Altitude	Villages	Habitat Status	Habitat Types	Length of PWAR (km)	Estimated area in 30 m Road Reserve (ha)
0-6.5	2175-2340 m	Ha Seshote – Ha Salemone	Modified	Arable land, settlement	6.5	19.5
6.5-10	2340-2440 m	Ha Salemone – Ha Tielase	Near-natural	Grassland, wetland / seep zone (rare plants)	3.5	10.5
10-14	2440-2450 m	Ha Tielase – Ha Sekila	Near-natural	Grassland, seeps,	4	12
14-17.5	2450-2850 m	Ha Sekila-Ha Sekolopata- upper ridges (west) of Semenanyane valley	Near-natural	Grassland, Liseleng River, Valley head fen wetlands	3.5	10.5
17.5-22	2850-2550 m	Upper ridges of Semenanyane valley – Kosheteng (east)	Near-natural	Montane shrubland, Valley-head fen wetlands, Semenanyane River	4.5	13.5
22-31	2550-2800-2500 m	Kosheteng-Makhoaba - Ha Monothotsa	Near-natural	High altitude grassland / montane shrubland, wetlands	9	27
31-37.5	2500-2180 m	Ha Monothotsa-Makhiseng	Modified	Arable land, settlement, existing road	6.5	19.5
37.5-41	2180 – 2140 m	Makhiseng-Makhoaba River-Lipeleng	Modified	Makhoaba River, degraded grassland, arable land, settlement	3.5	10.5
41-54	2150 - 2046	Lipeleng-Masokong	Modified	Degraded grassland, arable land, settlement	13	39
					<b>54</b>	<b>162</b>

**Table 4.11 Extent and Location of Habitat Status Classes along the Powerline Route**

<b>Pylon Bend Point</b>	<b>Altitude</b>	<b>Villages</b>	<b>Habitat Status</b>	<b>Habitat Types</b>	<b>Length of Power-line (km)</b>
1-5	2180-2400 m	Matsoku substation-across Matsoku River – Ha Makhoana	Modified	Arable land, settlement, very degraded grassland	3
5-7	2400-2440 m	Top of ridge (above Ha Makhoana) - Pitseng	Near-natural	Degraded grassland	1.5
7-14	2440-2450 m	Pitseng – Ha Sekila	Modified	Arable land, degraded grassland	7.14
14-20	2450-2810-2585 m	Ha Sekila-Semenanyane valley - Kosheteng	Near-natural	Grassland, Valley head fen wetlands Semenanyane River	6.56
20-23	2585-2800-2550 m	Kosheteng-Makhoaba-Ha Monothotsa	Near-natural	High altitude grassland / montane shrubland, wetlands	4.69
23-26	2500-2424 m	Ha Monothotsa-Marasele	Modified	Arable land, settlement, existing road	2.97
26-27	2424 – 2709 m	Marasele – top of ridge	Near-natural	Montane grassland	0.74
27-29	2150 – 2046 m	Ridge-Thuhloane-Makokoaneng	Modified	Arable land, settlement, degraded grassland	4.67
29-33	2045 – 2100 m	Makokoaneng-Polihali substation	Modified	Degraded grassland, arable land, settlement	4.10
					<b>35.37</b>

Figure 4.19 Map of Habitat Status of the PWAR

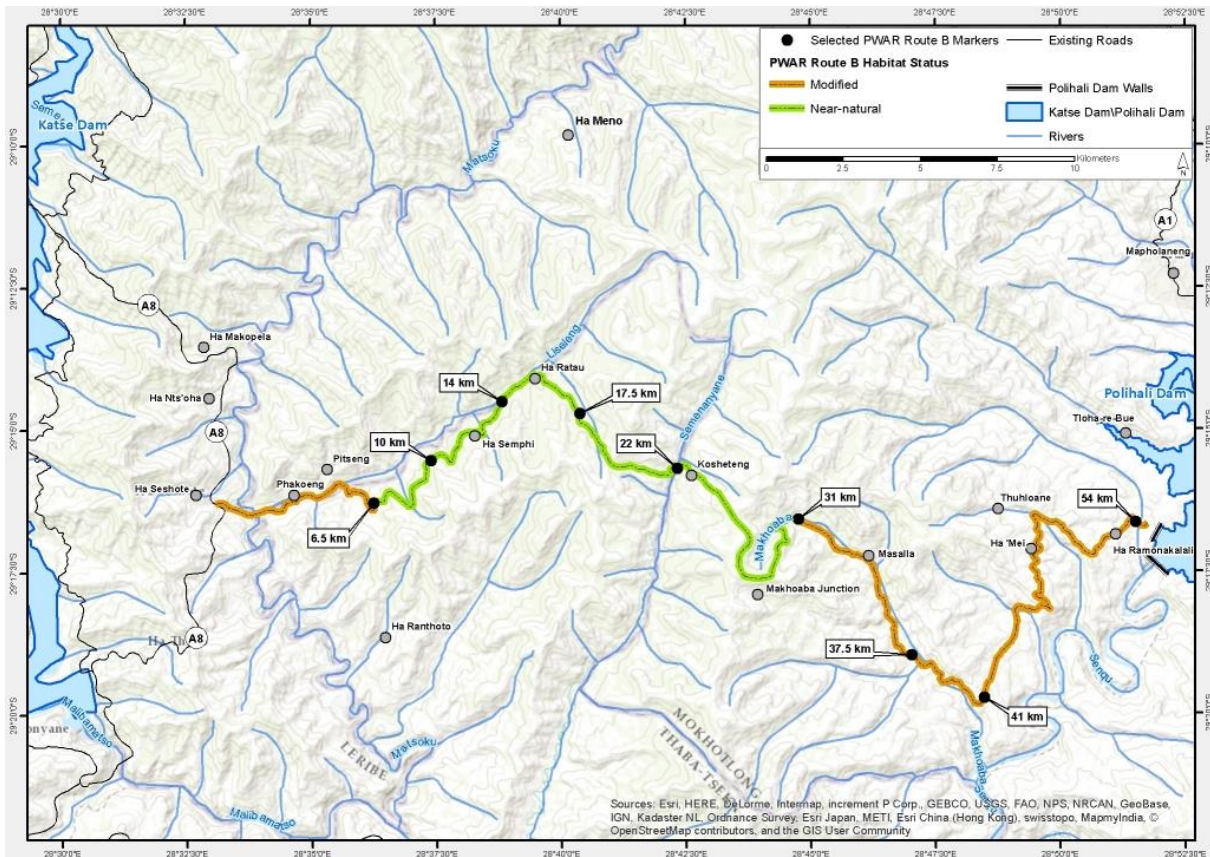
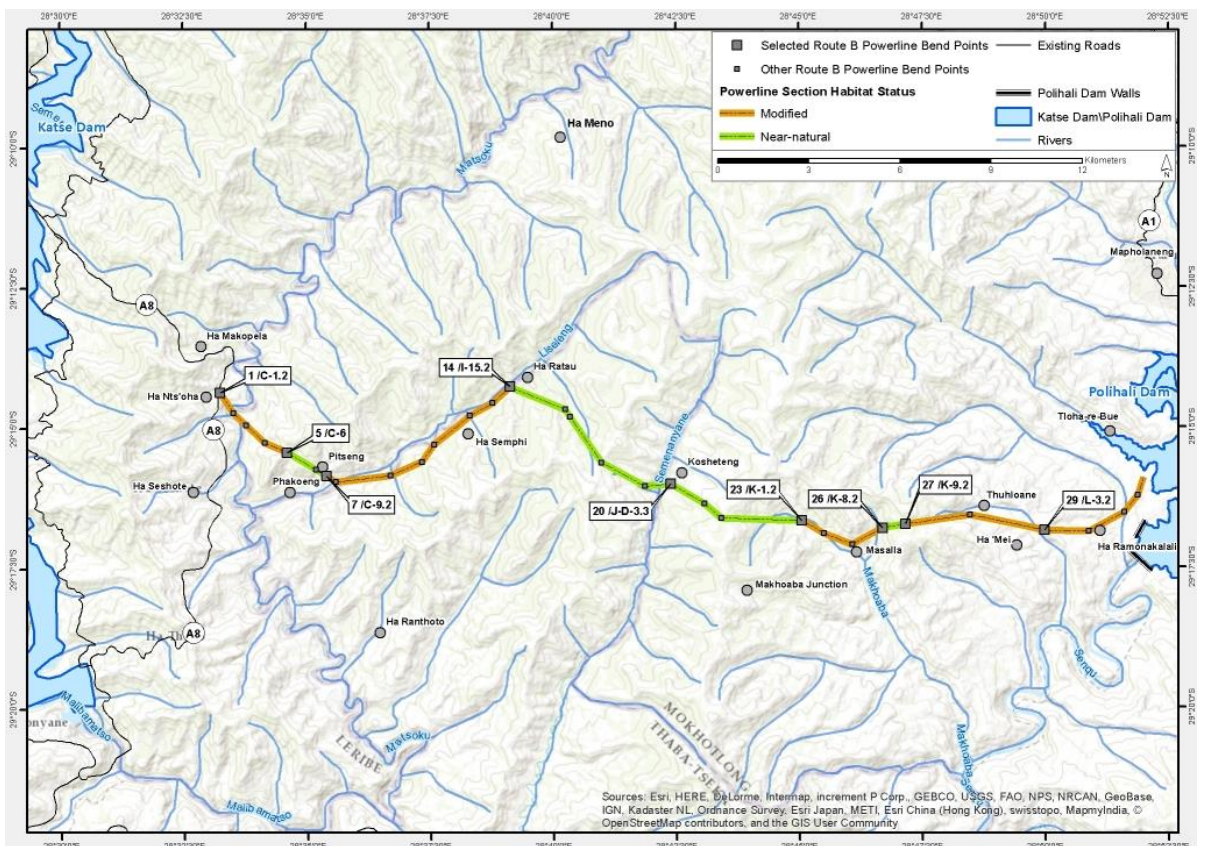


Figure 4.20 Map of Habitat Status of the Powerline Route







# Section 5 Assessment of Impacts

## 5.1 Construction Phase

### 5.1.1 Impact of Site Clearance and Cut and Fill on Vegetation and Flora

#### 5.1.1.1 Description of Impact

This impact will involve the clearance of vegetation associations and constituent flora and topsoil, and the cut and fill (including blasting) of rocky slopes to create the required road servitude and the pylon locations and access tracks for powerline construction. Road construction will require a working road servitude width of 30 m (including 10 m for the paved road, shoulders and stormwater drainage) along the 54.5 km length of the PWAR. The powerline of ~35.4 km length will require ~106 pylons, including 33 deviation (bend-point) pylons, and 42.5 km of local tower access tracks and new common roads. Estimated land take requirements are as follows:

- **Road Construction Footprint:** The area that will be impacted by site clearance in the road construction footprint will be approximately 164 ha (within the 30 m Road Reserve), allowing for construction access, rock spoil and dust impacts, and an additional ~6 ha for construction laydown of equipment and materials, making a total of **170 ha**; and
- **Powerline Construction Footprint:** The area impacted by the powerline may require in the order of 18 ha permanent land for 106 pylon locations; substation expansion, and 42.5 km of access roads, and 120 ha of temporary land for the 35 km powerline servitude and laydown and construction sites.

Based on these estimates, the total area of habitat permanently affected is estimated at 170 ha for the road and 20 ha for the road, totalling ~190 ha.

Habitats affected comprise mainly fields in the lower lying areas, interspersed with degraded grassland and rocky outcrops and - at high altitudes >2700 m - degraded subalpine shrubland / grassland mosaic. Impacts on wetland habitat are covered under a separate wetland specialist study (WCS, 2017: P2W-6004-DFR-0005).

Road and powerline construction activities will have a direct impact that will result in a loss of habitat and flora species in the footprint. Construction activities will also include the generation of dust from heavy vehicles, such as bulldozers and other light vehicle traffic, and blasting. Blasting to widen the road will create waste rock with the excess disposed of by dumping along the lowside of the cleared road servitude, and which will smother additional roadside vegetation.

#### 5.1.1.2 Sensitivity of Receptors

The main vegetation type to be affected by this impact will be the widespread Montane Grassland / Rocky Outcrop mosaic along the road and powerline route. This vegetation mosaic has been heavily overgrazed within the PWAC and is in an ecologically degraded state with low to moderate biodiversity value along most of the route. Habitat between kp 25 and 29 has been heavily grazed but still supports high floristic diversity, including numerous DAC endemics, as well as several seep wetlands, and is considered to have high biodiversity value. Four plant species of conservation concern occur in the vicinity of the road and powerline. The most threatened of these is *Boophone disticha*, which has a national red data classification of Endangered (Talukdar, 2002), although this is a widespread species in Lesotho and South Africa that does not meet the IUCN threshold for EN status. A large population was located at kp 7-8 in a wetland / grassland / rocky outcrop mosaic but road realignment of the route between kp 7 and 9 has already largely mitigated this impact. Three Vulnerable species are present in the PWAC footprint, namely *Jamesbrittenia lesutica*, *Eucomis autumnalis* and *Dicoma anomala*. However, *Dicoma anomala* has been incorrectly assessed and is a widespread and common species that should not be considered to be of conservation concern.

