

# **Volume 3: Annexure E Terrestrial Ecology Specialist Report**

Lesotho Highlands Development Authority

Contract LHDA No.: 6014

Contract Name: Professional Services for the  
Environmental & Social Impact Assessment  
(ESIA) for the Polihali Reservoir & Associated  
Infrastructure

Document Ref: P2W-6014-DFR-0002\_02

Document Date: 13 September 2017

**ECOREX**  
CONSULTING ECOLOGISTS



---

**Revision History**

Version	Issue Date	Description of Changes
00	28 April	First Draft for Client Review
01	14 July	Second Draft for Client Approval
02	13 September	Final Report

# Abbreviations and Acronyms

AoI	Area of Influence
BPST	Bulk Power Supply & Telecommunications
BMP	Biodiversity Monitoring Plan
CBD	Convention on Biological Diversity
CES	Coastal & Environmental Services
CMP	Comprehensive Mitigation Plan
DAC	Drakensberg Alpine Centre (of endemism)
DNA	Deoxyribose Nucleic Acid
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
ESMP	Environmental and Social Management Plan
FSL	Full Supply Level
GIS	Geographic Information System
GPS	Geographic Positioning System
ICM	Integrated Catchment Management
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
KZN	KwaZulu-Natal
LHDA	Lesotho Highlands Development Authority
LHWC	Lesotho Highlands Water Commission
LHWP	Lesotho Highlands Water Project
masl	Metres above sea level
MDTP	Maloti Drakensberg Transfrontier Project
MDTCA	Maloti Drakensberg Transfrontier Conservation Area
MRA	Managed Resource Area
NT	Near Threatened (relates to species on the IUCN Red Data Species List)
PRAI	Polihali Reservoir and Associated Infrastructure
PWAR	Polihali Western Access Corridor
PS	Performance Standard
RAP	Resettlement Action Plan
RMA	Range Management Area
SANBI	South African National Biodiversity Institute
SCP	Systematic Conservation Planning
TBM	Tunnel Boring Machine
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

<b>Technical Term</b>	<b>Definition</b>
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 Habitat	Animal that digs burrows. 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> .
Project Area	The Area of Influence defined within a 5 km radius of the FSL level 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

<b>Technical Term</b>	<b>Definition</b>
Vulnerable	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) 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

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

- Samuel Zwakala of the Mokhotlong MDTP office for assisting with field surveys;
- The ERM team for arranging logistics;
- Grant Benn for preparing field mapping and report maps; and
- Jessica Hughes for her review and inputs into this report.

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 Reservoir area. 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 the inundation zone and adjacent hills in late January/early February 2017. Information on natural resource usage by communities in and around the reservoir area 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 within the vicinity of the Polihali Reservoir. Data from previous reporting in the Polihali 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 the advanced works project infrastructure; dam and tunnel construction; inundation and operation.

## Baseline Assessment – Key Findings

### **Vegetation Communities**

- CES (2014a) described much of the Project Area as comprising a “mosaic of grassland, seeps and wetlands” and agricultural lands, with numerous rocky outcrops and cliffs embedded within this mosaic. Within this description they included three distinctive vegetation associations, namely Intact Seeps, Degraded Seeps and a Rocky Outcrop / Grassland Mosaic. These vegetation associations corresponded with the sample sites surveyed in this study, apart from the presence of dwarf shrubland, which was present on some steep slopes in the Khubelu and Senqu valleys.
- MDTP (2007) classified most of the Project Area, including the entire inundation zone as *Cymbopogon* species – *Aristida congesta* communities, while some higher lying portions of the Project Area were mapped as *Themeda triandra*-dominated communities. This broadly matches the vegetation pattern encountered during this study, where the lower, steep slopes were dominated by *Cymbopogon dieterlenii* and other species, while the upper slopes and crests were dominated by *Themeda triandra* and species such as *Diheteropogon filifolius* and *Brachiaria serrata*.

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

- Five of the species recorded in the dam basin and adjacent hillslopes during this study are considered species of conservation concern; four of these are classified as Vulnerable, either by Raimondo *et al* (2009) (*Alepidea cordifolia*), or by Talukdar (2002) (*Jamesbrittenia lesutica*, *Eucomis autumnalis* and *Dicoma anomala*), of which *J. lesutica* and *D. anomala* occur within the inundation zone; one Vulnerable species, *Aloe polyphylla*, occurs in the higher lying mountains adjacent to the Project Area, but has not been recorded as occurring naturally within the Project Area; and one species is classified as Near Threatened (*Aristaloe aristata*), which also occurs within the inundation zone.
- CES (2014a) recorded an additional Vulnerable species (*Drimia saniensis*) in the higher lying mountains adjacent to the Project Area.

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

- The communities living within the dam basin and adjacent land are heavily dependent on plant resources, either as a source of grazing or browsing for their livestock, or directly for firewood or medicinal purposes. 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 dam basin and adjacent hills and are considered to be important resources for local communities. In the downstream area, interviews conducted in the social study (LHDA Contract 6001) confirmed that the majority of resources harvested (56%) are used to supplement the communities' food supply; 30 percent of the wild plants collected are used for medicinal purposes, and 12 percent were used for other purposes such as fuel, construction and spiritual use.

### ***Mammals***

- Integration of data from CES (2014b) and this study produced a list of 16 mammal species confirmed to occur in the Project Area, of which eight occur in the inundation area. This compares favourably with the total of 16 species observed in the Katse River catchment during previous surveys;
- One Near Threatened mammal was confirmed to occur within the inundation area (African Clawless Otter) and another Near Threatened species was recorded in the high mountains to the west of the inundation area (Grey Rhebok);
- Sloggett's Rat was the only mammal species recorded during fieldwork that is endemic to the Drakensberg Mountains; individuals were seen at high altitude well away from the inundation area and it is unlikely to occur below 2500 masl;
- Very few fauna species are specifically protected under Lesotho legislation; two protected species were confirmed to occur within the inundation area (African Clawless Otter, Water Mongoose), and two species were confirmed to occur in the high mountains adjacent to the Project Area (Grey Rhebok and Mountain Reedbuck).

### ***Herpetofauna***

- Integration of data from CES (2014b) and this study produced a list of nine reptile species and six amphibian species confirmed to occur in the Project Area, of which four reptiles and five amphibians occur in the inundation area;
- No threatened or Near Threatened reptile or amphibian species were recorded by CES (2014b) or during this survey and none are likely to occur within the inundation area;
- 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***

- 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 in the Senqu and Khubelu River valleys 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 within the reservoir area and proposed infrastructure areas has been seriously impacted by overgrazing and grass cover is sparse in many areas;
- The greatest threat to herpetofauna in the Project Area is likely to be habitat loss or degradation, particularly degradation of grassland habitat through severe overgrazing.

## Key Potential Impacts

Key potential impacts of the Polihali Reservoir on flora, mammals and herpetofauna were identified and assessed according to the Project Phases, and summarised below.

### *Advanced Works and Construction Phase*

- **Site Clearance:** Clearance of 123 ha in the advanced infrastructure footprint and inundation or direct impacts on ~5600 ha of degraded grassland / agricultural mosaic in the reservoir area will result in direct loss of vegetation and flora (including four flora species of conservation importance although none are highly localized or particularly threatened; loss of useful plant resources and habitat of terrestrial fauna (mammals and herpetofauna) all of which are widely distributed and not threatened. These impacts are all of **Moderate** significance before mitigation and **Minor** post-mitigation.
- **Blasting:** Blasting of the advance infrastructure footprint and for the dam walls and tunnels over a 2-3 year period will disturb fauna and cause of loss of rocky habitat for crevice-dwelling fauna in these areas, particularly snakes, lizards and small mammals. Since the habitats are highly degraded and fauna diversity low and limited to widely distributed species, the impact is localized and of **Minor** significance.

### *Inundation*

- Flooding of the dam basin and adjacent effects will impact an estimated 2952 ha of grassland and 514 ha of rocky habitat and flora species, including the inundation of planted spiral aloes in villages. This is rated as an impact of **Moderate** significance for grassland and rocky ridge habitats and **Negligible** for the few degraded wetland seeps that occur;
- Loss of plant resources in the dam basin that are used by local communities for medicinal or other purposes is considered to be of **Moderate** significance as the majority are widely distributed but reduced to **Minor** significance with mitigation. The loss of Endangered spiral aloes in inundated villages is considered of **Major** significance (subject to confirmation of numbers affected) but can be reduced to **Negligible** significance with mitigation (i.e. relocation prior to inundation).
- Inundation of fauna grassland and rocky outcrop habitat is rated as **Moderate** significance for the grassland and rocky outcrop habitat as the fauna present are widely distributed and none are considered particularly threatened, while the impact significance for the degraded seeps is rated as **Minor**.

### *Operation Phase*

The main impact on terrestrial vegetation of the operation phase relates to the ongoing increased human land use and harvesting pressures on the scarce and degraded natural resources in the

area surrounding the dam which is expected to expand and intensify over time as communities are displaced from the reservoir and more people in-migrate to the area in search of opportunities. This may have highly significant impacts in areas such as the biodiversity-rich Phutha Sheep Stud should encroachment into this area be permitted. The long-term impacts of increasing land use pressures around the dam is rated as **Major** significance for the grassland and rocky habitats and **Critical** significance if human encroachment is not controlled in the Phutha Sheep Stud.

## Summary Impact Tables

### Advanced Works Phase

Impact of Site Clearance on Vegetation and Flora				
	Grassland		Rocky Ridges and Cliffs	
	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>

Impact of Site Clearance on Useful Natural Plant Resources				
	Grassland		Rocky Ridges and Cliffs	
	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>

Impact of Site Clearance on Mammal and Herpetofaunal Assemblages				
	Grassland		Rocky Ridges and Cliffs	
	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>

Impact of Blasting on Mammals and Herpetofauna				
	Grassland		Rocky Ridges and Cliffs	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct		Direct	
Magnitude	Small	Small	Small	Small
Sensitivity	Medium	Medium	Medium	Medium
Significance	<b>Minor</b>	<b>Minor</b>	<b>Minor</b>	<b>Minor</b>

Impact of Inundation on Vegetation and Flora						
	Grassland		Rocky Ridges and Cliffs		Wetland seeps	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct		Direct		Direct	
Magnitude	Medium	Small	Medium	Small	Medium	Small

<b>Sensitivity</b>	Medium	Medium	Medium	Medium	Low	Low
<b>Significance</b>	<b>Moderate</b>	<b>Minor</b>	<b>Moderate</b>	<b>Minor</b>	<b>Minor</b>	<b>Negligible</b>

Impact of Inundation on Useful Plant Resources						
	Grasslands including seeps		Rocky Ridges and Cliffs		Spiral aloes (in villages)	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
<b>Type of Impact</b>	Direct		Direct		Direct	
<b>Magnitude</b>	Medium	Small	Medium	Small	Medium	Small
<b>Sensitivity</b>	Medium	Medium	Medium	Medium	High	High
<b>Significance</b>	<b>Moderate</b>	<b>Minor</b>	<b>Moderate</b>	<b>Minor</b>	<b>Major*</b>	<b>Moderate*</b>

\*depending on results of spiral aloe census

Impact of Inundation on Mammals and Herpetofauna						
	Grassland		Rocky Ridges and Cliffs		Seeps	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
<b>Type of Impact</b>	Direct		Direct		Direct	
<b>Magnitude</b>	Medium	Medium	Medium	Medium	Medium	Medium
<b>Sensitivity</b>	Medium	Medium	Medium	Medium	Low	Low
<b>Significance</b>	<b>Moderate</b>	<b>Moderate</b>	<b>Moderate</b>	<b>Moderate</b>	<b>Minor</b>	<b>Minor</b>

**Operational Phase**

Impact of Increased Pressure on Natural Resources by Displaced Communities				
	Rocky Outcrop / Grassland Mosaic		Phutha Sheep Stud	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
<b>Type of Impact</b>	Indirect		Indirect	
<b>Magnitude</b>	Medium	Small	High	Negligible
<b>Sensitivity</b>	High	High	High	High
<b>Significance</b>	<b>Major</b>	<b>Moderate</b>	<b>Critical</b>	<b>Negligible</b>

**Mitigation Measures**

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

**Biodiversity Awareness and Training**

- Develop induction and training and awareness materials for biodiversity 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; and
- Minimise spread of alien invasive plants through cleaning of vehicles, equipment, and regular checks.

***Spiral Aloe Census of Villages to be Resettled***

- Spiral aloe census to quantify number of aloes that will be inundated; and
- Spiral aloe relocation with resettler households or to other plant safeguard sites such as a proposed Polihali botanical garden.

***Plant Search and Rescue and Establishment of Plant Safeguard Areas (e.g. Community or Botanical Gardens)***

- Search and rescue of priority plants in advanced infrastructure footprint and inundation area by experienced field botanist/s;
- Establish community or new botanical garden at Polihali or near Mokhotlong to enhance Lesotho biodiversity awareness and to benefit communities through school groups and sale of plants; and
- Consider implementation of a project to teach community members to propagate and sell spiral aloes (to reduce pressure on wild populations).

***Important Plant Resources***

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

***Conservation Management of Phutha Sheep Stud***

- Protection of Phutha Sheep Stud from grazing and settlement, and possible expansion if feasible; and
- Relocate Mokhotlong waste management site to suitable area away from Phutha Sheep Stud to avoid littering and through traffic.

***Snake awareness, monitoring, and relocation during inundation***

- Undertake snake trapping and relocation during inundation to avoid persecution and human conflicts; and
- Awareness raising of snakes and other herpetofauna.

***Other faunal rescue during inundation***

- Assessment and search and rescue of fauna on future islands in Polihali Reservoir.

**Other Recommendations**

- Implement integrated catchment management measures to enhance grazing and biodiversity of the Polihali Catchment. This should include remote-sensing based monitoring of rangeland condition supported by field-based surveys;
- Incorporate relevant long-term biodiversity mitigation and monitoring measures presented in this report into the Biodiversity Management Plan for the LHWP Phase II; and
- Compile a biodiversity offset strategy focused on identifying suitable biodiversity offset areas in the higher lying portions of the Lesotho Highlands mountain zone above 2800 m (subalpine) which typically have a higher proportion of endemic and restricted-range species than the lower lying areas. Attention should be focused on portions of the Polihali catchment which meet a range of biodiversity features worthy of protection to compensate for impacts of LHWP Phase

II, and should also consider inclusion of other biodiversity impacted by LHWP Phase I that remain inadequately protected. Identification of such areas should aim to meet the objectives of the Maloti Drakensberg Transfrontier Park (MDTP) which previously earmarked the upper Senqu and Mokhotlong/Sanqebethu catchments for enhanced protection.

Principles that should be considered 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.



# Table of Contents

<b>Section 1</b>	<b>Introduction .....</b>	<b>1-1</b>
1.1	Background .....	1-1
1.2	Study Team .....	1-1
1.3	Scope of Terrestrial Flora and Fauna Study .....	1-1
1.4	Project Description and Location .....	1-2
<b>Section 2</b>	<b>Legal and Policy Framework .....</b>	<b>2-1</b>
2.1	Legislation and Policies .....	2-1
2.1.1	Lesotho Legislation Specific to Biodiversity .....	2-1
2.1.2	Protected Species .....	2-2
2.2	Relevant Initiatives .....	2-3
2.3	International Conventions .....	2-4
2.4	International Good Practice .....	2-5
2.4.1	Introduction .....	2-5
2.4.2	Performance Standard 6 (PS6): Biodiversity Conservation and Sustainable Management of Living Natural Resources .....	2-5
<b>Section 3</b>	<b>Approach and Methods .....</b>	<b>3-1</b>
3.1	Introduction .....	3-1
3.1.1	Objectives .....	3-1
3.1.2	Approach .....	3-1
3.1.3	Methods and Activities .....	3-1
3.1.4	Assumptions and Limitations .....	3-2
3.2	Review of Previous Data .....	3-3
3.2.1	Relevant Data .....	3-3
3.2.2	Vegetation and Flora .....	3-4
3.2.3	Mammals and Herpetofauna .....	3-8
3.3	Surveys and Data Analysis .....	3-8
3.3.1	Sampling Sites / Areas .....	3-8
3.3.2	Villages Surveyed for Natural Resource Use .....	3-9
3.3.3	Field Survey Methods .....	3-12
3.3.4	Data Entry and Analysis .....	3-12
3.4	Impact Assessment .....	3-12
<b>Section 4</b>	<b>Baseline Environment .....</b>	<b>4-1</b>
4.1	Area of Influence .....	4-1
4.2	Vegetation and Flora .....	4-1
4.2.1	Global and Regional Context .....	4-1
4.2.2	Description of Vegetation Types .....	4-5
4.2.3	Species of Conservation Importance .....	4-7
4.2.4	Important Plant Resources for Local Communities .....	4-11

4.2.5	Alien Invasive Species .....	4-13
4.2.6	Threats to Habitats and Flora Species .....	4-14
4.3	Mammals .....	4-16
4.3.1	Global and Regional Context .....	4-16
4.3.2	Mammal Habitats .....	4-16
4.3.3	Mammal Species Diversity .....	4-17
4.3.4	Species of Conservation Importance .....	4-20
4.3.5	Threats to Mammal Species .....	4-22
4.4	Herpetofauna .....	4-24
4.4.1	Global and Regional Context .....	4-24
4.4.2	Herpetofaunal Habitats .....	4-24
4.4.3	Herpetofauna Species Diversity .....	4-25
4.4.4	Species of Conservation Importance .....	4-29
4.4.5	Threats to Herpetofauna .....	4-29
4.5	Habitat Status .....	4-30
4.5.1	Modified Habitat .....	4-30
4.5.2	Natural Habitat .....	4-30
4.5.3	Critical Habitat .....	4-30
4.5.4	Summary of Habitat Status .....	4-30
<b>Section 5</b>	<b>Impact Assessment .....</b>	<b>5-1</b>
5.1	Advanced Works and Construction Phase .....	5-1
5.1.1	Impact of Site Clearance on Vegetation and Flora .....	5-1
5.1.2	Impact of Site Clearance on Plants Used by Communities .....	5-2
5.1.3	Impact of Site Clearance on Mammals and Herpetofauna .....	5-3
5.1.4	Impact of Blasting on Mammals and Herpetofauna .....	5-4
5.1.5	Impact of Inundation on Vegetation and Flora .....	5-5
5.1.6	Impact of Inundation on Useful Plant Resources .....	5-7
5.1.7	Impact of Inundation on Mammals and Herpetofauna .....	5-8
5.2	Operation Phase .....	5-10
5.2.1	Impact of Altered Flows on Downstream Vegetation Communities and Flora .....	5-10
5.2.2	Impact of Increased Pressure on Natural Resources by Displaced Communities .....	5-10
<b>Section 6</b>	<b>Mitigation and Monitoring .....</b>	<b>6-1</b>
6.1	Mitigation .....	6-1
6.1.1	Advanced Works / Construction Phase .....	6-1
6.1.2	Operation Phase .....	6-1
6.2	Monitoring .....	6-1
6.2.1	Advanced Works / Construction Phase .....	6-1
6.2.2	Operation Phase .....	6-1
<b>Section 7</b>	<b>Other Recommendations .....</b>	<b>7-1</b>
<b>Section 8</b>	<b>References .....</b>	<b>8-1</b>

## List of Figures

Figure 1.1	Proposed Polihali Dam Infrastructure Layout .....	1-4
Figure 3.1	Vegetation / Land Cover Mapping and Transect Locations from CES (2014a) .....	3-6
Figure 3.2	Ecological Units Digitised from 1983-1987 RMD Mapping for MDTP (2007).....	3-7
Figure 3.3	Location of Flora and Fauna Transects within the PRAI.....	3-10
Figure 3.4	Location of Villages where Natural Resource Use Surveys were Conducted .....	3-11
Figure 4.1	Vegetation Types in the PRAI Project Area (Mucina and Rutherford, 2006) .....	4-4
Figure 4.2	Protected Areas of Lesotho in relation to the PRAI Project Area .....	4-4
Figure 4.3	Vegetation Types in the PRAI Project Area (CES, 2014).....	4-5
Figure 4.4	Photographs of Representative Habitat Types.....	4-6
Figure 4.5	Representative Species of Conservation Concern .....	4-9
Figure 4.6.	Photos of some endemic and near-endemic species occurring in the Project Area .....	4-10
Figure 4.7	Examples of Flora Species Used by Local Community Members.....	4-12
Figure 4-8	Alien Invasive Plant Species Recorded in Project Area .....	4-14
Figure 4.9	Threats to Habitats and Flora .....	4-15
Figure 4.10	Representative Habitat Types for Mammals .....	4-17
Figure 4.11.	Photos of selected mammal species found within or adjacent to the Project Area .....	4-19
Figure 4.12.	Location of conservation important fauna in the Project Area .....	4-23
Figure 4.13	Representative Habitat Types for Fauna .....	4-24
Figure 4.14	Photos of selected reptile species recorded in the Project Area .....	4-28

## List of Tables

Table 1.1	Authors and Contributors to this Report .....	1-1
Table 2.1	Legislation Relevant to Biodiversity .....	2-1
Table 2.2	Initiatives Relevant to Flora and Fauna Protection in the Project Area .....	2-3
Table 2.3	International Conventions Relevant to the Project .....	2-4
Table 3.1	List of Transects Sampled in the PRAI During February 2017 Fieldwork .....	3-8
Table 3.2	List of villages and Key Informants Surveyed for Natural Resource Use.....	3-9
Table 3.3	Impact Significance Rating Table .....	3-13
Table 4.1	Protected Areas of Lesotho .....	4-3
Table 4.2.	Species of Plants of Conservation Concern .....	4-7
Table 4.3	Plant Families with the Most Endemic and Near Endemic Plant Species in the Project Area .....	4-10
Table 4.4	Mammals Recorded in the Project Area .....	4-19
Table 4.5.	Mammal Species of Conservation Importance .....	4-22
Table 4.6	Reptiles and Amphibians Confirmed to Occur in the Project Area.....	4-26
Table 4.7	Summary of Habitat Status in the Project Area and Inundation Area from CES Mapping... ..	4-31
Table 5.1	Impacts of Site Clearance on Terrestrial Vegetation and Flora.....	5-2
Table 5.2	Impact of Site Clearance on Plants Used by Surrounding Communities .....	5-3
Table 5.3	Impact of Site Clearance on Mammals and Herpetofauna.....	5-4
Table 5.4	Impact of Blasting on Mammals and Herpetofauna.....	5-5
Table 5.5	Impact of Inundation on Vegetation and Flora.....	5-7
Table 5.6	Impact of Inundation on Useful Plant Resources .....	5-8
Table 5.7	Impact of Inundation on Mammals and Herpetofauna.....	5-10
Table 5.8	Impact of Increased Pressure on Natural Resources by Displaced Communities .....	5-12
Table 6.1	Mitigation Measures for Flora and Fauna.....	6-1
Table 6.2	Post – Construction / Inundation Monitoring Requirements for Terrestrial Flora and Fauna .....	6-6



# Section 1 Introduction

## 1.1 Background

This report is the terrestrial ecology specialist report that covers vegetation and flora, mammals and herpetofauna of the Polihali Reservoir area. Birds are reported on in a separate specialist study. The report has been compiled to provide inputs into the ESIA for the Polihali Reservoir and Associated Infrastructure (PRAI) as outlined in Section 1.4.

Flora and Fauna baseline studies of the Polihali Reservoir and adjacent areas were undertaken in 2014 by CES. This report draws on the CES baseline data and additional data collected during surveys for this study.

## 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 and interpret the usefulness of available data contained in existing reports and databases, particularly the CES (2014) baseline flora and fauna studies;
- Review previous field data and mapping to confirm priority field survey areas (and accessibility), including both the CES (2014) baseline data 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 of the Polihali Dam infrastructure and inundation zones and areas above the Full Supply Level (FSL) to confirm the

- presence of priority species and habitats, such as stands of *Kniphophia* (red-hot poker) spp., and localised species which may occur on dolerite dykes, rocky outcrops or seepage zones;
- **Mammals and Herpetofauna:** undertake a foot and vehicle-based field survey to supplement available data on medium-large mammals and herpetofauna and their habitats in the Polihali Project area. Surveys required foot searches in representative habitats (e.g. along streams, seeps, rocky ridges, grassland). 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. All species or evidence seen (e.g. scats, burrows, tracks, etc.) were to be recorded by 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.
  - 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, including the predicted trajectory in the absence of the PRAI project;
    - Tabulates and maps the survey sites/areas, and location of priority species;
    - Provides photographs of representative habitats where surveys were conducted;
    - Identifies and assesses the direct and indirect impacts of the Project (based on the Project Description provided in Section 1.4) for different phases: advance works, construction, inundation, and operation; and
    - Describes mitigation measures and other recommendations for minimizing impacts on terrestrial biodiversity.

## 1.4 Project Description and Location

The Project comprises the following components, as shown in Figure 1.1.

**Polihali Dam, Saddle Dam and Reservoir:** The proposed Polihali Dam is a 164 m high, concrete-faced rockfill dam with a side channel spillway located approximately 2 km downstream of the confluence of Khubelu and Senqu Rivers. The Saddle Dam is a 50 m high, concrete-faced rockfill embankment dam. During construction, the works will be protected by upstream and downstream embankment coffer dams with two diversion tunnels through the left flank, one 7 m and one 9 m in diameter. The Full Supply Level (FSL) for Polihali Reservoir is 2075 metres above sea level (masl). The flood demarcation level is 2080 masl and exceeds the 1:100 year flood level in the upper reaches of Polihali Reservoir. The Reservoir will inundate an area of approximately 5042 ha upstream of the Dam at the 2075 FSL (C4/SEED, 2008).

**Quarries and Borrow Pits:** material for the rockfill embankments are proposed to be obtained from quarries located on the left and right banks upstream of the Polihali Dam wall, primarily below the FSL. It is also proposed that material suitable for use as concrete aggregate will be obtained from the Tsilantso quarry. Advance geotechnical investigations will be undertaken to: i) confirm the quarry locations, ii) test the suitability of sand sourced from the Senqu and Khubelu Rivers near their confluence for use in concrete; and iii) locate additional quarry sources for use as concrete aggregates near the proposed bridge sites along the A1 Road.

**Polihali to Katse Transfer Tunnel (Eastern Side):** The Polihali to Katse transfer tunnel comprises the intake works and gate shaft at the western edge of the Polihali Reservoir (just upstream of the confluence with the Khubelu and Senqu Rivers). Associated infrastructure for construction will include site access roads, quarries, plant yards, labour accommodation, spoil areas and other tunnel works areas. Tunnelling activities will be done using both drill-and-blast methods and a Tunnel Boring Machine (TBM).

**Major Bridges (Senqu, Khubelu and Mabunyaneng Bridges), and Associated Road Works:**

Three major bridges will be constructed on the Senqu, Khubelu and Mabunyaneng on the existing A1 national road between Oxbow and Mokhotlong. Portions of the A1 near the bridge locations will be realigned due to inundation by the reservoir, and a number of other existing roads and tracks will require replacement. A new pedestrian bridge (Tlhakola Bridge) is proposed across the reservoir at Tlhakola. Note: the scope of the PRAI ESIA does not include the replacement of existing roads and tracks that will be inundated or the construction of new feeder roads and minor bridges.

**Bulk Power Supply and Telecommunications** infrastructure to be located at the Polihali Reservoir that is included in this ESIS are:

- A new substation at Masokong near the advanced infrastructure area;
- A new telecommunications mast on the hill; and
- A new 33kV powerline from Tlokoeng across the reservoir to the permanent camp area (for future electrical distribution by LEC on the west side of the reservoir).

