



SWARTBERG COMPLEX WORLD HERITAGE SITE & NATURE RESERVES

PART OF THE
CAPE FLORAL REGION PROTECTED AREAS
WORLD HERITAGE SITE

Western Cape, South Africa

Protected Area Management Plan 2020 – 2030

DATE APPROVED: [Date]

MOST RECENT UPDATE: 20 February 2020



environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

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Western Cape
Government



United Nations
Educational, Scientific and
Cultural Organization



World
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CITATION

CapeNature. 2020. Swartberg Complex World Heritage Site & Nature Reserves:
Protected Area Management Plan 2020-2030. Internal Report, CapeNature. Cape Town.

AUTHORISATIONS

In terms of Section 41(4) the Minister hereby approves the part of the Protected Area Management Plan for the Swartberg Complex World Heritage Site and Nature Reserves (SCWHS&NR) designated as World Heritage Sites (See Appendix 1, Table 1).

TITLE	NAME	SIGNATURE	DATE
NATIONAL MINISTER: Environment, Forestry and Fisheries	Ms Barbara Creecy		

In terms of Section 41(4) the MEC hereby approves the part of the Protected Area Management Plan for the Swartberg Complex World Heritage Site and Nature Reserves designated as Provincial Nature Reserves (everything not included above – see Appendix 1, Tables 1 & 2).

TITLE	NAME	SIGNATURE	DATE
PROVINCIAL MINISTER: Department of Environmental Affairs and Development Planning	Mr Anton Bredell		

Recommended:

TITLE	NAME	SIGNATURE	DATE
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CHIEF EXECUTIVE OFFICER: CapeNature	Dr Razeena Omar		5/03/2020

Review Date: 10 years from the date of approval by the MEC and Minister.

ACKNOWLEDGEMENTS

All stakeholders are thanked for their participation and contribution to the development of this management plan.

This management plan was prepared by the reserve management committee comprised of AnneLise Schutte-Vlok, Natalie Anthea Baker, Tom Barry, Kgaugelo Shadung and Phillip Esau with significant inputs from:

- Dr Andrew Turner (reptiles and amphibians)
- Dr Antoinette Veldtman (invertebrates, general assistance with the Open Standards procedures and support)
- Mss Erika Swanepoel and Nicolette Mouries (tourism)
- Ms Jeanne Gouws (freshwater)
- Mr Keith Spencer (integrated catchment and strategic information framework)
- Mr Kevin Shaw (avifauna)
- Mr Lucky Seabi (socio-economic context)
- Dr Marienne de Villiers (mammals and protected area expansion)
- Dr Martine Jordaan (fish)
- Mr Llewellyn Jacobs (SOB data provision)
- Mr Mbulelo Jacobs (management and support)
- Mr Patrick Meyer (maps and GIS support)
- Dr Ruida Stanvliet (facilitation of initial workshop)
- Ms Therese Forsyth (sensitivity, zonation and zone of influence analyses)
- Ms Theresa van der Westhuizen (inputs to game and damage causing animals)
- Mr Tierck Hoekstra (assistance with proclamation information)
- Dr Zwido Lidzhegu (Miradi software application, topography and geology)
- Swartberg, Gamkaberg and Kammanassie field rangers (provision of ecological data)
- All contributors of photographs.

The following external experts are thanked for their specialist inputs into certain sections of the management plan:

- Dr John Almond (palaeontological and geological heritage sections)
- Prof Graham Kerley (ecotypical game species)
- Dr Alan Lee (avifaunal section)
- Mr Francis Steyn, Mss Liz Eglington and Jenny Cullinan (inputs regarding agricultural best practices for pollination)
- Mr Jan Vlok (Fynbos, Succulent Karoo, Subtropical Thicket and Cape mountain zebra focal values).

Dr Ruida Pool-Stanvliet (CapeNature – Ecologist: Flora, West Region) is thanked for internal review.

Mr Anthony Marshall (Emmeritus CapeNature Integrated Catchment Manager) is thanked for external review.

[Cover page images courtesy of Mr Jan Vlok (primary image) and Mr John Sharples (secondary image).]