*Jamesbrittenia lesutica* is endemic to Lesotho and is a more accurate indication of conservation importance. This species occurs at moderate density on steep rocky slopes on the eastern third of the PWAC. A single population of *Eucomis autumnalis* was located at the same site as *Boophone disticha*, near kp 7-8.

Within the Montane Grassland / Rocky Outcrop Mosaic the habitats most vulnerable to degradation are grassland on crests or terraces and seeps, both of which are heavily targeted by grazing livestock. Habitat that cannot be cultivated or grazed, such as rocky ridges and cliffs, has low vulnerability to degradation. However, grassland has moderate resilience to disturbance, while rocky ridges / cliffs and seeps have low resilience. Overall the grassland and rocky ridge habitats are considered to have *Medium* sensitivity to site clearance.

#### 5.1.1.3 Assessment of Impact

The impact of site clearance on vegetation and flora will be long term to permanent and will have a high intensity in the PWAR and powerline footprint. However, the extent of the impact will be relatively small (limited to the ~170 ha of the PWAR and ~18 ha of the powerline footprint (including access roads) footprint, and the vegetation type is mostly ecologically degraded to varying extents, resulting in an impact magnitude of *Medium*. Prior to the implementation of any mitigation measures, the significance of this impact on terrestrial vegetation and flora in higher lying Near-natural Habitats of the PWAC is considered **Moderate**. Impact significance of habitat clearance and blasting in lower lying Modified Habitats is considered **Minor**.

#### 5.1.1.4 Mitigation Measures

The following mitigation measures are recommended for the impact of site clearance on vegetation and flora:

- Pre-construction plant surveys focused on sensitive sections of the PWAR, powerline and access roads to identify species of conservation importance for relocation to safeguard sites or which can be avoided by minor deviations in access tracks;
- Identify suitable host areas for relocated plants, which could include community nurseries or the botanical garden at Katse Dam or for later use in landscaping or rehabilitation. Relocation of plants should be done under the supervision of the botanist and someone with horticultural experience of indigenous plant species. Plant relocation sites may need to be fenced-off to restrict access by livestock;
- Where possible, no borrow pits or quarries should be sited within the section of the road above 2700 masl, e.g. kp 18-31 between Ha Sekolopata and Makhoaba Pass. Where necessary in this area, the footprint must be minimised and any excavations should be rehabilitated or modified for future use (e.g. as laybys or view points);
- Topsoil shall be removed during site clearance and stored separately for re-use in rehabilitation of disturbed areas, roadsides and on rock spoil heaps to aid natural revegetation; and
- Minimise spread of alien invasive plants by cleaning all vehicles and equipment at designated vehicle washing bays, and avoiding import of contaminated plant material in borrow pit or topsoil material. Regular checks and removal of alien plants from construction areas. Contractors shall be required to prepare a method statement for management of alien invasive plants.



**Table 5.1 Impacts of Site Clearance and Cut and Fill on Terrestrial Vegetation and Flora**

Impact of Site Clearance and Cut and Fill for Road and Powerline Construction on Vegetation and Flora				
Project Phase:	Construction Phase			
	Grassland and Rocky Habitats in Modified Habitats (Table 4.10 and Table 4.11) (Mostly low lying areas <2700 m)		Grassland and Rocky Habitats in Near-natural Habitats (Table 4.10 and Table 4.11) (Mostly subalpine zone >2700 m)	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct		Direct	
Magnitude	Medium	Small	Medium	Small
Sensitivity	Low	Low	Medium	Medium
Significance	<b>Minor</b>	<b>Negligible</b>	<b>Moderate</b>	<b>Minor</b>

#### 5.1.1.5 Residual Impact

Implementation of the measures listed in 5.1.1.4 is predicted to result in a residual impact significance of **Minor** in high lying Near-natural Habitats, and **Negligible** in lower lying Modified Habitats.

### 5.1.2 Destruction of Planted Spiral Aloes in Villages during Road Construction

#### 5.1.2.1 Description of Impact

Planted Spiral Aloes (*Aloe polyphylla*) that have been collected in the high mountains along the PWAC are present at several villages within the road footprint and could potentially be destroyed during road construction. These include villages such as Ha Salemone (lower) (where Photo 8 in Figure 4.10 was taken) and in some villages along the Makhoaba River.

#### 5.1.2.2 Sensitivity of Receptors

The Spiral Aloe is endemic to the high mountains of Lesotho and is a popular horticultural subject worldwide. The high demand for this species has resulted in over-collection of wild plants and subsequent declines of wild populations, resulting in the species being classified as Vulnerable. This decline is evident within the Project Area where only planted aloes occur outside homesteads along the PWAC and wild populations are restricted to colonies in remote mountainous areas. Several natural colonies may exist in the broader area around the PWAC: colonies were said by local informants to be present at two locations in the Semenanyana and Semena catchments. The planted aloes in villages are still believed to be genetically representative of wild populations of *Aloe polyphylla* and should be assigned high importance. The sensitivity of this receptor is thus *High*.

#### 5.1.2.3 Assessment of Impact

The impact of site clearance on planted populations of Spiral Aloe will be long term to permanent and will have a medium intensity in the infrastructure footprint if no mitigation measures are in place. Even though the number of plants potentially impacted by road construction is expected to be low – in the order of a few individuals - these represent genetically viable individuals of this threatened species, and their loss would likely result in increased collection to replace them in new homesteads, resulting in an impact magnitude of *Medium*. Prior to the implementation of any mitigation measures, given the high sensitivity of spiral aloes the significance of this impact is considered **Major**.

#### 5.1.2.4 Mitigation Measures

The following mitigation measures are recommended for the impact of site clearance on planted populations of Spiral Aloe:

- Undertake a census of spiral aloes located near homesteads that require demolition and relocate aloes to new homesteads or other safe locations prior to site clearance;
- Undertake a census of natural aloe populations in the broader PWAC area prior to or during road construction to establish a baseline for monitoring of future operational phase impacts;
- Suitable sites for replanting (if not at new homesteads) need to be identified under the supervision of a botanist or horticulturist;
- Relocation of aloes must be undertaken by a horticulturist with previous experience in relocation of such species; and
- A nursery or suitable holding facility (e.g. Katse nursery) needs to be set up for the care of these aloes until they can be planted at the new sites.

**Table 5.2 Impact of Road Construction on Planted Spiral Aloe Populations**

Impact of Road Construction on Planted Spiral Aloe Populations		
Project Phase:	Construction Phase	
	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct	
Magnitude	Medium	Negligible
Sensitivity	High	High
Significance	Major	Negligible

#### 5.1.2.5 Residual Impact

Implementation of the measures described in 5.1.2.4 is predicted to reduce the magnitude to *Negligible* and the impact significance to **Negligible**.

### 5.1.3 Impact of Site Clearance on Other Plants Used by Communities

#### 5.1.3.1 Description of Impact

As described in Section 5.1.1, road and powerline construction will involve the clearance of a relatively narrow strip of vegetation and topsoil in the footprint of the construction area, estimated at approximately 170 ha over the length of the PWAR and 18 ha for pylon and access roads. This will be a direct impact that is expected to result in some loss of plant resources utilised by surrounding communities for medicinal, food or weaving purposes.

#### 5.1.3.2 Sensitivity of Receptors

Most of the plant species utilised by surrounding communities for food, medicinal or spiritual purposes are located within the widespread Montane Grassland / Rocky Outcrop Mosaic that is prevalent throughout the Project Area. While this vegetation mosaic has been overgrazed in places, particularly at the eastern end of the PWAC (closer to Polihali) and has moderate to low biodiversity value, a number of useful plant species were located within the general vicinity of PWAC during fieldwork (as described in Section 4.2.4). These include widespread species used for medicinal purposes, such as *Pelargonium sidoides*, *Boophane disticha*, *Dicoma anomala*, *Asclepias gibba*, *Cheilanthes eckloniana*, *Haemanthus humilis* and *Gazania krebsiana*. Other useful species include plants used for firewood such as *Diospyros austro-africana*, *Euryops tysonii* and *Searsia*

*divaricata*, and species with important spiritual uses such as *Gladiolus saundersii*, *Helichrysum splendidum* and *Polygala hottentota*. The culturally important Spiral Aloe does not occur naturally within the infrastructure footprint.

Given the high reliance of local communities on a wide range of useful plants, although they appear to be widespread and fairly common within the Project Area, their sensitivity to site clearance is assigned as *Medium*.

#### 5.1.3.3 Assessment of Impact

The impact of site clearance on important plant resources will be long term to permanent and will have a high intensity. However, the extent of the impact will be small (limited to the impact footprint), and the vegetation type is ecologically degraded, resulting in an impact magnitude of *Medium*. Prior to the implementation of any mitigation measures, the significance of this impact on important plant resources will be **Moderate**.

#### 5.1.3.4 Mitigation Measures

The following measures are recommended as mitigation for the impact of site clearance on important plant resources:

- Local traditional medicine practitioners and members of local communities should be encouraged to harvest plant resources within the impact footprint prior to site clearance either for immediate use or replanting or both; and
- Local communities should be supported to start plant nurseries to propagate and grow useful plant resources.

**Table 5.3 Impact of Site Clearance on Plants Used by Surrounding Communities**

Impact of Site Clearance for Construction of Road and Transmission Lines on Useful Natural Plant Resources in Infrastructure Footprint				
Project Phase:	Construction Phase			
	Grassland and Rocky Habitats in Modified Habitats (Table 4.10 and Table 4.11) (Mostly low lying areas <2700 m)		Grassland and Rocky Habitats in Near-natural Habitats (Table 4.10 and Table 4.11) (Mostly subalpine zone >2700 m)	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct		Direct	
Magnitude	Medium	Small	Medium	Small
Sensitivity	Medium	Medium	Medium	Medium
Significance	<b>Moderate</b>	<b>Minor</b>	<b>Moderate</b>	<b>Minor</b>

#### 5.1.3.5 Residual Impact

Implementation of the measures described in Section 5.1.3.4 is predicted to reduce the impact significance to **Minor**.

## 5.1.4 Impact of Site Clearance and Blasting on Mammals and Herpetofauna

### 5.1.4.1 Description of Impact

As described in Section 5.1.1, this impact will involve the clearance of vegetation and topsoil in the infrastructure footprint over an area of ~190 ha (~170 ha for PWAR and ~18 ha powerline), and blasting of rocky areas to clear the servitude, particularly in the high lying areas along the PWAC. This will have a direct impact on mammal and herpetofauna through direct disturbance (noise and



vibration), loss of habitat, particularly rocky outcrop habitat), as well as faunal mortalities as a result of blasting. This will particularly affect burrowing or crevice-dwelling fauna such as lizards, snakes, and rodents/moles. Fauna within the flyrock zone (where blast debris lands) may also be impacted by smothering of habitat.

#### 5.1.4.2 Sensitivity of Receptors

The main vegetation type to be affected by this impact will be the widespread Montane Grassland / Rocky Outcrop Mosaic that is prevalent throughout the Project Area, which includes two main faunal habitats, namely natural grassland and rocky outcrops. Some cropped fields also occur. These habitats have been heavily disturbed and overgrazed within the infrastructure footprint by livestock and settlement, and are in an ecologically degraded state, particularly at lower altitudes. Mammal and herpetofauna (reptiles and amphibians) species and abundance are low and no conservation priority species were recorded in the infrastructure footprint, although high altitude stream crossings may have two endemic frog species (Maluti River Frog, Phofung River Frog). Faunal habitats within the road footprint are considered to have low biodiversity value below 2700 masl and medium value above this altitude, with rocky habitats having higher value as refuge zones for reptiles and small mammals; overall the faunal habitats are considered to have Medium sensitivity to site clearance and blasting. Most mammal and herpetofauna in the Project Area are common and widespread species with few priority species found to occur in the infrastructure footprint area. None of the mammal or reptile species present in the Project Area are known to rely on verbal cues for establishing territory and / or finding suitable mates, so it is assumed that blasting noise will have limited short-term impacts on these fauna in the vicinity of the impact footprints. Territory establishment of frogs that do rely on such cues may be impacted for short-term periods only. Mammals such as water mongoose or African clawless otter could occur intermittently at larger stream crossings, mostly in the more remote central part of the PWAC.

#### 5.1.4.3 Assessment of Impact

The impact of site clearance on small mammal and herpetofaunal assemblages will be long term to permanent and will have a high intensity. However, the extent of the impact will be relatively small (limited to the impact footprint), and the faunal habitats are mostly ecologically degraded to some extent, resulting in an impact magnitude of *Medium* for the entire PWAR route. The impact of blasting on mammal and herpetofaunal assemblages will be localised to specific locations within the infrastructure footprint zone and will be short term and of high intensity, occurring intermittently during road construction. Prior to the implementation of any mitigation measures, the significance of this impact on mammals and herpetofauna will be **Moderate** across the entire PWAC.