Note: the construction of a new 132kV powerline from Katse (Matsoku Intake substation) to Polihali (Masokong substation) and a new paved road from Ha Seshote to Polihali falls under a separate ESIS for the Polihali Western Access Corridor (PWAC, LHDA Contract 6004).

**Project Housing and Site Establishment:** The Phase II works will be built under a number of construction contracts, each of which will require accommodation facilities for staff and the labour force, site offices, workshops, plant yards, quarries, explosives stores and other works areas. In general, all temporary accommodation, offices and buildings needed for a particular construction contract will be provided by the relevant construction contractor and will be removed at the end of construction.

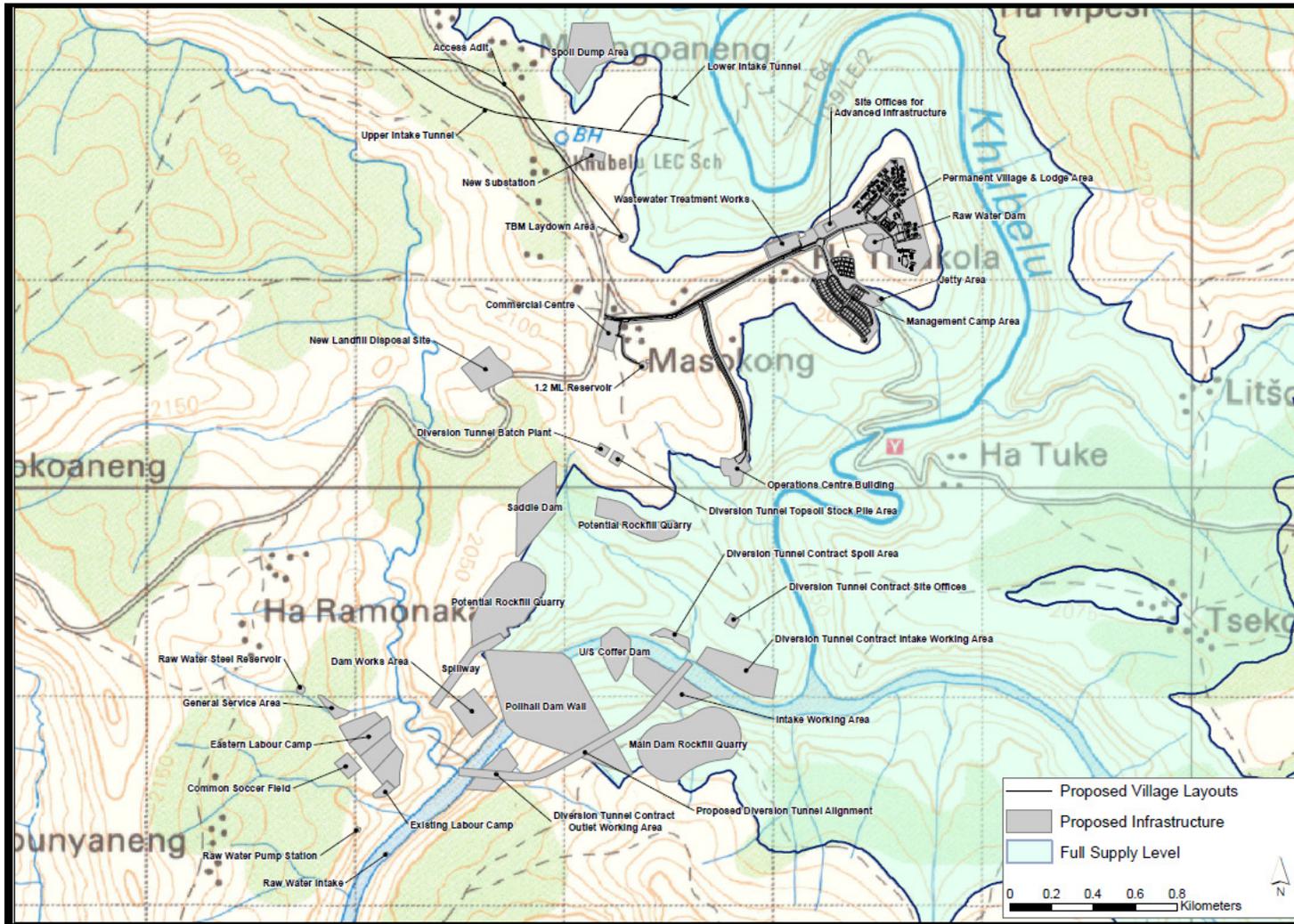
Where facilities will have long-term use during the operation of the scheme, these will be designed and built to appropriate standards for permanent works under the advance infrastructure contracts.

The permanent facilities include:

- Staff accommodation at the Polihali Reservoir area, built as a village with all communal services. This will be the accommodation for the Employer, Engineer and Contractor's staff during construction of the Main Works and for operations staff following the completion of dam and tunnel construction;
- A visitors' lodge at the staff village, which will become a tourist facility; and
- The Employer's and Engineer's offices at the dam site, which will become the operations staff offices and visitor centre.

Temporary construction areas include labour camps and works areas for construction of the eastern sections of the Polihali Western Access Road (PWAR); Bulk Power Supply and Telecommunications (BPST) component, and Polihali-Katse Transfer Tunnel, and for the Polihali Dam and Saddle Dam and bridges. The labour camps will be provided with a raw water supply (contractors will provide their own sewage treatment and waste facilities). The Transfer Tunnel and Dam works areas/ sites will be provided with a raw water supply and a power supply.

Figure 1.1 Proposed Polihali Dam Infrastructure Layout



# 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
<p>Lesotho Environment Act No.10 of 2008</p>	<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) Biotic assemblages</li> <li>17 n) Habitat of Red Data Book species</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) Natural resource areas</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>
<p>Historical Monuments,</p>	<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</li> </ul>

Legislation	Requirements
Relics, Fauna and Flora Act No 41 of 1967	<p>consent of the commission;</p> <ul style="list-style-type: none"> <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	<p>Regulates all aspects pertaining to the management of rangelands. Further information is provided in the Specialist Rangelands Study.</p> <p><i>Management of rangelands in a sustainable manner is recognised as being a primary means to enhance biodiversity protection in Lesotho.</i></p>

### 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 *Searsia 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 in the Project Area**

Initiative	Summary
Maloti Drakensberg Transfrontier Project	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. The current MDTP focus is on protection and management of the

Initiative	Summary
	Sehlabathebe National Park and ongoing vulture monitoring.
SABONET plant list	The 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</i> -legala 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 covered in the separate specialist wetland report (P2W-6014-DFR-0004; WCS 2017).

## 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**

Initiative	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 do not occur in the project footprint although some occur higher up the feeder river valleys of the Polihali catchment. However, planted aloes occur in villages and will be affected by the project.</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>
United Nations Convention to Combat Desertification (UNCCD)	The Convention to Combat Desertification aims to reverse and prevent desertification/land degradation. <i>Overutilization of natural resources by communities dependent on these natural resources has led to extensive land degradation in the PRAI Area of Influence (Aoi). 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>

Initiative	Key Provisions and Relevance to Lesotho
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), although its catchment abuts that of the Ukhahlamba Drakensberg WHS in South Africa. Sehlabathebe National Park is a UNESCO WHS designated as such in 2012.</i></p>

## 2.4 International Good Practice

### 2.4.1 Introduction

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, as described below.

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

PS6 recognizes 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 (see Section 3.5);
- Assessment of ecosystem services (a component of defining Critical Habitat);
- Assessment of the impact on legally protected and internationally recognized 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 information contained in the CES baseline, was required to provide the basis for the identification and assessment of the impacts of project construction, reservoir inundation and dam operation on flora and fauna. In addition, feasible and practical mitigation and other management and monitoring measures and additional recommendations to enhance biodiversity protection in the Project Area were required to be identified and described.

### 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 Polihali catchment in order to pre-identify features and areas of interest and to inform the selection of representative areas for fieldwork;
- 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 minimize data gaps;
- Realistic identification and assessment of project impacts that draws upon previous experience and monitoring results of Phase 1 dams;
- 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 31<sup>st</sup> January and 10<sup>th</sup> February 2017 to collect supplementary data on mammals, herpetofauna, and flora in the key impact zones of project infrastructure and inundation (see Section 3.3.3);
- **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 GIS and photographs collated;

- **Baseline reporting** – the flora and fauna baseline data was collated into the integrated terrestrial ecology report as the basis for 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 construction and operations camps and offices, and ancillary infrastructure; Polihali Dam and saddle walls; spillway and diversion tunnels; quarries (where known); tunnel intake and rock dump areas (including road access); bridges, and realignment of the A1 road over the Khubelu;
  - b) inundation of the reservoir; and
  - c) operation of the dam.
- **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 and size of Project Area

The Project Area extends over a large area - estimated at ~39,346 ha of mountainous terrain - which is poorly served by unpaved road access. An estimated ~5600 ha will be directly affected below the 2080 m (1:100 year flood level) by inundation and adjacent land use changes, and an additional 123 ha is within the footprint of temporary and permanent infrastructure. The large Project Area meant that surveys were mainly focussed on areas that were under-surveyed by the previous CES (2014) baseline surveys, notably the infrastructure footprint and adjacent areas. However, despite this constraint, the survey achieved sufficient coverage of representative areas as much of the infrastructure footprint and inundation area is significantly altered for agriculture, grazing or settlement, and is in a highly degraded state.

#### 2. Available mapping and infrastructure design

The field survey was based on best available mapping of the planned infrastructure layout, which is still under ongoing more detailed design. It is possible that some additional areas may be identified for infrastructure or quarries/borrow pits that have not been assessed in this study. However, given the level of land use transformation and degradation in the dam basin area, it is unlikely that any new additional areas will be of significant importance for flora, mammals or herpetofauna. It is therefore believed that the information obtained to date for the dam basin - both through the CES (2014) baseline and follow up surveys - is a robust reflection of the biodiversity remaining in the Project Area and that there is a low likelihood that additional priority species will be identified. This is supported by the findings of CES (2014) which found no localised priority plant, mammal or herpetofauna species that are not widely distributed elsewhere.

#### 3. Drought conditions and overgrazing

Lesotho has been experiencing drought conditions over the last few years as a result of lower than normal rainfall, which has exacerbated land use pressures resulting in worsened degradation of rangelands, and reduced diversity and abundance of biodiversity. As a consequence, the results of the flora and fauna surveys for this study are not considered fully representative of conditions that may pertain during normal or high rainfall years. Therefore, the baseline conditions recorded during the CES (2014) survey and the recent February 2016

survey are not considered a sufficient baseline against which future monitoring can be compared. Future monitoring will require additional baseline data to be gathered prior to dam inundation and correlated with rainfall. This will provide a more robust baseline for future monitoring. In wetter years it is possible that additional plant species of conservation concern may occur which could require search and rescue prior to inundation.

#### 4. Species identification

Severe overgrazing by livestock has resulted in large areas of grassland having limited vegetation cover. It is possible that some species, particularly geophytes, were overlooked because of being browsed and not allowed an opportunity to flower. Most geophytes can only be positively identified if in flower.

#### 5. Birds

Birds (avian fauna) are covered under a separate bird study by *AVISENSE*. Note: the faunal study by CES for the Polihali Project Area included birds under the faunal report.

## 3.2 Review of Previous Data

### 3.2.1 Relevant Data

The team has a wealth of studies relevant to the broader project area but only two primary information sources have specific information on flora and fauna for the Polihali Project Area: CES (2014) baseline studies for Polihali Dam, and the Rall *et al.* (2008) Baseline Biological Survey for the Polihali Dam Feasibility study (C4/SEED, 2008).

Relevant flora and fauna reports consulted for this study are listed in Box 3.1.

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

<p>Rall <i>et al.</i> 2008. Polihali Dam: Baseline Biological Survey (for Feasibility Study Phase 2). Contract LHWC 001.</p> <p>CES 2014a. LHWP Polihali Dam: Baseline Flora Survey. LHDA Contract No. 6002.</p> <p>CES 2014a. LHWP Polihali Dam: Baseline Fauna Survey. LHDA Contract No. 6002.</p> <p>Anchor, 2014. Phase 1 Biological Resources Monitoring: Flora of the Katse Dam Catchment. LHDA Contract No. 1273.</p> <p>Anchor, 2014. Phase 1 Biological Resources Monitoring: Mammals of the Katse Dam Catchment. LHDA Contract No. 1273.</p> <p>Anchor, 2014. Phase 1 Biological Resource Monitoring: Katse Catchment Land Cover Change Analysis 1991-2013.</p> <p>MDTP 2007. Degradation Mapping and Veld Assessment Report. Project for Maluti Drakensberg Transfrontier Project (Lesotho Highlands).</p> <p>AfriDev 1996-2000. Annual biological monitoring of Katse. LHDA Contract No. 615.</p> <p>ERM 2012. ESIA for Letseng Mine Expansion. Project for Gem Diamonds.</p>
---

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

### 3.2.2.1 CES (2014) Baseline Vegetation Surveys

CES (2014a) conducted three surveys 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. Land cover types mapped by CES (2014a) were grassland, seeps and wetlands; cliffs; rocky outcrops; woodland; riverine; agriculture, and water. Different grassland communities were not distinguished.

A total of 15 transects out of the 80 transects were within the inundation area (Figure 3.1) but only one transect was located near the infrastructure footprint for the dam. Transects used the point-intersect method. Data analysis used Twinspan and Decorana to characterize vegetation types. Permanova analysis was used to test for variation in vegetation communities for the transect data.

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. These are:

- *Jamesbrittenia lesutica*
- *Urginea saniensis*
- *Aloe polyphylla*
- *Dicoma anomala*

*Aloe polyphylla* (spiral aloe) has been assessed in Lesotho as Critically Endangered (Talukdar, 2002) and was only recorded planted near households. No wild spiral aloe plants were found.

The broad vegetation communities described and mapped in CES (2014a) were found to correspond with the sample sites surveyed in this study, apart from the presence of dwarf shrubland, which was present on some steep slopes in the Khubelu and Senqu valleys. It is unlikely that this community is more recent than the 2014 surveys, which suggests that this community was viewed as part of the “Mosaic of grassland, seeps and wetlands” mapped in Figure 3.1.

### 3.2.2.2 MDTP (2007) Historic Vegetation Mapping

Detailed vegetation mapping of the Highlands was prepared in the early 1980s under a 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).

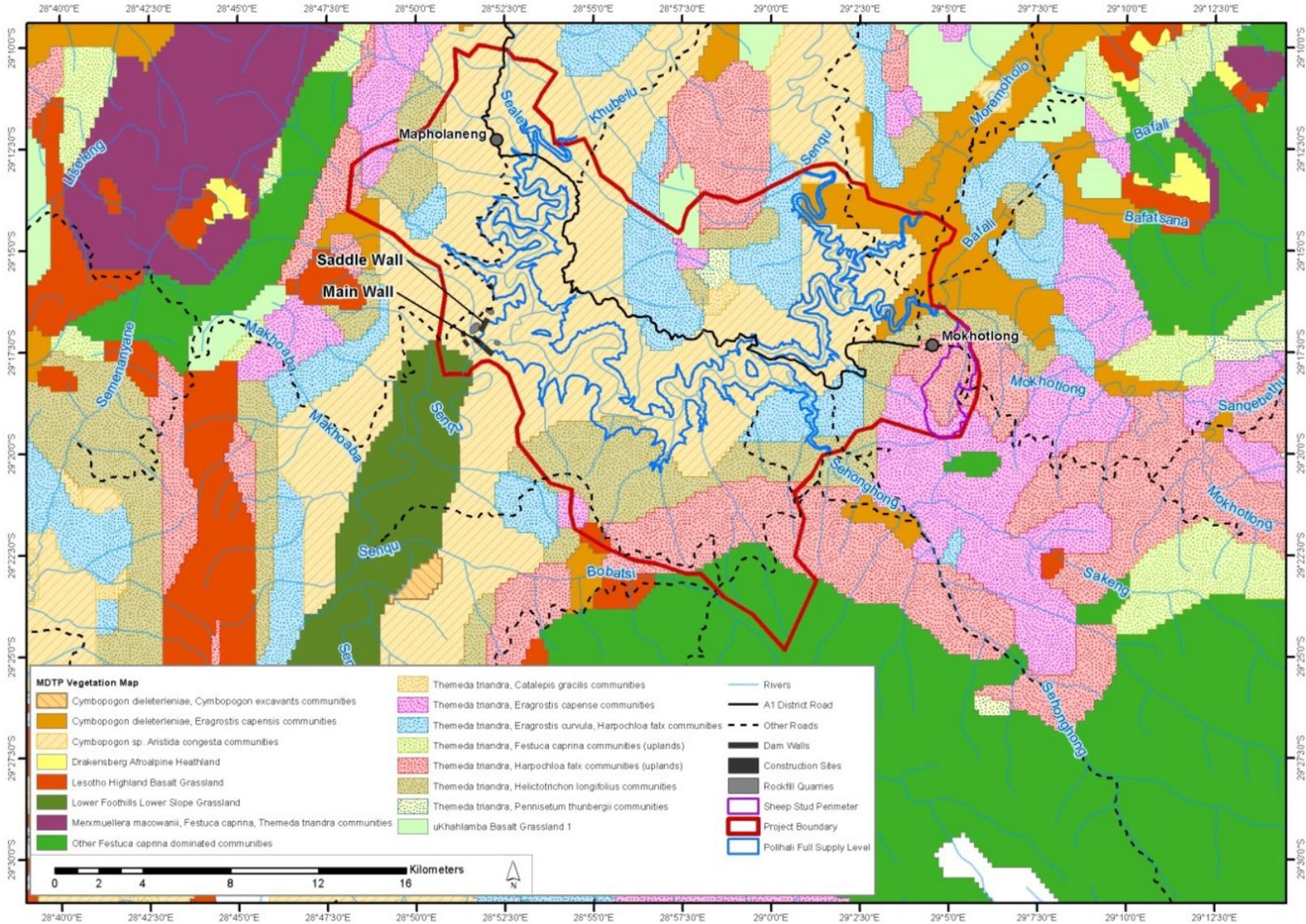
The MDTP vegetation mapping identified 47 vegetation type classes (referred to as ‘ecological units’) across the Lesotho Highlands of which six classes fall within the Polihali Project Area (Figure 3.2). Most of the Project Area, including all of the inundation area was mapped as dominated by *Cymbopogon – Aristida congesta* communities, while some higher lying portions of the Project Area were mapped as *Themeda triandra*-dominated communities. This broadly matches the vegetation pattern encountered within the Project Area, where the lower, steep slopes were dominated by *Cymbopogon dieterlenii* and other species, while the upper slopes and crests were dominated by *Themeda triandra* and species, such as *Diheteropogon filifolius* and *Brachiaria serrata*.

Discrepancies between the historic MDTP vegetation map and the observed vegetation type distribution pattern of the PRAI Project Area may be a function of the scale and format of the mapping on the aerial imagery. The MDTP mapping appears to under-represent the *Themeda*-dominated communities in the higher-lying areas, while the *Cymbopogon* communities are indicated as covering some of the higher crests and plateaus in the Project Area, where field data indicate that *Themeda* is dominant. With the heavy grazing pressure on grassland in the Project Area, it is

highly unlikely that *Themeda*-dominated grassland would have increased since the 1980s, since *Themeda triandra* is a species that decreases under intense and ongoing grazing pressure.



Figure 3.2 Ecological Units Digitised from 1983-1987 RMD Mapping for MDTP (2007)



### 3.2.3 Mammals and Herpetofauna

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 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.

Small mammals were trapped using Sherman traps placed in linear arrays of 10 traps during a nine-day survey in January 2014 and over five days in March 2014. 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 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 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. Nocturnal visits were also made to several wetland sites to record amphibian activity.

## 3.3 Surveys and Data Analysis

### 3.3.1 Sampling Sites / Areas

Based on the availability of transect data from the CES (2014a) study, sample sites were located mainly in the vicinity of the planned infrastructure at the dam wall and within the inundation area along the Senqu and Khubelu Rivers and their respective tributaries. Sampling took place along meandering transects at ten locations in the Project Area (Figure 3.3). Transects varied in length from 800 m to 6690 m and survey time varied from 30 minutes to 5.5 hours (Table 3.1).

**Table 3.1 List of Transects Sampled in the PRAI During February 2017 Fieldwork**

Transect	Area	Date	Time	Latitude	Longitude	Distance (m)	Time (min)
PRAI-Bot 1	Senqu	31/1/2017	12:30 PM	29.28636°	28.86359°	2290	90
PRAI-Bot 2	Khubelu	4/2/2017	8:30 AM	29.26826°	28.88140°	1930	100
PRAI-Bot 3	Khubelu	4/2/2017	10:15 AM	29.27095°	28.87794°	1360	60
PRAI-Bot 4	Khubelu	4/2/2017	12:00 PM	29.27097°	28.87431°	2945	180
PRAI-Bot 5	Khubelu	4/2/2017	3:30 PM	29.27461°	28.86945°	1659	60
PRAI-Bot 6	Senqu / Libibing	5/2/2017	8:00 AM	29.31952°	28.98561°	6690	330
PRAI-Bot 7	Senqu	5/2/2017	3:00 PM	29.29368°	28.99746°	800	30
PRAI-Bot 8	Senqu	5/2/2017	4:00 PM	29.29381°	28.98933°	915	30
PRAI-Bot 9	Ntsupe	2/2/2017	2:15 PM	29.25179°	28.85429°	1500	60
PRAI-Bot 10	Tsibohong	2/2/2017	3:30 PM	29.22778°	28.86947°	1200	60

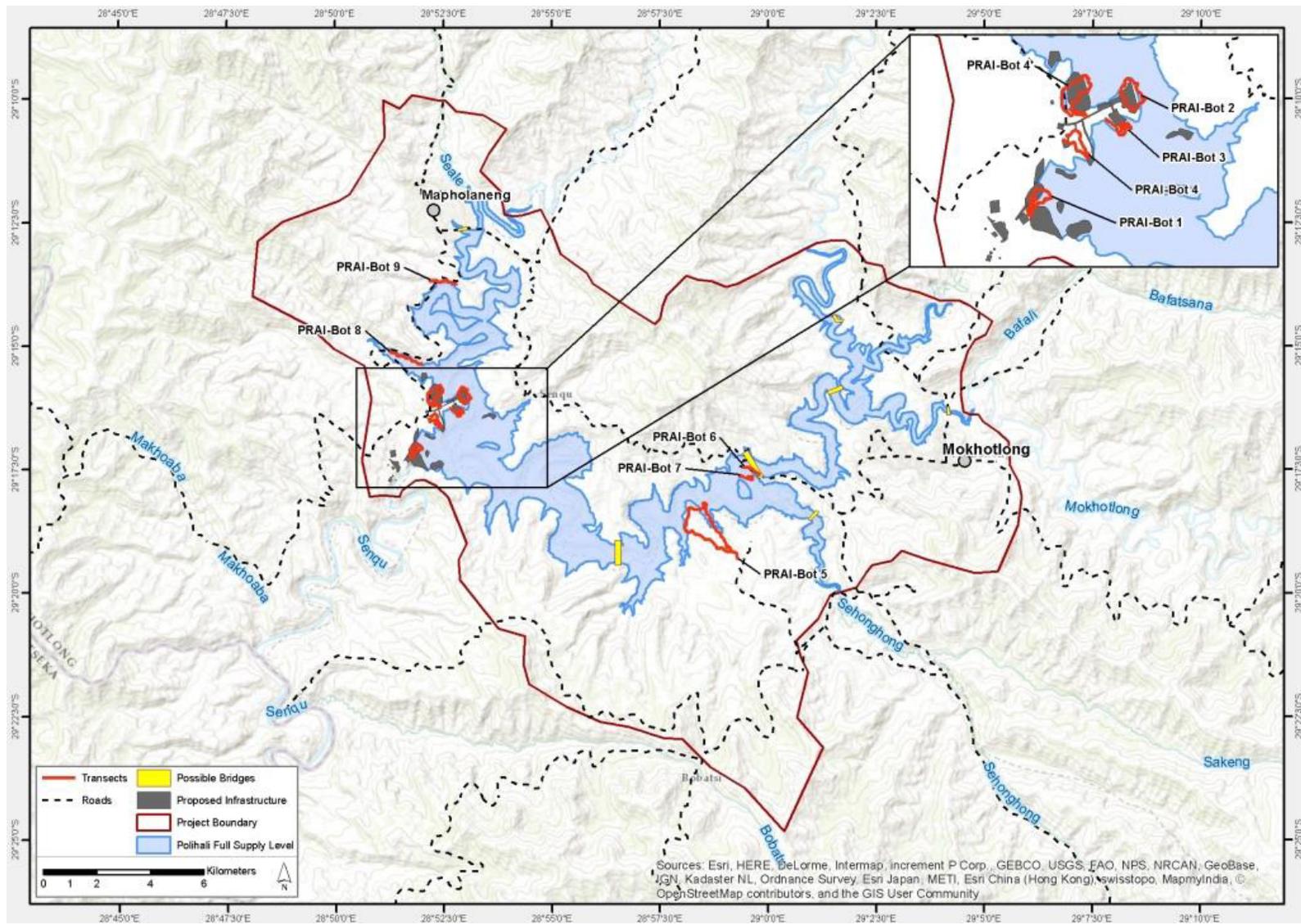
### 3.3.2 Villages Surveyed for Natural Resource Use

Natural resource use surveys were undertaken in 14 villages listed in Table 3.2.