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GLOSSARY

Term	Explanation
Adaptive Management	The incorporation of a formal learning process into conservation action. Specifically, it is the integration of knowledge, management, and monitoring, to provide a framework to systematically test assumptions, promote learning, and supply timely information for management to make decisions and adjust actions based on outcomes of monitoring.
Ethnobotany	Ethnobotany is the scientific study of the traditional knowledge and customs of a people concerning plants and their medicinal, religious and other uses.
Factor	A generic term for an element of a conceptual model including direct and indirect threats, opportunities, and associated stakeholders. It is often advantageous to use this generic term since many factors – for example tourism – could be both a threat and an opportunity. Also known as root causes or drivers.
Focal Value	An element of biodiversity (natural value) or heritage (cultural value) of the protected area, which can be a species, habitat, ecological system, or heritage feature, that management strives to protect, and threats towards which management should strive to minimise. All focal values at a site should collectively represent the biodiversity and heritage features of concern at the site.
Goal	A formal statement detailing a desired impact of a project, such as the desired future status of a target. A good goal meets the criteria of being linked to targets, impact oriented, measurable, time limited, and specific.
Heritage Resources	Means any place or object of cultural significance as per the Heritage Resources Act, 1999 (Act No. 25 of 1999).
Indicator	A measurable entity related to a specific information need such as the status of a value / factor, change in a threat, or progress toward an objective. A good indicator meets the criteria of being: measurable, precise, consistent, and sensitive.
Key Ecological Attribute	An aspect of a focal value's biology or ecology that if present, define a healthy focal value and if missing or altered, would lead to the outright loss or extreme degradation of that focal value over time.
Living Heritage	Means the intangible aspects of inherited culture, and may include: (a) cultural tradition; (b) oral history; (c) performance;

	(d) ritual; (e) popular memory; (f) skills and techniques; (g) indigenous knowledge systems; and (h) the holistic approach to nature, society and social relationships; in terms of the Heritage Resources Act.
Objective	A formal statement detailing a desired outcome of a project such as reducing a critical threat. A good objective meets the criteria of being: results oriented, measurable, time limited, specific, and practical. If the project is well conceptualized and designed, realization of a project's objectives should lead to the fulfilment of the project's goals and ultimately its vision. Compare to vision and goal.
Situation analysis	The purpose of a situation analysis is to understand the relationships between the biological environment and the social, economic, political, and institutional systems and drivers that affect the focal values of the protected area.
Vision	A description of the desired long-term future or ultimate condition that stakeholders see and management strives to achieve for the protected area.

ACRONYMS AND ABBREVIATIONS

APO	Annual Plan of Operations
ASPT	Average Score Per Taxon
BIRP	Birds in Reserve Project
BMP	Biodiversity Management Plan
BMP-s	Biodiversity Management Plan for Species
CBA	Critical Biodiversity Area
CEO	Chief Executive Officer
CFR	Cape Floristic Region
CFRPA	Cape Floral Region Protected Areas
CMP	Conservation Measures Partnership
CR	Critically Endangered
CREW	Custodians of Rare and Endangered Wildflowers
DEA	Department of Environmental Affairs (now Department of Environment, Forestry and Fisheries)
DEA&DP	Department of Environmental Affairs and Development Planning
DWAF	Department of Water Affairs and Forestry (now Department of Water and Sanitation)
EMI	Environmental Management Inspector
EPWP	Expanded Public Works Programme
FMU	Fire Management Unit
FPA	Fire Protection Association in terms of the National Veld and Forest Fire Act, 1998 (No. 1 of 1998).
GCBR	Gouritz Cluster Biosphere Reserve
GIS	Geographical Information System
GTUP	Game Translocation Utilisation Policy
IAPO	Integrated Annual Plan of Operations
ICM	Integrated Catchment Management
IDP	Integrated Development Plan
IUCN	International Union for Conservation of Nature and Natural Resources
IWP	Integrated Work Plan
KKRWSS	Klein Karoo Rural Water Supply Scheme