#### 5.1.4.4 Mitigation Measures

The following measures are recommended as mitigation for the impact of site clearance and blasting on small mammal and herpetofaunal assemblages:

- At least one member of the construction staff should be trained in the handling of snakes and lizards in order that any such fauna found to occur in the infrastructure area can be removed and relocated to a safe location away from settlements.
- All construction staff should be made aware of the requirement to avoid killing of snakes and other fauna and shall be informed of the procedure to notify a designated snake-handler to remove and relocate any individuals encountered. Snakes should be released discretely in rocky areas out of eyesight of local residents (to avoid persecution).

No suitable mitigation measures are recommended for the impact of blasting on small mammal and herpetofaunal assemblages.

**Table 5.4 Impact of Site Clearance and Blasting on Mammals and Herpetofauna**

Impact of Site Clearance and Blasting on Mammal and Herpetofaunal Assemblages				
Project Phase:	Construction Phase			
	Grassland and Rocky Habitats in Modified Habitats (Table 4.10 and Table 4.11) (Mostly low lying areas <2700 m)		Grassland and Rocky Habitats in Near-natural Habitats (Table 4.10 and Table 4.11) (Mostly subalpine zone >2700 m)	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct		Direct	
Magnitude	Medium	Small	Medium	Small
Sensitivity	Medium	Medium	Medium	Medium
Significance	<b>Moderate</b>	<b>Minor</b>	<b>Moderate</b>	<b>Minor</b>

#### 5.1.4.5 Residual Impact

Implementation of the mitigation measures described in Section 5.1.4.4 is predicted to result in a reduction of impact significance to **Minor**.

## 5.2 Operation Phase

### 5.2.1 Increased Spread of Alien Invasive Plants

#### 5.2.1.1 Description of Impact

Construction activities involving the movement of vehicles and equipment from other possible alien plant contaminated areas to the PWAC Project Area and the import of weed contaminated soil, aggregate or other road-building materials may encourage the growth and spread of alien invasive plants along the access roads. Kalwij *et al.* (2008) in Carbutt (2012) notes that mountain pass roads can extend the distribution of alien plants beyond reasonable altitudinal expectations, as recorded along Sani Pass where the expected altitudinal limit of distribution of several alien species was exceeded due to anthropogenically induced soil disturbance, increased water runoff and vehicular traffic which facilitate the spread of propagules. To date, Carbutt (2012) indicates that 170 alien species (mostly in the Poaceae and Asteraceae families) have invaded the Drakensberg Alpine Centre (DAC) within which the project area lies. It also identifies a further 23 current emerging invader species and another 27 future invader species for the DAC (the latter mostly falling into the Rosaceae and Fabaceae families). Climate change, specifically increasingly warmer temperatures, may facilitate encroachment of alien invasive plants into higher altitude areas which currently have fewer alien species.

If alien encroachment from road development is not actively managed alien plants may encroach further into areas with low incidence of alien plants, and can, over time, replace indigenous grassland or shrubland, reducing natural biodiversity and the availability of grazing resources. In addition, several invasive species likely to spread into the Project Area are unpalatable and may be toxic to animal that graze on them, such as *Phytolacca octandra*, *Senecio inaequidens*, *Lythrum hyssopifolia*, *Schkuhria pinnata* and *Echium vulgare*.

The lower lying and more settled parts of the PWAC already exhibit some degree of alien plant invasion along roadsides, particularly in the more densely settled stretches where the existing unpaved road is better maintained between Polihali and Marasele (kp 33-54.5). Alien invasive plant density was low in the higher-lying central parts of the route (classed as Near-natural Habitats). Examples of alien invasive plants evident along the road are summarised in Section 4.2.5.

The areas with more disturbed habitats, settlement and more regular road upgrading (classed as Modified) are considered to have *Medium* sensitivity to increase in alien spread. The more remote high altitude areas are of higher biodiversity value and although more inhospitable climatically for the majority of alien invasive plants are susceptible to alien encroachment from road construction and operation over time, especially under global warming scenarios and are assigned *High* sensitivity.

### 5.2.1.2 Assessment of Impact

Alien invasive plant spread is a direct impact which would be initiated during the construction phase and can be expected to continue to spread and encroach over the longer-term if it is not monitored and addressed on an ongoing basis. Since the road construction will largely follow an existing track or gravel road along which some evidence of alien invasive plants are already present in parts, the intensity of the impact in areas rated as Modified Habitat is considered moderate and overall magnitude is assigned as *Medium* for these sections. The more remote areas at higher altitude with few settlements and little alien species and which are of *High* sensitivity to alien spread are susceptible to encroachment by more tolerant alien invasive plants and are also assigned a magnitude of *Medium*. Overall significance is rated as **Moderate** for areas of *Medium* sensitivity and **Major** for areas of *High* Sensitivity.

### 5.2.1.3 Mitigation Measures

Alien invasive plant control measures should be initiated during construction by the road and powerline contractors with post-construction monitoring extending for one year during which it is expected that control measures will be implemented for all new alien invasive plant encroachment caused by road construction. Thereafter, LHDA will be responsible for ongoing alien plant management throughout the Polihali Dam construction period until the road maintenance is handed over to the Roads Directorate.

Post-construction alien management should involve regular monitoring and removal of aliens either by hand or through the use of appropriate herbicides.

**Table 5.5 Impact of Alien Plant Invasion on Plant and Faunal Habitats**

Impact of Alien Plant Invasion on Vegetation and Faunal Habitats				
Project Phase:	Operation Phase			
	Grassland and Rocky Habitats in Modified Habitats (Table 4.10 and Table 4.11) (Mostly low lying areas <2700 m)		Grassland and Rocky Habitats in Near-natural Habitats (Table 4.10 and Table 4.11) (Mostly subalpine zone >2700 m)	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct		Direct	
Magnitude	Medium	Small	Medium	Small
Sensitivity	Medium	Medium	High	High
Significance	<b>Moderate</b>	<b>Minor</b>	<b>Major</b>	<b>Moderate</b>

### 5.2.1.4 Residual Impact

Implementation of the mitigation measures described in Section 5.1.4.4 is predicted to result in a reduction of impact significance to **Minor** for Modified Habitats and **Moderate** for Near-natural Habitats.

## 5.2.2 Increased Collection and Sale of Wild Populations of Spiral Aloe

### 5.2.2.1 Description of Impact

While Spiral Aloes (*Aloe polyphylla*) no longer occur as wild populations within the footprint of the PWAC, discussions with livestock herders and other local community members revealed that wild populations are still present in the more remote higher-lying central parts of the PWAC (estimated to occur within 5-10 km of the road). The construction of the PWAC would significantly improve access to these remnant populations, and facilitate increased opportunities for their sale, potentially leading to the extinction of wild populations within the broader Project Area. New road access at Mohale Dam in the mid-1990s resulted in the rapid decline of a large colony in that area.

### 5.2.2.2 Sensitivity of Receptors

The Spiral Aloe is endemic to the high mountains of Lesotho and is a popular horticultural plant worldwide. The high demand for this species has resulted in over collection of wild plants and subsequent declines of wild populations and the species has been classified by IUCN as Vulnerable. The conservation of remnant wild populations of this species is critically important and the sensitivity of this receptor is thus assessed as *High*.

### 5.2.2.3 Assessment of Impact

The impact of improved access to wild populations of Spiral Aloe will be permanent and is predicted to have a high intensity if no mitigation measures are in place. Although the number of populations of wild plants within the vicinity of the PWAC is unknown (said by local informants to be about 100 in a colony), the impact magnitude is considered to be *Large*. Prior to the implementation of any mitigation measures, the significance of this impact is considered *Critical*.

### 5.2.2.4 Mitigation Measures

The following mitigation measures are recommended for the impact of improved access to wild populations of Spiral Aloe:

- Bill boards to be erected at both ends of the PWAR informing road users of the illegality of purchasing wild spiral aloes;
- Flyers and information sessions at schools;
- Awareness raising of all contractors and suppliers in induction and tool box talks;
- Monitoring of the collection and sale by relevant government authorities (e.g. Department of Environment) and LHDA staff (or contractors);
- Increased collaboration between LHDA and relevant government authority on monitoring and enforcement;
- Census of remaining wild colonies along the road to set a baseline for monitoring; and
- Implementation of projects for community members to learn spiral aloe propagation and to legally sell aloes (and other plants) to road users and to replant aloes into existing or old colony locations to reduce pressure on natural populations.



**Table 5.6 Impact of Increased Access to Wild Populations of Spiral Aloe**

Impact of Increased Spiral Aloe Collection and Sale		
Project Phase:	Operational Phase	
	Pre-Mitigation Impact	Residual Impact
Type of Impact	Indirect	
Magnitude	Large	Low
Sensitivity	High	High
Significance	<b>Critical</b>	<b>Moderate</b>

#### 5.2.2.5 Residual Impact

Implementation of all the measures described in Section 5.2.2.4 is predicted to reduce the impact significance to **Moderate**.

### 5.2.3 Impact of Increased Access to Natural Resources

#### 5.2.3.1 Description of Impact

The remote central part of the PWAC, particularly kp 18-31 from Ha Sekolopata to the Makhoaba loop, is currently inaccessible to vehicles at certain times of the year, particularly during the middle of the rain season and during snowfalls in winter. Natural resources within this zone have not been as heavily harvested as the lower-lying regions and have healthier populations of important medicinal plants such as *Boophone disticha*, *Eucomis autumnalis*, *Euphorbia clavarioides* and *Pelargonium sidoides*. The construction of the PWAR will significantly improve access to these areas and is likely to result in increased pressure on natural resources. It has been reported that people from outside the highlands come to harvest resources to sell at markets as far as South Africa (CES, 2014a). This is an indirect / induced impact of unknown spatial extent.

#### 5.2.3.2 Sensitivity of Receptors

Most of the plant species utilised by surrounding communities for food, medicinal or spiritual purposes are located within the widespread Montane Grassland / Rocky Outcrop Mosaic that is prevalent throughout the Project Area. While this vegetation mosaic has been heavily overgrazed and the natural resources heavily utilised over much of the PWAC, the central higher-lying part of the route has viable populations of useful plant species that are likely to come under pressure once road construction is complete. Three areas were identified as 'botanical gardens' during the cultural heritage survey at Ha Salemonie (kp 7-8); Ha Semphi (kp 11) and Ha Thene (kp 16), although there may be others. Given the high reliance of local communities on plant resources, although they appear to be widespread and fairly common within the Project Area, the sensitivity to increased utilisation pressure is considered *Medium* for the areas of Near-natural Habitat in higher lying areas and *Low* for the Modified Habitats (see Table 4.10 and Table 4.11).

#### 5.2.3.3 Assessment of Impact

The impact of increased access to natural resources by surrounding communities and their livestock will be permanent and is expected to be of high intensity particularly in the less accessible parts of the PWAC. The spatial extent of the impact is unknown but can be expected to occur within the entire Liseleng, Semenanyane and upper Makhoaba River valleys, with incremental effects over time as resources diminish. Although the affected vegetation types along the PWAC, particularly closer to the Senqu valley, are generally ecologically degraded with impoverished flora assemblages, important flora species still occur in places and the impact magnitude is assessed as *Low* in the Modified Habitats and *Medium* in the Near-natural habitats. Prior to the implementation of any mitigation measures, the significance of this impact on useful plant resources will be **Moderate** in Near-natural habitats and **Low** in Modified Habitats.

### 5.2.3.4 Mitigation Measures

The following measures are recommended as mitigation for the impact of increased pressure on natural resources:

- Creation of indigenous plant nurseries – the idea of such nurseries would be to take pressure off the medicinal plants that are currently harvested in the area by providing access to these plants at no cost. In order for this to be viable, nurseries would have to be externally funded by LHDA or other sources. Community members interested in horticulture of such plants should be trained and supported. Such nursery initiatives could be linked to recommendations for a community gardens or other safeguarded areas near the Polihali infrastructure area to showcase the region's indigenous biodiversity and to raise awareness for school groups and other visitors. Such initiatives should be undertaken under a broad Biodiversity Management Plan for Phase II of the LHWP.
- Integrated catchment management (ICM) strategy – ultimately a holistic and multi-disciplinary approach to integrated catchment management to improve livestock and grazing practices is critical to resolving the ongoing decline in range resources and to arrest the loss of biodiversity in the Polihali sub-catchment. Such a strategy is planned by LHDA and will require close coordination between all relevant ministries, LHDA staff and district and community stakeholders. It should be aligned with the national ICM strategy that has recently been initiated (end of 2016). Given the history of catchment management initiatives in Phase 1 areas and elsewhere in Lesotho over the recent decades, this strategy will require concerted effort and commitment by all relevant stakeholders involved with grazing, livestock, agriculture / food security, and biodiversity protection.