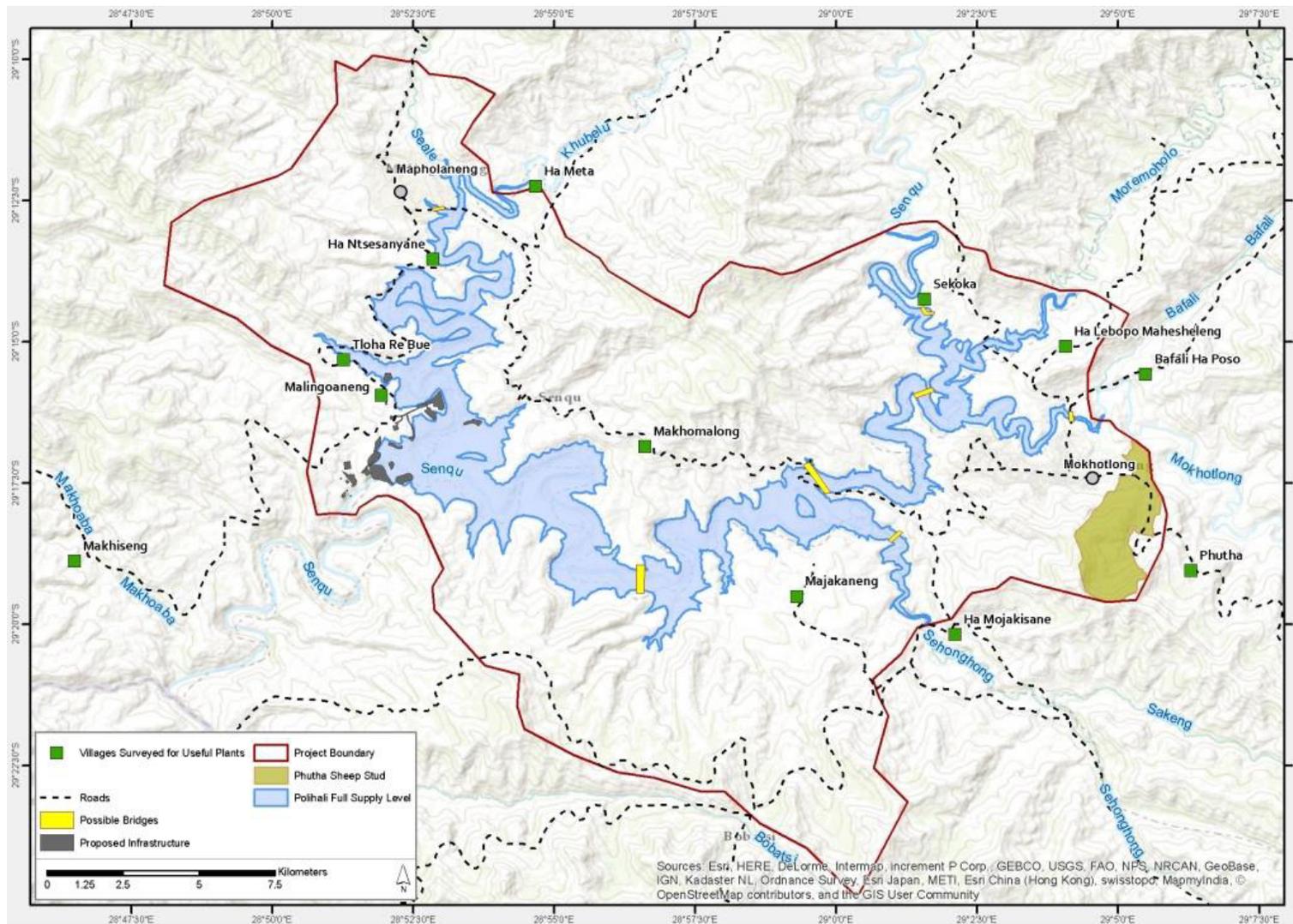
**Table 3.2 List of villages and Key Informants Surveyed for Natural Resource Use**

Date	Village	Informants
2/02/2017	Malingoaneng	
3/02/2017	Makhiseng	Paseka Lesita
4/02/2017	Ha Ntsesanyane	Tiholo Ntsesanyane
3/02/2017	Mokokoaneng/ Makhoarane	Ntate Moshoeshoe Roelane
7/02/2017	Majakaneng	Chief Ramabanta Lemphane & Mr Puo Matjiane
7/02/2017	Ha Mojakisane	Chief Mojakisane Tsita
7/02/2017	Popa Makhomalong	Manthatisi Sekonyela & Mr Ramasimphane Nehelo
8/2/2017	Phutha	Mr Motsoane Mosebo
8/2/2017	Sekoka	Mr Matalasi
8/2/2017	Ha Lebopo -Mahesheleng	Chief Naha & Malineo Lebopo
8/2/2017	Bafali Ha Poso	
9/2/2017	Malingoaneng –Tloha-Re-Bue	Mr Thabo Raisi Mrs Nkhelleng Pule Mosa & Mankeletseng Lengoasa
9/2/2017	Ha Ntsesanyane	Matokelo Lefala
9/2/2017	Ha Meta	Makhaufa Sekonyela Sello & Mampule Mafelesi

Figure 3.3 Location of Flora and Fauna Transects within the PRAI



**Figure 3.4 Location of Villages where Natural Resource Use Surveys were Conducted**



### 3.3.3 Field Survey Methods

#### 3.3.3.1 Vegetation and Flora

All visible and identifiable plants were recorded on either side of a variable-length meandering transect, with the focus placed on locating species of conservation importance. Transects were located in areas where the likelihood of finding these species was optimal, e.g. 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.

#### 3.3.3.2 Natural Resource Use

Data on natural resource use was obtained through consultations in 13 villages (Table 3.2) that were surveyed by Khotso Kobisi between the 2<sup>nd</sup> and 9<sup>th</sup> February 2017 in order to better understand the extent of dependence on natural resource use and the distribution and scarcity/abundance of plants used by local communities in the reservoir area. Twenty informants were interviewed and questioned about the plants used, the purpose of use, their location and availability / abundance.

#### 3.3.3.3 Mammals

Mammal sampling was limited to visual observations and collection of evidence such as spoor and dung along the flora transects. Additional observations were also made while driving between sample sites. No trapping of small mammals was undertaken for this study; pit-fall trapping was undertaken by CES (2014b) who recorded low small mammal density and diversity.

#### 3.3.3.4 Herpetofauna

Herpetofaunal sampling took place through active searching of likely reptile and amphibian habitat while walking the flora transects. 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. Maluti River Frogs were sampled coincidentally through electro-fishing by the aquatic specialist, Rob Palmer, and the data shared. Additional herpetofauna observations were made while driving between sample sites. No trapping of reptiles or amphibians was undertaken, apart from sweep netting of tadpoles in wetlands and isolated pools in rivers. Photographs of tadpole mouthparts were taken using a Nikon AF-S Micro Nikkor 105mm VR lens, and these were identified later using available literature.

### 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

Impacts were assessed in accordance with the standard impact assessment methodology provided by ERM and the ratings provided in Table 3.3. However, the impact significance table for biodiversity impacts has been modified slightly to allow for a Critical rating for biodiversity impacts of large magnitude on biodiversity receptors of High or Very High sensitivity (e.g. endangered/critically endangered species). This is to align 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.

**Table 3.3 Impact Significance Rating Table**

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	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>1</sup>.

---

<sup>1</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 of the proposed PRAI (referred to in this report as the Project Area) on terrestrial flora and fauna comprises:

- The terrestrial habitats within the FSL that will be inundated by the reservoir and immediately adjacent to the FSL (i.e. within the 2080 m level) - estimated at 5600 ha;
- Terrestrial habitats within the infrastructure footprint estimated at 123 ha and comprising construction camps, offices, laydown areas, and supporting infrastructure (e.g. waste landfill, sewage works); access roads, and quarries; and
- Adjacent habitats above the FSL and around the infrastructure footprint that will be impacted by displacement of livestock grazing, cultivation and human settlement in the reservoir (estimated at the ~5 km boundary from the FSL).

## 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>2</sup>. The Project Area is situated within 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 eastern boundary of the Project Area borders on the Drakensberg Alti-montane Grasslands and Woodlands ecoregion, which is the alpine part of the Drakensberg Mountains above 2500 masl, but is not actually represented within the PRAI area.

#### 4.2.1.2 National Vegetation Types

Mucina and Rutherford (2006) describe 11 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 entire Project Area, while Drakensberg Afroalpine Heathland is present in the higher-lying mountains to the west and south-east of the Project Area, where Lesotho Mires and Drakensberg Wetlands are also present (Figure 4.1). Senqu Montane Shrubland is present in the Senqu River valley downstream of the dam wall. 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*,

<sup>2</sup> [www.worldwildlife.org/ecoregions/at1003](http://www.worldwildlife.org/ecoregions/at1003). Accessed 13 March 2017

*Helichrysum basalticum*, *Heliophila alpina*, *Lobelia galpinii* and *Eucomis schijffii*. In addition, there are a number of species that are endemic to this vegetation type, including *Argyrobium 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).

#### 4.2.1.3 Centres of Endemism

The Project Area is situated within the Drakensberg Alpine Centre of plant endemism (DAC) (van Wyk and Smith, 2001; Carbutt and Edwards, 2004; Carbutt and Edwards, 2006). This centre of plant endemism covers approximately 40 000km<sup>2</sup> of the Drakensberg Mountain Range in Lesotho and South Africa, and comprises six floristic regions (Hilliard and Burt, 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).

The KwaZulu-Natal Drakensberg has been designated as a major centre of rare and endemic species within the DAC, with approximately 60 percent of the DAC's endemics occurring there and 26 percent of the species being strictly endemic to this region (Carbutt and Edwards, 2004). Approximately 13 percent of the plant species occurring in the DAC are strictly endemic to the region and 24 percent are near-endemic, which is a high level of endemism relative to some other centres of endemism in South Africa. Less than six percent of the DAC is currently conserved, mostly in the uKhahlamba-Drakensberg Park in KwaZulu-Natal. Despite the Lesotho Maloti Mountains dominating much of the DAC, only three percent of the conserved land in the DAC falls within this region, including the Sehlabathebe National Park (Carbutt and Edwards, 2006).

#### 4.2.1.4 Priority and Protected Areas

Protected areas of Lesotho in relation to the Project Area are shown in Figure 4.2 and summarised in Table 4.1. None of the formally designated protected areas lie close to the Project Area.

The project is however located adjacent to the Maloti Drakensberg Transfrontier Conservation Area (MDTCA) along the border with South Africa. This area was previously defined by the Maloti Drakensberg Transfrontier Project (MDTP) as a priority for improved rangeland management and biodiversity conservation. The MDTP, which covered the entire Lesotho Highlands areas, identified a number of areas as priority areas for conservation, including the upper Senqu source, which was proposed as a new protected area but which was not implemented. The Mokhotlong-Sanquebethu Managed Resource Area (MRA) up to and including Sani Top was later identified as one of the four national priorities for the MDTP Phase II programme (MDTP 2009). 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 WHS. 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.

Only the Phutha Sheep Stud located to the south east of Mokhotlong (and outside the area of inundation) has any degree of protection in the Project Area and is in good condition with high biodiversity value.

**Table 4.1 Protected Areas of Lesotho**

<b>Name</b>	<b>Size<sup>3</sup></b>	<b>IUCN Class</b>
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 RMA	52 000 ha	VI
Phutha Sheep Stud	690 ha	VI

---

<sup>3</sup> Areas obtained from Lesotho Biodiversity Strategy and Action Plan for Sehlabathebe, Tsehlanyane, Bokong and RMAs (NES 2000) and may not be accurate.

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

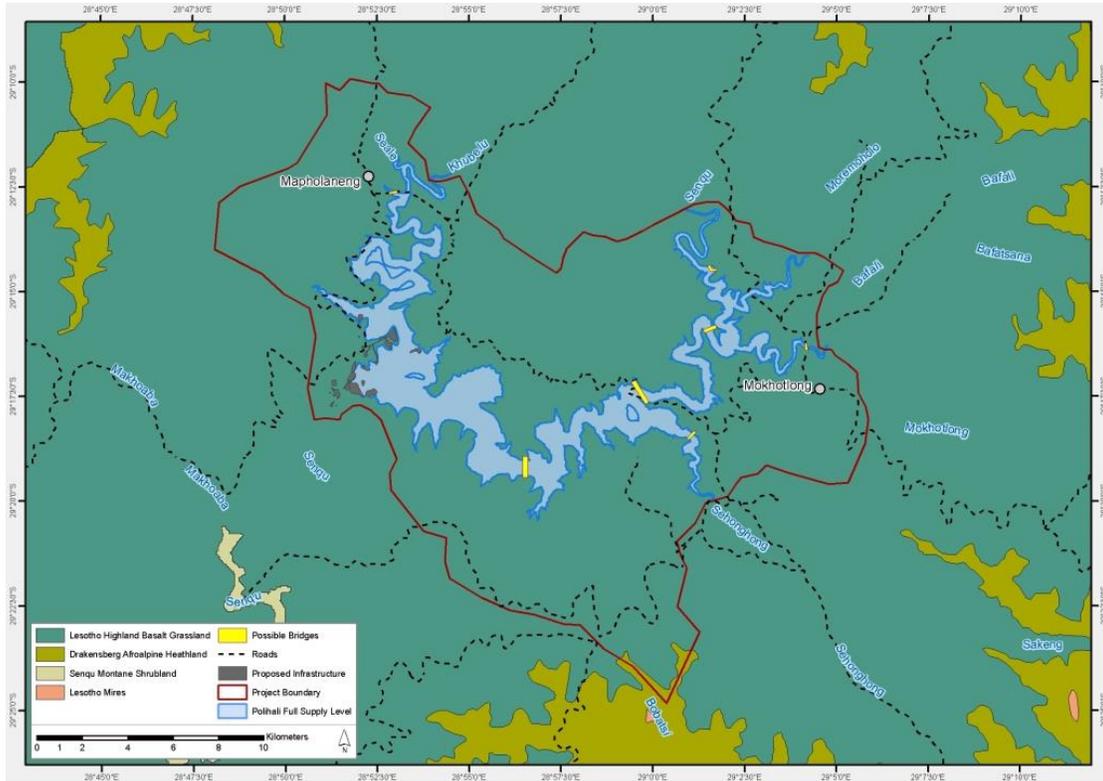
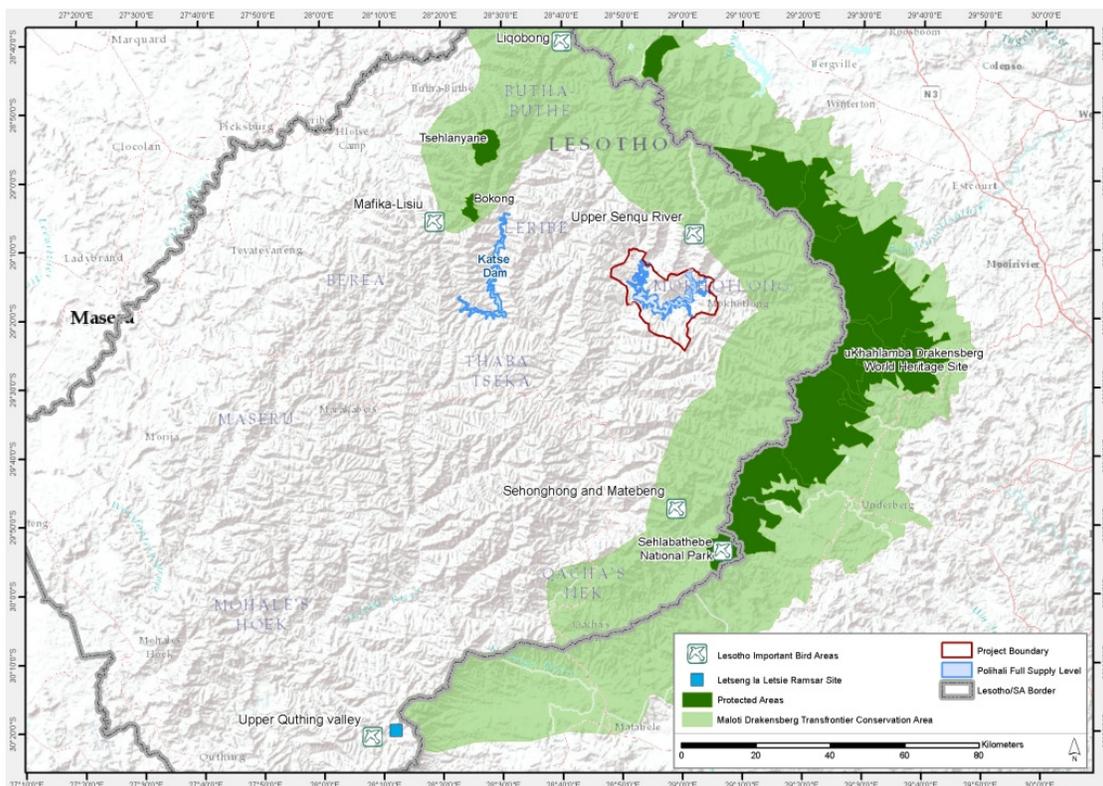


Figure 4.2 Protected Areas of Lesotho in relation to the PRAI Project Area



## 4.2.2 Description of Vegetation Types

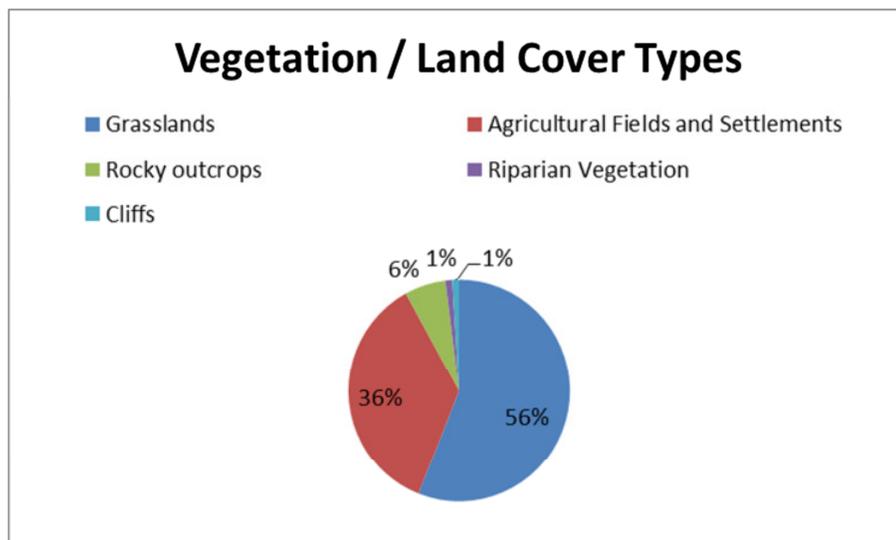
CES (2014a) described the vegetation of the Polihali Dam basin and surrounding higher-lying ground based on a set of 80 transects. They identified three broad vegetation associations, namely Intact Seeps, Degraded Seeps and a Rocky Outcrop / Grassland Mosaic (Figure 3.1). However, the largely intact seep association was confined to the Phutha Sheep Stud to the south-east of Mokhotlong, and is not relevant to the current Project Area, and the Degraded Seep association is covered under the wetland specialist report (P2W-6004-DFR-0004; WCS, 2017) and will not be dealt with further here. Rocky Outcrops / Grassland Mosaic were further sub-divided into two sub-associations by CES (2014a):

- **Rocky Outcrops** – comprised areas along mountain ridges and rocky slopes; found throughout the Project Area from low to high altitudes; dominant species included grasses such as *Eragrostis chloromelas*, *E. capensis*, *Tristachya hispida*, *Aristida bipartita* and other *Aristida* species; herbs and dwarf shrubs included *Felicia muricata*, *Artemesia afra*, *Scabiosa columbaria* and various *Helichrysum* species; this vegetation association had the highest biodiversity index score (24.1), which is an index measuring alpha diversity of species within a particular habitat.
- **Grasslands** – confined to level to gently sloping areas such as the mountain tops, plateaus and on gentle slopes; dominant species were very similar to those found in rocky outcrops and included *Eragrostis racemosa*, *E. capensis*, *E. curvula*, *Harporchloa falx* and *Microchloa caffra*; in very degraded areas a *Cynodon* species was dominant and in less severely grazed areas *Heteropogon contortus* and *Themeda triandra* were dominant; herbs such as *Felicia muricata* and *Scabiosa columbaria* were also prevalent; grasslands were given a moderate biodiversity index score (12.9), which is an index measuring alpha diversity of species within a particular habitat.

The floristic composition of these two vegetation types was found to include numerous species indicative of disturbance and degradation, and *Themeda* and *Festuca* dominated grasslands have been replaced by grassland dominated by *Aristida* and *Eragrostis* species.

Additional vegetation sub-associations that were briefly described by CES (2014a) are Cliffs, Riparian Vegetation and Agricultural Fields and Plantations. Based on the CES vegetation and land use mapping represented in Figure 3.1, 56 percent of the Project Area comprises degraded grasslands, with the remainder made up by agricultural fields and settlements (36%), rocky outcrops (6%), riparian vegetation (1%) and cliffs (1%) (Figure 4.3).

**Figure 4.3** Vegetation Types in the PRAI Project Area (CES, 2014)

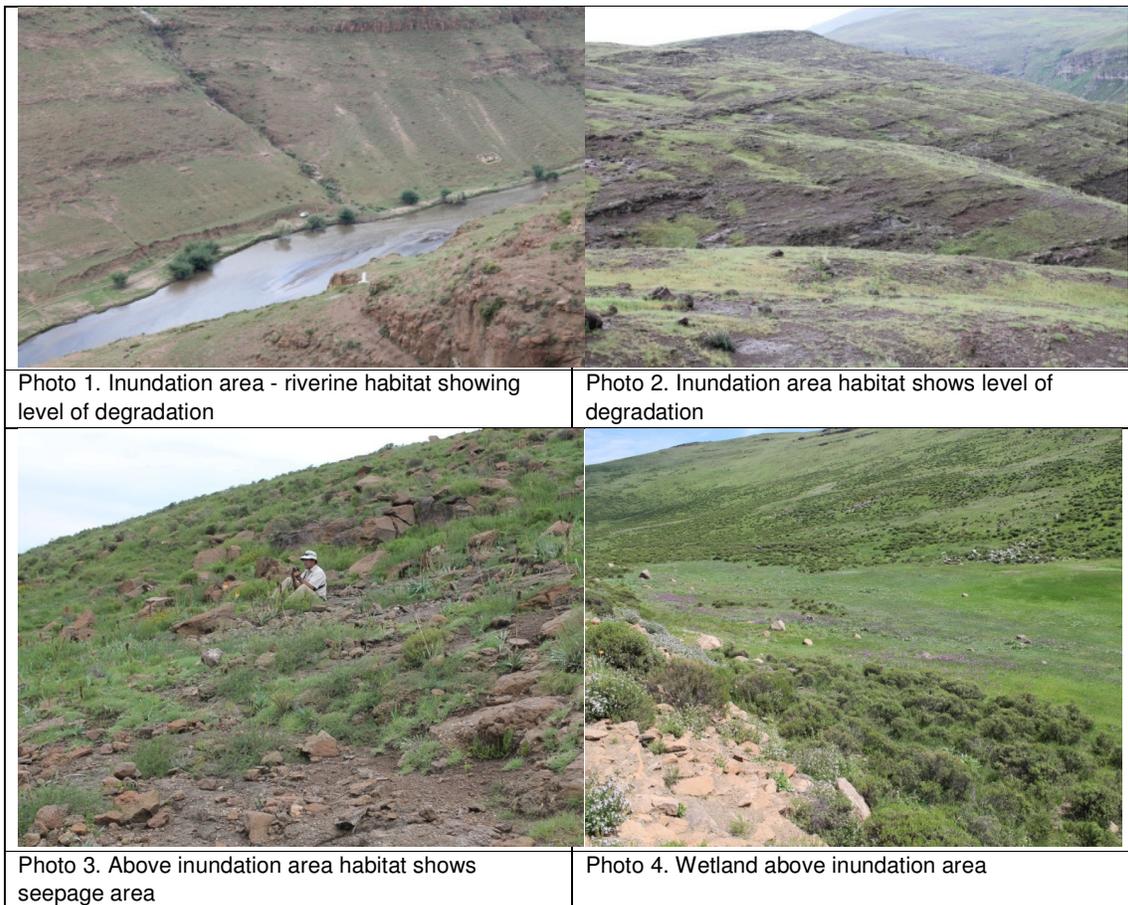


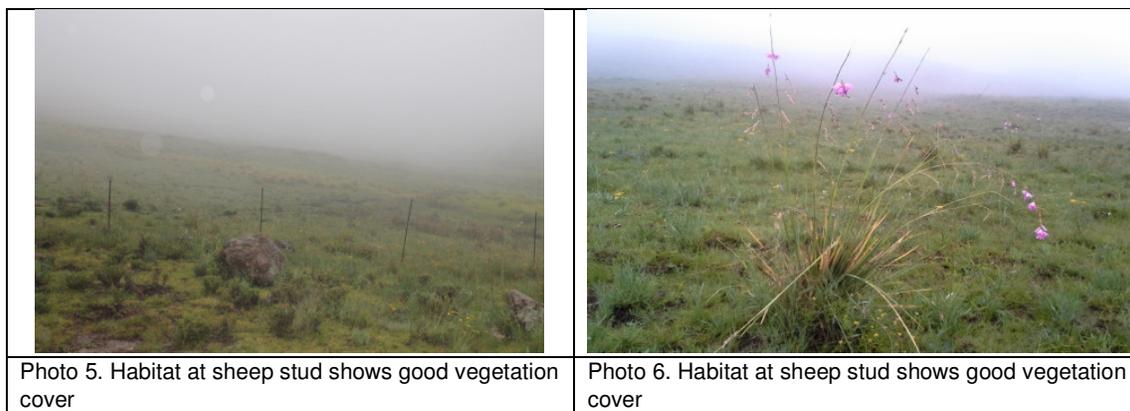
Altitude and aspect are likely to be key drivers of species composition of grasslands in the Project Area. A floristic survey of the Katse Dam catchment area (Barker *et al.*, 2014) found grasslands at lower altitudes to be dominated by C4 Increaser grasses such as *Aristida* species, while higher altitudes were dominated by Decreaser grasses such as *Themeda triandra* and C3 Increaser species such as *Merxmuellera disticha*. Aspect also played a significant role in determining species composition of grasslands in the Katse catchment, with drier, North-facing slopes being dominated by *Aristida* and *Eragrostis* grass species and moister, cooler South-facing slopes having a higher proportion of Decreaser grasses such as *Themeda triandra* and Increaser species such as *Festuca caprina* and *Catalepis gracilis*.

The results of the current study support the above classification, with the addition of a dwarf shrubland vegetation association, which is found on mountain tops and steep, heavily grazed mountain slopes. Dominant shrubs are *Euryops tysonii*, *Pentzia cooperi* and *Helichrysum trilineatum*, all of which are heavily harvested for firewood. Plants identified in the Project Area are summarised in Appendix A.

Representative vegetation types in the PRAI Project Area are shown in Figure 4.4.

**Figure 4.4 Photographs of Representative Habitat Types**





Source: K Kobisi 2017

### 4.2.3 Species of Conservation Importance

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

Five of the species recorded in the dam basin and adjacent hillslopes during this study are considered species of conservation concern as defined by Raimondo *et al.* (2009) (Table 4.2). One of these is classified as Vulnerable, namely *Alepidea cordifolia*, while three species have been classified as Vulnerable by Talukdar (2002), namely *Dicoma anomala*, *Jamesbrittenia lesutica* and *Eucomis autumnalis*. However, the conservation status of *Dicoma anomala* is in need of reassessment in Lesotho as it is unlikely to be threatened. One species assessed as Near Threatened by Talukdar (2002), *Aristaloe aristata*, was also confirmed to occur in the Project Area during fieldwork (Figure 4.5).

**Table 4.2 Species of Plants of Conservation Concern**

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Preferred Habitat	Area Recorded	Abundance
<b>DICOTS</b>							
<b>Apiaceae</b>							
<i>Alepidea cordifolia</i>	Lesoko	Forb	Vulnerable	Not endemic	Hillslope seeps, drainage lines	Phutha Sheep Stud	Scarce
<b>Asteraceae</b>							
<i>Dicoma anomala</i>	Hloenya	Forb	Vulnerable	Not endemic	Rocky grassland on hillslopes and plateaus	Masakong	Common
<b>Scrophulariaceae</b>							
<i>Jamesbrittenia lesutica</i>		Forb	Vulnerable	Strict endemic	Rocky grassland and dwarf shrubland on steep slopes	Masakong & Majakaneng	Fairly common
<b>MONOCOTS</b>							
<b>Asphodelaceae</b>							
<i>Aristaloe aristata</i>	Lekhalana	Succulent	Near Threatened	Near-endemic	Rocky scrub in valleys or on hillslopes	Masakong & Phutha Sheep Stud	Uncommon
<b>Hyacinthaceae</b>							
<i>Eucomis autumnalis</i>		Geophyte	Vulnerable	Not endemic	Grassland on gentle slopes and plateaus, edges of hillslope seeps	Phutha Sheep Stud	Scarce

In addition, one species classified as Vulnerable by Talukdar (2002) was confirmed to occur in the higher-lying catchment of the Senqu and Khubelu Rivers adjacent to the Project Area, namely *Aloe polyphylla*, although this species was not recorded or is likely to be present within the reservoir area and surrounding hills. Each of the species of conservation concern is dealt with in more detail below and photos of selected species displayed in Figure 4.5.