m.a.s.l.	Metres above sea level
MEC	Member of Executive Council
METT-SA	Management Effectiveness Tracking Tool - South Africa
MOA	Memorandum of Agreement
MTEF	Medium Term Expenditure Framework
NEMA	National Environmental Management Act
NEM:BA	National Environmental Management: Biodiversity Act
NEM:PAA	National Environmental Management: Protected Areas Act
NFEPA	National Freshwater Ecosystem Priority Area
NGO	Non-governmental Organisation
NPAES	National Protected Area Expansion Strategy
PAAC	Protected Area Advisory Committee
SABAP2	South African Bird Atlas version 2
SANBI	South Africa National Biodiversity Institute
SASS 5	South African Scoring System version 5
SCWHS&NR	Swartberg Complex World Heritage Site & Nature Reserves
SDF	Spatial Development Framework
SOB	State of Biodiversity
SOP	Standard Operating Procedure
TMG	Table Mountain Group
TPC	Threshold of Potential Concern
U-AMP	User Asset Management Plan
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WCNCB	Western CapeNature Conservation Board
WCPAES	Western Cape Protected Area Expansion Strategy
WHS	World Heritage Site
WMA	Water Management Area
WWF-SA	World Wild Fund for Nature – South Africa
ZOI	Zone of Influence

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- **Table 1:** Land parcels that comprise the Swartberg Complex World Heritage Site.
- **Table 2:** Land parcels that comprise Provincial Nature Reserves in the Swartberg Complex World Heritage Site and Nature Reserves (everything not included above in Appendix 1 Table 1).

Appendix 2: Maps of the Swartberg Complex World Heritage Site and Nature Reserves.

Appendix 3: Stakeholder Engagement Report: Swartberg Complex World Heritage Site and Nature Reserves.

EXECUTIVE SUMMARY

In compliance with the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) and Chapter 4 of the World Heritage Convention Act, 1999 (Act No. 49 of 1999), the management authority of a protected area is required to develop management plans for each of its protected areas.

The Swartberg Complex was inscribed as a World Heritage Site (WHS) by the World Heritage Convention, UNESCO (United Nations Educational, Scientific and Cultural Organisation) in 2004 and extended in 2015 as part of the Cape Floral Region Protected Areas (CFRPA) WHS. The latter comprises a serial property of ten protected areas covering a total area of 187 578.96 ha. Several additional properties have since been acquired for conservation purposes in order to expand and consolidate the protected area network, which increased the total size of the protected area network to 198 308.24 ha. A buffer zone of approximately 92 295.67 ha designed to facilitate functional connectivity and mitigate the effects of global climate change and other anthropogenic influences has also been identified. The Swartberg Complex World Heritage Site & Nature Reserves (SCWHS&NR) is thus supported and buffered by a wide network of adjacent or surrounding conserved areas ranging from Provincial Nature Reserves to Stewardship sites and Mountain Catchment Areas.

The SCWHS&NR forms part of the Core Area of the Gouritz Cluster Biosphere Reserve (GCBR) that is the fourth biosphere reserve in the Western Cape and the seventh in South Africa. This biosphere reserve is also the largest in South Africa covering 3 187 893 ha and creates a corridor along the Gouritz River, where naturally occurring indigenous animals and plants could disperse freely from the conservation areas of the inland mountains (Anysberg-Swartberg and Gamkaberg-Rooiberg ranges) to those of the coastal Langeberg-Outeniqua mountains ranges.

The SCWHS&NR management plan comprises 12 sections.

Section one comprises the authorisation and acknowledgements. The national minister is authorised under section 25(1) of the World Heritage Convention Act, 49 of 1999 to approve the management plan for a protected area so nominated, or declared under the World Heritage Convention Act.

Both the national minister and MEC in a particular province has concurrent jurisdiction to approve a management plan for a protected area submitted under Section 39(2) of the National Environmental Management: Protected Areas Act, 57 of 2003.

In developing the management plan for SCWHS&NR, CapeNature as the management authority strives to establish biodiversity conservation as a foundation for a sustainable economy, providing ecosystem services, access and opportunities for all.

Section two outlines the legal status of the SCWHS&NR and provides the biophysical and ecological context. The SCWHS&NR is situated on the east-west axis of the Cape Fold Mountains along the border between the Cape Floral Region and the semi-arid Karoo in the Western Cape Province of South Africa. The protected area network lies to the west of the Baviaanskloof, to the north-east of the Langeberg Complex, east of Anysberg WHS and inland of the Garden Route Complex.