**Table 5.7 Impact of Increased Pressure on Natural Resources through Increased Access to Resources**

Impact of Increased Pressure on Natural Resources through Increased Access to Resources				
Project Phase:	Operational Phase			
	Grassland and Rocky Habitats in Modified Habitats (Table 4.10 and Table 4.11) (Mostly low lying areas <2700 m)		Grassland and Rocky Habitats in Near-natural Habitats (Table 4.10 and Table 4.11) (Mostly subalpine zone >2700 m)	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Indirect		Indirect	
Magnitude	Medium	Small	Medium	Small
Sensitivity	Low	Low	Medium	Medium
Significance	<b>Minor</b>	<b>Negligible</b>	<b>Moderate</b>	<b>Minor</b>

### 5.2.3.5 Residual Impact

Implementation of the measures described in Section 5.2.3.4 is predicted to result in a reduction of impact significance in the lower-lying areas to **Negligible** and in higher-lying areas above 2700 masl to **Minor**.



# Section 6 Mitigation and Monitoring

## 6.1 Mitigation

### 6.1.1 Construction Phase

Table 6.1 sets out the mitigation measures required to be implemented to avoid and minimise expected impacts of the PWAR and powerline on terrestrial flora and fauna.

It is assumed that standard mitigation measures to minimise the infrastructure and works areas footprints will be covered under the EMP prepared as part of the ESIS and which will be implemented by the relevant contractors. These will include restricting works areas to the minimum footprint required; managing access/ haul routes used by vehicles/equipment; separation and stockpiling of topsoil and reinstatement of disturbed works areas post-construction; pollution and waste management controls, and controls on worker behaviour.

Specific construction phase mitigation measures include biodiversity awareness of construction staff through tool box talks, pre-construction surveys and search and rescue of plants, including a census of wild spiral aloes (that may be targeted for collection and sale along the new PWAR); and alien invasive plant control measures.

### 6.1.2 Operation Phase

Mitigation for biodiversity impacts during the operation phase relates largely to effectively managing the potential increase of collection and sale of wild populations of *Aloe polyphylla* through education of the public (e.g. bill boards at either end of the PWAR; flyers and information sessions at schools) monitoring of collection and sale by relevant government authority and LHDA staff, as well as monitoring of remaining wild colonies.

Recommendations for protecting higher lying biodiversity important areas of the PWAC as a form of compensation measure (or partial offset) are proposed in Section 7. These could be considered either as part of a broader ICM strategy for the LHWP Phase II area or as part of a broader offset development initiative under a future Biodiversity Management Plan (BMP).

## 6.2 Monitoring

### 6.2.1 Construction Phase

The only monitoring requirements for flora and fauna during the construction phase relate mainly to construction and post-construction monitoring of alien invasive plants. A pre-construction census of wild spiral aloe colonies is recommended as a baseline for future monitoring.

### 6.2.2 Operation Phase

Monitoring for vegetation and fauna during the operational phase are specified in Table 6.2, and include ongoing monitoring and management of alien invasive plants, and spiral aloe harvesting and sale.





Ref	Activity	Requirements / specifications	Responsibility	Scheduling / Timing/ Frequency	Phase	Performance Indicator(s)	Training Requirements
		<ul style="list-style-type: none"> <li>Conduct a baseline assessment of wild Spiral Aloe populations on the higher lying mountains within a 5-8 km corridor of the road footprint, based on information from local informants.</li> <li>Retain and reuse soils for reinstatement and rehabilitation of disturbed areas and temporary construction sites.</li> </ul>					locations, etc.).
2.2	Minimise spread of alien invasive plants	<ul style="list-style-type: none"> <li>Develop a method statement that describes measures to avoid spread of alien invasive plants. This shall include: <ul style="list-style-type: none"> <li>Prevention of spread on machinery and equipment e.g. washing down of machinery / equipment with herbicides prior to use in PWAC Project Area;</li> <li>Measures to restrict alien spread in transfer of materials from weed-infested areas, (e.g. borrow pits etc.);</li> <li>Stockpiling of topsoils confirmed to be free or with limited weeds;</li> <li>Control measures for alien plants, including use of herbicides;</li> <li>Sources and use of compost and mulch from weed-free suppliers;</li> <li>Monitoring and eradication of weeds during and post-construction;</li> <li>Reporting requirements for monitoring and eradication.</li> </ul> </li> <li>Implement alien invasive plant control measures;</li> <li>Ongoing monitoring and control of weeds.</li> </ul>	Contractor: EM and ECO.  Checks by LHDA.	Monthly monitoring checks during site establishment and post construction phase	Prior to and during site clearance	<ul style="list-style-type: none"> <li>Alien invasive plants remain absent or of minimal extent in infrastructure development areas.</li> </ul>	Contractor staff responsible for alien plant control trained in all aspects of alien plant management.  Staff trained and equipped to use herbicides.
<b>3</b>	<b>Spiral Aloe Census of Villages to be Resettled</b> <b>Objective:</b> <i>protect spiral aloes in villages to be impacted by road construction and enhance spiral aloe protection in the broader area of the PWAC</i>						
3.1	Spiral aloe census	<ul style="list-style-type: none"> <li>Conduct a census of spiral aloes that occur in villages within road footprint that require resettlement.</li> </ul>	LHDA : Botanist and RAP consultants	Prior to construction		<ul style="list-style-type: none"> <li>Spiral aloe census report.</li> </ul>	

Ref	Activity	Requirements / specifications	Responsibility	Scheduling / Timing/ Frequency	Phase	Performance Indicator(s)	Training Requirements
3.2	Spiral aloe relocation	<ul style="list-style-type: none"> <li>Confirm number of spiral aloes that need to be relocated to new settlement sites and identify spiral aloes that can be relocated to proposed safeguard sites (e.g. community gardens, Katse Botanical Garden or possible new garden at Polihali);</li> <li>Prepare method statement that documents the requirements for removal, labelling, storage, transportation and replanting of spiral aloes;</li> <li>Relocate spiral aloes to new houses for resettlers or to new community gardens, Polihali infrastructure area or other safeguard areas.</li> </ul>	LHDA: RAP consultants	Prior to construction		<ul style="list-style-type: none"> <li>Confirmation of spiral aloe relocation requirements;</li> <li>Spiral aloe relocation method statement;</li> <li>Evidence of spiral aloe relocation.</li> </ul>	Induction training by Client's EM for management staff on EA requirements.
3.3	Spiral aloe propagation and replanting programme	<ul style="list-style-type: none"> <li>Train community members to propagate spiral aloes for sale and for replanting into wild colonies;</li> <li>Facilitate permitting processes for legal sales.</li> </ul>	LHDA & Department of Environment	Prior to construction		<ul style="list-style-type: none"> <li>Evidence of viable community spiral aloe propagation projects;</li> <li>Evidence of relocation to wild colonies.</li> </ul>	Training of community members in spiral aloe propagation
<b>4</b>	<b>Plant Search and Rescue and Establishment of Safeguard Plant Protection Areas</b> <i>Objective: Recover priority plant species from construction zone and relocate to safeguarded plant areas. Additional objectives can include showcasing and creating awareness of Lesotho's biodiversity to visitors, and through propagation and sale to provide an opportunity to provide income to local residents.</i>						
4.1	Search and rescue of priority plants	<ul style="list-style-type: none"> <li>Appoint suitably qualified or experienced botanist to conduct active searches for priority species prior to infrastructure site clearance;</li> <li>Conduct foot searches of PWAC footprint and quarry areas to recover priority plants;</li> <li>Bag, store and look after plants in temporary nursery area/s prior to use in landscaping of infrastructure areas or community or other botanical gardens (see 3.2);</li> <li>Collect seeds of suitable plants for landscaping and propagation in designated area/s;</li> <li>Replant rescued plants and seeds in accordance with landscaping plan for the advanced infrastructure area;</li> <li>Landscaping shall prioritise use of indigenous naturally occurring plants and shall include a list of suitable plants.</li> </ul>	LHDA: botanist and support team to be appointed	Prior to site clearance	Preparation and during site clearance	<ul style="list-style-type: none"> <li>Botanist appointed</li> <li>Proof of active searches in form of documentation and retrieved plants;</li> <li>Nursery established for temporary relocation of rescued plants and seeds;</li> <li>Dedicated nursery manager appointed to manage the nursery and recover seeds;</li> <li>Landscaping plan developed for infrastructure areas dominated by indigenous plants.</li> </ul>	Nursery staff trained in plant rescue and propagation.

Ref	Activity	Requirements / specifications	Responsibility	Scheduling / Timing/ Frequency	Phase	Performance Indicator(s)	Training Requirements
4.2	Establish botanical garden or plant safeguard areas (e.g. community gardens)	<ul style="list-style-type: none"> <li>Appoint qualified horticulturalist or botanist to plan the siting and layout of plant safeguard areas and work with local community members to develop one or more community nurseries.</li> </ul>	LHDA: botanist appointed	Plan during detailed design phase and implement prior to construction	Construction Phase	<ul style="list-style-type: none"> <li>Plant safeguard areas / botanical garden design plan prepared.</li> <li>Sufficient resources (staff, materials and funding) allocated for nursery establishment and maintenance.</li> </ul>	Training of staff to implement plant protection and relocation

**Table 6.2 Post-Construction Monitoring Requirements for Terrestrial Flora and Fauna**

No.	Aspect	Objectives	Method	Frequency and months	Sampling locations	Detection limit / Performance Target	Responsibility	Reporting
<b>Flora Monitoring Requirements</b>								
1	Spiral Aloe populations	Provide a baseline assessment of wild Spiral Aloe populations within a 5 km buffer of the road footprint. Conduct annual surveys of these populations to monitor population dynamics and health	<ul style="list-style-type: none"> <li>Employ local residents (e.g. herders) who know of wild populations to escort a botanist to each of these known populations;</li> <li>Conduct a count of all plants in each population, including proportion of mature plants, evidence of recruitment (seedlings, suckers) and evidence of harvesting;</li> <li>Photographic record of fixed sites for visual record of population condition.</li> </ul>	Annually	The number of wild populations within the proposed buffer is unknown. At least 5 colonies should be monitored, but preferably all the populations if less than 10 colonies found.	Baseline assessment; Annual monitoring report	LHDA, in collaboration with botanist.	Summary report to be submitted to LHDA and Dept. of Environment
2	Plant survival in nurseries and botanical garden	Verify the survival rate of plants relocated from the PWAC to plant nurseries and botanical garden	<ul style="list-style-type: none"> <li>Managers of any established nurseries and proposed botanical garden should record the survival rate of relocated plants and species and treatment measures used. This will confirm the effectiveness of management and contribute to knowledge of the propagation and growing of indigenous plants.</li> </ul>	Monthly	n/a	Survival rate of relocated and propagated plants.	LHDA, in collaboration with botanist.	Summary monthly report for LHDA



No.	Aspect	Objectives	Method	Frequency and months	Sampling locations	Detection limit / Performance Target	Responsibility	Reporting
<b>Alien Invasive Plant Monitoring</b>								
1	Alien plant monitoring	Monitor the occurrence of alien invasive plants along the PWAR and construction camps and laydown areas used by contractors	<ul style="list-style-type: none"> <li>Conduct pre-construction survey to record and map severity of alien plant encroachment, including in areas where currently absent;</li> <li>Conduct spot checks along the PWAR during and after construction to confirm rate of spread of alien plants;</li> <li>Compile a photographic record of alien plants at specific localities (recorded with GPS);</li> <li>Complete an alien invasive plant monitoring data sheet recording location, type and estimated extent of alien plants along the route as a baseline for monitoring.</li> </ul>	Pre-construction survey; Monthly during construction and post construction, and bi-annually on an ongoing basis.	To be confirmed in pre-construction survey and included under the Biodiversity Management Plan for longer term monitoring. Sites expected to include locations at intervals along the entire route.	Rate of spread	LHDA, in conjunction with botanist	Summary report post surveys. Overall report.
<b>Fauna (non-avian) Monitoring Requirements</b>								
1	Frog monitoring	Monitor the occurrence and survival of indicator frog species such as Maluti River Frog in rivers and streams such as the Liseleng and Semenanyane Rivers	<ul style="list-style-type: none"> <li>Aquatic sampling using sweep netting and acoustic recording at sites.</li> </ul>	Annually during construction.	To be confirmed under Biodiversity Management Plan but expected to include: <ul style="list-style-type: none"> <li>Monitoring sites at selected perennial rivers and streams along the PWAC.</li> </ul>	To be confirmed in Biodiversity Monitoring Plan (BMP).	LHDA, in conjunction with ecologist	Summary report post surveys. Overall report.

## Section 7 Other Recommendations

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In addition to the mitigation measures outlined in Section 6 a number of recommendations are made here for consideration as part of broader biodiversity and catchment management initiatives that are expected to be implemented under a future Integrated Catchment Management Strategy and Biodiversity Management Plan (BMP) for the LHWP Phase II Project Area.