The CES (2014a) baseline study recorded three of the above species of conservation concern in the Project Area (*Jamesbrittenia lesutica*, *Dicoma anomala* and *Aristaloe aristata*) and confirmed the presence of two Vulnerable species at higher altitudes outside of the Project Area (*Aloe polyphylla*, *Urginea saniensis*).

***Alepidea cordifolia* (Vulnerable)**

This is a tall herb of grassy drainage lines and hillslope seeps that was only located in a near-natural seep in the Sheep Stud during fieldwork, and which is unlikely to be present in the degraded seeps present within the dam basin. Once widespread in Lesotho, it has been heavily harvested for traditional medicine and has disappeared from a number of localities in the country (Talukdar, 2002).

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

This small aloe was located in rocky scrub at two localities, one along the Khubelu River within the proposed dam basin and another site on a hillslope in the Sheep Stud. Much suitable habitat is present within the Project Area and 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).

***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 justify threatened status. Reassessment of this species under IUCN criteria is likely to result in a status of Least Concern.

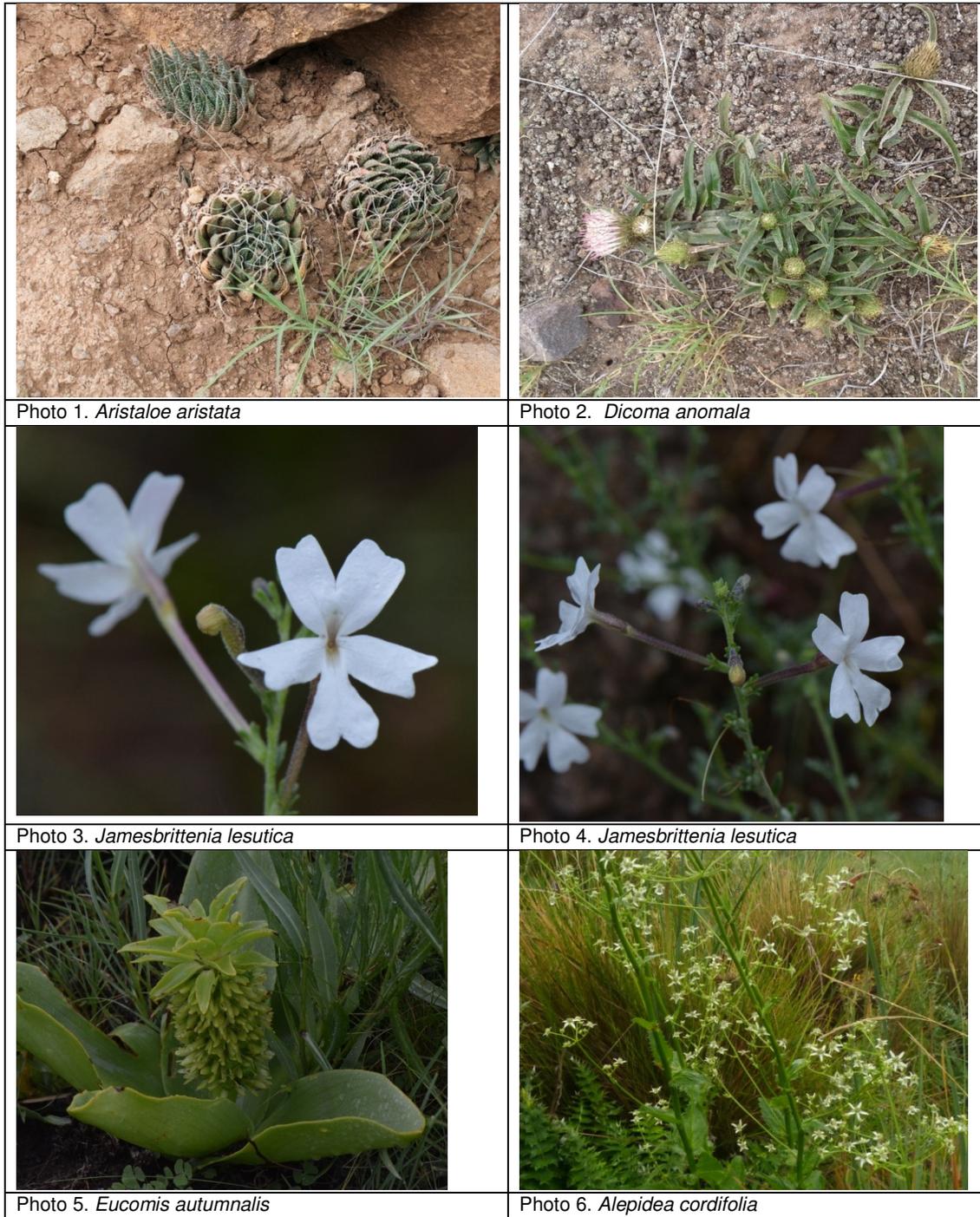
***Eucomis autumnalis* (Vulnerable)**

The pineapple flower is a geophyte that was located in grassland on hillslopes and at the edge of wetlands in the Sheep Stud area and in the mountains to the west of the Project Area during this study. It is either absent or present in very small numbers within the dam basin but was not located below the proposed FSL during fieldwork. 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 the Project Area, occurring in rocky grassland and dwarf shrubland on mountain slopes, mostly above the proposed FSL of the dam. Population density is higher in the higher-lying mountains to the west and south-east of the Project Area (W McClelland, *pers.obs.*).

Figure 4.5 Representative Species of Conservation Concern



Source: Photos 1-2 K. Kobisi; Photos 3-6 W. McClelland

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

About 334 species are endemic and 595 species near-endemic to the DAC (Carbutt and Edwards, 2006). About 21 percent of the 299 plant species recorded in the Project Area during fieldwork are either strictly endemic (13 species) or near-endemic (51 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 (23 species) and Scrophulariaceae (7 species) (Table 4.3). The family Asteraceae also has 69 percent 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 4.6.

**Table 4.3 Plant Families with the Most Endemic and Near Endemic Plant Species in the Project Area**

Family	Strict Endemics	Near Endemics	Total
Asteraceae	9	14	23
Scrophulariaceae	2	5	7
Geraniaceae	0	3	3
Iridaceae	1	2	3
Poaceae	0	3	3

**Figure 4.6. Photos of Some Endemic and Near-Endemic Species Occurring in the Project Area**



Photo 5. *Berkheya multijuga*Photo 6. *Berkheya multijuga*

Source: W McClelland 2017

#### 4.2.4 Important Plant Resources for Local Communities

The communities living within the dam basin and adjacent land are heavily dependent on plant resources, either as a source of grazing or browsing for their livestock, or directly for firewood or medicinal purposes. 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 dam basin and adjacent hills and are considered to be important resources for local communities (Appendix 3). 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 4.7.

According to CES (2014a) 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. Surveys 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 were *Aristaloe aristata*, *Hermannia woodii*, *Gomphacarpus fruticosus*, *Amaranthus hybridus* and *Datura stramonium*. These included species that 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 *Aristaloe aristata*, *Delosperma* sp. and *Artemesia afra* that were 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) before one can speak to their ancestors. This is a frequent occurrence for traditional healers, diviners and herbalists 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 construction of items such as baskets and hats and five species served a dual use such as being important for both medicinal and spiritual use.

In the downstream area, interviews conducted in the social study (LHDA Contract 6001) confirmed that the majority of resources harvested (56%) are used to supplement communities' food supply; 30 percent of the wild plants collected are used for medicinal purposes, and 12 percent were used for other purposes such as fuel, construction and spiritual use.

**Figure 4.7** Examples of Flora Species Used by Local Community Members



Photo 5. *Pelargonium sidoides*Photo 6. *Hyparrhenia hirta*

Source: K Kobisi 2017

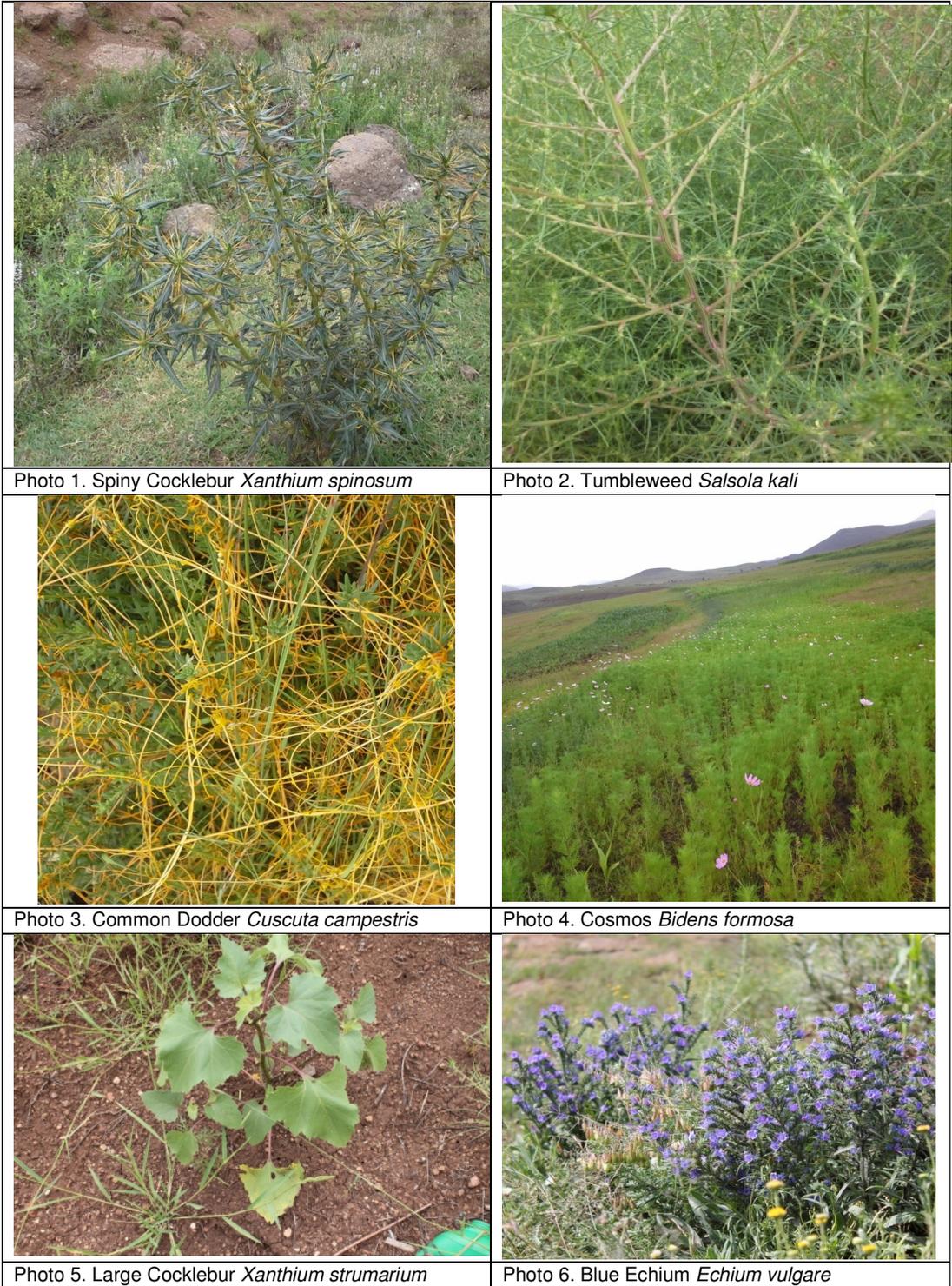
### 4.2.5 Alien Invasive Species

A report on invasive alien species in Lesotho (unreferenced in CES 2014) lists 65 invasive plant species, of which 51 are terrestrial species. The International Union for the Conservation of Nature (IUCN) define 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 *S. kali*, *E. plantagineum* and *B. formosa* are particularly prominent at the edges of cultivated fields, while *S. 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 along the Senqu and Khubelu Rivers, 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, 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 being actively managed.

**Figure 4-8 Alien Invasive Plant Species Recorded in Project Area**



Source: K Kobisi 2017

### 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 in

the Senqu and Khubelu River valleys has exposed soil to rain and wind, resulting in serious soil erosion in some areas such as Malingoaneng, Tloha-Re-Bue and below Majakaneng. 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*, *Searsia divaricata*, *Searsia erosa*, *Pentzia cooperi*, *Rhamnus prinoides*, *Felicia filifolia* and other *Searsia* species.

The degraded habitat condition in the Polihali reservoir area is exacerbated by its location in what is commonly referred to as a 'rain shadow' with lower rainfall than neighbouring areas of Katse to the west. In addition, the recent and on-going drought has contributed to the increased grazing pressure, and increased human pressures on natural plants for food and medicinal purposes. It is not possible to quantify the rate of degradation in the Polihali area that has occurred as no studies appear to be available that have assessed this through use of remote sensing for example. Land use changes in the Katse reservoir area (Anchor, 2014) were assessed using remote sensing analysis over three time series (1993, 2005 and 2013) to determine land cover change since the reservoir was inundated.

Anchor (2014) found that changes in land cover between 1993 and 2005 were relatively small (+/- 5 %) and mainly consisted of increases in subsistence farming, especially close to the dam. From 2005-2013 changes in land cover types were more extensive, the largest being decreases in intact grassland of up to 15 percent in the areas within 5 km of the dam and increasing cultivation. Conversion to subsistence farming and decreases in biomass were greatest close to the dam. Other changes were small but included changes from intact grassland to *Chrysocoma*-dominated vegetation. Similar changes to those observed in the Phase 1 areas can be expected in the Polihali area over time. Overall, it was clear that areas closest to the dam had been transformed and degraded at a much higher rate than areas further away from the dam (>7.5 km). The reasons for the changes in land cover types and distance from the dam are not clear as the observed changes could not be correlated with information on population settlements, and livestock numbers and grazing patterns. It is surmised that the observed changes are largely attributable to increased grazing and cultivation as a result of displacement from the reservoir area, possibly combined with increasing population due to improved access and dam construction activities.

**Figure 4.9 Threats to Habitats and Flora**

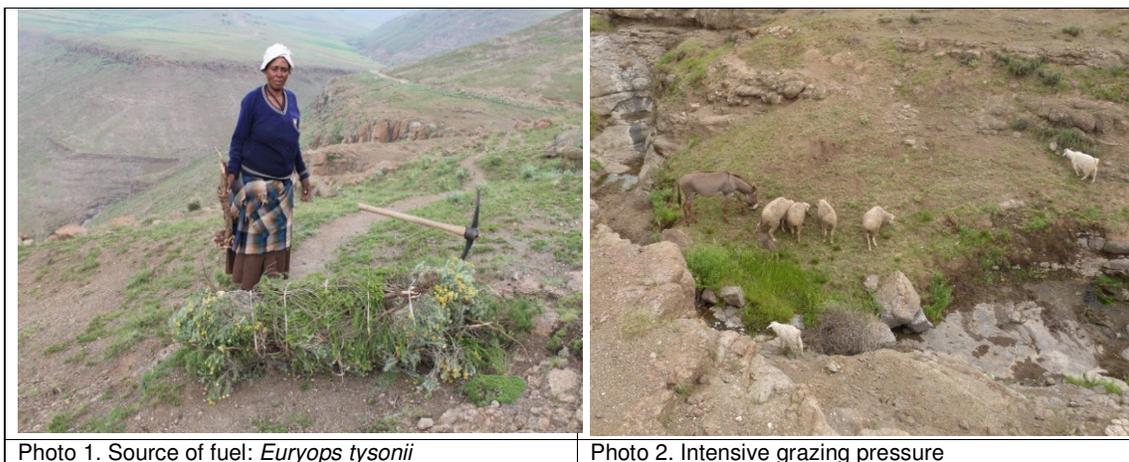


Photo 1. Source of fuel: *Euryops tysonii*

Photo 2. Intensive grazing pressure

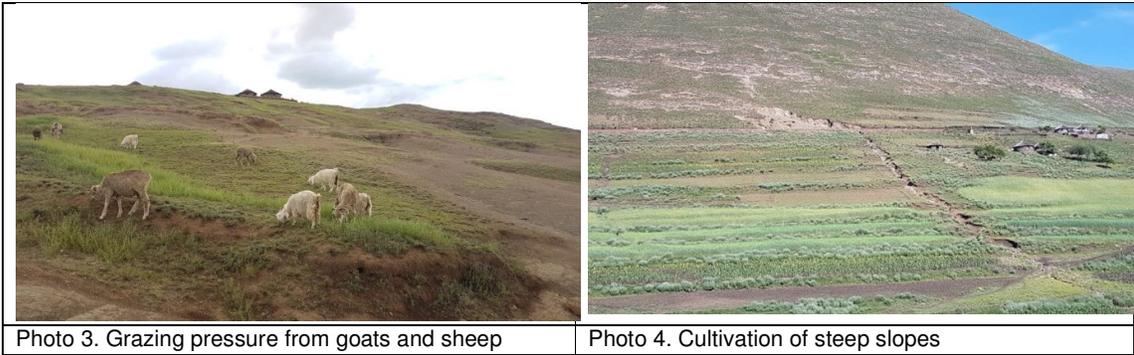


Photo 3. Grazing pressure from goats and sheep

Photo 4. Cultivation of steep slopes

Source: Photo 1: K Kobisi 2017; Photo 3 &amp; 4: J Hughes.

## 4.3 Mammals

### 4.3.1 Global and Regional Context

The Project Area is situated within the Drakensberg Montane Grasslands, Woodlands and Forests ecoregion, which covers much of central and eastern Lesotho<sup>4</sup>. 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 three broad structural vegetation types are present (Figure 4.10). These form the following broad mammal habitats:

- **Dwarf Shrubland** – this habitat is prominent on some of the heavily grazed mountain slopes within the Project Area, particularly drier north- and west-facing slopes, and is also the dominant habitat above 2700 masl to the west of the Project Area; low, microphyllous shrubs form a sparse to dense woody stratum, often on shallow, rocky soils;
- **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;
- **Riparian Thickets** - this is a very limited habitat that is confined to the banks of the Senqu and Khubelu Rivers and their tributaries; thickets are linear in structure and highly fragmented; species using this habitat are also associated with adjacent rivers or streams.

<sup>4</sup> [www.worldwildlife.org/ecoregions/at1003](http://www.worldwildlife.org/ecoregions/at1003). Accessed 13 March 2017

**Figure 4.10 Representative Habitat Types for Mammals**

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 of mammals 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 percent 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. According to CES (2014b) approximately 30 mammal species historically occurred in the Project Area, of which 17 have been confirmed from Mokhotlong (Lynch 1994). Du Plessis *et al.* (2014) listed 33 mammal species likely to be present in the nearby Katse catchment area, nine of which have been confirmed in the Project Area.

Two surveys were conducted in the Project Area by CES (2014b), one of which involved trapping of small mammals at five sites (Mokhotlong, Senqu River (Polihali) dam site, Senqu – Mokhotlong River junction, and two sites in the Phutha Sheep Stud). Eleven species were confirmed to occur in the Project Area, although only seven species were found within the vicinity of the inundation area (Table 4.4). Incidental mammal observations in February 2017 has increases this total to 16 mammal species, of which eight have been confirmed within the inundation area (Table 4.4). This compares favourably with the total of 16 species observed in the Katse River catchment by Du Plessis *et al.* (2014).

### **Carnivores**

Three carnivore species were confirmed to occur within the Project Area, two of which were in the inundation area (African Clawless Otter (*Aonyx capensis*); Marsh Mongoose (*Atilax paludinosus*) and Black-backed Jackal (*Canis mesomelas*). Caracal (*Caracal caracal*) is also likely to occur in very low numbers but no evidence of this species was found.

### **Antelope**

Only two antelope species are likely to occur within the Project Area and both have been recorded in the high altitude mountains adjacent to the inundation area. A single Mountain Reedbuck was reportedly seen on a remote, high altitude (2714 m) peak during the CES survey (CES, 2014b) and a family group of four Grey Rhebok were seen in a remote valley to the west of the Project Area during this study (Figure 4.11).

### **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).

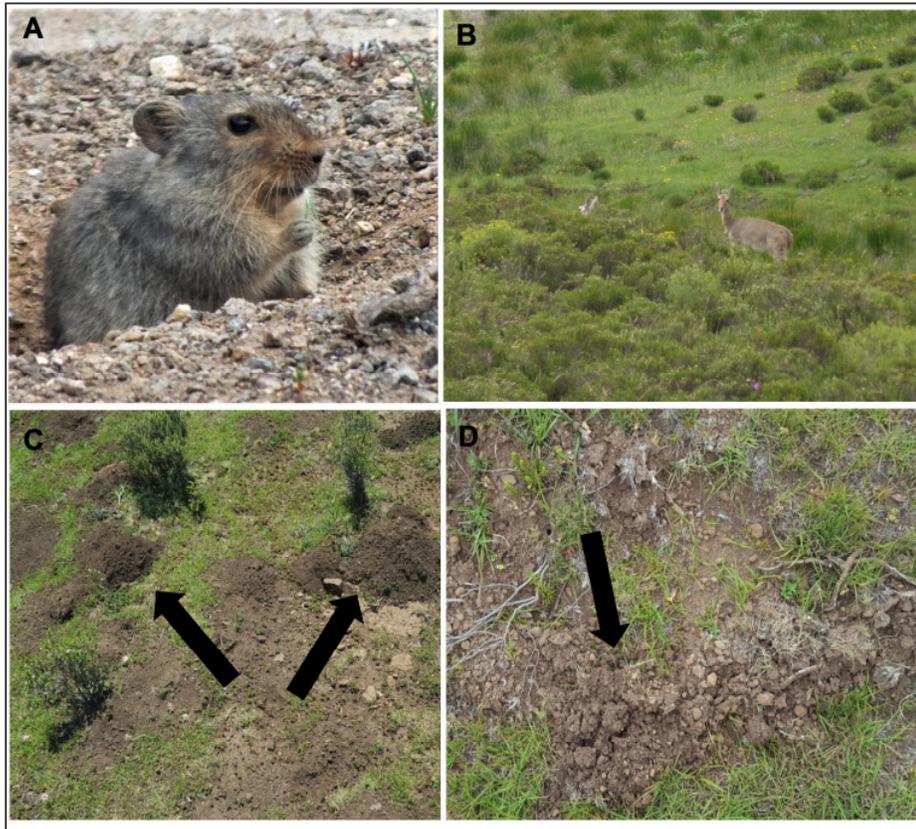
### **Small mammals**

Three rodents (Striped Mouse (*Rhabdomys pumilio*), Multimammate Mouse (*Mastomys natalensis*), Grey Climbing Mouse (*Dendromus melanotis*)) and two shrew species (Forest Shrew (*Myosorex varius*) and Greater Musk Shrew (*Crocidura flavescens*)) were trapped by CES (2014b) during their wet season survey. Soil mounds of Common Mole-rat (*Cryptomys hottentotus*) were observed at a number of localities within and above the inundation area during this study and by CES (2014b), particularly in deeper soils adjacent to or in seeps. Sloggett's Rat was seen at high altitude well away from the inundation area during this study (R. Palmer *pers. comm.*) and by CES (2014b), but it is unlikely to occur below 2500 masl in the Project Area.

The distinctive subsoil runs of a golden mole species (most likely Sclater's Golden Mole) were located at numerous sites in the higher mountains to the west of the inundation area during February 2017 fieldwork, but was not observed anywhere near the reservoir area and is unlikely to be present there. Much suitable habitat for Rock Hyrax (*Procavia capensis*) is present in the Project Area and animals or their middens were observed at seven sites in the Project Area by CES (2014b) and on the western periphery of the reservoir area by the ornithologists. Dung pellets of Scrub Hare (*Lepus saxatilis*) were found at a few sites within the inundation area, although these

were located more frequently in the mountains to the west, where dung middens of a Red Rock Hare (*Pronolagus* species) were also located.

**Figure 4.11 Photos of Selected Mammal Species Found Within or Adjacent to the Project Area**



A – Sloggett's Rat, B – Grey Rhebok, C – Common Mole-rat mounds, D – Golden mole sub-surface runs  
Source: W. McClelland, 2017

**Table 4.4 Mammals Recorded in the Project Area**

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	Inundation area (Mokhotlong) Phutha Sheep Stud	Uncertain
Greater Musk Shrew	<i>Crocidura flavescens</i>	LC	Near-endemic to SA, Lesotho and Swaziland	Wide variety of habitat types	Phutha Sheep Stud	Uncertain
Grey Climbing Mouse	<i>Dendromus melanotis</i>	LC	Widespread	Various grassland types, sometimes associated with stands of tall grass	Phutha Sheep Stud	Uncertain
Natal Multimammate Mouse	<i>Mastomys natalensis</i>	LC	Widespread	Wide variety of habitat types	Inundation area (Mokhotlong)	Probably common

Common Name	Scientific Name	IUCN Status	Endemic status	Habitat Type	Area recorded	Abundance in Project Area
Striped Mouse	<i>Rhabdomys pumilio</i>	LC	Widespread	Wide variety of habitat types	Inundation area, Phutha Sheep Stud	Probably common
Sloggett's Rat	<i>Otomys sloggetti</i>	LC	Drakensberg endemic	High altitude shrubland and grassland; usually above 2600 masl	High mountains west of the inundation area	Fairly common
Common Mole-rat	<i>Cryptomys hottentotus</i>	LC	Widespread	Wide variety of habitat types	Inundation area, high mountains to the west	Fairly common
Rock Hyrax	<i>Procavia capensis</i>	LC	Widespread	Cliffs and large dolerite outcrops	Seven sites in inundation area	Fairly common
Scrub Hare	<i>Lepus saxatilis</i>	LC	Widespread	Wide variety of habitat types	Inundation area, high mountains to the west	Fairly common
Rock rabbit sp.	<i>Pronolagus sp.</i>	LC	Endemic to SA, Lesotho and Swaziland	Rocky outcrops in grassland	High mountains west of the inundation area	Uncommon
Sclater's Golden Mole	<i>Chlorotalpa sclateri</i>	LC	Drakensberg near-endemic	High altitude shrubland and grassland above 2500 masl	High mountains west of the inundation area	Fairly common
Cape Clawless Otter	<i>Aonyx capensis</i>	NT	Widespread	Rivers, streams	Senqu River (inundation area)	Scarce
Water Mongoose	<i>Atilax paludinosus</i>	LC	Widespread	Rivers, streams	Senqu River (inundation area)	Scarce
Black-backed Jackal	<i>Canis mesomelas</i>	LC	Widespread	Wide variety of habitat types	High mountains west of the inundation area	Scarce
Mountain Reedbuck	<i>Redunca fulvorufula</i>	LC	Widespread	Montane grassland	High mountains outside of the inundation area	Scarce
Grey Rhebok	<i>Pelea capreolus</i>	NT	Endemic to SA, Lesotho and Swaziland	High altitude shrubland and grassland above 2500 masl	High mountains west of the inundation area	Scarce

### 4.3.4 Species of Conservation Importance

#### 4.3.4.1 Threatened and Near Threatened Species

One Near Threatened mammal species was recorded in the Project Area by CES (2014b), namely African Clawless Otter, and one Near Threatened species was recorded in the high mountains to the west of the inundation area during this study, namely Grey Rhebok. However, Grey Rhebok is unlikely to occur within the inundation area or the adjacent lower-lying hills.