The SCWHS&NR is inscribed as a WHS as part of the CFRPA WHS. The SCWHS&NR represents outstanding examples of significant ongoing ecological and biological processes in the evolution of terrestrial ecosystems and plant communities such as a natural fire regime and natural flow of water through the area, supporting unique indigenous freshwater fish assemblages and agricultural sectors, and connectivity for species migration, gene flow, dispersal, etc. In addition, the protected area network contains important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value. The SCWHS&NR is a centre of endemism for plants, amphibians, small mammals and importantly, endemic and threatened freshwater fish.

Furthermore, the Swartberg and Kammanassie Mountain Ranges are identified as National Strategic Water Source Areas. These mountain catchments provide good quality water for the agricultural sector in the rural areas and the urban areas of Prince Albert, Zoar, De Rust, Klaarstroom, Ladismith, Calitzdorp, Vanwyksdorp, Oudtshoorn and Uniondale.

The remainder of section two gives the socio-economic and organisational context of the SCWHS&NR.

Section three describes the policy framework under which the SCWHS&NR operates. CapeNature is subject to the framework of the Constitution of the Republic of South Africa (1996), national legislation including the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEM:PAA), National World Heritage Convention Act, 1999 (Act No. 49 of 1999) and all associated regulations and norms and standards for the Management of Protected Areas in South Africa and all other relevant requirements as set out in the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA).

This section gives the purpose of protected area management and the guiding principles under which it operates. This section further highlights CapeNature's application of a Strategic Adaptive Management Cycle. The organisation followed the Open Standards for the Practice of Conservation, which is an adaptive management framework that enables management teams to develop the most effective conservation strategies based on the best available traditional, expert and scientific information. The Open Standards framework facilitates Strategic Adaptive Management through the identification of explicit measures of success and the incorporation of lessons learned over time. It furthermore sets out the principles and procedures followed for Protected Area Management Effectiveness, Monitoring and Evaluation and explains the policy frameworks under which the SCWHS&NR operates.

Section four outlines procedures for stakeholder engagement during the development of the management plan, including formal processes for public comment on the draft plan, and establishes procedures for public participation during the implementation phase of this plan.

Section five states the purpose and the vision of the SCWHS&NR. This section makes provision for CapeNature to manage the SCWHS&NR exclusively for the purpose for which it was declared. It presents the vision, purpose, focal values and key threats

foundational to developing the desired state for the protected area. The vision of the SCWHS&NR is:

“The Swartberg Complex World Heritage Site and Nature Reserves conserves living landscapes that represent the region’s biodiversity and ecosystems through integrated management and partnerships for the benefit of all”.

The focal values of the SCWHS&NR are: The Fynbos Mosaic, Succulent Karoo and Subtropical Thicket, Freshwater Ecosystems, Cape mountain zebra, and the Cultural Heritage and Rural Landscape of the SCWHS&NR. A host of human wellbeing benefits will flow from the protected area network’s natural and cultural assets including, and of particular importance to the SCWHS&NR, freedom of choice and capacity to act independently, tourism and nature based economic opportunities, security from natural disasters, and water security and environmental resilience. The main threats to the focal biodiversity values of the SCWHS&NR were identified as:

- Inappropriate fire regimes;
- Over-abstraction of surface and groundwater;
- Illegal harvesting of indigenous flora;
- Hunting and/or collection of indigenous fauna;
- Invasive alien flora and fauna;
- Inappropriate agricultural activities such as land clearing;
- Over-stocking and over-grazing;
- Lack of genetic mixing in Cape mountain zebra subpopulations;
- Hybridisation risk between Cape mountain zebra and other zebra species;
- Habitat fragmentation and alteration; and the
- Impact of the commercial bee industry on indigenous pollinators.

Clear measurable outcome-based goals, strategies and objectives were based upon the information derived from the viability and threats assessment of the focal values. A desired future condition was established for focal values by setting measurable, time-bound goals directly linked to the values and their key attributes. Goals are underpinned by strategies affected by management actions and essential activities.