### 1. Integrated catchment management

Sustainable rangeland management is critical to enhanced biodiversity in Lesotho. Therefore, measures that lead to successful moderation of grazing intensity and soil conservation in the PWAC Project Area are expected to increase grassland biomass and net flora and fauna biodiversity. The ICM strategy for the Polihali Reservoir sub-basin is expected to address issues related to overall catchment condition with a view to reducing the rate of soil loss, and optimising rangeland condition to support the prevailing livestock-based economy. The ICM strategy should also include the PWAC corridor area and identify opportunities to enhance grazing and land use pressures in support of biodiversity (and wetland) protection.

### 2. Biodiversity Management Plan

The future BMP that will be developed for the LHWP Phase II area should encompass biodiversity protection, enhancement and monitoring measures for impacts arising from the PWAC, some of which are recommended in Section 6.1 and 6.2 in addition to biodiversity offset measures recommended under Point 3 below. Such biodiversity conservation measures are separate to the rangeland improvement and soil conservation measures that will be covered under the ICM strategy. Determining the separation and overlaps between the ICM and BMP will be a task for the next phase of work.

### 3. Biodiversity Offset Considerations

Biodiversity offsets recommendations have been made in the PRAI ESIS and are relevant here as part of a much broader biodiversity offset consideration for LHWP Phase 2. The higher lying portions of the Lesotho Highlands mountain zone above 2700-2800 m (sub-alpine) typically have a higher proportion of endemic and restricted-range species than the lower lying areas. These areas are generally considered to have higher conservation value than most areas of Lesotho, largely by virtue of the lower livestock grazing intensity. However, only a small proportion of the subalpine zone of Lesotho is conserved (Sehlabathebe, Bokong and Tsehlanyane – totalling about 13,700 ha). The MDTP has recognised the importance of conserving these high lying areas of the country. Priority areas identified previously include the upper Senqu sources; the Mokhotlong - Sanqebethu and Sani Top areas for enhanced protection (MDTP, 2009). However, little meaningful interventions have yet been achieved towards this goal due to lack of funding.

It is recommended that the scope of work for the BMP include a component that covers a broad assessment and quantification of the full extent of biodiversity features and ecological services that will be impacted by the LHWP Phase II development (including Polihali reservoir and PWAC) and sets out an approach to identifying suitable areas that could best protect the priority biodiversity features in the long term. This should include consideration of the relative viability and biodiversity value of protecting portions of the PWAC (such as upper Liseleng and Semenanyane valleys) and upper Polihali catchment areas. Careful coordination between, and separation of, the scopes of work of the ICM strategy and the BMP will be required.

Considerations that should be included in defining an offset or compensation area include.

- The compensatory protected area(s) should preferably be ecologically similar or better than the habitat converted or degraded by the project;
- The proposed areas should be subject to limited existing (or anticipated) threats to biodiversity (e.g. free of mining risks, future dams, etc.);
- For a true offset, the compensatory protected area(s) should be of equivalent value and no smaller (and preferably bigger based on suitable multiplier values as a basis for determination of habitat metrics) than the original natural habitat converted or degraded by the project;
- Designation of such areas should complement other government/conservation partner programs and align with previously designated priority areas (e.g. MDTP) or other national or regional initiatives to implement the Convention on Biological Diversity;
- Identifying suitable areas and management measures to achieve biodiversity gains in biodiversity protection will require discussions and agreements with a range of national and district stakeholders as well as Principal Chiefs;
- Fundamental to the success of such a protected area will be successful implementation of controlled grazing regimes which will require the buy in and support of livestock owners in the area;
- Formal interventions to arrest the degradation of wetland ecosystems may be required to optimise the success of wetland restoration; and
- Performance targets will need to be defined for any compensation or offset areas for a range of biodiversity features and ecological processes to confirm improvement in biodiversity over time.

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## Appendix A: Full Plant Species List for PWAC Project Area





Appendix Table A.1: Full List of Plant Species Recorded in Polihali Western Access Corridor

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power Line
<b>FERNS</b>									
<b>Anemiaceae</b>									
<i>Mohria vestita</i>	Lehorometso	Fern				x	x	x	x
<b>Aspleniaceae</b>									
<i>Asplenium trichomanes</i>	Lehorometso	Fern				x		x	x
<b>Lycopodiaceae</b>									
<i>Lycopodium clavatum</i>		Fern				x			x
<b>Sinopteridaceae</b>									
<i>Cheilanthes eckloniana</i>	Mamarakoaneng	Fern				x	x	x	x
<i>Cheilanthes hirta</i>	Mamahuoaneng	Fern				x		x	x
<i>Cheilanthes involuta</i>	Lehorometso	Fern				x		x	x
<b>DICOTS</b>									
<b>Apiaceae</b>									
<i>Alepidea thodei</i>		Forb		Strict		x		x	x
<i>Berula erecta</i>	Lehlatso	Forb				x		x	x
<i>Heteromorpha cf. arborescens</i>	Monkhoane	Shrub					x	x	
<b>Anacardiaceae</b>									
<i>Searsia divaricata</i>	Kolitsana	Shrub		Near			x	x	x
<b>Apocynaceae: Asclepiadoideae</b>									
<i>Asclepias gibba</i>	Montsokoane	Forb				x		x	
<i>Gomphocarpus physocarpus</i>	Moithimolo	Shrub				x		x	x
<i>Pachycarpus sp.</i>	Leshokhoa	Forb			Protected	x		x	
<i>Pachycarpus vexillaris</i>	Leshokhoa	Forb		Near	Protected	x			x
<i>Schizoglossum bidens</i>		Forb		Near		x		x	
<i>Stenostelma sp. A</i>		Forb				x		x	
<b>Asteraceae</b>									
<i>Arctotis arctotoides</i>	Putsoa-pululu	Forb				x		x	
<i>Artemisia afra</i> *	Lengana	Forb				x		x	x
<i>Berkheya cirsifolia</i>	Mohato-o-mosoeu	Forb		Strict		x	x	x	x

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power Line
<i>Berkheya multijuga</i>	Mohatollo	Forb		Near		x			x
<i>Bidens bipinnata</i> *	Moonyane	Forb				x		x	
<i>Bidens formosa</i> *	Palesa	Forb				x		x	
<i>Chrysocoma ciliata</i>	Sehalahala	Shrub				x	x	x	x
<i>Cineraria lyratiformis</i>	Tlali-tlali	Shrub				x		x	x
<i>Cirsium vulgare</i> *		Forb				x		x	
<i>Conyza podocephala</i>	Manku-a-maholo	Forb				x		x	
<i>Cotula paludosa</i>		Forb		Strict		x		x	x
<i>Cotula radicalis</i>		Forb		Strict		x		x	x
<i>Cotula socialis</i>		Forb		Strict		x		x	
<i>Dicoma anomala</i>	Hloenya	Forb	Vulnerable			x		x	x
<i>Euryops laxa</i>	Rapeisi	Forb				x	x	x	
<i>Euryops tysonii</i>	Rapeisi	Forb		Near			x	x	
<i>Felicia filifolia</i>	Leholo	Shrub				x	x	x	
<i>Felicia muricata</i>	Mamileng	Forb				x	x	x	x
<i>Felicia petiolata</i>	Khotolia-ea-thaba	Forb		Near		x			x
<i>Gazania krebsiana</i>	Tsikitleane	Forb				x		x	x
<i>Gymnopentzia bifurcata</i>	Sehalahala	Shrub		Near		x	x	x	x
<i>Haplocarpha scaposa</i>	Papetloana	Forb				x		x	x
<i>Helichrysum albo-brunneum</i>		Forb		Near		x		x	
<i>Helichrysum aureonitens</i>	Tooane-ntja	Forb				x		x	x
<i>Helichrysum aureum var. monocephalum</i>	Tšoene	Forb				x		x	
<i>Helichrysum basalticum</i>		Forb		Strict		x	x	x	x
<i>Helichrysum caespitium</i>	Phate-ea-ngaka	Forb				x		x	x
<i>Helichrysum callicomum</i>		Forb				x		x	
<i>Helichrysum confertum</i>		Forb		Strict		x			
<i>Helichrysum cymosum</i>		Forb		Near		x	x		
<i>Helichrysum dregeanum</i>	Tooane-ea-thaba	Forb				x		x	
<i>Helichrysum montanum</i>		Forb				x		x	
<i>Helichrysum nudifolium</i>	Boleba	Forb				x			

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power Line
<i>Helichrysum odoratissimum</i>	Phefo	Forb				x		x	x
<i>Helichrysum praecurrens</i>		Forb				x		x	
<i>Helichrysum sessilioides</i>		Forb		Strict		x		x	
<i>Helichrysum splendidum</i>	Phefo-ea-loti	Shrub				x	x	x	
<i>Helichrysum subglomeratum</i>		Forb				x		x	x
<i>Helichrysum trilineatum</i>	Hokobetsi	Shrub		Near		x	x	x	x
<i>Hirpicium armerioides</i>	Shoeshoe-ea-loti	Forb		Near		x		x	x
<i>Osteospermum sinuatum</i>		Forb				x	x	x	x
<i>Pentzia cooperi</i>	Lelingoana	Shrub		Near			x	x	x
<i>Schkuhria pinnata</i> *	Mamatutuoele	Forb				x		x	
<i>Senecio asperulus</i>	Moferefere	Forb				x		x	x
<i>Senecio discodregeanus</i>	Lehlomane-le-lenyenyane	Forb				x	x	x	x
<i>Senecio inaequidens</i>	Khotolia	Forb				x		x	
<i>Senecio isatideus</i>	Lehlomane-le-leputsoa	Forb				x		x	x
<i>Senecio othonniflorus</i>	Lehlomane	Forb				x	x	x	x
<i>Senecio polyodon</i>	Sebea-mollo-sa-mekhoabo	Forb		Near		x		x	x
<i>Senecio rhomboideus</i>	Lehlomane-la-thaba	Forb				x		x	x
<i>Tagetes minutus</i> *	Monkhane	Forb				x		x	
<i>Taraxacum officinale</i> *	Fukuthoane	Forb				x		x	
<i>Ursinia montana</i>	Leabo	Forb		Near				x	x
<i>Ursinia tenuiloba</i>		Forb				x		x	
<i>Zinnia peruviana</i> *	Lipilopilo	Forb				x		x	x
<b>Boraginaceae</b>									
<i>Cynoglossum austro-africanum</i>		Forb		Near		x		x	
<i>Cynoglossum hispidum</i>	Bohomenyana	Forb						x	
<i>Echium vulgare</i> *	Bohomenyana	Forb				x		x	x
<b>Brassicaceae</b>									
<i>Capsella bursa-pastoris</i> *	Tlhako-ea-khomo	Forb				x		x	x
<i>Erucastrum austro-africanum</i>	Sepaile-sa-thaba	Forb				x		x	
<i>Heliophila rigidisciula</i>		Forb				x	x	x	x



Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power Line
<i>Rorippa nudiuscula</i>	Papasane	Forb				x		x	x
<b>Buddlejaceae</b>									
<i>Buddleja salviifolia</i>	Lelothoane	Tree					x	x	
<i>Gomphostigma virgatum</i>	Mosika-noka	Shrub						x	x
<b>Campanulaceae</b>									
<i>Wahlenbergia krebisii</i>		Forb		Near		x		x	x
<b>Caryophyllaceae</b>									
<i>Cerastium arabis</i>		Forb				x		x	
<i>Dianthus basuticus</i>	Hlokoana-la-tsela	Forb		Near	Protected	x		x	x
<i>Silene bellidioides</i>	Likoomana	Forb				x		x	x
<i>Silene</i> sp.		Forb				x			x
<i>Silene undulata</i>		Forb				x		x	x
<b>Chenopodiaceae</b>									
<i>Salsola kali</i> *	Lekoerekoere	Forb				x		x	
<b>Convolvulaceae</b>									
<i>Cuscuta campestris</i>		Forb				x		x	
<b>Crassulaceae</b>									
<i>Cotyledon orbiculata</i>	Serelile	Succulent				x		x	x
<i>Crassula alba</i>	Feko	Succulent				x		x	
<i>Crassula dependens</i>		Succulent				x		x	
<i>Crassula natalensis</i>	Bohobe-ba-setsomi	Succulent		Near		x	x	x	x
<i>Crassula peploides</i>	Moorra-metsi	Succulent		Near		x		x	x
<i>Crassula setulosa</i>	Serelilenyana	Succulent				x		x	
<b>Cucurbitaceae</b>									
<i>Kedrostris capensis</i>	Sesepa-sa-linoha	Forb				x		x	
<i>Zehneria scabra</i>		Forb				x		x	x
<b>Dipsacaceae</b>									
<i>Scabiosa columbaria</i>	Selomi	Forb				x		x	x
<b>Ebenaceae</b>									
<i>Diospyros austro-africana</i>	Senokonoko	Shrub		Near		x	x	x	x