Two Vulnerable mammal species potentially occur within the vicinity of the Project Area, namely White-tailed Rat (*Myodomys 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). The only suitable grassland habitat for this species was located in the Sheep Stud property and it is improbable that it occurs within the degraded grassland and seeps within the inundation area. However, increased pressures for grazing in the Phutha Sheep Stud may threaten grassland condition that may provide habitat for this species. 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 it utilises crevices in rock faces, as do other *Laephotis* species. Such habitat is plentiful within the inundation area especially the cliffs along the Senqu and Khubelu Rivers.

One Near Threatened species, the Grassland Vlei Rat (*Otomys auratus*), potentially occurs in grassland and seeps in the Project Area. 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. The best potential habitat for Grassland Vlei Rat is within the Phutha Sheep Stud property. It has a lower likelihood of occurrence in the degraded grassland and seeps in the inundation area. Du Plessis *et al.* (2014) recorded *O. auratus* at three sites in the nearby Katse catchment area.

Branch summarised the conservation status and habitats of bats in the Lesotho Highlands in CES (2014b), listing five Near Threatened and one Vulnerable 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, which is dealt with above.

#### 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 usually above 2600 masl (Taylor 2016). Mokotjomela *et al.* (2010) noted that populations of Sloggett's Rat are not currently under threat. Individuals of this species were seen at high altitude well away from the inundation area during this study (R. Palmer *pers.comm.*) and by CES (2014b), but it is unlikely to occur below 2500 masl in the Project Area.

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 a golden mole species (most likely to be Sclater's Golden Mole) were located at numerous sites in the higher mountains to the west of the inundation area during February 2017 fieldwork, but were not recorded anywhere within close vicinity of the inundation area where it is unlikely to be present (Figure 4.10).

#### 4.3.4.3 Protected Species

Very few fauna species are specifically protected under Lesotho legislation, although the Historical Monuments, Relics, Fauna and Flora Act (Act No. 41 of 1967) lists the following groups of mammals that are protected in Lesotho: All antelope species; all Baboons and Monkeys; Bushpig and Warthog; Antbear, Pangolin and Honey Badger; Porcupine and Hedgehog; Springhare, and Otters and Mongooses.

Of these groups, two species were confirmed to occur within the inundation area, namely African Clawless Otter and Water Mongoose, and two species were confirmed to occur in the high mountains adjacent to the Project Area during this study (Grey Rhebok) and by CES (2014b) (Mountain Reedbuck).

Mammals of conservation importance are summarised in Table 4.5.

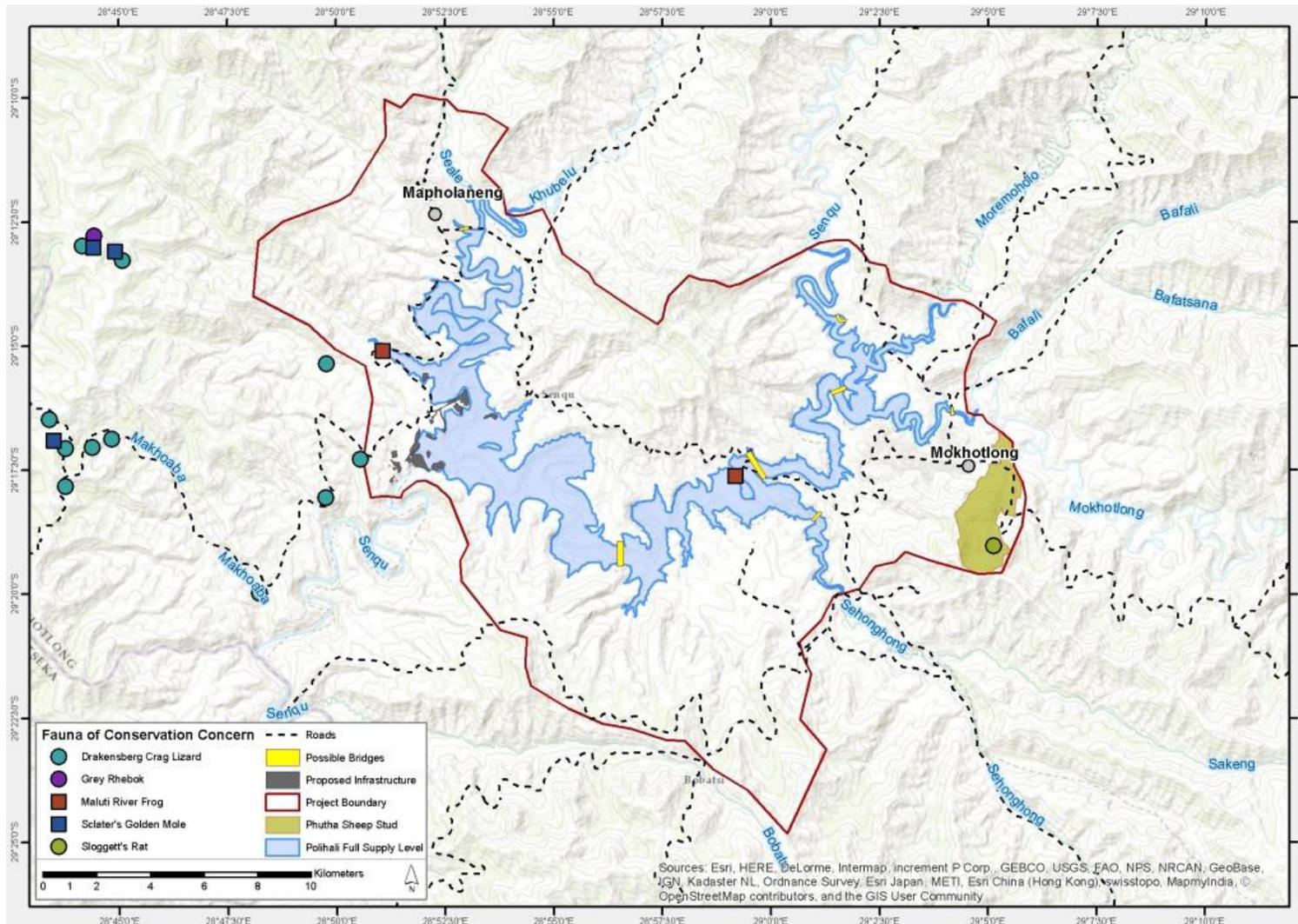
**Table 4.5. Mammal Species of Conservation Importance**

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	High mountains west of the inundation area	Fairly common
Sclater's Golden Mole	<i>Chlorotalpa sclateri</i>	LC	Drakensberg near-endemic	High altitude shrubland and grassland above 2500 masl	High mountains west of the inundation area	Fairly common
Cape Clawless Otter	<i>Aonyx capensis</i>	NT	Widespread	Rivers, streams	Senqu River (inundation area)	Scarce
Grey Rhebok	<i>Pelea capreolus</i>	NT	Endemic to SA, Lesotho and Swaziland	High altitude shrubland and grassland above 2500 masl	High mountains west of the inundation area	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 within the reservoir area and proposed infrastructure areas has been seriously impacted by overgrazing and grass cover is sparse in many areas.

Figure 4.12 Location of Conservation Important Fauna in the Project Area



## 4.4 Herpetofauna

### 4.4.1 Global and Regional Context

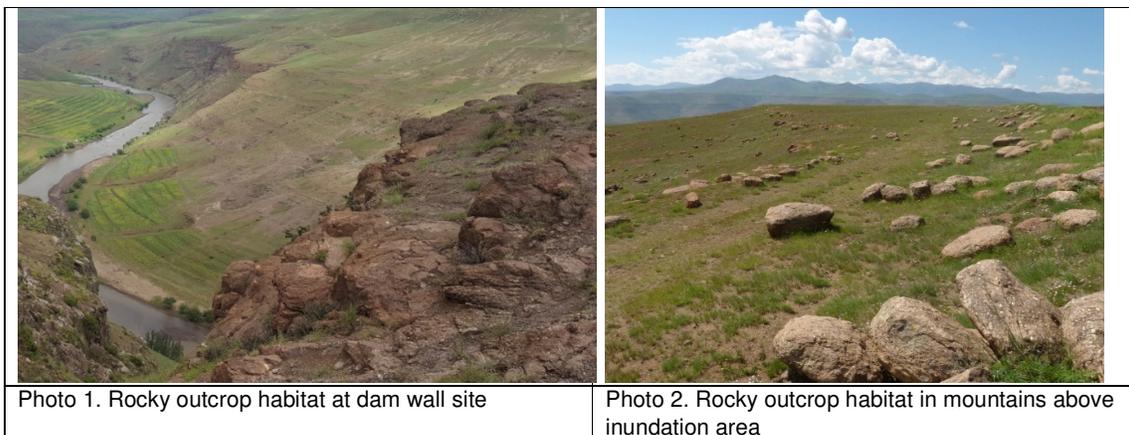
The Drakensberg Montane Grassland, Woodland, and Forest ecoregion described in section 4.2.1 is home to five endemic frog species, three of which occur in fast-flowing streams at high altitudes in Lesotho, namely Maluti River Frog (*Amietia vertebralis*), Phofung River Frog (*Amietia hymenopus*) and 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.

### 4.4.2 Herpetofaunal Habitats

The three broad herpetofaunal habitats in the Project Area are described in section 4.3.2 and examples are shown in Figure 4.13. Within these are the following important microhabitats for herpetofauna:

- Cliffs and rocky outcrops – this is the most important microhabitat for reptiles in the Project Area, and three lizard species were confined large 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 the 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 4.13 Representative Habitat Types for Fauna**



	
<p>Photo 3. Degraded seep habitat above Khubelu River in the inundation area</p>	<p>Photo 4. Natural seep habitat in the Phutha Sheep Stud</p>
	
<p>Photo 5. Perennial river habitat along Khubelu River</p>	<p>Photo 6. Seasonal stream habitat just above Senqu River in the inundation area</p>

Source: W McClelland 2017

### 4.4.3 Herpetofauna Species Diversity

#### 4.4.3.1 Reptiles

Even though the reptile fauna of Lesotho is poorly known, it is clear that diversity is low, particularly in the Lesotho Highlands. Ambrose (2006) lists 45 reptiles for Lesotho, of which one species is now considered extinct: Southern African Python (*Python natalensis*). This represents less than eight percent 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 Project Area during fieldwork. Reptiles confirmed to occur during this study increase this total to nine reptile species in the Project Area, or 64 percent of the species known to occur in the Lesotho Highlands (Table 4.6). Studies in the nearby Katse River catchment recorded 11 reptile species (Harvey, 2014).

As with CES (2014b), the most frequently encountered reptiles in the Project Area were lizard species, particularly Southern Rock Agama and Burchell's Sand Lizard (*Pedioplanis burchellii*) within the inundation area. Speckled Mountain Skink was found within the inundation area, but was more frequently encountered at higher altitudes, while Drakensberg Crag Lizard was not recorded below 2200 masl and was the most common lizard species above 2600 masl to the west of the Project Area. 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 in surveys during February 2017. CES (2014b) caught a single snake species (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 during this study, namely Common Slugeater (*Duberria lutrix*).

Photos of selected reptile species found during fieldwork are displayed in Figure 4.14.

#### 4.4.3.2 Amphibians

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 (CES, 2014b) 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*). All three of these were recorded by Harvey (2014) in the nearby Katse catchment.

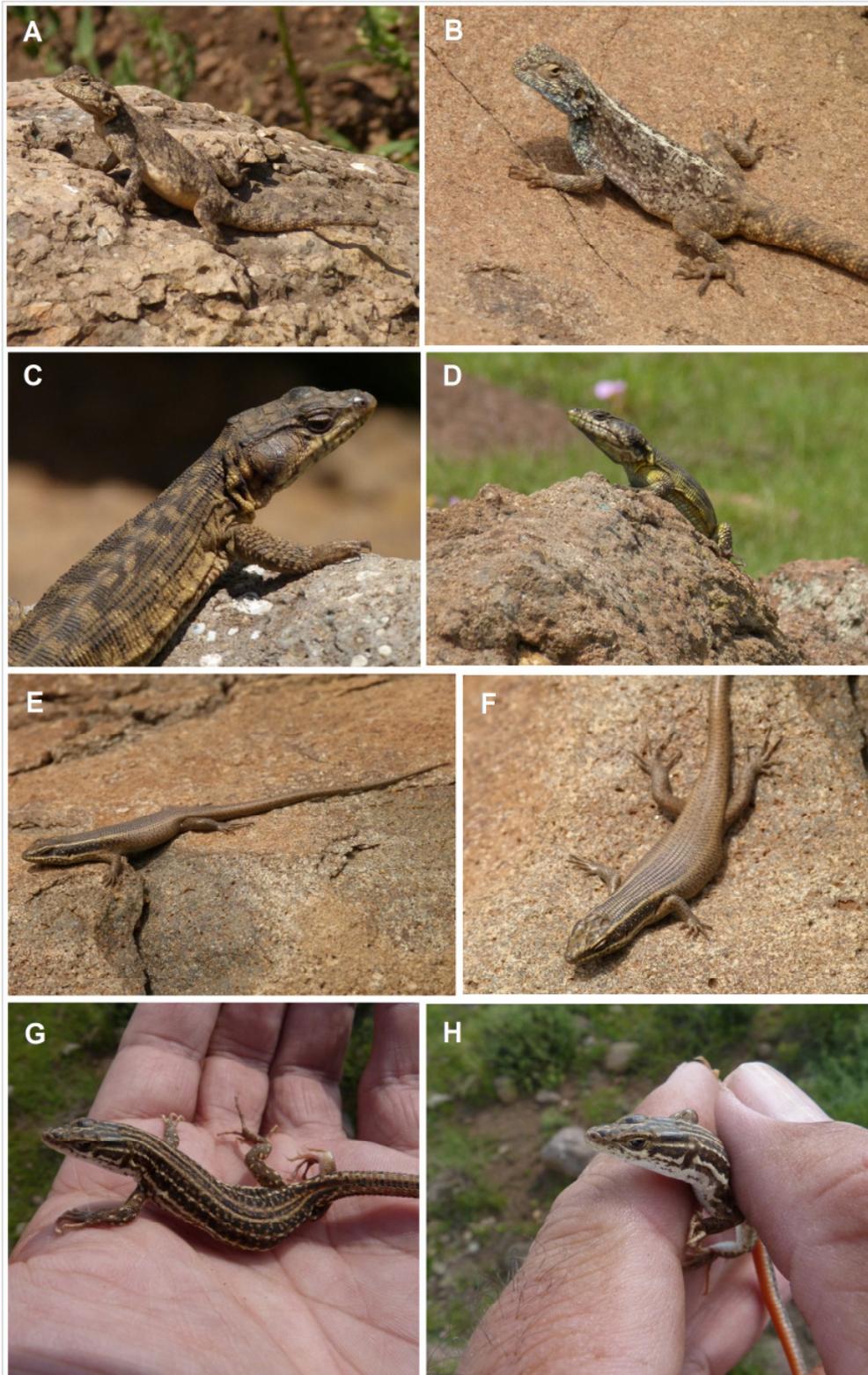
Five amphibian species were recorded in the inundation zone and one species in a high-altitude seep by CES (2014b), four of which were confirmed to occur during this study, representing 75 percent of the species known to occur in Mokhotlong District (Table 4.6). River frogs of the *Amietia queketti-poyntoni* complex were the most frequently encountered species in riverine habitat within the inundation area, occurring in perennial rivers and seasonal streams, while the Maluti River Frog was caught at several sites in the Senqu and Khubelu Rivers. The Cloud Toad (*Vandijkophrynus gariensis nubicolus*) and Clicking Stream Frog are not confined to riparian systems and were found far from water on occasion. The Raucous Toad recorded by CES (2014b) represents the first record for the Mokhotlong District, but was recorded in the nearby Katse catchment by Harvey (2014).

**Table 4.6 Reptiles and Amphibians Confirmed to Occur in the Project Area**

Common Name	Scientific Name	IUCN Status	Endemic status	Habitat Type	Area recorded	Abundance
<b>Reptiles</b>						
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 in the Project Area	Numerous localities above the inundation area to the south-east of Mokhotlong and west of the Project Area (this study)	Common at preferred altitude of above 2600 masl
Southern Rock Agama	<i>Agama atra</i>	LC	Not endemic	Rocky outcrops and scree slopes in grassland and shrubland; wide range of altitudes	Numerous localities within and above the inundation area (this study)	Possibly the most common lizard species in the inundation area
Cape Skink	<i>Trachylepis capensis</i>	LC	Not endemic	Dolerite outcrops in grassland	Recorded by CES (2014b) at one site within the inundation area and one site at higher altitudes	Uncommon, probably overlooked.

Common Name	Scientific Name	IUCN Status	Endemic status	Habitat Type	Area recorded	Abundance
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 within the inundation area, but mostly at higher altitudes (this study)	Uncommon in the inundation area but 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 within and above the inundation area (this study)	Common within and above the inundation area
Puff Adder	<i>Bitis arietans</i>	LC	Not endemic	Wide range of habitat types	Reported by local residents during the CES (2014b) study	Scarce
Common Slug-eater	<i>Duberria lutrix</i>	LC	Not endemic	Wide range of habitat types	One locality south-east of Mokhotlong just above the FSL	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 during the CES (2014b) study	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 (CES, 2014b)	Scarce
<b>Amphibians</b>						
River frog	<i>Amietia delalandii</i> - <i>poyntonii</i> complex	LC	Not endemic	Prefers vegetated rivers and streams, usually relatively close to water	Recorded throughout the inundation area and at higher altitudes (this study and CES (2014b))	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 inundation area, along Senqu and Khubelu Rivers (this study)	Fairly common
Clicking Stream Frog	<i>Strongylopus grayii</i>	LC	Not endemic	Wetlands in a wide variety of vegetation types	Found at two sites in mountains above inundation area (this study)	Uncommon, probably overlooked.
Cloud Toad	<i>Vandijkophrynus gariensis</i> <i>nubicolus</i>	LC	Drakensberg near-endemic	Short, open grassland in stony areas, sometimes near wetlands	Numerous localities within and above the inundation area (CES, 2014b)	Common
Raucous Toad	<i>Amietophrynus rangeri</i>	LC	Not endemic	Wide variety of aquatic habitats	Two sites within the inundation area (CES, 2014b)	Probably fairly common
Common Platanna	<i>Xenopus laevis</i>	LC	Not endemic	Wide variety of aquatic habitats	Several sites within the inundation area (CES, 2014b)	Fairly common

Figure 4.14 Photos of Selected Reptile Species Recorded in the Project Area



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

Source: W. McClelland, 2017

#### 4.4.4 Species of Conservation Importance

Conservation status of herpetofauna are summarised in Table 4.6. Main points of relevance to the status of threatened and endemic/near-endemic species are summarised here.

##### 4.4.4.1 Threatened and Near Threatened Species

- No threatened or Near Threatened reptile or amphibian species were recorded by CES (2014b) or during this survey and none are likely to occur within the inundation area.
- Neither of the two Near Threatened reptiles known to occur at high altitudes along Lesotho / KwaZulu-Natal border, namely Cottrell's Mountain Lizard and Lang's Crag Lizard, is likely to occur within the Project Area.
- One Data Deficient reptile species (the Cream-spotted Mountain Snake) also 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 and nearly endemic to Lesotho (occurring marginally into the Free State, KwaZulu-Natal and Eastern Cape provinces), namely Maluti River Frog and Phofung River Frog. The Maluti River Frog was confirmed to occur in the study area at a number of sites along the Senqu and Khubelu Rivers (Figure 4.12 above), but the Phofung River Frog is unlikely to be present because of the low altitude of the inundation area.
- Four reptile species (Cream-spotted Mountain Snake, Lang's Crag Lizard, Cottrell's Mountain Lizard and Essex's Mountain Lizard) are strictly endemic to the Drakensberg Mountains, where they are confined to the high-altitude eastern edge of the Drakensberg Mountains along the Lesotho / KwaZulu-Natal border, but are unlikely to be present at the lower altitudes in the inundation area.
- Near-endemic reptiles to the Drakensberg Mountains include the Drakensberg Crag Lizard, Drakensberg Flat Gecko and Spiny Crag Lizard, but only the Drakensberg Crag Lizard was confirmed at altitudes much higher than the inundation area (Figure 4.14).

##### 4.4.4.3 Protected Species

- None of the protected herpetofauna listed under the Historical Monuments, Relics, Fauna and Flora Act (Act No. 41 of 1967), which include monitor lizards (*Varanus* species) and chelonians (tortoises and terrapins), 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).

The greatest threat to herpetofauna in the Project Area is likely to be habitat loss or degradation, particularly degradation of grassland habitat through severe overgrazing. Even though a number of species occur within microhabitats within grassland, such as dolerite outcrops, the ecological and structural integrity of the surrounding habitat is critically important for providing a food supply and 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 below.

### 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 Project Area is cultivated fields, which occurs predominantly on footslopes, river valleys and lower-lying hill crests throughout the Project Area as well as the majority of grassland habitat. Much of the grassland has been severely overgrazed to the extent that ecological functionality has been compromised and species composition has been altered, and can be classified as Modified Habitat. Other examples of Modified Habitat include towns and rural villages, and the occasional plantations of alien trees. 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.

The main remaining portion of grassland that can be considered 'Natural Habitat' in the Project Area is that within the Phutha Sheep Stud, which due to reduced grazing pressure still exhibits a reasonably high diversity of plants and good biomass cover. Other near-natural habitats in the Project Area comprise cliffs and rocky outcrops, albeit typically surrounded by degraded grassland but which retain a natural diversity of plants due to inaccessibility to grazing livestock.

### 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, 2012a).

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

Extent of habitat types and status based on mapping undertaken by CES (2014) is summarised in Table 4.7. Of the approximate 37,486 ha in the Project Area, modified habitats occupy over 90 percent, mainly comprising degraded grassland (55%); agriculture (30%), plantation and settlement (6%) and river corridors (6%). Only cliff faces and rocky outcrops could be considered near-natural, albeit surrounded by generally degraded grassland and agriculture.

**Table 4.7 Summary of Habitat Status in the Project Area and Inundation Area from CES Mapping**

Habitat Type	Status	Extent (ha) Project Area	%	1:100 year flood level (2080 masl)	%
Grassland mosaic (with seeps/ wetlands)	Modified	20 806	55	2 953	53
Rocky outcrops	Near – natural	2258	6	514	9
Cliff faces	Near – natural	206	0.5	64.5	1.0
Riverine corridor	Modified	747	2	721	13
Agricultural	Modified	11 107	30	1 325	24
Plantation	Modified	21	<0.5	0	0
Settlement	Modified	2 283	6	27	0.5
	<b>Total</b>	<b>37 486</b>	<b>100</b>	<b>5 604</b>	<b>100</b>

Note: figures rounded up. The extent of agricultural fields and settlement are likely to be underestimated given the scale of the mapping and should be treated with caution. Estimates of the true extent of fields that will be inundated are expected to be quantified under the Resettlement Action Plan (RAP).



# Section 5 Impact Assessment

## 5.1 Advanced Works and Construction Phase

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

#### 5.1.1.1 Description of Impact

This impact will involve the clearance of vegetation and topsoil in order to prepare for the construction of infrastructure for camps and operational works areas, the infrastructure footprint and tunnel intake near Masokong (above the Khubelu River), and the construction footprint of the dam wall, saddle dam and nearby labour camps along the Senqu River. The area that will be impacted by site clearance in the infrastructure footprint will be approximately 123 ha, comprising degraded and heavily grazed grassland and rocky outcrops.

This will be a direct impact that will result in a loss of natural habitat and flora species in the impact footprint. The impact will also include the generation of dust by heavy vehicles such as bulldozers and other light vehicle traffic, and blasting. Excessive dust generation is likely to smother vegetation adjacent to access roads or construction sites, reducing capacity of plants to photosynthesise.

#### 5.1.1.2 Sensitivity of Receptors

The main vegetation type to be affected by this impact will be the widespread Rocky Outcrop / Grassland Mosaic that is prevalent throughout the Project Area, which includes scattered Degraded Seeps. This vegetation mosaic has been heavily overgrazed within the footprint of advanced works infrastructure and is in an ecologically degraded state with low to moderate biodiversity value. Two plant species of conservation concern occur within the impact footprint, namely *Jamesbrittenia lesutica* and *Dicoma anomala*, both of which have a national status of Vulnerable. 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 a higher density outside of the inundation area and infrastructure footprint, but scattered plants were found within the impact footprint, particularly on steep rocky slopes.

Within the Rocky Outcrop / Grassland 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 infrastructure footprint. However, the extent of the impact will be relatively small (limited to the 123 ha of infrastructure 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 terrestrial vegetation and flora is considered **Moderate**.

#### 5.1.1.4 Mitigation Measures

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

- An experienced field botanist should conduct a detailed inspection of the footprints of all advanced works infrastructure and identify any species of conservation importance that may need to be relocated to adjacent suitable habitat;

- Suitable relocation sites should be identified by the botanist outside of the area of potential disturbance, possibly including a botanical garden area similar to that at Katse Dam. Some plants could be relocated to a nursery area for use in landscaping of the permanent village, commercial centre and operation centre areas. Relocation of plants should be done under the supervision of the botanist and someone with horticultural experience, preferably in relocation of indigenous plant species. Plant relocation sites should be fenced-off to restrict access by livestock;
- Topsoil and vegetation removed for site clearance should be stored in an appropriate manner to prevent loss by wind or erosion and used in habitat restoration and landscaping.

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

Impact of Site Clearance for Advanced Works (Camps, Offices, Lodge, laydown) on Vegetation and Flora				
Project Phase:	Advanced Works Phase			
	Grassland		Rocky Ridges and Cliffs	
	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>

#### 5.1.1.5 Residual Impact

Implementation of the measures listed in Section 5.1.1.4 is predicted to result in a residual impact significance of **Minor**.

## 5.1.2 Impact of Site Clearance on Plants Used by Communities

### 5.1.2.1 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 ~123 ha on the east side of the future Polihali Reservoir. This will be a direct impact that will result in a loss of plant resources utilised by surrounding communities.

### 5.1.2.2 Sensitivity of Receptors

Most of the plant species utilised by surrounding communities for food, medicinal or spiritual purposes are located within the widespread Rocky Outcrop / Grassland Mosaic that is prevalent throughout the Project Area. While this vegetation mosaic has been heavily overgrazed within the infrastructure footprint and has moderate to low biodiversity value, a number of useful plant species were located within the general vicinity of the infrastructure footprints during fieldwork (as described in Section 4.2.4). These include widespread species used for medicinal purposes, such as *Dicoma anomala*, *Asclepias gibba*, *Cheilanthes eckloniana*, *Haemanthus humilis* and *Gazania krebsiana*, species 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*.

### 5.1.2.3 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 relatively 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**.

### 5.1.2.4 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 allowed and encouraged to harvest plant resources within the impact footprint prior to site clearance;
- Local communities should be aided with technical and material support to start plant nurseries to propagate and grow useful plant resources.

**Table 5.2 Impact of Site Clearance on Plants Used by Surrounding Communities**

Impact of Site Clearance for Advanced Works (Camps, Offices, Lodge, laydown) on Useful Natural Plant Resources in Infrastructure Zone				
Project Phase:	Advanced Works Phase			
	Grassland		Rocky Ridges and Cliffs	
	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>

### 5.1.2.5 Residual Impact

Implementation of the measures described in Section 5.1.2.4 is predicted to reduce the impact significance to **Minor**.