The goals for the SCWHS&NR:

1. By 2030 the invasive alien plant infestation will be maintained at less than 2% and all high altitude team (HAT) sites would have been cleared 99%.
2. By 2030 the veld age will be in an ecologically healthy condition and 50% of the *Protea* indicator species have flowered more than three times; 80% of fires have occurred in the correct fire season and the size of 90% of single fires would not have exceeded 5000 ha.
3. By 2030 the ecosystem health condition of all wetlands in the SCWHS&NR will have a near natural condition and have good wetland buffers. (Wetlands include seepage areas.)
4. By 2030 river flow of abstracted rivers is maintained above 80%.

5. By 2030 there will be an established groundwater monitoring programme to improve the understanding of groundwater dependent ecosystems.
6. By 2030 three priority properties will have signed perpetuity stewardship agreements and another two as biodiversity agreements or higher within priority corridors.
7. By 2030 Cape mountain zebra will have 10-20 breeding family groups with a ratio of 1:3 (stallion: mares) and bachelor herds present with no unnatural mortalities and between 5-10% births* per year with the entire population body condition** falling in 2 or above. (* 5-10% of total populations on Gamkaberg and Kammanassie; ** body condition 1 = very thin/poor, 2 = lean/moderate, 3 = healthy/good).
8. By 2030 allelic diversity in some Cape mountain zebra populations is increased.
9. By 2030 no hybrid individuals of Cape mountain zebra would have been recorded and allelic diversity has been restored at meta-population level.
10. By 2030 all rivers within the SCWHS&NR are maintained in a healthy state to support fish species of conservation concern.
11. By 2030 all domestic livestock, extra-limital and invasive faunal species are removed or appropriately managed within the SCWHS&NR.
12. By 2030 an integrated compliance and enforcement programme is being implemented.
13. By 2030 biodiversity and ecosystems and sustainable and regulated resource use are in accordance with applicable legislation, CapeNature policies and procedures.
14. By 2030 all human disturbance to heritage features within the SCWHS&NR is limited to maintain, or where feasible, improve condition.
15. By 2030 anti-litter, energy and water saving campaigns within the SCWHS&NR are contributing towards a healthy environment.
16. By 2030 the natural and scenic landscapes are recognized and preserved as important landscape features providing ecosystem services that support human wellbeing.

Achieving human wellbeing, derived from healthy responsibly-managed ecological infrastructure and heritage, requires that:

1. By 2030 access to environmentally responsible infrastructure*, intact ecosystems and optimal biodiversity adding economic value to ecotourism

products and socio-economic development is sustainably facilitated and maintained. (* Aligned with the zonation scheme).

2. By 2030 the SCWHS&NR provides managed opportunities for accessing nature and nature-based activities in a manner which is not harmful to the natural environment.
3. By 2030 the coordinated disaster management plan will promote and facilitate security from natural disasters, for example (but not limited to) wild fire, drought and flooding for the benefit of the target communities.
4. By 2030 the SCWHS&NR will, through integrated catchment management, protect and enhance the provision of water quality and quantity contributing to the water resilience for the Breede-Gouritz catchment management area.

The remainder of section five presents the results of the sensitivity analysis of the SCWHS&NR. The sensitivity analysis was based on biodiversity, heritage and physical informants and allows for direct comparison of sites both within and between reserves to support CapeNature's planning at local and regional scales. The method ensures that the location, nature and required mitigation for access, activities, and infrastructure development within protected areas can be guided by the best possible landscape-level biodiversity informants.

Section six outlines the zoning plan for the SCWHS&NR. The protected area network forms part of a planning matrix and locating the SCWHS&NR in terms of the municipal integrated development plan is aimed at minimising conflicting development in either the protected area or the neighbouring municipal area. It furthermore establishes a coherent spatial framework within and around the protected area network to guide and co-ordinate conservation, tourism and visitor experience, access and utilisation, and stakeholder and neighbour relations. It intends to minimise user conflict by separating potentially conflicting activities such as wildlife viewing, recreational activities and tourism accommodation, whilst ensuring that activities and utilisation continues in appropriate areas and do not conflict with the goals and objectives of the SCWHS&NR.