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power Line
<b>Euphorbiaceae</b>									
<i>Euphorbia clavarioides</i>	Sehlooko	Succulent				x	x	x	x
<i>Euphorbia epicyparissias</i>	Sehlakoana-se-senyane	Forb				x		x	x
<b>Fabaceae: Papilionoideae</b>									
<i>Argyrolobium marginatum</i>		Forb				x		x	x
<i>Argyrolobium</i> sp.		Forb				x		x	
<i>Dichilus reflexus</i>	Lesita-tlali	Forb				x	x	x	x
<i>Indigofera woodii</i>		Forb		Near		x		x	
<i>Lessertia depressa</i>	Musapelo	Forb				x		x	
<i>Lotononis galpinii</i>		Forb		Near		x	x	x	x
<i>Lotononis laxa</i>	Musa-pelo-oa-matlapa-o-monynyane	Forb				x		x	
<i>Lotononis sericophylla</i>		Shrub		Near		x		x	x
<i>Trifolium burchellianum</i>	Moroko	Forb				x	x	x	x
<b>Fumariaceae</b>									
<i>Cysticapnos pruinosa</i>		Forb		Near		x	x	x	x
<b>Gentianaceae</b>									
<i>Sebaea cf. sedoides</i>	Marama-a-baroetsana	Forb				x		x	x
<b>Geraniaceae</b>									
<i>Geranium multisectum</i>	Hlapi-e-kholo	Forb		Near		x	x	x	
<i>Monsonia attenuata</i>	Malengoana	Forb		Near		x		x	x
<i>Pelargonium cf. ranunculophyllum</i>		Forb		Near		x		x	
<i>Pelargonium sidoides</i>	Khoara	Forb				x		x	x
<b>Gunneraceae</b>									
<i>Gunnera perpensa</i>		Forb						x	x
<b>Lamiaceae</b>									
<i>Acrotome inflata</i>	Sea-le-moea	Forb				x		x	
<i>Mentha aquatica</i>	Kuena-ea-mekhoabo	Forb			Protected			x	x
<i>Mentha longifolia</i>	Kuena	Forb			Protected			x	x
<i>Stachys rugosa</i>	Taraputsoe	Forb				x		x	x

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power Line
<b>Lobeliaceae</b>									
<i>Lobelia galpinii</i>	Motlapatšuiniana	Forb		Strict		x		x	x
<i>Lobelia cf. preslii</i>	Motlapatšuiniana	Forb		Near		x		x	x
<i>Lobelia pteropoda</i>	Motlapatšuiniana	Forb				x	x	x	x
<b>Malvaceae</b>									
<i>Hermannia coccocarpa</i>	Qena-e-nyenyane	Forb				x		x	
<i>Hermannia depressa</i>	Selentljane	Forb				x	x	x	
<i>Hibiscus trionum</i>		Forb				x		x	x
<i>Malva parviflora</i> *	Tikamotse	Forb				x		x	x
<b>Mesembryanthemaceae</b>									
<i>Delosperma hirtum</i>	Motabo	Succulent		Near		x		x	x
<i>Delosperma lavisiae</i>	Motabo	Succulent		Near		x		x	
<i>Delosperma</i> sp. B	Motabo	Succulent				x			x
<b>Molluginaceae</b>									
<i>Psammotropha mucronata</i>	Mothujoana	Forb				x		x	x
<b>Onagraceae</b>									
<i>Epilobium hirsutum</i>	Letsoai-la-balisana	Forb				x			x
<i>Epilobium salignum</i>		Forb				x		x	x
<i>Oenothera rosea</i> *	Moopeli	Forb				x		x	
<b>Orobanchaceae</b>									
<i>Alectra capensis</i>	Moema-nosi	Forb				x		x	
<i>Striga bilabiata</i>	Seona	Forb				x		x	x
<b>Oxalidaceae</b>									
<i>Oxalis obliquifolia</i>	Bolila	Forb				x	x	x	x
<b>Papaveraceae</b>									
<i>Papaver aculeatum</i> *	Sehlohlo	Forb				x		x	x
<b>Phytolaccaceae</b>									
<i>Phytolacca octandra</i> *	Monatja	Forb				x		x	x
<b>Polygalaceae</b>									
<i>Polygala hottentota</i>	Ntšebele	Forb				x	x	x	

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power Line
<i>Polygala rehmannii</i>	Bolao-bo-boholo	Forb				x		x	x
<i>Polygala rhinostigma</i>		Forb		Near		x		x	x
<b>Polygonaceae</b>									
<i>Persicaria cf. attenuata</i>	Khamane	Forb						x	x
<i>Rumex lanceolata</i>	Bolila-ba-likhomo	Forb				x		x	
<b>Ranunculaceae</b>									
<i>Ranunculus meyeri</i>	Hlapi-ea-metsi-e-nyenyane	Forb				x			x
<i>Ranunculus multifidus</i>		Forb				x		x	
<b>Rosaceae</b>									
<i>Prunus persica</i> *		Tree						x	x
<i>Rosa rubiginosa</i> *	Morobei	Shrub				x		x	
<i>Rubus ludwigii</i>	Monokotsoai	Shrub				x		x	
<b>Rubiaceae</b>									
<i>Anthospermum monticola</i>	Phakisane	Forb		Near		x	x	x	x
<i>Galium capense</i>	Mabone	Forb				x		x	x
<i>Pentanisia prunelloides</i>	Setima mollo	Forb				x		x	
<b>Salicaceae</b>									
<i>Populus alba</i> *	Papoliri	Tree						x	
<i>Salix babylonica</i> *	Moluoane	Tree						x	
<i>Salix fragilis</i> *	Lebelete	Tree						x	
<i>Salix mucronata</i>	Lebelete	Tree						x	
<b>Santalaceae</b>									
<i>Thesium costatum</i>	Marakalle	Forb				x		x	
<i>Thesium cf. imbricatum</i>		Forb				x		x	
<b>Scrophulariaceae</b>									
<i>Chaenostoma patrioticum</i>		Forb				x		x	
<i>Diascia anastrepta</i>	Malana-a-konyana	Forb		Strict		x		x	x
<i>Diascia integerrima</i>	Bolao-ba-litoeba	Forb		Near		x	x	x	x
<i>Hebenstretia comosa</i>		Forb				x		x	
<i>Jamesbrittenia breviflora</i>	Phiri-ea-hlaha	Forb		Near		x		x	



Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power Line
<i>Jamesbrittenia lesutica</i>	Phiri-ea-hlaha	Forb	Vulnerable	Strict		x	x	x	
<i>Jamesbrittenia pristisepala</i>	Sesepa-sa-linoha	Forb		Near		x	x	x	
<i>Manulea cf. crassifolia</i>		Forb		Strict		x		x	x
<i>Nemesia caerulea</i>		Forb		Near		x		x	
<i>Nemesia rupicola</i>		Forb				x		x	x
<i>Phygelius aequalis</i>	Mafifi-matso	Shrub		Near		x		x	x
<i>Selago flanaganii</i>		Forb		Strict		x	x	x	
<i>Selago cf. immersa</i>		Forb		Near		x		x	x
<i>Selago galpinii</i>		Forb		Near		x		x	x
<i>Zaluzianskya pulvinata</i>	Theleli	Forb		Near		x	x	x	x
<i>Zaluzianskya rubrostellata</i>	Theleli	Forb		Strict		x		x	x
<b>Solanaceae</b>									
<i>Datura stramonium*</i>	Letjoi	Shrub				x		x	
<i>Solanum retroflexum</i>	Limomontso	Shrub				x		x	
<i>Withania somnifera</i>	Moferangope	Shrub				x		x	
<b>Thymelaeaceae</b>									
<i>Gnidia aberrans</i>		Forb				x		x	
<i>Passerina montana</i>	Lekhapu-le-lenyenyane	Shrub				x	x	x	x
<b>Zygophyllaceae</b>									
<i>Tribulus terrestris</i>	Tšehlo	Forb				x		x	
<b>MONOCOTS</b>									
<b>Agavaceae</b>									
<i>Agave americana *</i>		Succulent				1	1		
<b>Alliaceae</b>									
<i>Tulbaghia acutiloba</i>	Motsuntsunyane	Geophyte				1	1		
<b>Amaryllidaceae</b>									
<i>Boophone disticha</i>	Leshoma	Geophyte	Endangered			x		x	
<i>Haemanthus humilis</i>	Tsebe-ea-phofu	Geophyte				x		x	x
<b>Araceae</b>									
<i>Zantedeschia albomaculata</i>	Mohalalitoe	Geophyte				x	x	x	

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power Line
<b>Asparagaceae</b>									
<i>Asparagus asparagoides</i>		Shrub				x		x	x
<b>Asphodelaceae</b>									
<i>Aristaloe aristata</i>	Lekhalana	Succulent	Near Threatened	Near		x		x	
<i>Aloe polyphylla</i>		Succulent	Vulnerable	Strict		x		x	
<i>Bulbine narcissifolia</i>	Khomo-ea-balisa	Succulent			Protected	x	x	x	x
<i>Kniphofia caulescens</i>		Geophyte				x			x
<i>Kniphofia ritualis</i>	Lelutla	Geophyte		Near		x	x	x	x
<b>Colchicaceae</b>									
<i>Colchicum striatum</i>		Forb				x		x	x
<i>Wurmbea elatior</i>		Forb				x			x
<b>Commelinaceae</b>									
<i>Commelina africana</i>	Khotsoana	Forb				x		x	x
<b>Cyperaceae</b>									
<i>Carex acutiformis</i>		Sedge				x		x	
<i>Carex austro-africana</i>	Lesuoane	Sedge				x		x	
<i>Cyperus rupestris</i>	Roroana	Sedge				x		x	x
<i>Cyperus semitrifidus</i>		Sedge				x		x	x
<i>Ficinia cinnamomea</i>	Sechaba	Sedge				x		x	
<i>Scirpus ficinioides</i>	Loli	Sedge					x	x	x
<b>Hyacinthaceae</b>									
<i>Albuca shawii</i>	Morotoana-phookoana	Geophyte		Near		x	x	x	
<i>Dipcadi gracillimum</i>	Morotoana-phookoana	Geophyte				x		x	
<i>Drimiopsis sp.</i>		Geophyte				x		x	
<i>Eucomis schijffii</i>		Geophyte		Strict		x		x	
<i>Eucomis autumnalis</i>	Mathethebale	Geophyte	Vulnerable			x		x	x
<i>Ledebouria sandersonii</i>		Geophyte				x		x	
<i>Ornithogalum cf. graminifolium</i>	Mahae	Geophyte				x	x	x	
<b>Hypoxidaceae</b>									
<i>Hypoxis costata</i>	Moli-boea	Geophyte				x		x	x

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power Line
<i>Rhodohypoxis rubella</i>		Geophyte		Strict		x			x
<b>Iridaceae</b>									
<i>Dierama robustum</i>	Lethepu	Geophyte		Near		x		x	x
<i>Gladiolus permeabilis</i>		Geophyte				x		x	
<i>Gladiolus saundersii</i>	Mokhabebe	Geophyte		Strict		x	x	x	x
<i>Hesperantha</i> sp.		Geophyte					x	x	x
<i>Romulea macowanii</i>		Geophyte				x		x	
<b>Orchidaceae</b>									
<i>Corycium dracomontanum</i>		Geophyte				x	x	x	x
<i>Satyrium longicauda</i>	Mametsana	Geophyte				x			x
<b>Poaceae</b>									
<i>Aristida bipartita</i>	Mohlolohali	Grass				x		x	x
<i>Aristida congesta</i>	Lemanamana	Grass				x	x	x	
<i>Aristida diffusa</i>	Bohlanya-ba-lipere	Grass				x		x	
<i>Brachiaria serrata</i>	Lengole-la-namane	Grass				x		x	x
<i>Bromus catharticus</i> *		Grass				x		x	
<i>Catalepis gracilis</i>	Joang-ba-matlapa	Grass		Near		x	x	x	x
<i>Cymbopogon caesius</i>	Moshanyana-oa-maralleng	Grass				x		x	
<i>Cymbopogon dieterlenii</i>		Grass				x	x	x	x
<i>Cynodon hirsutus</i>		Grass				x			x
<i>Ehrharta calycina</i>		Grass				x		x	x
<i>Elionurus muticus</i>	Tlhoko	Grass				x		x	x
<i>Eragrostis caesia</i>	Tsaane-ea-loti	Grass				x		x	x
<i>Eragrostis capensis</i>	Baroana	Grass				x		x	x
<i>Eragrostis chloromelas</i>	Moseka	Grass				x		x	x
<i>Eragrostis curvula</i>	Tsaane	Grass				x		x	x
<i>Eragrostis plana</i>	Molula	Grass				x		x	x
<i>Eragrostis racemosa</i>	Seritšoane-sa-lithota	Grass				x	x	x	x
<i>Eustachys paspaloides</i>	Sebokunyana	Grass				x		x	
<i>Festuca caprina</i>	Letsiri	Grass				x			x