## 5.1.3 Impact of Site Clearance on Mammals and Herpetofauna

### 5.1.3.1 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 ~123 ha and blasting of rocky areas to level the ground for infrastructure development on the plateau areas located on the east side of the future Polihali Reservoir. This will be a direct impact that will result in disturbance of fauna and loss of faunal habitats.

### 5.1.3.2 Sensitivity of Receptors

The main vegetation type to be affected by this impact will be the widespread Rocky Outcrop / Grassland Mosaic that is prevalent throughout the Project Area, which includes two main faunal habitats, namely natural grassland, rocky outcrops and cliffs. 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. Mammal and herpetofauna (reptiles and amphibians) species and abundance are low and no conservation priority species were recorded in the infrastructure footprint. While faunal habitats in the advanced infrastructure area are considered to have low biodiversity value, overall they are considered to have *Medium* sensitivity to site clearance.

### 5.1.3.3 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 ecologically degraded, resulting in an impact magnitude of *Medium*. Prior to the implementation of any mitigation measures, the significance of this impact on mammals and herpetofauna will be **Moderate**.

### 5.1.3.4 Mitigation Measures

The following measures are recommended as mitigation for the impact of site clearance 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 the designated snake-handler to remove and relocate any individuals encountered.

**Table 5.3 Impact of Site Clearance on Mammals and Herpetofauna**

Impact of Site Clearance for Advanced Works Infrastructure on Mammal and Herpetofaunal Assemblages				
Project Phase:	Advanced Works Phase			
	Grassland		Rocky Ridges and Cliffs	
	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 mitigation measures described in Section 5.1.3.4 is predicted to result in a reduction of impact significance to **Minor** in all habitats.

## 5.1.4 Impact of Blasting on Mammals and Herpetofauna

### 5.1.4.1 Description of Impact

Blasting will be required to prepare the advance infrastructure footprint for construction over a six-month period (scheduled for early 2018) and for tunnel intake and dam construction over an approximate two-year period commencing in 2019/2020. This will have a direct impact on mammal and herpetofauna through direct disturbance (noise and vibration); loss of habitat, particularly rocky outcrop / cliff habitat, as well as faunal mortalities as a result of blasting. Blasting 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

Most mammal and herpetofauna in the Project Area are common and widespread species with no priority species found to occur in the infrastructure footprint area. None of the mammal or herpetofauna species present in the Project Area is 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 blast zones. Mammals such as Water Mongoose

or African Clawless Otter could occur intermittently near the tunnel intake or dam wall but with low likelihood, and will likely be displaced from the area. Due to the prevailing ecologically degraded state of the grassland and rocky habitats and low faunal diversity and abundance, habitats within the infrastructure area are considered to have low-moderate biodiversity value. Rocky habitats have a higher biodiversity value as crevices and rocks are a refuge zone for reptiles in particular.

Faunal habitats most vulnerable to blasting impacts are grassland on crests or terraces, which is heavily targeted by grazing livestock. Overall, grassland habitats and rocky ridges and cliffs are considered to have *Medium* sensitivity to blasting.

#### 5.1.4.3 Assessment of Impact

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 site preparation over a six-month period. Blasting for dam and tunnel construction will be of high intensity in three areas (tunnel intake on the lower Khubelu River) and construction of the main dam and saddle dam walls) and will extend over a longer period (2-3 years). Since the impacted faunal habitats are already impoverished and exhibit low species abundance and diversity due to habitat degradation through cultivation, settlement, overgrazing and hunting pressures, the impact magnitude is considered *Small*. Given the medium sensitivity of the faunal the significance of this impact on mammals and herpetofauna is likely to be **Minor**.

#### 5.1.4.4 Mitigation Measures

No suitable mitigation measures are recommended for the impact of blasting on small mammal and herpetofaunal assemblages. The significance of the impact will thus remain **Minor**.

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

Impact of Blasting for Advanced Works (Infrastructure Establishment) and Construction Phase (Tunnel intake and Dam) on Mammals and Herpetofauna				
Project Phase:	Advanced Works and Construction Phase			
	Grassland		Rocky Ridges and Cliffs	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct		Direct	
Magnitude	Small	Small	Small	Small
Sensitivity	Medium	Medium	Medium	Medium
Significance	<b>Minor</b>	<b>Minor</b>	<b>Minor</b>	<b>Minor</b>

#### 5.1.4.5 Residual Impact

No suitable measures can be recommended as mitigation for the impact of blasting on small mammal and herpetofaunal assemblages. The significance of the impact will thus remain **Minor**.

## 5.1.5 Impact of Inundation on Vegetation and Flora

### 5.1.5.1 Description of Impact

The inundation of the Polihali Reservoir will result in approximately 5600 ha of habitat being flooded (as per estimates in Table 4.7). This will be a direct impact that will result in a loss of an estimated 2952 ha of grassland and 514 ha of rocky habitat and flora species in the inundation zone. Agriculture and settlement comprises ~1351 ha or 24 percent of the inundation area.

### 5.1.5.2 Sensitivity of Receptors

The main vegetation type to be inundated will be the widespread Rocky Outcrop / Grassland Mosaic that is prevalent throughout the Project Area. This vegetation mosaic has been heavily overgrazed or transformed for agriculture and settlement within the footprint of the reservoir, and is in an ecologically degraded state with low to moderate biodiversity value. Riparian vegetation along rivers and streams will also be inundated.

Two plant species of conservation concern occurring within the reservoir area will be inundated; namely *Jamesbrittenia lesutica* (Vulnerable) and *Aristaloe aristata* (Near Threatened). Both species also occur outside of the inundation area and are reasonably widespread, usually occurring in the vicinity of rocky outcrops or rock-covered slopes. *Eucomis autumnalis* (Vulnerable) is potentially present but was not confirmed within the inundation zone. *Dicoma anomala* is fairly common on the higher slopes within the inundation zone; and is currently classified as Vulnerable within Lesotho, but its status has been incorrectly assessed and is a widespread and common species that should not be considered to be of conservation concern.

While all habitats within the Rocky Outcrop / Grassland Mosaic will be inundated, certain habitats are considered more sensitive than others based on their biodiversity or ecological values. Grassland and rocky habitats in the reservoir are of *Medium* sensitivity to inundation due to the presence of two species of conservation concern, while the few degraded seeps in the inundation area are of *Low* sensitivity.

### 5.1.5.3 Assessment of Impact

The impact of inundation on vegetation and flora will be permanent and will have a high intensity due to the complete loss of habitats, and the extent of the impact will be large (~5600 ha), resulting in an overall impact magnitude rated as *Medium*. Given the *Medium* sensitivity of the grassland and rocky habitats that will be inundated, the significance of this impact (pre-mitigation) on terrestrial vegetation and flora is considered to be **Moderate**, while that for degraded wetland seeps is **Minor**.

### 5.1.5.4 Mitigation Measures

The following measures are recommended as mitigation for the impact of inundation on vegetation and flora:

- An experienced field botanist should conduct a detailed inspection of potential microhabitats for key conservation-important plant species within the inundation zone and identify any important populations that could and should be rescued and relocated;
- A botanical garden should be planned and established near the dam infrastructure zone (similar to that for Katse Dam) as a refuge for the relocation of conservation priority and other representative indigenous plant species, including useful medicinal plants. A suitable area representing a range of representative micro-habitats should be identified by a botanist. Such area should be fenced and excluded from grazing. Development of such garden should consider lessons learned from Katse botanical garden.
- The process of relocating plants to adjacent sites should be under the supervision of the botanist and someone with horticultural experience, and preferably in relocation and replanting of indigenous plant species.

**Table 5.5 Impact of Inundation on Vegetation and Flora**

Impact of Inundation on Vegetation and Flora						
Project Phase:	Construction / Inundation Phase					
	Grassland		Rocky Ridges and Cliffs		Wetland seeps	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct		Direct		Direct	
Magnitude	Medium	Small	Medium	Small	Medium	Small
Sensitivity	Medium	Medium	Medium	Medium	Low	Low
Significance	Moderate	Minor	Moderate	Minor	Minor	Negligible

#### 5.1.5.5 Residual Impact

Implementation of the mitigation measures described in 5.1.5.4 is predicted to reduce the impact significance to **Minor** for grassland and rocky area vegetation and **Negligible** for degraded wetland seeps.

### 5.1.6 Impact of Inundation on Useful Plant Resources

#### 5.1.6.1 Description of Impact

The inundation of the Polihali Reservoir will result in the flooding of approximately 5600 ha of habitat. This will be a direct impact that will result in a loss of grassland, rocky outcrop and seep habitats containing important plant resources that are utilised by surrounding communities. In addition, inundation will flood several villages, several of which are expected to have spiral aloes planted around homesteads that are assessed as critically endangered in the wild.

#### 5.1.6.2 Sensitivity of Receptors

Most of the plant species utilised by surrounding communities are located within the widespread Rocky Outcrop / Grassland Mosaic that is the dominant vegetation type within the inundation zone. This vegetation mosaic has been heavily overgrazed and has moderate to low biodiversity (Section 4.2.4). These include widespread species used for medicinal and other purposes, such as *Dicoma anomala*, *Asclepias gibba*, *Cheilanthes eckloniana*, *Haemanthus humilis* and *Gazania krebsiana*, species 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*. In addition, inundation will flood several villages which include individuals of spiral aloe (*Aloe polyphylla*) - assessed as critically endangered in Lesotho - that are frequently planted outside homesteads for cultural/spiritual and aesthetic purposes.

Due to the presence of culturally important plant species, the grassland and rocky habitats are considered to be of *Medium* sensitivity.

#### 5.1.6.3 Assessment of Impact

The impact of inundation on important plant resources will be permanent and of high intensity, and the extent of the impact is large due to the size of the reservoir (5600 ha). Although the majority of the species used appear to be reasonably common and widespread in the wild, community members are highly dependent on plant species for food, fuel and medicinal uses. The presence of the reservoir may increase pressure on available plant resources and may require community members to travel further to collect such useful plants. Flooding of planted spiral aloes located around homesteads in inundated villages will have direct impacts on this species and may lead to an increase in harvesting of specimens in wild colonies to replace those flooded. The number of spiral aloes that may be affected has not been quantified but several were seen in villages that will be affected by flooding, such as Tloha-Re-Bue. The impact magnitude is assessed as *Medium* for

useful plants in grassland and rocky habitats and *Large* for spiral aloes inundated in villages (subject to quantification). The pre-mitigation significance of the inundation impact on useful plant resources is assessed as **Moderate** for widespread species and **Major** for spiral aloes planted in villages.

#### 5.1.6.4 Mitigation Measures

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

- Populations of plants considered to be important to local communities should be identified within the inundation zone through discussions with traditional medicinal practitioners, followed by fieldwork to locate these populations;
- Local traditional medicine practitioners should be encouraged to harvest plant resources from these key sites prior to inundation and support (and resources) provided to establish medicinal plant nurseries around the reservoir;
- Local communities should be given support to harvest and stockpile firewood and other plant resources from the entire inundation zone prior to inundation; and
- A census of spiral aloes located in villages that will be inundated should be undertaken to quantify the number of aloes that will be affected. Homesteads that will be relocated should be supported to translocate their spiral aloes to new resettlement areas as part of the Resettlement Action Plan (RAP). Any spiral aloes that homestead owners do not wish to relocate should be relocated into a botanical garden to be established near the Polihali Dam area.

**Table 5.6 Impact of Inundation on Useful Plant Resources**

Impact of Inundation on Useful Plant Resources						
Project Phase:	Construction / Inundation Phase					
	Grasslands including seeps		Rocky Ridges and Cliffs		Spiral aloes (in villages)	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct		Direct		Direct	
Magnitude	Medium	Small	Medium	Small	Medium	Small
Sensitivity	Medium	Medium	Medium	Medium	High	High
Significance	<b>Moderate</b>	<b>Minor</b>	<b>Moderate</b>	<b>Minor</b>	<b>Major*</b>	<b>Moderate*</b>

\* pending confirmation through census of aloes

#### 5.1.6.5 Residual Impact

Implementation of all measures described in Section 5.1.6.4 could result in a reduction of impact significance to **Minor** for widespread useful plants, and **Moderate** for spiral aloes (subject to quantification and confirmation of potential relocation).

## 5.1.7 Impact of Inundation on Mammals and Herpetofauna

### 5.1.7.1 Description of Impact

The inundation of the Polihali Reservoir will result in the loss of ~5600 ha of habitat for mammal and herpetofaunal assemblages, comprising natural grassland, rocky outcrops / cliffs, degraded seeps and riparian vegetation. This will be a direct impact comprising loss of habitat and mortalities of

fauna that are not able to escape the inundation zone prior to inundation. Inundation is estimated to take in the order of 28 months depending on catchment rainfall and flow releases.

#### 5.1.7.2 Sensitivity of Receptors

The main vegetation type to be affected by this impact will be the widespread Rocky Outcrop / Grassland Mosaic that is prevalent throughout the inundation zone, which includes three main faunal habitats, namely natural grassland, rocky outcrops / cliffs and degraded seeps. The Rocky Outcrop / Grassland vegetation has been heavily overgrazed and is in an ecologically degraded state with moderate to low biodiversity value.

While all faunal habitats within the Rocky Outcrop / Grassland Mosaic will be inundated, certain habitats are more sensitive than others as a result of current land uses and human activities. All habitats, particularly grassland and degraded seeps exhibit a high degree of degradation from existing land use practices, while habitat that cannot be cultivated or grazed, such as rocky ridges and cliffs, are less vulnerable to such land use pressures.

Two faunal groups that are likely to be most impacted by inundation are those species living on cliffs along the Khubelu and Senqu Rivers, and fossorial (digging) reptiles (e.g. lizards) and rodents. The cliff-dwelling species are unlikely to find suitable nearby cliff habitat to escape to and the fossorial species will most likely drown when their subterranean habitat is flooded. However, no key species of conservation importance within these groups were recorded from the inundation zone, although species such as Sclater's Golden Mole have been recorded at higher altitudes in the Project Area.

One mammal species of conservation concern that is likely to be impacted during inundation is African Clawless Otter, which is classified as Near Threatened. However, this species is highly mobile and is expected to be able to escape the inundation zone although may be subject to hunting if seen trying to move to surrounding areas. Otters are known to feed regularly in man-made impoundments and it is possible that species may occur in portions of the inundation zone once the lake habitat has stabilised. One frog species of conservation concern, the Maluti River Frog, was confirmed to occur within the inundation zone along the Senqu River. This species is a habitat specialist along fast-flowing mountain rivers and streams and will lose its habitat during inundation. It is unlikely to recolonise the inundation zone once aquatic habitat has stabilised.

Based on the above, the overall sensitivity of the different faunal habitats is considered *Medium*.

#### 5.1.7.3 Assessment of Impact

The impact of inundation on mammal and herpetofauna assemblages will be permanent and will be of high intensity. Inundation will flood 5600 ha of habitat in the reservoir, including the loss of ~575 ha of rocky and cliff habitat; ~2963 ha of grassland mosaic, and 721 ha of riverine habitat. Given that these habitats are widespread in the Project Area and surrounding areas, the impact magnitude is assessed as *Medium*. Since the sensitivity of the faunal habitats is *Medium* for grassland and rocky habitats and *Low* for degraded seeps, the impact significance on mammals and herpetofauna is predicted to be **Moderate** for loss of grassland and rocky habitat and **Minor** for loss of seeps.

#### 5.1.7.4 Mitigation Measures

Mitigation for inundation impacts on fauna is limited and unlikely to have a notable benefit, apart from search and rescue of animals from islands that will form in the reservoir. Search and rescue of species such as lizards and snakes prior to inundation is likely to require intensive effort for limited benefit due to the scarcity and difficulty of catching these animals in rock cracks and crevices.

Consideration should, however, be given to installation of pit fall traps in focussed areas below villages around the reservoir where frogs, snakes and reptiles are more likely to occur (e.g. across drainage lines, rocky areas or near seep zones), and to move out of the inundation area as it fills.

This will also assist with minimising the risk of mortality of snakes from humans as they move out of the inundation zone potentially up into villages around the reservoir.

**Table 5.7 Impact of Inundation on Mammals and Herpetofauna**

Impact of Inundation on Mammals and Herpetofauna						
Project Phase:	Construction / Inundation Phase					
	Grassland		Rocky Ridges and Cliffs		Seeps	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Direct		Direct		Direct	
Magnitude	Medium	Medium	Medium	Medium	Medium	Medium
Sensitivity	Medium	Medium	Medium	Medium	Low	Low
Significance	<b>Moderate</b>	<b>Moderate</b>	<b>Moderate</b>	<b>Moderate</b>	<b>Minor</b>	<b>Minor</b>

#### 5.1.7.5 Residual Impact

No suitable measures can be recommended as mitigation for the impact of inundation on mammal and herpetofaunal assemblages. The significance of the impact is predicted to remain **Moderate** for grassland and rocky habitats and **Minor** for seeps.

## 5.2 Operation Phase

### 5.2.1 Impact of Altered Flows on Downstream Vegetation Communities and Flora

Altered flows within the Senqu River as a result of the Polihali Reservoir are likely to result in changes to downstream riparian vegetation communities. These are covered under the aquatic ecology specialist report (Palmer 2017; P2W-6014-DFR-0005). Altered flows are unlikely to impact the terrestrial systems dealt with in this report.

### 5.2.2 Impact of Increased Pressure on Natural Resources by Displaced Communities

#### 5.2.2.1 Description of Impact

The displacement of people and their livestock from the inundation zone of the Polihali Reservoir is likely to place additional pressure on natural resources on the slopes above the reservoir. The natural resources in these areas are already under severe pressure from overgrazing by livestock and hunting with dogs. This is an indirect / induced impact of unknown spatial extent. Monitoring results from Phase 1 dams (Anchor Consultants, 2014) demonstrated that land use and vegetation biomass showed more notable changes in close proximity to the dams than areas further away. This was assumed to be linked to increased human and livestock pressures as a result of displacement from the reservoir and increased human activity as a result of improved road access.

#### 5.2.2.2 Sensitivity of Receptors

The vegetation communities on the hillslopes and terraces above the inundation zone are the same vegetation communities represented within the Polihali Reservoir, although the ecological condition of the habitats appear to be in better ecological condition in places, probably as a result of rangeland management interventions and lower settlement pressures. These higher lying areas have a higher abundance of some conservation-important species such as *Jamesbrittenia lesutica*, and other conservation important species that are not confirmed to occur within the inundation

zone, such as *Eucomis autumnalis* and *Alepidea cordifolia*. The Phutha Sheep Stud which occupies ~690 ha is the most important tract of natural habitat remaining within the Project Area and may come under increasing pressure for grazing and possibly settlement. Taking into account the high vulnerability and low resilience of grassland in the Senqu valley to increased grazing and settlement pressures, the sensitivity of the Rocky Outcrop / Grassland Mosaic community and the Phutha Sheep Stud is rated as *High*.

### 5.2.2.3 Assessment of Impact

The impact of increased land use pressures on natural resources by displaced communities and their livestock will be long-term to permanent and is expected to be of high intensity. An estimated 18 villages occur in the Project Area of which 2500 households in 5 to 8 villages and an unknown number of livestock as well as extensive cropping (at minimum ~1325 ha) will be displaced from the reservoir area. The spatial extent of the impact is unknown but can be expected to occur within the entire Project Area, with incremental effects over time as resources diminish. Although the affected vegetation types in the areas around the inundation area are generally ecologically degraded with impoverished flora assemblages, important flora species still occur and the impact magnitude is assessed as *Medium*. However, the Phutha Sheep Stud is in a significantly better ecological state and the magnitude of this impact if settlement or increased grazing is allowed to occur in that area would be *Large*. Prior to the implementation of any mitigation measures, the significance of this impact on rangeland, flora and fauna, and useful plant resources will be **High** in the Phutha Sheep Stud and **Moderate** in other grassland/rocky habitats of the Project Area.

### 5.2.2.4 Mitigation Measures

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

- Increased protection status for the Phutha Sheep Stud - this should include the employment of staff to patrol the property and ensure that illegal grazing and hunting does not take place. The area should remain off-limits to settlement. Consideration should be given to proclaiming the area as a nature reserve with low impact ecotourism and accommodation facilities. Other recommendations in Section 7 relate to establishing and protection of a portion of the upper catchment as a form of offset to compensate for project impacts on biodiversity.
- 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 funded, either by LHDA or through external funding. Community members interested in horticulture of such plants should be trained and supported. Such nursery initiatives should be linked to recommendations for a botanical garden or other form of botanical safeguard area near Polihali to showcase the region's indigenous biodiversity and to raise awareness for school groups and other visitors.
- Integrated catchment management 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 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 5.8 Impact of Increased Pressure on Natural Resources by Displaced Communities**

Impact of Increased Pressure on Natural Resources by Displaced Communities				
Project Phase:	Operational Phase			
	Rocky Outcrop / Grassland Mosaic		Phutha Sheep Stud	
	Pre-Mitigation Impact	Residual Impact	Pre-Mitigation Impact	Residual Impact
Type of Impact	Indirect		Indirect	
Magnitude	Medium	Small	High	Negligible
Sensitivity	High	High	High	High
Significance	<b>Major</b>	<b>Moderate</b>	<b>Critical</b>	<b>Negligible</b>

**5.2.2.5 Residual Impact**

Implementation of the measures described in Section 5.2.2.4 is predicted to result in a reduction of impact significance in the Phutha Sheep Stud to **Negligible** and in other areas of grassland habitat to **Moderate**.

# Section 6 Mitigation and Monitoring

---

## 6.1 Mitigation

### 6.1.1 Advanced Works / Construction Phase

Table 6.1 sets out the mitigation measures required to be implemented to avoid and minimise expected impacts of the Polihali Dam 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 construction phase EMP that will be compiled under the ESIS, for implementation 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.

### 6.1.2 Operation Phase

Mitigation for biodiversity impacts during the operation phase relates largely to integrated catchment management approaches to enhancing rangeland condition. Recommendations for protecting portions of the catchment as a form of compensation measure (or partial offset) are proposed in Section 7.

## 6.2 Monitoring

### 6.2.1 Advanced Works / Construction Phase

No specific monitoring requirements for flora and fauna during the construction phase are deemed necessary.

Due to the degraded state of the Project Area, and lack of highly threatened species, terrestrial ecological aspects (flora, mammals and herpetofauna) of the PRAI Project Area are not considered to require long term monitoring, apart from perhaps the Maluti Frog. Monitoring should be focused on other biodiversity aspects of real concern such as cliff nesting birds, wetlands and rangelands (which are covered under different reports), and to focus efforts on a biodiversity offset (with attendant monitoring focussed in any offset areas, including for Maluti minnow (not affected by Phase II)).

However, some measures are specified under mitigation in Table 6.1 include monitoring of aspects such as snakes during inundation in order to minimise potential impacts on these biota (and to humans).

### 6.2.2 Operation Phase

Monitoring for vegetation and fauna post construction and inundation are specified in Table 6.2.

**Table 6.1 Mitigation Measures for Flora and Fauna**

Ref	Activity	Requirements / specifications	Responsibility	Scheduling / Timing/ Frequency	Phase	Performance Indicator(s)	Training Requirements
<b>1</b>	<b>Biodiversity Awareness and Training</b>						
	<b>Objective:</b>						
1.1	Develop induction and training and awareness materials for biodiversity and hold regular training sessions.	<p>Implement education and awareness training of construction staff on minimizing habitat disturbance and prohibition of collection / harvesting of natural resources (e.g. posters, toolbox talks, etc.). Specific measures include:</p> <ul style="list-style-type: none"> <li>• Design and put up posters representing biodiversity in the project area;</li> <li>• Develop biodiversity education and awareness material;</li> <li>• Hold regular tool box talks with staff informing them of the following restrictions: <ul style="list-style-type: none"> <li>• Prevention of fires;</li> <li>• Harvesting of plants and picking of flowers;</li> <li>• Alien invasive species;</li> <li>• Killing of snakes, lizards and other fauna.</li> </ul> </li> <li>• Instruct staff what to do and where to seek help if snakes or young or injured animals are encountered to ensure they can be live caught and released.</li> </ul>	Contractors	Ongoing	Prior to and throughout advanced works and construction phases	<ul style="list-style-type: none"> <li>• Induction and awareness materials prepared and approved prior to on-site construction activities;</li> <li>• Posters on biodiversity developed and put up in central locations e.g. labour camp central areas; contractor offices.</li> <li>• Induction materials set out restrictions on causing harm to biodiversity;</li> <li>• Tool box talks on general habitat and species protection provided at regular intervals;</li> <li>• All staff signed proof of attendance of induction and tool box talks.</li> <li>• Designated staff member assigned responsibility for safe removal and release of snakes.</li> </ul>	<p>All staff to undergo Induction.</p> <p>Regular tool box talks.</p> <p>Designated on-site snake handler trained to catch and release snakes and administer anti-venom (if required).</p>
<b>2</b>	<b>Vegetation, Flora and Fauna Habitats</b>						
	<b>Objective:</b> <i>minimise impacts of site clearance on vegetation and flora, and faunal habitats</i>						
2.1	Minimising impacts of site clearance on terrestrial habitats and flora and fauna	<ul style="list-style-type: none"> <li>• Develop a site layout and clearance plan that indicates the footprint of site clearance including topsoil stockpile zones;</li> <li>• Develop a method statement for topsoil storage that demonstrates measures to minimize soil loss through erosion and stockpile soil in such a way to minimize soil compaction;</li> <li>• Retain and reuse soils for reinstatement and rehabilitation of disturbed areas and temporary</li> </ul>	Contractors	Prior to and during site clearance		<ul style="list-style-type: none"> <li>• Spiral aloe census and relocation report.</li> </ul>	Contractor staff responsible for topsoil removal and stockpiling trained in aspects of appropriate stockpiling (height restrictions, locations, etc.).