Section seven describes infrastructure and procedures necessary for management of the SCWHS&NR, inclusive of operations and visitors. It provides information on access facilities, operational facilities, control measures as well as commercial and community use.

Section eight deals with expansion of the SCWHS&NR and is aligned with CapeNature's 2015-2020 Protected Areas Expansion Strategy. Sites have been identified through systematic conservation planning and include sites that contain Critical Biodiversity Areas. The main mechanism for expansion for this is through the acquisition of priority areas through stewardship.

Section nine presents the concept development plan, which sets out the long-term plan for the development of the SCWHS&NR in keeping with the purpose of the SCWHS&NR and with due consideration for protected area expansion and the zoning plan.

Section 10 presents the Strategic Plan for the SCWHS&NR. The strategic plan was derived from an assessment of the conservation situation, inclusive of the biological environment and the social, economic, cultural and institutional systems that influence values. Strategic intervention points formed the basis for developing strategies from which detailed actions with timeframes were developed to guide implementation, monitoring and evaluation. The strategies of the SCWHS&NR that were identified to abate critical threats to focal values are:

Strategy 1: Through partnerships address the negative impacts that invasive alien vegetation has on fire regimes, biodiversity and water availability within the SCWHS&NR and Zone of Influence (ZOI).

Strategy 2: In collaboration with partners promote and implement ecologically sound fire management through integrated fire management operations and awareness raising within the SCWHS&NR and ZOI.

Strategy 3: Through partnership address agricultural and urban (including industrial) water use best practice, pollution incidents and compliance within the ZOI.

Strategy 4: Determine through partnerships and collection of empirical evidence the impact of groundwater abstraction on groundwater dependent ecosystems.

Strategy 5: Through partnership promote the establishment of ecological corridors to allow for seasonal migration and growth of Cape mountain zebra subpopulations.

Strategy 6: Maintain genetic diversity in the Cape mountain zebra meta-population in collaboration with relevant Biodiversity Management Plan (BMP) partners.

Strategy 7: In collaboration with relevant BMP partners, quantify the extent of genetic contamination due to hybridisation with other equine species and safeguard Cape mountain zebra in their natural distribution range.

Strategy 8: Through existing partnerships implement alien invasive fish control and or removal guided by legislation and policy in priority rivers.

Strategy 9: Through partnerships and elevated extension work, address alien invasive, domestic and extra-limital fauna within the SCWHS&NR and its ZOI in line with relevant legislation and policies (LandCare, Agriculture and research institutions).

Strategy 10: Address illegal and unsustainable resource utilisation practices which includes domestic animals, extra-limital game, poaching, over-grazing and land degradation within the SCWHS&NR and its ZOI through partnerships and elevated extension work (LandCare, Agriculture and research institutions).

Strategy 11: Ensure the conservation of biodiversity and ecosystems and the sustainable and regulated use of resources within the SCWHS&NR and its ZOI through the development and strengthening of partnerships.

Strategy 12: Through partnerships share, evaluate and enhance the management and protection of cultural and natural heritage values both internally and externally.

Strategy 13: Promote the values of a healthy environment for the benefit of present and future generations within the SCWHS&NR and ZOI through partnerships.

Strategy 14: Through partnership and elevated extension work, address illegal and inappropriate agricultural and development activities (such as land clearing, riparian and instream modification, tourism developments) within the SCWHS&NR and its ZOI. (i.e. LandCare, Agriculture and research institutions, Department of Environmental Affairs & Development Planning).

Strategy 15: Promote the Protected Areas Expansion Strategy in collaboration with neighbouring landowners to support ecological processes and maintain living landscapes.

Section 11 provides an overview of costing and fund allocation for strategies. It outlines the existing financial resources (current budget), funding shortfalls, sources of alternate funding and future financial projections.

Finally, section 12 contains the references, Appendix 1 has a list of the land parcels constituting the SCWHS&NR, Appendix 2 contains the maps discussed in the management plan and Appendix 3 contains the stakeholder engagement report.