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power Line
<i>Festuca costata</i>	Lekolojane	Grass		Near		x		x	x
<i>Harpochloa falx</i>	Lefokololi	Grass				x		x	x
<i>Helictotrichon longifolium</i>	Litse-ba-pulumo	Grass		Near		x		x	x
<i>Helictotrichon turgidulum</i>	Litse-ba-pulumo	Grass				x		x	
<i>Heteropogon contortus</i>	Selokana	Grass				x		x	x
<i>Hyparrhenia hirta</i>	Mohlomo	Grass				x	x	x	x
<i>Karoochloa purpurea</i>		Grass				x	x	x	x
<i>Koeleria capensis</i>	Boshoane	Grass				x		x	x
<i>Melica decumbens</i>		Grass				x		x	
<i>Melinis nerviglumis</i>	Letjotjo	Grass				x	x	x	
<i>Merxmuellera disticha</i>	Moseha	Grass				x		x	x
<i>Merxmuellera drakensbergensis</i>	Molala-hlolo	Grass		Near		x	x	x	x
<i>Merxmuellera macowanii</i>	Mosika-nokana	Grass		Near		x		x	x
<i>Pennisetum thunbergii</i>	Nyalothi	Grass				x		x	
<i>Pentaschistis aroides</i>	Joang-ba-mehlaka	Grass					x		x
<i>Stiburus conrathii</i>		Grass		Near		x		x	
<i>Themeda triandra</i>	Seboku	Grass						x	x
<i>Tragus racemosus</i>	Bore-ba-ntja	Grass				x		x	
<i>Trichoneura grandiglumis</i>	Joang-ba-tsela	Grass				x	x	x	
<b>TOTAL</b>		<b>254</b>	<b>6</b>	<b>68</b>	<b>6</b>	<b>233</b>	<b>61</b>	<b>234</b>	<b>148</b>





## Appendix B: Priority Plant Species for PWAC Project Area



**Appendix Table B.1: Priority Plant Species Recorded in PWAC Project Area**

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power-line
<b>DICOTS</b>									
<b>Apiaceae</b>									
<i>Alepidea thodei</i>		Forb		Strict		x		x	x
<b>Anacardiaceae</b>									
<i>Searsia divaricata</i>	Kolitsana	Shrub		Near			x	x	x
<b>Apocynaceae: Asclepiadoideae</b>									
<i>Pachycarpus sp.</i>	Leshokhoa	Forb			Protected	x		x	
<i>Pachycarpus vexillaris</i>	Leshokhoa	Forb		Near	Protected	x			x
<i>Schizoglossum bidens</i>		Forb		Near		x		x	
<b>Asteraceae</b>									
<i>Berkheya cirsiifolia</i>	Mohato-o-mosoeu	Forb		Strict		x	x	x	x
<i>Berkheya multijuga</i>	Mohatollo	Forb		Near		x			x
<i>Cotula paludosa</i>		Forb		Strict		x		x	x
<i>Cotula radicalis</i>		Forb		Strict		x		x	x
<i>Cotula socialis</i>		Forb		Strict		x		x	
<i>Dicoma anomala</i>	Hloenya	Forb	Vulnerable			x		x	x
<i>Euryops tysonii</i>	Rapeisi	Forb		Near			x	x	
<i>Felicia petiolata</i>	Khotolia-ea-thaba	Forb		Near		x			x
<i>Gymnopentzia bifurcata</i>	Sehalahala	Shrub		Near		x	x	x	x
<i>Helichrysum albo-brunneum</i>		Forb		Near		x		x	
<i>Helichrysum basalticum</i>		Forb		Strict		x	x	x	x
<i>Helichrysum confertum</i>		Forb		Strict		x			
<i>Helichrysum cymosum</i>		Forb		Near		x	x		
<i>Helichrysum sessilioides</i>		Forb		Strict		x		x	
<i>Helichrysum trilineatum</i>	Hokobetsi	Shrub		Near		x	x	x	x
<i>Hirpicium armerioides</i>	Shoeshoe-ea-loti	Forb		Near		x		x	x
<i>Pentzia cooperi</i>	Lelingoana	Shrub		Near			x	x	x
<i>Senecio polyodon</i>	Sebea-mollo-sa-mekhoabo	Forb		Near		x		x	x



Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power-line
<i>Ursinia montana</i>	Leabo	Forb		Near				x	x
<b>Boraginaceae</b>									
<i>Cynoglossum austro-africanum</i>		Forb		Near		x		x	
<b>Campanulaceae</b>									
<i>Wahlenbergia krebsii</i>		Forb		Near		x		x	x
<b>Caryophyllaceae</b>									
<i>Dianthus basuticus</i>	Hlokoana-la-tsela	Forb		Near	Protected	x		x	x
<b>Crassulaceae</b>									
<i>Crassula natalensis</i>	Bohobe-ba-setsomi	Succulent		Near		x	x	x	x
<i>Crassula peploides</i>	Moora-metsi	Succulent		Near		x		x	x
<b>Ebenaceae</b>									
<i>Diospyros austro-africana</i>	Senokonoko	Shrub		Near		x	x	x	x
<b>Fabaceae: Papilionoideae</b>									
<i>Indigofera woodii</i>		Forb		Near		x		x	
<i>Lotononis galpinii</i>		Forb		Near		x	x	x	x
<i>Lotononis sericophylla</i>		Shrub		Near		x		x	x
<b>Fumariaceae</b>									
<i>Cysticapnos pruinosa</i>		Forb		Near		x	x	x	x
<b>Geraniaceae</b>									
<i>Geranium multisectum</i>	Hlapi-e-kholo	Forb		Near		x	x	x	
<i>Monsonia attenuata</i>	Malengoana	Forb		Near		x		x	x
<i>Pelargonium cf. ranunculophyllum</i>		Forb		Near		x		x	
<b>Lamiaceae</b>									
<i>Mentha aquatica</i>	Kuena-ea-mekhoabo	Forb			Protected			x	x
<i>Mentha longifolia</i>	Kuena	Forb			Protected			x	x
<b>Lobeliaceae</b>									
<i>Lobelia galpinii</i>	Motlapatšuiyana	Forb		Strict		x		x	x
<i>Lobelia cf. preslii</i>	Motlapatšuiyana	Forb		Near		x		x	x
<b>Mesembryanthemaceae</b>									
<i>Delosperma hirtum</i>	Motabo	Succulent		Near		x		x	x

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power-line
<i>Delosperma lavisiae</i>	Motabo	Succulent		Near		x		x	
<b>Polygalaceae</b>									
<i>Polygala rhinostigma</i>		Forb		Near		x		x	x
<b>Rubiaceae</b>									
<i>Anthospermum monticola</i>	Phakisane	Forb		Near		x	x	x	x
<b>Scrophulariaceae</b>									
<i>Diascia anastrepta</i>	Malana-a-konyana	Forb		Strict		x		x	x
<i>Diascia integerrima</i>	Bolao-ba-litoeba	Forb		Near		x	x	x	x
<i>Jamesbrittenia breviflora</i>	Phiri-ea-hlaha	Forb		Near		x		x	
<i>Jamesbrittenia lesutica</i>	Phiri-ea-hlaha	Forb	Vulnerable	Strict		x	x	x	
<i>Jamesbrittenia pristisepala</i>	Sesepa-sa-linoha	Forb		Near		x	x	x	
<i>Manulea cf. crassifolia</i>		Forb		Strict		x		x	x
<i>Nemesia caerulea</i>		Forb		Near		x		x	
<i>Phygellus aequalis</i>	Mafifi-matso	Shrub		Near		x		x	x
<i>Selago flanaganii</i>		Forb		Strict		x	x	x	
<i>Selago cf. immersa</i>		Forb		Near		x		x	x
<i>Selago galpinii</i>		Forb		Near		x		x	x
<i>Zaluzianskya pulvinata</i>	Theleli	Forb		Near		x	x	x	x
<i>Zaluzianskya rubrostellata</i>	Theleli	Forb		Strict		x		x	x
<b>MONOCOTS</b>									
<b>Amaryllidaceae</b>									
<i>Boophone disticha</i>	Leshoma	Geophyte	Endangered			x		x	
<b>Asphodelaceae</b>									
<i>Aristaloe aristata</i>	Lekhalana	Succulent	Near Threatened	Near		x		x	
<i>Aloe polyphylla</i>		Succulent	Vulnerable	Strict		x		x	
<i>Bulbine narcissifolia</i>	Khomo-ea-balisa	Succulent			Protected	x	x	x	x
<i>Kniphofia caulescens</i>		Geophyte		Near		x			x
<i>Kniphofia ritualis</i>	Lelutla	Geophyte		Near		x	x	x	x
<i>Wurmbea elatior</i>		Forb		Near		x			x
<b>Hyacinthaceae</b>									

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Grassland / Rocky Outcrop Mosaic	Montane Shrubland	PWAR	Power-line
<i>Albuca shawii</i>	Morotoana-phookoana	Geophyte		Near		x	x	x	
<i>Eucomis schijffii</i>		Geophyte		Strict		x		x	
<i>Eucomis autumnalis</i>	Mathethebale	Geophyte	Vulnerable			x		x	x
<b>Hypoxidaceae</b>									
<i>Rhodohypoxis rubella</i>		Geophyte		Strict		x			x
<b>Iridaceae</b>									
<i>Dierama robustum</i>	Lethepu	Geophyte		Near		x		x	x
<i>Gladiolus saundersii</i>	Mokhabebe	Geophyte		Strict		x	x	x	x
<b>Poaceae</b>									
<i>Catalepis gracilis</i>	Joang-ba-matlapa	Grass		Near		x	x	x	x
<i>Festuca costata</i>	Lekolojane	Grass		Near		x		x	x
<i>Helictotrichon longifolium</i>	Litse-ba-pulumo	Grass		Near		x		x	x
<i>Merxmuellera drakensbergensis</i>	Molala-hlolo	Grass		Near		x	x	x	x
<i>Merxmuellera macowanii</i>	Mosika-nokana	Grass		Near		x		x	x
<i>Stiburus conrathii</i>		Grass		Near		x		x	
<b>TOTAL</b>		<b>77</b>	<b>6</b>	<b>70</b>	<b>6</b>	<b>71</b>	<b>25</b>	<b>69</b>	<b>53</b>

## Appendix C: Useful Plant Species in PWAC Project Area





**Appendix Table C.1: Useful Plant Species in the PWAC Project Area**

Scientific Name	Local Name	Growth Form	Habitat Type	Area recorded	Uses of Resources	Propagation Potential
<i>Aloe polyphylla</i>	Kharetsa	Succulent	Rocky ridge	Makhiseng, Mokokoaneng, Makhoarane, Majakaneng, Ha Mojakisane, Ha Ntseanyane, Phuta, Sekoka, Ha Lebopo - Mahesheleng, Bafali Ha Poso, Ha Meta	Medicinal, ornamental	High
<i>Aristaloe aristata</i>	Lekhalana	Succulent	Rocky ridge	Masakong, Ha Mojakisane, Popa Makhomalong, Bafali Ha Poso, Ha Meta	Medicinal, ornamental	High
<i>Anthospermum hispidulum</i>	Phakisani-ea-ntuna	Forb	Grassland	CES (2014a)	Medicinal	Low
<i>Argyrobium marginatum</i>	Phakisani-ea-mosali	Forb	Grassland	CES (2014a)	Medicinal	Moderate
<i>Argyrobium spp</i>	Tsoetla	Forb	Grassland	Ha Mojakisane	Medicinal	Moderate
<i>Artemisia afra</i>	Lengana	Shrub	Grassland	Majakaneng	Medicinal, firewood	High
<i>Asclepias gibba</i>	Montsokoane	Forb	Grassland	Ha Mojakisane	Medicinal	Moderate
<i>Asparagus microraphis</i>	Lerara-tau	Shrub	Rocky ridge	Ha Mojakisane	Medicinal	Moderate
<i>Berkheya cirsiifolia</i>	Mohlobahlobane	Forb	Grassland	Kosheteng	Medicinal	High
<i>Bidens bipinnata *</i>		Forb	Disturbed areas	Throughout	Medicinal	High
<i>Boophone disticha</i>	Leshoma	Geophyte	Grassland	kp 7-8	Medicinal	Moderate
<i>Buddleja salviifolia</i>	Lelothoane	Tree	Gorges	Malingoaneng Tloha-Re-Bue, Ha Ntseanyane	Firewood, medicinal	High
<i>Bulbine narcissifolia</i>	Khomo-ea-balisa	Forb	Seeps slopes	Sekoka	Medicinal	High
<i>Carex austro-africana</i>	Lesuoane	Sedge	Wetlands	Malingoaneng Tloha-Re-Bue	Fodder	Moderate
<i>Cheilanthes eckloniana</i>	Mohuaneng	Fern	Rocky areas	Throughout	Medicinal	Moderate
<i>Chrysocoma ciliata</i>	Sehalahala	Shrub	Degraded slopes	Ha Ntseanyane	Firewood	Moderate
<i>Cotyledon orbiculata</i>	Papetloana	Forb	Rocky ridge	Popa Makhomalong, Ha Mojakisane	Medicinal	High
<i>Crassula alba</i>	Phakamisa sandla	Succulent	Rocky areas	CES (2014a)	Spiritual	High
<i>Crassula dependens</i>	Mohata-metsi-o-monyenyane	Succulent	Rocky areas	CES (2014a)	Medicinal	High
<i>Cymbopogon dieterlenii</i>	Seboku	Grass	Grassland	Widespread	Spiritual	Moderate
<i>Cysticapnos pruinosa</i>	Lefakatsane	Forb	Rocky areas	Widespread	Medicinal	Moderate
<i>Datura stramonium*</i>	Letjoi	Forb	Disturbed areas	Widespread	Medicinal	High