Ref	Activity	Requirements / specifications	Responsibility	Scheduling / Timing/ Frequency	Phase	Performance Indicator(s)	Training Requirements
		construction sites.					
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 with herbicides prior to use; restricting relocation of materials from weed-infested areas, etc.;</li> <li>Stockpiling of topsoils confirmed to be free or with limited weeds;</li> <li>Use of herbicides to contain weeds;</li> <li>Sources and use of compost and mulch from weed-free suppliers;</li> <li>Monitoring and eradication of weeds during and post-site establishment;</li> <li>Reporting requirements for monitoring and eradication.</li> </ul> </li> <li>Implement alien invasive plant control measures.</li> </ul>	Contractor: EM and ECO.  Checks by LHDA.	Monthly monitoring checks during site establishment, construction and post construction of infrastructure	Prior to and during site clearance and construction	<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> <i>Objective: rescue spiral aloes in village areas inundated by the dam and implement a propagation and replanting programme</i>						
3.1	Spiral aloe census and relocation	<ul style="list-style-type: none"> <li>Conduct a census of spiral aloes that occur in villages within the FSL that require resettlement;</li> <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 botanical 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 community or new botanical garden at Polihali.</li> </ul>	LHDA: Botanist and RAP consultants.	Prior to resettlement and inundation		<ul style="list-style-type: none"> <li>Spiral aloe census report;</li> <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.
3.2	Spiral aloe propagation and replanting	<ul style="list-style-type: none"> <li>Implement a training programme to teach community members to propagate spiral aloes for replanting into wild colonies and for sale to tourists / visitors;</li> </ul>	LHDA: Botanist and RAP consultants.	Prior to resettlement and inundation		<ul style="list-style-type: none"> <li>Spiral aloe census report;</li> <li>Confirmation of spiral aloe relocation requirements;</li> <li>Spiral aloe relocation method</li> </ul>	Induction training by Client's EM for management staff on EA

Ref	Activity	Requirements / specifications	Responsibility	Scheduling / Timing/ Frequency	Phase	Performance Indicator(s)	Training Requirements
		<ul style="list-style-type: none"> <li>Obtain necessary authorization and permits for spiral aloe sale.</li> </ul>				statement; <ul style="list-style-type: none"> <li>Evidence of spiral aloe relocation.</li> </ul>	requirements.
<b>4</b>	<b>Plant Search and Rescue and Establishment of New Plant Safeguard Areas (e.g. botanical garden or community gardens at Polihali and/or Phutha Sheep Stud)</b> <b>Objective:</b> Recover priority plant species from inundation zone and relocate to a botanical garden to showcase and create awareness of Lesotho's biodiversity to visitors, and through propagation and sale to provide an opportunity to provide income to local residents.						
4.1	Search and rescue of priority plants – advanced infrastructure	<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 advanced infrastructure, tunnel inlet and dam wall 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 botanical garden (see 4.2);</li> <li>Collect seeds of suitable plants for landscaping and propagation in botanical garden;</li> <li>Replant rescued plants and seeds in accordance with landscaping plan;</li> <li>Landscaping shall prioritise use of indigenous naturally occurring plants and shall include a list of suitable plants.</li> </ul>	LHDA: botanist / horticulturalists 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>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.
4.2	Establish botanical garden or plant safeguard areas at Polihali / Mokhotlong	<ul style="list-style-type: none"> <li>Appoint qualified botanists/horticulturalists to plan the siting and layout of community nurseries and/or botanical garden or other safeguard sites;</li> <li>Confirm a suitable site near Polihali or Mokhotlong area with potential for creating micro-habitat diversity (e.g. wetland / seep zone, sheltered slopes preferably dominated by south-facing aspect and gentle gradients).</li> </ul>	LHDA: botanist / horticulturalists to be appointed	Plan during Advance Works phase and implement prior to inundation	Advanced Works to Construction and Inundation Phase	<ul style="list-style-type: none"> <li>Botanical garden layout and design plan prepared;</li> <li>Sufficient resources (staff, materials and funding) allocated for establishment and maintenance.</li> </ul>	Induction training by Client's EM for management staff on EA requirements.
<b>5</b>	<b>Protection of Phutha Sheep Stud</b> <b>Objective:</b> Protect sheep study as intact example of grassland and wetland habitats and as refuge for biodiversity.						
5.1	Protection of Phutha Sheep Stud	<ul style="list-style-type: none"> <li>Appoint range management officers to patrol and enforce grazing restrictions in Phutha Sheep Stud;</li> <li>Erect signage on entrance roads to and</li> </ul>	LHDA and Livestock Department, Range	Prior to site clearance	Preparation and during site clearance	<ul style="list-style-type: none"> <li>Range management officers appointed and trained;</li> <li>Signage erected;</li> <li>Establishment of tourism</li> </ul>	Range management officers trained in

Ref	Activity	Requirements / specifications	Responsibility	Scheduling / Timing/ Frequency	Phase	Performance Indicator(s)	Training Requirements
		<p>through the sheep stud to highlight its protection status and avoidance of fires, harvesting, grazing pressures;</p> <ul style="list-style-type: none"> <li>• Consider establishment of small ecotourism facility (e.g. 3-4 rondavels) to provide accommodation to visitors and create options for horse-riding;</li> <li>• Create trails and paths within the sheep stud for use by visitors;</li> <li>• Prioritise additional grazing restrictions in buffer area around the sheep stud and work with district stakeholders to consider increasing size of the sheep stud area with aim of designating it as a nature reserve.</li> </ul>	Management Division			facility with associated walking trails.	law enforcement.
5.2	Mokhotlong waste management site	<ul style="list-style-type: none"> <li>• Work with District officials in Waste Management departments to avoid creation of a new waste management site near Phutha Sheep Stud in order to minimize throughflow of traffic and risk of dumping and littering en route in the sheep stud;</li> <li>• Provide assistance to identify a suitable waste landfill site for Mokhotlong town.</li> </ul>	LHDA and Waste Management Authorities of Mokhotlong	Initiated during Advance Works Phase	Starting during site preparation phase	<ul style="list-style-type: none"> <li>• Waste management / landfill site located away from sheep stud.</li> </ul>	NA
<b>6</b>	<b>Snake awareness, monitoring, and relocation during inundation</b>						
	<i>Objective: Minimise risk of snake bite to local residents and optimise protection of snakes by translocating snakes during inundation.</i>						
6.1	Snake trapping and relocation during inundation	<ul style="list-style-type: none"> <li>• Confirm the potential and viability of installing pitfall traps and fence lines in strategic locations around the inundation area to entrap snakes that move out of the inundation area during reservoir filling;</li> <li>• If snake trapping deemed appropriate, appoint qualified herpetologist to plan the siting and layout of the pitfall traps and fencelines;</li> <li>• Continue pitfall trapping for snakes, lizards and other fauna during inundation and relocate caught specimens to suitable areas where they will not be persecuted by local residents.</li> </ul>	LHDA: herpetologist and support team to be appointed	Summer search and rescue efforts	Plan during Advance Works phase and implement prior to and during inundation	<ul style="list-style-type: none"> <li>• Documented proof of efforts made to verify the efficacy of Phase 1 search and rescue;</li> <li>• Search and rescue action plan or method statement compiled;</li> <li>• Search and rescue documented and verifying level of effort and success rates in terms of catch and release.</li> </ul>	Train snake-handlers for catch and release
6.1	Awareness raising of snakes and other herpetofauna	<ul style="list-style-type: none"> <li>• Create awareness of the types of snakes in the project area and the importance of snakes in the ecosystem (and in pest control) through</li> </ul>	LHDA: herpetologist to		Plan during Advance Works phase and	<ul style="list-style-type: none"> <li>• Evidence of posters compiled and erected in public places.</li> </ul>	

Ref	Activity	Requirements / specifications	Responsibility	Scheduling / Timing/ Frequency	Phase	Performance Indicator(s)	Training Requirements
		posters and leaflets to be erected and distributed in public locations, including schools.	be appointed		implement prior to and during inundation		
<b>7</b>	<b>Other faunal rescue during inundation</b>						
	<i>Objective: Optimise protection of fauna that may become flooded or stranded by rising waters during inundation.</i>						
7.1	Search and rescue of fauna on future islands in Polihali Reservoir	<ul style="list-style-type: none"> <li>Conduct faunal surveys on areas of the Polihali Basin that are expected to become islands during inundation to determine the faunal presence that may become stranded;</li> <li>Consider the viability of conducting search and rescue of faunal species on future island locations using active search and rescue and installation of pit fall traps and fence lines and small mammal live traps.</li> </ul>	LHDA: herpetologist and small mammals specialists, and support team to be appointed	Monthly surveys in summer months during inundation	Implement during inundation	<ul style="list-style-type: none"> <li>Reports on faunal surveys conducted and efficacy of search and rescue efforts.</li> </ul>	Training of local ecologists in search and rescue, catch and release techniques.

**Table 6.2 Post – Construction / Inundation 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	Vegetation condition	Provide an overall indication of vegetation cover and biomass and trajectory of change post inundation	<ul style="list-style-type: none"> <li>Remote sensing based analysis using Non-Differential Vegetation Index (NDVI), as per methods used on Phase 1 (GeoTerrimage 2014);</li> <li>Analysis should consider determination of extent of change at different distances from the reservoir taking into consideration settlement patterns, aspect and altitude gradients;</li> <li>Ground-truthing of selected sites around the dam based on a belt transect methodology should be conducted to verify remote sensing based results;</li> <li>Photographic record of fixed sites for visual record of vegetation condition;</li> <li>Ideally, in order to attribute the causes of any vegetation condition changes, data on livestock ownership/numbers, rainfall and settlement patterns also need to be gathered;</li> </ul> <p>Note: it is recommended this task is included within the Integrated Catchment Management Strategy.</p>	Every 5 years	Selected groundtruthing sites in the Polihali sub-basin at minimum, possibly expanded to select areas in entire upper catchment.	n/a	LHDA, in collaboration with Range Management Department, and others such as Livestock Department, Meteorology, and Human Settlement.	Summary report to be submitted to LHDA.
2	Plant survival in nurseries and botanical garden	Verify the survival rate of plants relocated from the dam basin 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	To be determined: survival rate of relocated and propagated plants.		Summary monthly report for LHDA.

No.	Aspect	Objectives	Method	Frequency and months	Sampling locations	Detection limit / Performance Target	Responsibility	Reporting
<b>Fauna (non-avian) Monitoring Requirements</b>								
1	Frog monitoring	Monitor the occurrence and survival of indicator frog species such as Maluti River Frog	<ul style="list-style-type: none"> <li>• Aquatic sampling using sweep netting, and acoustic recording at sites;</li> <li>• Surveys should link with fish monitoring requirements that use electrofishing to correlate data on frogs caught.</li> </ul>	Annually during filling and post inundation, reducing to every 5 years 2 years after inundation complete.	To be confirmed under Biodiversity Management Plan but expected to include: <ul style="list-style-type: none"> <li>• Along the edge of the dam</li> <li>• Sites immediately at FSL in upstream rivers and every 2-3 km upstream of this in the Khubelu, and Mokhotlong, Moremoholo Rivers.</li> </ul>	To be confirmed in Biodiversity Monitoring Plan (BMP). Measure population numbers and compare with CES data on previous distribution	LHDA	Summary report post surveys. Overall report.



## Section 7 Other Recommendations

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

### 1. Integrated catchment management

It is recognised that 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 catchment can be expected to increase grassland biomass and net flora and fauna biodiversity. The ICM strategy for Polihali is expected to address issues related to overall catchment condition with a view to reducing the rate of soil loss and dam sedimentation, and optimising rangeland condition to support the prevailing livestock-based economy. The ICM strategy should consider a combination of remote sensing derived land cover mapping and rangeland quality data to monitor changes in rangeland condition over time, similar to that undertaken for Phase 1 catchments.

### 2. Biodiversity Management Plan

The future BMP that will be developed for the LHWP Phase II catchment is expected to address the full range of measures specific to biodiversity protection and enhancement, and which will include search and rescue and other flora and fauna protection measures, some of which are recommended in Section 6.1. Such biodiversity conservation measures are separate from the rangeland improvement and soil conservation measures that will be covered under the ICM strategy. Determining the separation and overlaps will be a task for the next phase of work.

### 3. Protection of Upper Catchment Area

The higher lying portions of the Lesotho Highlands mountain zone above 2800 m (subalpine) 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 and had promoted the creation of a protected area at Senqu Sources. It later prioritised the Mokhotlong – Sanquebethu and Sani Top areas for enhanced protection (MDTP 2009). However, it appears that conservation of these areas have not progressed as yet and it is recommended that further attention be given to identifying conservation initiatives as part of a biodiversity offset initiative for Phase II.

In light of the extent of impacts under Phase I (Katse and Mohale) and those predicted under Phase II (Polihali), combined with the serious extent of biodiversity and rangeland degradation evident in the Polihali catchment, it is strongly recommended that a sizeable upper catchment area be identified and protected as a form of compensation for cumulative impacts of the LHWP dams. 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 dam and sets out an approach to identifying suitable areas in the wider catchment that could best protect this range of features in the long-term. Additional conservation actions focused on restoring or protecting specific features should be included as part of a broad package of biodiversity protection measures. Careful coordination between the scopes of work for the ICM strategy and the BMP will be required to avoid duplication and to achieve synergies.

Principles that should be considered 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;
- 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.

Identifying suitable protection areas will need to balance a range of factors (including willingness of Principle Chiefs to engage in initiatives) and should also consider opportunities for protecting biodiversity that may not be directly affected by Phase II but will meet the broader conservation objectives of Lesotho.

## Section 8 References

---

Ambrose, D P (1999) *Lesotho Annotated Bibliography*, Institute of Education (National University of Lesotho).

Ambrose, D (2006) Reptiles including annotated species checklist. In: *Lesotho Annotated Bibliography* Section 166. House 9 Publications, National University of Lesotho 3rd Edition, Roma, Lesotho.

Avenant (2007) Review of the Status of and Threats of Priority Mammals in the Lesotho Highlands. Unpublished report.

Barker, N, Forsythe, K, Clark, V R, Ramatla, S, Kheekhe, M, Dold, A, Kobisi, K, Norman, Y and Turpie, J K (2014) *Flora of the Katse Dam catchment*. Specialist report for Contract 1273: Biological Resources Monitoring within Phase 1 of the LHWP Catchments 2013-14. Report no. AEC/14/12 submitted by Anchor Environmental Consultants to the Lesotho Highlands Development Authority.

Bates, M F and Haacke, W O (2003) The frogs of Lesotho: Diversity and distribution. *Navors. nas. Mus.*, Bloemfontein 19(6): 101-158.

Bronner G N and Bennett N C (2016) *Chlorotalpa sclateri*. In: Child M F, Roxburgh L, Do Linh San E, Raimondo D, Davies-Mostert H T (eds) *The Red List of Mammals of South Africa, Swaziland and Lesotho*. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Carbutt, C and Edwards, T J (2004) The flora of the Drakensberg Alpine Centre. *Edinburgh Journal of Botany*. 60(3) 581-607.

Carbutt, C and Edwards, T J (2006) The endemic and near-endemic angiosperms of the Drakensberg Alpine Centre. *South African Journal of Botany*. 72 105-132.

CES (2014a) Final Report: Baseline Botanical Survey. Lesotho Highlands Polihali Dam Project. Coastal and Environmental Services, Grahamstown.

CES (2014b) Final Report: Terrestrial Fauna. Lesotho Highlands Polihali Dam Project. Coastal and Environmental Services, Grahamstown.

Child M F, Roxburgh L, Do Linh San E, Raimondo D, Davies-Mostert H T (eds) (2016) *The Red List of Mammals of South Africa, Swaziland and Lesotho*. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Coetzee, N and Monadjem, A (2008) *Mystromys albicaudatus*. The IUCN Red List of Threatened Species 2008: e.T14262A4428195. <http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T14262A4428195.en>. Downloaded on 13 March 2017.

Du Plessis, J, Avenant, N and Putsane, T (2014) *Mammals of the Katse Dam catchment*. Specialist report for Contract 1273: Biological Resources Monitoring within Phase 1 of the LHWP Catchments 2013-14. Report no. AEC/14/12 submitted by Anchor Environmental Consultants to the Lesotho Highlands Development Authority.

Harvey, J (2014) *Herpetofauna of the Katse Dam catchment*. Specialist report for Contract 1273: Biological Resources Monitoring within Phase 1 of the LHWP Catchments 2013-14. Report no. AEC/14/12 submitted by Anchor Environmental Consultants to the Lesotho Highlands Development Authority.

Hilliard, O M and Burt, B L (1987) *The botany of the Southern Natal Drakensberg*. 253 pp. National Botanic Gardens, Cape Town.

- Lynch, C D (1994) Mammals of Lesotho. *Mem.Nas.Mus.Bloemfontein* 10:177-241.
- MDTP, 2007. Spatial assessment of biodiversity priorities in the Lesotho Highlands. Technical report. Authors: J Hughes, G Benn, M Laros, Sept 2007.
- MDTP, 2009: Action Plan for Phase II (2008-2012) of the Maloti Drakensberg Transfrontier Programme.
- Mokotjomela, T, Schwaibold, U and Pillay, N (2010). Population surveys of the ice rat *Otomys sloggetti robertsi* in the Lesotho Drakensberg. *African Zoology*. 45: 225-232.
- Monadjem A, Taylor P J, Cotterill F P D and Schoeman M C (2010) Bats of Southern and Central Africa. Wits University Press, Johannesburg.
- Mucina, L and Rutherford, M C (2006) The vegetation of South Africa, Lesotho and Swaziland. 808 pp. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- Rowe-Rowe D T and Taylor P J (1996) Distribution patterns of terrestrial mammals in KwaZulu-Natal. *South African Journal of Zoology* 31:131-144.
- Taylor, P J (2016). *Otomys sloggetti*. The IUCN Red List of Threatened Species 2016: e.T15659A22396618. <http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T15659A22396618>. en. Downloaded on 13 March 2017.
- Talukdar, S (2002) Lesotho. In: Golding, J S (ed) Southern African plant Red Data Lists. Southern African Botanical Diversity Network Report 14. SABONET, Pretoria.
- van Wyk, A E and Smith, G F (2001) Regions of floristic endemism in southern Africa. 467 pp. Umdaus Press, Pretoria.
- Williams, V L, Raimondo, D, Crouch, N R, Cunningham, A B, Scott-Shaw, C R, Lötter, M and Ngwenya, A M (2008). *Eucomis autumnalis* (Mill.) Chitt. National Assessment: Red List of South African Plants version 2015.1. Accessed on 2017/03/08.

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



Appendix Table A-1: Full Plant Species List Recorded in Polihali Reservoir Area

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Dam Basin area	Above Dam Basin	Sheep Stud
<b>FERNS</b>								
<b>Adiantaceae</b>								
<i>Adiantum poiretii</i>	Lehorometso	Fern				1		
<b>Anemiaceae</b>								
<i>Mohria vestita</i>	Lehorometso	Fern				1		
<b>Aspleniaceae</b>								
<i>Asplenium trichomanes</i>	Lehorometso	Fern				1		
<b>Ophioglossaceae</b>								
<i>Ophioglossum vulgatum</i>	Malijo	Fern						1
<b>Selaginellaceae</b>								
<i>Selaginella caffrorum</i>	Moriri-oa-matlapa	Fern				1	1	
<b>Sinopteridaceae</b>								
<i>Cheilanthes eckloniana</i>	Mamarakoaneng	Fern				1		1
<i>Cheilanthes hirta</i>	Mamahuoaneng	Fern				1		1
<i>Cheilanthes involuta</i>	Lehorometso	Fern				1		
<b>DICOTS</b>								
<b>Amaranthaceae</b>								
<i>Amaranthus thunbergii</i>	Theepe	Forb					1	
<b>Apiaceae</b>								
<i>Alepidea cordifolia</i>	Lesoko	Forb	Vulnerable					1
<i>Berula erecta</i>	Lehlatso	Forb				1	2	
<i>Heteromorpha cf. arborescens</i>	Monkhoane	Shrub				1	1	
<b>Anacardiaceae</b>								
<i>Searsia divaricata</i>	Kolitsana	Shrub		Near		1		1
<b>Apiaceae</b>								
<i>Polemannia simplicior</i>		Forb		Near		1		
<b>Apocynaceae: Asclepiadoideae</b>								
<i>Asclepias gibba</i>	Montsokoane	Forb					1	
<i>Asclepias stellifera</i>	Mohlatsisa	Forb					2	
<i>Gomphocarpus physocarpus</i>	Moithimolo	Shrub				1		1
<i>Miraglossum superbum</i>		Forb		Strict			2	
<i>Pachycarpus sp.</i>	Leshokhoa	Forb			Protected	1		
<i>Schizoglossum bidens</i>		Forb		Near		1	2	
<i>Stenostelma sp.</i>		Forb				1		
<b>Asteraceae</b>								
<i>Arctotis arctotoides</i>	Putsoa-pululu	Forb				1		
<i>Artemisia afra</i> *	Lengana	Forb				1	1	1
<i>Aster bakeranus</i>	Phooa	Forb					2	
<i>Athrixia angustissima</i>		Shrub						2
<i>Berkheya cirsiifolia</i>	Mohato-o-mosoeu	Forb		Strict		1	1	1
<i>Berkheya multijuga</i>	Mohatollo	Forb		Near				1
<i>Bidens bipinnata</i> *	Moonyane	Forb				1		2
<i>Bidens formosa</i> *	Palesa	Forb				1	1	
<i>Bidens pilosa</i> *	Moonyane	Forb				1	1	
<i>Chrysocoma ciliata</i>	Sehalahala	Shrub					1	2
<i>Cineraria lyratiformis</i>	Tlali-tlali	Shrub					1	1
<i>Conyza podocephala</i>	Manku-a-maholo	Forb				1	1	1
<i>Cotula hispida</i>		Forb		Near				2
<i>Cotula radicalis</i>		Forb		Strict			2	2
<i>Dicoma anomala</i>	Hloenya	Forb	Vulnerable			1	1	

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Dam Basin area	Above Dam Basin	Sheep Stud
<i>Eriocephalus sp.</i>	Sehalahala-sa-matlaka	Shrub					1	
<i>Eumorphia sericea</i>	Lirulello	Shrub		Strict			2	
<i>Euryops laxa</i>	Rapeisi	Forb				1	1	
<i>Euryops tysonii</i>	Rapeisi	Forb		Near		1	1	
<i>Felicia filifolia</i>	Leholo	Shrub					2	
<i>Felicia muricata</i>	Mamileng	Forb				1	1	1
<i>Felicia ovata</i>		Forb					2	
<i>Felicia petiolata</i>	Khotolia-ea-thaba	Forb		Near		1		
<i>Gazania krebsiana</i>	Tsikitlane	Forb				1	1	1
<i>Gerbera cf. parva</i>		Forb		Strict			2	
<i>Gerbera natalensis</i>		Forb					2	
<i>Gerbera viridifolia</i>	Moarubetso	Forb					2	
<i>Gnaphalium limicola</i>		Forb					2	
<i>Haplocarpha scaposa</i>	Papetloana	Forb				1	1	1
<i>Helichrysum albo-brunneum</i>		Forb		Near				2
<i>Helichrysum anomalum</i>		Forb		Near				2
<i>Helichrysum aureonitens</i>	Tooane-ntja	Forb				1	1	
<i>Helichrysum aureum var. monocephalum</i>	Tšoene	Forb						2
<i>Helichrysum caespititium</i>	Phate-ea-ngaka	Forb				1	1	
<i>Helichrysum confertum</i>		Forb		Strict			1	
<i>Helichrysum dregeanum</i>	Tooane-ea-thaba	Forb				1		2
<i>Helichrysum herbaceum</i>	Tlhako	Forb					2	
<i>Helichrysum marginatum</i>	Tooane-balingoana-e-tsoeu	Forb		Strict		2	2	
<i>Helichrysum montanum</i>	Toala-ea-loti	Forb		Near			2	
<i>Helichrysum nudifolium</i>	Boleba	Forb				1	2	2
<i>Helichrysum odoratissimum</i>	Phefo	Forb						1
<i>Helichrysum paronychioides</i>		Forb					2	
<i>Helichrysum splendidum</i>	Phefo-ea-loti	Shrub						2
<i>Helichrysum trilineatum</i>	Hokobetsi	Shrub		Near		1		
<i>Helichrysum zeyheri</i>	Motoantoanyane	Forb						2
<i>Hilliardiella pinifolia</i>		Forb						2
<i>Hirpicium armerioides</i>	Shoeshoe-ea-loti	Forb		Near				2
<i>Macowania sororis</i>		Forb		Strict			2	
<i>Nidorella undulata</i>	Mokoteli	Forb						2
<i>Osteospermum sinuatum</i>		Forb				1		1
<i>Pentzia cooperi</i>	Lelingoana	Shrub		Near		1		2
<i>Relhania dieterlenii</i>	Mamenoana	Shrub		Strict			2	
<i>Schkuhria pinnata</i> *	Mamatutuoete	Forb				1	1	
<i>Senecio asperulus</i>	Moferefere	Forb					1	
<i>Senecio barbatus</i>	Sebea-mollo-sa-thaba	Forb		Near			2	
<i>Senecio bupleuroides</i>	Lereko	Forb					2	
<i>Senecio burchellii</i>	Khotolia	Forb				1	1	
<i>Senecio discodregeanus</i>	Lehlomane-le-lenyenyane	Forb						1
<i>Senecio hastatus</i>	Khotolia-e-kholo	Forb					2	
<i>Senecio inaequidens</i>	Khotolia	Forb				1	1	2
<i>Senecio inornatus</i>	Lehlomane-le-leholo	Forb						2
<i>Senecio macrocephalus</i>	Sebea-mollo	Forb					2	

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Dam Basin area	Above Dam Basin	Sheep Stud
<i>Senecio polyodon</i>	Sebea-mollo-sa-mekhoabo	Forb		Near			1	
<i>Senecio rhomboideus</i>	Lehlomane-la-thaba	Forb				1	1	
<i>Senecio seminiveus</i>	Khotolia-ea-noka	Forb		Strict			2	
<i>Senecio ulopterus</i>		Forb		Near			2	
<i>Sonchus dregeanus</i>	Leharasoana	Forb				1	1	
<i>Tagetes minuta</i> *	Monkhane	Forb				1	1	
<i>Taraxacum officinale</i> *	Fukuthoane	Forb					2	
<i>Tragopogon dubius</i>	Moetse					1	1	
<i>Ursinia alpina</i>	Sehalikane	Forb		Near			2	
<i>Ursinia montana</i>	Leabo	Forb		Near			1	
<i>Ursinia tenuiloba</i>	Sehalikane	Forb					1	
<i>Xanthium spinosum</i>	Mokaola	Shrub				1		
<i>Xanthium strumarium</i>	Hlabahlabane	Shrub				1		
<i>Zinnia peruviana</i> *	Lipilopilo	Forb				1	1	
<b>Boraginaceae</b>								
<i>Cynoglossum austro-africanum</i>	Motlepere	Forb		Near			2	
<i>Cynoglossum hispidum</i>	Bohomenyana	Forb					2	
<i>Echium vulgare</i> *	Bohomenyana	Forb					1	
<i>Myosotis semiamplexicaulis</i>	Sethoto-sa-mathuoela	Forb		Near		1	2	
<b>Brassicaceae</b>								
<i>Heliophila elongata</i>		Forb					2	
<i>Heliophila formosa</i>		Forb				1		
<i>Heliophila lineata</i>		Forb					2	
<i>Heliophila rigidisciula</i>		Forb				1		2
<i>Raphanus raphanistrum</i> *		Forb					2	
<i>Rorippa nasturtium-aquaticum</i> *	Semetsing	Forb				2	2	
<b>Buddlejaceae</b>								
<i>Buddleja salviifolia</i>	Lelothoane	Tree				1		
<i>Gomphostigma virgatum</i>	Mosika-noka	Shrub				1		
<b>Cactaceae</b>								
<i>Opuntia ficus-indica</i> *		Succulent				1	1	
<b>Campanulaceae</b>								
<i>Wahlenbergia fasciculata</i>	Moopetsane	Forb		Near			2	
<i>Wahlenbergia huttonii</i>	Moopetsane	Forb					2	
<i>Wahlenbergia krebsii</i>	Tenane	Forb		Near				2
<i>Wahlenbergia sp.</i>		Forb				1		
<b>Caryophyllaceae</b>								
<i>Dianthus basuticus</i>	Hlokoana-la-tsela	Forb		Near	Protected		1	
<i>Dianthus cf. mooiensis</i>		Forb					2	
<i>Silene bellidioides</i>	Likoomana	Forb				1		1
<i>Silene burchellii</i>	Monyekane	Forb				1		
<b>Chenopodiaceae</b>								
<i>Salsola kali</i> *	Lekoerekoere	Forb						
<b>Convolvulaceae</b>								
<i>Cuscuta campestris</i> *		Forb				1	1	
<i>Ipomoea crassipes</i>	Maime	Forb				1	1	
<i>Ipomoea plebeia</i>		Forb						2
<b>Crassulaceae</b>								
<i>Cotyledon orbiculata</i>	Serelile	Succulent				1	1	1
<i>Crassula alba</i>	Feko	Succulent					1	1
<i>Crassula lanceolata</i>	Moriri-oa-matlapa	Succulent						2