1 INTRODUCTION

In working towards CapeNature's vision of conserving nature for a sustainable future, CapeNature's protected area management, in accordance with the purpose of the protected area, strives to:

- Conserve and represent natural habitats and indigenous biodiversity including threatened species for their scientific and conservation value in the Western Cape Province;
- Conserve representative samples of significant ongoing ecological processes in the evolution and development of ecosystems and communities of plants and animals;
- Provide ecosystem services that benefit people of the Western Cape;
- Manage protected areas effectively and efficiently, including the interrelationships between biophysical, social and economic environments;
- Ensure that protected area planning and management is integrated and participatory; and
- Provide for sustainable use and equitable access.

The management plan is a strategic adaptive management framework for the protected area, guided by the Open Standards for the Practice of Conservation (hereafter referred to as the Open Standards) (Conservation Measures Partnership (CMP) 2013) adaptive management paradigm. The Open Standards is dependent upon, and promotes stakeholder engagement and participatory planning in the development of the plan. The framework further stimulates the incorporation of mechanisms to facilitate stakeholder engagement and participation during operationalisation of the plan.

The Swartberg Complex World Heritage Site and Nature Reserves (SCWHS&NR) protected area management plan serves as a reference to the management and development of the protected area in its current and envisaged future state. It directs management at all levels. The management plan addresses:

- The mandate, human capacity and financial resources that are required to meet goals and objectives based on the condition of natural and cultural values, and core service areas requiring a focused effort;
- The delivery of socio-economic benefits to neighbouring communities;
- Flexibility of service delivery that encourages innovation and involvement by a wide range of government, community and non-government sectors;
- Performance indicators and accountability measures that provide for regular review and adaptive management.

2 LEGAL STATUS AND BACKGROUND

This Section provides a record of the legal status of the protected area, as well as its description, location and includes any areas designated by South Africa in terms of international agreements. Furthermore, it also provides an overview of the biophysical, biodiversity, heritage and socio-economic context.

2.1 Legal Status

2.1.1 Name and legal designations

The CFRPA WHS as inscribed in 2004 was proclaimed in terms of the World Heritage Convention Act, 1999 (Act No. 49 of 1999) in Government Gazette no. 31832, proclamation 72 of 30 January 2009.

The Swartberg Complex was inscribed as part of the CFRPA WHS by the World Heritage Convention, UNESCO (United Nations Educational, Scientific and Cultural Organisation) in 2004. It included the following protected areas, covering a total area of 112 285.2 ha:

- **Gamkapoort Nature Reserve** (established in terms of Section 6 (1) of the Nature Conservation Ordinance, 1974 (Ordinance No. 19 of 1974) on 22 September 1992 and proclaimed in the Provincial Gazette 4770 by Proclamation No. 93/1992);
- **Gamkaskloof (“Die Hel”) Nature Reserve** (established in terms of Section 6 (1) of the Nature Conservation Ordinance, 1974 (Ordinance No. 19 of 1974) on 12 April 1994 and proclaimed in the Provincial Gazette 4854 by Proclamation No. 37/1994);
- **Groot Swartberg State Forest Reserve** (proclaimed a State Forest Reserve in Government Notices under various Forest Acts between 1912 and 1978, but later released in terms of Government Notice No. 596 dated 5 May 2006); and
- **Swartberg East State Forest Reserve** (proclaimed a State Forest Reserve in Government Notices under various Forest Acts between 1912 and 1978, but later released in terms of Government Notice No. 596 dated 5 May 2006).

In 2015 the Swartberg Complex WHS was extended through the addition of several other protected areas:

- **Towerkop State Forest Reserve** (proclaimed a State Forest Reserve in Government Notices under various Forest Acts between 1912 and 1978, but later released in terms of Government Notice No. 596 dated 5 May 2006);
- **Paardenberg State Forest Reserve** (proclaimed as part of Towerkop State Forest Reserve under the Forest Act of 1984, but later released in terms of Government Notice No. 596 dated 5 May 2006);
- **Rooiberg State Forest Reserve** (proclaimed as part of Towerkop State Forest Reserve in Government Notices under various Forest Acts between 1890 and 1978, but later released in terms of Government Notice No. 596 dated 5 May 2006);
- **Kammanassie (‘Langkloof’) State Forest Reserve** (proclaimed a State Forest Reserve in Government Notices under various Forest Acts between

1923 and 1978, but later released in terms of Government Notice No. 596 dated 5 May 2006);

- **Groenefontein Provincial Nature Reserve** (established in terms of Section 6 (1) of the Nature Conservation Ordinance, 1974 (Ordinance No. 19 of 1974) on 1 August 2008 and proclaimed in the Provincial Gazette 6550 by Proclamation No. 10/2008); and
- **Gamkaberg Provincial Nature Reserve** (established in terms of Section 6 (1) of the Nature Conservation Ordinance, 1974 (Ordinance No. 19 of 1974) on 12 April 1994 and proclaimed in the Provincial Gazette 4854 by Proclamation No. 37/1994).