Scientific Name	Local Name	Growth Form	Habitat Type	Area recorded	Uses of Resources	Propagation Potential
<i>Dicoma anomala</i>	Hloenya	Forb	Grassland	Ha Ntsetsanyane, Popa Makhomalong, Sekoka, Bafali Ha Poso, Malingoaneng – Tloha-Re-Bue	Medicinal	Moderate
<i>Diospyros austro-africana</i>	Senokonoko	Tree	rocky ridge	Ha Mojakisane	Firewood, spiritual	Low
<i>Erica spp</i>	Lekhapu	Shrub	Gorges/ rocky ridge	Ha Mojakisane	Firewood	Moderate
<i>Euryops tysonii</i>	Rapeisi	Shrub	Degraded slopes	Malingoaneng, Ha Ntsetsanyane, Sekoka	Firewood	Moderate
<i>Euclea coriacea</i>	Ralokokotoana	Tree	Rocky ridge	Malingoaneng Tloha-Re-Bue; Ha Ntsetsanyane	Medicinal	Moderate
<i>Eucomis autumnalis</i>	Khapumpu	Forb	Grassland, seeps	Majakaneng, Ha Mojakisane, Ha Ntsetsanyane	Medicinal	Moderate
<i>Euphorbia clavarioides var. clavarioides</i>	Sehlooko	Forb	Rocky ridge	Majakaneng, Malingoaneng –Tloha-Re-Bue	Medicinal, food	High
<i>Eriosephalus sp</i>	Sehalahala-sa-matlaka	Shrublet	Rocky ridge	Malingoaneng Tloha-Re-Bue	Firewood	Moderate
<i>Felicia filifolius</i>	Leholo	Shrublet	Grassland / rocky outcrops	Uncertain	Firewood	Moderate
<i>Felicia muricata</i>	Mohantsoane	Forb	Grassland	Widespread	Medicinal	High
<i>Galium capense</i>	Monolo	Forb	Grassland	Widespread	Spiritual	Moderate
<i>Gazania krebsiana</i>	Tsikiltane	Forb	Grassland	Ha Mojakisane	Medicinal	High
<i>Gladiolus saundersii</i>	Khahla	Geophyte	Grassland	Eastern third of PWAC	Spiritual	High
<i>Gomphocarpus fruticosus</i>	Sehamela podi	Forb	Disturbed areas, streams	Widespread	Medicinal	High
<i>Gomphostigma virgatum</i>	Mosika noka	Shrub	River sand	Ha Meta Liphakoeng, Malingoaneng – Tloha-re-Bue, Ha Meta	Medicinal	High
<i>Gunnera perpensa</i>	Qobo	Forb	Wetlands	Sekoka, Phuta, Bafali Ha Poso, Malingoaneng –Tloha-Re-Bue, Ha Meta	Medicinal	Moderate
<i>Haemanthus humilis</i>	Tsepe-ea-pila	Geophyte	Rocky ridge	CES (2014a)	Medicinal	Moderate
<i>Haplocarpha scaposa</i>	Popetloane	Forb	Grassland	CES (2014a)	Medicinal	High
<i>Helichrysum caespitium</i>	Phate-ea-ngaka	Forb	Grassland	Masakong	Medicinal	Moderate
<i>Helichrysum cf nudifolium</i>	Letapiso	Forb	Grassland	CES (2014a)	Medicinal	Moderate
<i>Helichrysum odoratissimum</i>	Phefo	Forb	Grassland	Widespread	Medicinal	Moderate
<i>Helichrysum splendidum</i>	Phefo	Shrub	Grassland	CES (2014a)	Spiritual	High

Scientific Name	Local Name	Growth Form	Habitat Type	Area recorded	Uses of Resources	Propagation Potential
<i>Helichrysum trilineatum</i>	Hokobetsi	Shrub	Shrubland	Widespread	Firewood	Moderate
<i>Hermannia depressa</i>	Selentljane	Forb	Grassland	Masakong	Medicinal	Moderate
<i>Hermannia woodii</i>	Seletjane	Forb	Grassland	CES (2014a)	Medicinal, spritual	Moderate
<i>Heteromorpha arborescens</i> <i>var. abyssinica</i>	Monkhoane	Tree	Rocky ridge	Majakaneng	Medicinal	Moderate
<i>Hyparhennia hirta</i>	Mohlomo	Grass	North facing Gorges	Majakaneng, Malingoaneng –Tloha-Re-Bue	Thatching	Widespread
<i>Hypochoeris radicata</i> *	Lepheo-la-khoho	Forb	Disturbed areas	Widespread	Vegetable	High
<i>Hypoxis costata</i>	Moli	Geophyte	Grassland	CES (2014a)	Medicinal	Moderate
<i>Ipomoea crassipes</i>	Maime	Forb	Grassland	Masakong	Medicinal	Moderate
<i>Ipomoea plebeia</i>	Mabane	Forb	Grassland	CES (2014a)	Medicinal, spritual	Moderate
<i>Jamesbrittenia lesutica</i>	Natjoane	Shrub	Rocky areas	CES (2014a)	Medicinal	Moderate
<i>Juncus sp.</i>	Rororo	Sedge	Wetlands	CES (2014a)	Thatching, baskets	Moderate
<i>Kedrostis capensis</i>	Sesepa-sa-linoha	Forb	Rocky ridge	Malingoaneng Tloha-Re-bue	Medicinal	Moderate
<i>Kniphofia sp</i>	Qalooe	Forb	Moist mountain slopes	Sekoka	Medicinal	Moderate
<i>Lessertia depressa</i>	Musa-pelo	Forb	Grassland	CES (2014a)	Medicinal	Moderate
<i>Leucosidea sericea</i>	Cheeche	Tree	Gorges	Popa Makhomalong, Malingoaneng – Tloha-Re-Bue	Firewood, medicinal	High
<i>Malva parviflora</i>	Tikamotse	Forb	Around households	Popa Makhomalong	Medicinal	High
<i>Melolobium alpinum</i>	Musa - pelo	Forb	Grassland	CES (2014a)	Medicinal	Moderate
<i>Mentha longifolia</i>	Kuena	Forb	Along streams	Malingoaneng Tloha-re-Bue	Medicinal	High
<i>Merxmullera macowanii</i>	Mosea	Grass	Along water courses	Malingoaneng Tloha-re-Bue	Thatching	Moderate
<i>Monsonia attenuata</i>	Lemana-mana	Forb	Grassland	CES (2014a)	Spiritual	Moderate
<i>Oxalis obliquifolia</i>	Bolila	Forb	Grassland	CES (2014a)	Medicinal, food	Moderate
<i>Pachycarpus spp</i>	Leshokhoa	Forb	Grassland	Ha Ntsetsanyane	Medicinal	Moderate
<i>Papaver aculeatum</i>	Sihlehle	Forb	Disturbed areas	CES (2014a)	Food	High
<i>Passerina cf montana</i>	Lekhapu	Shrub	Mountain slopes	CES (2014a)	Firewood, spritual	Moderate
<i>Pelargonium sidoides</i>	Khoara	Forb	Seepage areas	Masakong, Sekoka, Malingoaneng –Tloha-re-Bue, Ha Meta	Medicinal	High

Scientific Name	Local Name	Growth Form	Habitat Type	Area recorded	Uses of Resources	Propagation Potential
<i>Pentanisia prunelloides</i>	Setima mollo	Forb	Rocky ridge	Ha Ntseanyane	Medicinal	Moderate
<i>Pentzia cooperi</i>	Lelingoana	Shrub	Mountain slopes	Ha Ntseanyane	Firewood	Moderate
<i>Phragmites australis</i>	Lehlaka-la-noka	Grass	River banks	Majakaneng	Thatching	Moderate
<i>Phygelius capensis</i>	Mafifi matso	Forb	Along streams	Majakaneng, Malingoaneng –Tloha-Re-Bue	Medicinal	High
<i>Phytolacca octandra</i>	Monatja	Forb	Along the road	Ha Meta Liphakoeng	Medicinal	High
<i>Polygala hottentotta</i>	lehlokoa-la-tsela	Forb	Grassland	CES (2014a)	Spiritual	Moderate
<i>Ranunculus multifidus</i>	Tlhapi	Forb	Wetlands	Ha Lebopo -Mahesheleng	Medicinal	High
<i>Rhamnus prinoides</i>	Mofifi	Tree	Gorges	Ha Mojakisane	Firewood, medicinal	High
<i>Rhus divaricata</i>	Kolitsana	Forb	Gorges	Popa Makhomalong, Ha Ntseanyane	Firewood, food	Moderate
<i>Rhus spp</i>	Tsinabele	Forb	Rocky ridge	Ha Ntseanyane, Malingoaneng –Tloha-Re-Bue	Firewood, food	Moderate
<i>Rorippa nasturtium-aquaticum</i>	Seliba	Forb	Wetlands, rivers	CES (2014a)	Spiritual	Moderate
<i>Rubus ludwigii</i>	Monokotsoai	Shrub	Gorges	Popa Makhomalong	Food	Moderate
<i>Rumex spp</i>	Khamane	Forb	Along streams	Ha Meta Liphakoeng	Medicinal	Moderate
<i>Rumex woodii</i>	Bolila-ba-likhomo	Forb	Rocky ridge	CES (2014a)	Medicinal	Moderate
<i>Salix species</i>	Meluoane	Trees	Along river banks	Popa Makhomalong, Malingoaneng –Tloha-Re-Bue	Firewood	High
<i>Scabiosa columbaria</i>	Selomi	Forb	Grassland	CES (2014a)	Medicinal	Moderate
<i>Scirpus falsus</i>	Leloli	Sedge	Along water courses	Bafali Ha Poso	Household	Moderate
<i>Selaginella caffrorum</i>	Moriri-oa-matlapa	Forb	On rock sheets	Ha Mojakisane	Medicinal	Low
<i>Senecio asperulus</i>	Letapisa	Forb	Grassland	Malingoaneng Tloha-Re-Bue	Medicinal	High
<i>Senecio burchellii</i>	Khotolia	Forb	Grassland	Malingoaneng –Tloha Re-Bue	Medicinal	High
<i>Senecio inaequidens</i>	Khotoliea	Forb	Grassland	CES (2014a)	Medicinal	High
<i>Senecio rhomboideus</i>	Sehalahala sama tlaka	Forb	Grassland, rocky areas	CES (2014a)	Medicinal	High
<i>Senecio spp</i>	Lehlomane	Forb	Grassland	Sekoka	Medicinal	High
<i>Sonchus dregeanus</i>	Leharasoana	Forb	Grassland	Majakaneng	Food, medicinal	High
<i>Stachys rugosa</i>	Taraputsoe	Forb	Grassland	Masakong	Medicinal	Moderate
<i>Tagetes minuta</i>	Senkhane	Forb	Disturbed areas	CES (2014a)	Household	High



Scientific Name	Local Name	Growth Form	Habitat Type	Area recorded	Uses of Resources	Propagation Potential
<i>Tragopogon dubius</i>	Moetse	Forb	Grassland	Masakong	Food, medicinal	High
<i>Trifolium burchellianum</i>	Moroko	Forb	Wetlands	Ha Lebopo - Mahesheleng	Medicinal	Moderate
<i>Tulbaghia acutiloba</i>	Motsuntsunyane	Forb	Seepage areas	Majakaneng	Medicinal	Moderate
<i>Urginea sp</i>	Moretele	Forb	Grassland	Ha Mojakisane	Medicinal	Moderate
<i>Ursinia alpina</i>	Khoanithi	Forb	Grassland	CES (2014a)	Spiritual	Moderate
<i>Wahlenbergia krebsii</i>	Monqua abadimo	Forb	Grassland	CES (2014a)	Medicinal	Moderate
<i>Withania somnifera</i>	Mofera ngope	Forb	rocky ridge	Ha Ntsesanyane	Medicinal	Moderate
<i>Zaluzianskya ovata</i>	Limomonyane	Forb	Grassland	CES (2014a)	Household	Moderate
<i>Zantedeschia albomaculata</i>	Mohalalitoe	Forb	Moist places	Sekoka	Medicinal, ornamental	High