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Dam Basin area	Above Dam Basin	Sheep Stud
<i>Crassula lanuginosa</i>		Succulent					2	
<i>Crassula natalensis</i>	Bohobe-ba-setsomi	Succulent		Near			1	
<i>Crassula peploides</i>	Moora-metsi	Succulent		Near		1	1	
<i>Crassula setulosa</i>	Serelilenyana	Succulent				1	2	
<i>Crassula vaillantii</i> *		Succulent					2	
<b>Cucurbitaceae</b>								
<i>Kedrostris capensis</i>	Sesepa-sa-linoha	Forb				1		
<b>Dipsacaceae</b>								
<i>Scabiosa columbaria</i>	Selomi	Forb				1	1	1
<b>Ebenaceae</b>								
<i>Diospyros austro-africana</i>	Senokonoko	Shrub		Near		1	1	
<i>Euclea coriacea</i>	Ralikokotoana	Shrub		Near	Protected			
<b>Ericaceae</b>								
<i>Erica sp.</i>		Shrub					1	
<b>Euphorbiaceae</b>								
<i>Clutia sp.</i>		Forb					2	
<i>Euphorbia clavarioides</i>	Sehlooko	Succulent				1		
<i>Euphorbia epicyparissias</i>	Sehlakoana-se-senyane	Forb				1		
<b>Fabaceae: Papilionoideae</b>								
<i>Argyrobium candicans</i>	Tsoetla	Forb					2	
<i>Argyrobium harveyanum</i>	Tsoetla	Forb					2	
<i>Argyrobium marginatum</i>	Tsoetla	Forb					2	
<i>Argyrobium sp.</i>		Forb				1		
<i>Dichilus reflexus</i>	Lesita-tlali	Forb					2	2
<i>Indigofera woodii</i>	Qoiqoi	Forb		Near			1	
<i>Lessertia depressa</i>	Musapelo	Forb				1		
<i>Lotononis galpinii</i>		Forb		Near		1		
<i>Lotononis laxa</i>	Musa-pelo-oo-matlapa-o-monynyane	Forb				1		2
<i>Melolobium microphyllum</i>	Mofahla-toeba	Forb				1	2	
<i>Sutherlandia frutescens</i>	Musa-pelo	Shrub				1		
<i>Trifolium burchellianum</i>	Moroko	Forb				1		1
<b>Gentianaceae</b>								
<i>Sebaea cf. sedoides</i>	Marama-a-baroetsana	Forb						
<b>Geraniaceae</b>								
<i>Monsonia attenuata</i>	Malengoana	Forb		Near				2
<i>Pelargonium bowkeri</i>	Bolila-ba-litsoene	Forb		Near		1		
<i>Pelargonium cf. ranunculophyllum</i>		Forb		Near		1		
<i>Pelargonium sidoides</i>	Khoara	Forb				1		
<b>Gunneraceae</b>								
<i>Gunnera perpensa</i>	Qobo	Forb						1
<b>Lamiaceae</b>								
<i>Acrotome inflata</i>	Sea-le-moea	Forb				1		
<i>Mentha aquatica</i>	Kuena-ea-mekhoabo	Forb			Protected			1
<i>Mentha longifolia</i>	Kuena	Forb			Protected	1		1
<i>Stachys rugosa</i>	Taraputsoe	Forb				1	1	
<b>Lobeliaceae</b>								
<i>Lobelia cf. preslii</i>	Motlapatšuiyana	Forb		Near		1		

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Dam Basin area	Above Dam Basin	Sheep Stud
<i>Lobelia erinus</i>	Motlapatšuiyana	Forb					2	
<i>Lobelia krebsiana</i>	Motlapatšuiyana	Forb					2	
<i>Lobelia pteropoda</i>	Motlapatšuiyana	Forb				1	1	
<i>Lobelia vanreenensis</i>	Motlapatšuiyana	Forb					2	
<b>Malvaceae</b>								
<i>Hermannia coccocarpa</i>	Qena-e-nyenyane	Forb				1		
<i>Hermannia depressa</i>	Selentljane	Forb				1		
<i>Hermannia woodii</i>	Phate-ea-naha	Forb		Near				2
<i>Hibiscus trionum</i>	Motaung	Forb				1		
<i>Malva parviflora</i> *	Tikamotse	Forb				1		
<b>Mesembryanthemaceae</b>								
<i>Delosperma lavisiae</i>	Motabo	Succulent		Near		1	2	
<i>Delosperma lineare</i>	Motabo	Succulent		Near			2	
<b>Molluginaceae</b>								
<i>Psammitropha mucronata</i>	Mothujoana	Forb		Near			1	
<b>Onagraceae</b>								
<i>Epilobium capense</i>	Letsoai-la-baroa	Forb						2
<i>Oenothera rosea</i> *	Moopeli	Forb				1		
<b>Orobanchaceae</b>								
<i>Alectra capensis</i>	Moema-nosi	Forb						1
<i>Striga asiatica</i> *		Forb				2	2	
<i>Striga bilabiata</i>	Seona	Forb				1		1
<b>Oxalidaceae</b>								
<i>Oxalis smithiana</i>	Bolila-ba-lipoli	Forb				1		
<i>Oxalis obliquifolia</i>	Bolila	Forb				1		1
<b>Papaveraceae</b>								
<i>Papaver aculeatum</i> *	Sehlohlo	Forb				1		
<b>Phytolaccaceae</b>								
<i>Phytolacca octandra</i> *	Monatja	Forb				1		
<b>Polygalaceae</b>								
<i>Polygala hispida</i>	Ntšebele	Forb						2
<i>Polygala hottentota</i>	Ntšebele	Forb				1		
<i>Polygala rehmannii</i>	Bolao-bo-boholo	Forb				1		2
<i>Polygala virgata</i>	Ntšebele-ea-moru	Shrub						2
<b>Polygonaceae</b>								
<i>Persicaria cf. attenuata</i>	Khamane	Forb				1		
<i>Polygonum aviculare</i> *	Lira-hali-bonoe	Forb						2
<i>Rumex acetosella</i>	Bolila-nyana	Forb						2
<i>Rumex woodii</i>	Bolila-ba-likhomo	Forb		Near				1
<b>Rhamnaceae</b>								
<i>Rhamnus prinoides</i>	Mofifi	Tree				1		
<b>Rosaceae</b>								
<i>Leucosidea sericea</i>	Cheeche	Tree				1		
<i>Prunus persica</i> *		Tree				1	1	
<i>Rosa rubiginosa</i> *	Morobei	Shrub				1		
<i>Rubus ludwigii</i>	Monokotsoai	Shrub					1	
<b>Rubiaceae</b>								
<i>Anthospermum monticola</i>	Phakisane	Forb		Near		1		
<i>Galium capense</i>	Mabone	Forb				1		2
<i>Pentanisia prunelloides</i>	Setima mollo	Forb					1	
<b>Salicaceae</b>								
<i>Populus alba</i> *	Papoliri	Tree				1		
<i>Populus nigra</i> *	Papoliri	Tree				2	2	

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Dam Basin area	Above Dam Basin	Sheep Stud
<i>Salix babylonica</i> *	Moluoane	Tree				1		
<i>Salix fragilis</i> *	Lebelete	Tree				1		
<i>Salix mucronata</i>	Lebelete	Tree				1		
<b>Scrophulariaceae</b>								
<i>Diascia anastrepta</i>	Malana-a-konyana	Forb		Strict		1	1	
<i>Diascia integerrima</i>	Bolao-ba-litoeba	Forb		Near			1	
<i>Diascia</i> sp.		Forb				1		
<i>Hebenstretia comosa</i>	Lebohlollo	Forb				1		
<i>Jamesbrittenia aurantiaca</i>	Phiri-ea-hlaha-e-nyenyane	Forb				1		
<i>Jamesbrittenia</i> cf. <i>breviflora</i>	Phiri-ea-hlaha	Forb		Near		1		
<i>Jamesbrittenia jurassica</i>	Phiri-ea-hlaha	Forb		Strict		1	1	
<i>Jamesbrittenia lesutica</i>	Phiri-ea-hlaha	Forb	Vulnerable	Strict		1		
<i>Phygellus aequalis</i>	Mafifi-matso	Shrub		Near			1	1
<i>Selago densiflora</i>	Mophethu	Forb		Near				2
<i>Selago galpinii</i>	Tšitoane-ea-setlolo	Forb		Near		1		
<i>Selago melliodora</i>	Mophethu	Forb		Strict				2
<i>Zaluzianskya ovata</i>	Letaabe	Forb						2
<b>Solanaceae</b>								
<i>Solanum retroflexum</i>	Limomontso	Shrub				1		
<i>Withania somnifera</i>	Moferangope	Shrub				1	1	
<b>Thymelaeaceae</b>								
<i>Passerina montana</i>	Lekhapu-le-nyenyane	Shrub				1		
<b>Zygophyllaceae</b>								
<i>Tribulus terrestris</i>	Tšehlo	Forb				1	1	
<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>Haemanthus humilis</i>	Tsebe-ea-phofu	Geophyte				1	1	
<b>Araceae</b>								
<i>Zantedeschia albomaculata</i>	Mohalalitoe	Geophyte					1	
<b>Asparagaceae</b>								
<i>Asparagus microraphis</i>	Lerara-tau	Forb				1		
<b>Asphodelaceae</b>								
<i>Aristaloe aristata</i>	Lekhalana	Succulent	Near Threatened	Near		1		
<i>Bulbine narcissifolia</i>	Khomo-ea-balisa	Succulent			Protected		2	2
<i>Kniphofia ritualis</i>	Lelutla	Geophyte		Near				1
<i>Trachyandra asperata</i>	Leloelenyana-la-lilomo	Geophyte					2	1
<i>Trachyandra saltii</i>	Motoropo-o-monyenyane	Geophyte					2	
<b>Commelinaceae</b>								
<i>Commelina africana</i>	Khotsoana	Forb				1		
<b>Cyperaceae</b>								
<i>Bulbostylis humilis</i>	Boea-ba-ntja	Sedge					2	
<i>Carex acutiformis</i>		Sedge						1
<i>Carex austro-africana</i>	Lesuoane	Sedge				1		
<i>Cyperus congestus</i>	Qoqothoane	Sedge					2	
<i>Cyperus rotundus</i>	Lejabutle	Sedge						2

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Dam Basin area	Above Dam Basin	Sheep Stud
<i>Cyperus rupestris</i>	Roroana	Sedge				1	1	1
<i>Eleocharis cf. schlechteri</i>		Sedge					2	
<i>Ficinia cinnamomea</i>	Sechaba	Sedge		Near			2	
<i>Isolepis costata</i>	Boliba	Sedge						2
<i>Isolepis setacea</i>	Leshomokho	Sedge					2	
<i>Kyllinga pulchella</i>	Qoqothoane-e-nyenyana	Sedge					2	
<i>Scirpus ficinioides</i>	Loli	Sedge					1	
<b>Hyacinthaceae</b>								
<i>Albuca pachychlams</i>	Mototse	Geophyte					2	
<i>Albuca shawii</i>	Morotoana-phookoana	Geophyte		Near		1		
<i>Dipcadi gracillimum</i>	Morotoana-phookoana	Geophyte				1	2	
<i>Dipcadi marlothii</i>	Morotoana-phookoana	Geophyte					2	
<i>Drimiopsis sp.</i>		Geophyte				1		
<i>Eucomis autumnalis</i>	Mathethebale	Geophyte	Vulnerable					1
<i>Ledebouria sandersonii</i>		Geophyte				1		
<i>Ornithogalum cf. graminifolium</i>	Mahae	Geophyte				1		
<i>Drimia depressa</i>	Moretele	Geophyte					2	1
<i>Drimia saniensis</i>	Leptjetlane-la-Sani	Geophyte	Vulnerable	Strict				
<i>Drimia calcarata</i>	Leptjetlane-le-lenenyane	Geophyte					2	
<b>Hypoxidaceae</b>								
<i>Hypoxis costata</i>	Moli-boea	Geophyte		Near				1
<b>Iridaceae</b>								
<i>Dierama latifolium</i>	Lethepu	Geophyte		Near				2
<i>Dierama robustum</i>	Lethepu	Geophyte		Near				1
<i>Gladiolus saundersii</i>	Mokhabebe	Geophyte		Strict	Protected	1		
<b>Orchidaceae</b>								
<i>Satyrium longicauda</i>	Mametsana	Geophyte						1
<b>Poaceae</b>								
<i>Agrostis lachnanthas</i>	Joang-ba-phororo	Grass						2
<i>Aristida bipartita</i>	Mohlolohali	Grass						1
<i>Aristida congesta</i>	Lemanamana	Grass				1		
<i>Aristida diffusa</i>	Bohlanya-ba-lipere	Grass				1		
<i>Brachiaria serrata</i>	Lengole-la-namane	Grass					1	
<i>Bromus catharticus</i> *		Grass				1	1	
<i>Catalepis gracilis</i>	Joang-ba-matlapa	Grass		Near			1	
<i>Cymbopogon sp.</i>		Grass						2
<i>Cymbopogon dieterlenii</i>	Moshanyana-oa-marallaneng	Grass				1		1
<i>Digitaria eriantha</i>	Moboeane	Grass				1		
<i>Diheteropogon filifolius</i>	Hloko-ea-matlapa	Grass				1		
<i>Ehrharta calycina</i>		Grass						1
<i>Elionurus muticus</i>	Tlhoko	Grass				1		1
<i>Eragrostis capensis</i>	Baroana	Grass				1		1
<i>Eragrostis chloromelas</i>	Moseka	Grass				1		2
<i>Eragrostis curvula</i>	Tšaane	Grass				1		1
<i>Eragrostis plana</i>	Molula	Grass				1		
<i>Eragrostis racemosa</i>	Seritšoane-sa-lithota	Grass						1
<i>Eustachys paspaloides</i>	Sebokunyana	Grass				1		1
<i>Festuca caprina</i>	Letsiri	Grass						2

Taxon	Sesotho Name	Growth Form	Red Data Status	DAC Endemic	Protected Status	Dam Basin area	Above Dam Basin	Sheep Stud
<i>Festuca costata</i>	Lekolojane	Grass		Near				2
<i>Fingerhuthia sesleriiformis</i>	Thota-poho	Grass						2
<i>Harpochloa falx</i>	Lefokololi	Grass					1	1
<i>Helictotrichon longifolium</i>	Litse-ba-pulumo	Grass		Near				1
<i>Helictotrichon turgidulum</i>	Litse-ba-pulumo	Grass						2
<i>Heteropogon contortus</i>	Selokana	Grass				1		1
<i>Hyparrhenia hirta</i>	Mohlomo	Grass				1		2
<i>Koeleria capensis</i>	Boshoane	Grass				1		2
<i>Melinis nerviglumis</i>	Letjotjo	Grass				1		
<i>Monocymbium ceresiiforme</i>	Meseletso	Grass						1
<i>Paspalum notatum</i> *		Grass				1	1	
<i>Pennisetum thunbergii</i>	Nyalothi	Grass						
<i>Pentaschistis aroides</i>	Joang-ba-mehlaka	Grass						
<i>Pentaschistis setifolia</i>	Letsiri-le-lenenyane	Grass						2
<i>Phragmites australis</i>	Lehlaka-la-noka	Grass				1		
<i>Setaria sphacelata</i>	Thusane	Grass						2
<i>Sporobolus sp</i>		Grass						2
<i>Stiburus conrathii</i>		Grass		Near				1
<i>Themeda triandra</i>	Seboku	Grass				1		1
<i>Tragus racemosus</i>	Bore-ba-ntja	Grass				1	1	
<i>Trichoneura grandiglumis</i>	Joang-ba-tsela	Grass				1	1	
		<b>299</b>	<b>6</b>	<b>71</b>		<b>155</b>	<b>139</b>	<b>105</b>

1=current survey

2=CES data

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



Appendix Table B-1: Priority Plant Species Recorded in Polihali Reservoir Area

Taxon	Sesotho Name	Growth Form	DAC Endemic	DAC Near-Endemic	Dam Basin, etc.	Above Dam Basin	Sheep Stud
<b>DICOTS</b>							
<b>Anacardiaceae</b>							
<i>Searsia divaricata</i>	Kolitsana	Shrub		x			
<b>Apiaceae</b>							
<i>Polemannia simplicior</i>		Forb		x			
<b>Apocynaceae: Asclepiadoideae</b>							
<i>Miraglossum superbum</i>		Forb	x			2	
<i>Schizoglossum bidens</i>		Forb		x	1	2	
<b>Asteraceae</b>							
<i>Berkheya cirsiifolia</i>		Forb	x		1	1	1
<i>Berkheya multijuga</i>	Mohatollo	Forb		x			1
<i>Cotula hispida</i>		Forb		x			2
<i>Cotula radicalis</i>		Forb	x			2	2
<i>Eumorphia sericea</i>		Shrub	x			2	
<i>Euryops tysonii</i>	Rapeisi	Forb		x			
<i>Felicia petiolata</i>	Khotolia-ea-thaba	Forb		x	1		
<i>Gerbera cf. parva</i>		Forb	x			2	
<i>Helichrysum albo-brunneum</i>		Forb		x			2
<i>Helichrysum anomalum</i>		Forb		x			2
<i>Helichrysum confertum</i>		Forb	x			1	
<i>Helichrysum marginatum</i>		Forb	x		2	2	
<i>Helichrysum montanum</i>		Forb		x		2	
<i>Helichrysum trilineatum</i>	Hokobetsi	Shrub		x	1		
<i>Macowania sororis</i>		Forb	x			2	
<i>Pentzia cooperi</i>	Lelingoana	Shrub		x	1		2
<i>Relhania dieterlenii</i>		Shrub	x			2	
<i>Senecio barbatus</i>		Forb		x		2	
<i>Senecio polyodon</i>		Forb		x		1	
<i>Senecio seminiveus</i>	Khotolia-ea-noka	Forb	x			2	
<i>Senecio ulopterus</i>		Forb		x		2	
<i>Ursinia alpina</i>		Forb		x		2	
<i>Ursinia montana</i>		Forb		x		1	
<b>Boraginaceae</b>							
<i>Cynoglossum austro-africanum</i>		Forb		x		2	
<i>Myosotis semiamplexicaulis</i>	Sethoto-sa-mathuoela	Forb		x	1	2	
<b>Campanulaceae</b>							
<i>Wahlenbergia fasciculata</i>		Forb		x		2	
<i>Wahlenbergia krebsii</i>	Tenane	Forb		x			2
<b>Caryophyllaceae</b>							
<i>Dianthus basuticus</i>	Hlokoana-la-tsela	Forb		x			
<b>Crassulaceae</b>							
<i>Crassula natalensis</i>	Bohobe-ba-setsomi	Succulent		x		1	
<i>Crassula peploides</i>	Moora-metsi	Succulent		x	1	1	
<b>Ebenaceae</b>							
<i>Diospyros austro-africana</i>	Senokonoko	Shrub		x	1	1	
<i>Euclea coriacea</i>	Ralikokotoana	Shrub		x	1	1	
<b>Fabaceae: Papilionoideae</b>							
<i>Indigofera woodii</i>		Forb		x		1	
<i>Lotononis galpinii</i>		Forb		x	1		
<b>Geraniaceae</b>							

Taxon	Sesotho Name	Growth Form	DAC Endemic	DAC Near-Endemic	Dam Basin, etc.	Above Dam Basin	Sheep Stud
<i>Monsonia attenuata</i>		Forb		x			2
<i>Pelargonium bowkeri</i>	Bolila-ba-litsoene	Forb		x	1		
<i>Pelargonium cf. ranunculophyllum</i>		Forb		x	1		
<b>Lobeliaceae</b>							
<i>Lobelia cf. preslii</i>		Forb		x	1		
<b>Mesembryanthemaceae</b>							
<i>Delosperma lavisiae</i>		Succulent		x	1	2	
<i>Delosperma lineare</i>		Succulent		x		2	
<b>Molluginaceae</b>							
<i>Psammotropha mucronata</i>	Mothujoana	Forb		x		1	
<b>Polygonaceae</b>							
<i>Rumex woodii</i>		Forb		x			1
<b>Rubiaceae</b>							
<i>Anthospermum monticola</i>		Forb		x	1		
<b>Scrophulariaceae</b>							
<i>Diascia anastrepta</i>		Forb	x		1	1	
<i>Diascia integerrima</i>	Bolao-ba-litoeba	Forb		x			
<i>Jamesbrittenia cf. breviflora</i>		Forb		x	1		
<i>Jamesbrittenia jurassica</i>		Forb	x		1	1	
<i>Jamesbrittenia lesutica</i>		Forb	x		1		
<i>Phygellus aequalis</i>	Mafifi-matso	Shrub		x		1	1
<i>Selago densiflora</i>		Forb		x			2
<i>Selago galpinii</i>		Forb		x	1		
<i>Selago melliodora</i>		Forb	x				2
<b>MONOCOTS</b>							
<b>Asphodelaceae</b>							
<i>Aristaloe aristata</i>	Lekhalana	Succulent		x	1		
<i>Kniphofia ritualis</i>	Lelutla	Geophyte		x			1
<b>Cyperaceae</b>							
<i>Ficinia cinnamomea</i>		Sedge		x		2	
<b>Hyacinthaceae</b>							
<i>Albuca shawii</i>		Geophyte		x	1		
<b>Hypoxidaceae</b>							
<i>Hypoxis costata</i>		Geophyte		x			1
<b>Iridaceae</b>							
<i>Dierama latifolium</i>		Geophyte		x			2
<i>Dierama robustum</i>	Lethepu	Geophyte		x			1
<i>Gladiolus saundersii</i>	Mokhabebe	Geophyte	x		1		
<b>Poaceae</b>							
<i>Catalepis gracilis</i>	Joang-ba-matlapa	Grass		x		1	
<i>Helictotrichon longifolium</i>	Litse-ba-pulumo	Grass		x			1
<i>Stiburus conrathii</i>		Grass		x			1
		67	15	52	24	33	19

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



Scientific Name	Local Name	Growth Form	Habitat Type	Area recorded	Uses of Resources	Propagation Potential
<i>Albuca pachyklamys</i>	Moretele-omu-soeu	Geophyte	Rocky areas	CES (2014a)	Spiritual	Moderate
<i>Aloe polyphylla</i>	Kharetsa	Succulent	Rocky ridge	Makhiseng, Mokokoaneng, Makhoarane, Majakaneng, Ha Mojakisane, Ha Ntsesanyane, 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>Asclepias spp.</i>	Delenene (Bheka-mina-ngedwa)	Forb	Grassland	CES (2014a)	Spiritual	Moderate
<i>Asparagus microraphis</i>	Lerara-tau	Shrub	Rocky ridge	Ha Mojakisane	Medicinal	Moderate
<i>Berkheya cirsiifolia</i>	Mohlobahlobane	Forb	Grassland	CES (2014a)	Medicinal	High
<i>Buddleja salviifolia</i>	Lelothoane	Tree	Gorges	Malingoaneng Tloha-Re-Bue, Ha Ntsesanyane	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	CES (2014a)	Medicinal	Moderate
<i>Chrysocoma ciliata</i>	Sehalahala	Shrub	Degraded slopes	Ha Ntsesanyane	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>Cymbopogon dieterlenii</i>	Seboku	Grass	Grassland	CES (2014a)	Spiritual	Moderate
<i>Cysticapnos pruinosa</i>	Lefakatsane	Forb	Rocky areas	CES (2014a)	Medicinal	Moderate
<i>Dianthus cf mooiensis</i>	Ntsebele, lekoanya-tsele	Forb	Grassland	CES (2014a)	Spiritual	Moderate
<i>Dicoma anomala</i>	Hloenya	Forb	Grassland	Ha Ntsesanyane, Popa Makhomalong, Sekoka, Bafali Ha Poso, Malingoaneng -Tloha-Re-Bue	Medicinal	Moderate
<i>Dierama cf latifolium</i>	Lethepu	Geophyte	Grassland	CES (2014a)	Medicinal	Moderate
<i>Digitaria eriantha</i>	Molula	Grass	Grassland	CES (2014a)	Medicinal, spritual	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 Ntsesanyane, Sekoka	Firewood	Moderate
<i>Euclea coriacea</i>	Ralikokotoana	Tree	rocky ridge	Malingoaneng Tloha-Re-Bue; Ha Ntsesanyane	Medicinal	Moderate

Scientific Name	Local Name	Growth Form	Habitat Type	Area recorded	Uses of Resources	Propagation Potential
<i>Eucomis autumnalis</i>	Khapumpu	Forb	Grassland, seeps	Majakaneng, Ha Mojakisane, Ha Ntsesanyane	Medicinal	Moderate
<i>Euphorbia clavarioides</i> var. <i>clavarioides</i>	Sehlooko	Forb	rocky ridge	Majakaneng, Malingoaneng – Tloha-Re-Bue	Medicinal, food	High
<i>Eriocephalus</i> sp	Sehalahala-sa-matlaka	Shrublet	rocky ridge	Malingoaneng Tloha-Re-Bue	Firewood	Moderate
<i>Felicia muricata</i>	Mohantsoane	Forb	Grassland	CES (2014a)	Medicinal	High
<i>Galium capense</i>	Monolo	Forb	Grassland	CES (2014a)	Spiritual	Moderate
<i>Gazania krebsiana</i>	Tsikitlane	Forb	Grassland	Ha Mojakisane	Medicinal	High
<i>Gladiolus saundersii</i>	Khahla	Geophyte	Grassland	CES (2014a)	Spiritual	High
<i>Gomphocarpus fruticosus</i>	Sehamela podi	Forb	Disturbed areas, streams	CES (2014a)	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 caespititium</i>	Phate-ea-ngaka	Forb	Grassland	Masakong	Medicinal	Moderate
<i>Helichrysum cf nudifolium</i>	Letapiso	Forb	Grassland	CES (2014a)	Medicinal	Moderate
<i>Helichrysum splendidum</i>	Pheefo	Shrub	Grassland	CES (2014a)	Spiritual	High
<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> var. <i>abyssinica</i>	Monkhoane	Tree	rocky ridge	Majakaneng	Medicinal	Moderate
<i>Hyparrhennia hirta</i>	Mohlomo	Grass	North facing Gorges	Majakaneng, Malingoaneng – Tloha-Re-Bue	Thatching	Widespread
<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</i> sp.	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</i> sp	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-	Medicinal	High

Scientific Name	Local Name	Growth Form	Habitat Type	Area recorded	Uses of Resources	Propagation Potential
				Re-Bue		
<i>Merxmüllera 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 Ntsesanyane	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
<i>Pentania prunelloides</i>	Setima mollo	Forb	rocky ridge	Ha Ntsesanyane	Medicinal	Moderate
<i>Pentzia cooperi</i>	Lelingoana	Shrub	Mountain slopes	Ha Ntsesanyane	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>Searsia divaricata</i>	Kolitsana	Forb	Gorges	Popa Makhomalong, Ha Ntsesanyane	Firewood, food	Moderate
<i>Searsia spp</i>	Tsinabele	Forb	rocky ridge	Ha Ntsesanyane, 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	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

Scientific Name	Local Name	Growth Form	Habitat Type	Area recorded	Uses of Resources	Propagation Potential
<i>Tagetes minuta</i>	Senkhane	Forb	Disturbed areas	CES (2014a)	Household	High
<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