The inscription of these additional protected areas by UNESCO increased the total size of the Swartberg Complex WHS to 187 578.96 ha. Currently the extension is in the process of being proclaimed in terms of the above-mentioned Act. A full list of the land parcels included in the WHS, as well as their declarations and status are presented in Appendix 1 Table 1.

In recent years several properties have been acquired for conservation purposes in order to expand and consolidate the protected areas (e.g. Vaalhoek, Triangle, Kwessie, Fontein, Heimersrivier, Rooilifantskloof Nature Reserves; Appendix 2 Map 1). These properties (totalling 10 729.28 ha in size) have not been included as part of the land parcels inscribed as WHS, but form part of the protected area network managed by CapeNature. Some have already been and others are in the process of being proclaimed as Provincial Nature Reserves. Appendix 1 Table 2 provides a list of these land parcels.

The spatial boundaries for the individual land parcels within the CapeNature reserve layers were extracted from the cadastral boundaries spatial layer provided by the Surveyor-General (SG) (Office of the Chief Surveyor-General 2011). According to the Land Survey Act, 1997 (Act No. 8 of 1997), and the South African Spatial Data Infrastructure established as per the Spatial Data Infrastructure Act, 2003 (Act No. 54 of 2003), the Surveyor-General is the custodian of all cadastral surveying and land information.

Each land parcel boundary was verified against available proclamations and SG diagrams. Any differences between the SG cadastral boundaries and the proclaimed areas of the SG diagrams were corrected accordingly. The areas for each land parcel were calculated using geographical information system (GIS) with the projection set to Universal Transverse Mercator, zone 34 South.

Mountain Catchment Areas (MCA)

Following Government Notice No. 1938 of 29 September 1978, a series of private properties adjacent to the SCWHS&NR were declared Mountain Catchment Areas under the Mountain Catchment Areas Act, 1970 (Act No. 63 of 1970 (as amended)). These are all shown in Appendix 2 Map 1, and form part of the buffer area around the protected area network.

2.1.2 Contractual agreements

The properties mentioned above that were purchased for conservation purposes by the WWF-SA, Department of Public Works and the Berning and Stauth families (i.e. Vaalhoek, Triangle, Kwessie, Fontein, Heimersrivier, Rooiolifantskloof) are managed by CapeNature, based on a 99 year lease contract.

2.1.3 Location, extent and highest point

The SCWHS&NR is located on the east-west axis of the Cape Fold Mountains along the border between the Cape Floral Region and the semi-arid Karoo in the Western Cape Province of South Africa. This protected area network falls within the Klein Karoo area north of the Langeberg-Outeniqua Mountain Ranges and consists largely of the Swartberg Mountain Range along the northern boundary and the Rooiberg-Gamkaberg and Kammanassie as insel mountains in the centre. The total size of the SCWHS&NR is 198 308.24 ha (Appendix 2 Map 1).

This massive protected area network is situated between Laingsburg and Ladismith in the northwest and west, Prince Albert in the north, Willowmore in the northeast, Uniondale in the southeast and Vanwyksdorp in the southwest. Oudtshoorn is the main town, located in the centre.

For reference and management purposes the SCWHS&NR has been split into three clusters, with the larger clusters consisting of different sectors and will be referred to as such throughout the management plan (Appendix 2 Map 1):

- **Swartberg Cluster** consisting of Towerkop, Groot Swartberg, Swartberg East, Gamkaskloof and Gamkapoort sectors (total size: 131 255.71 ha);
- **Gamkaberg Cluster** consisting of Gamkaberg, Fontein, Heimersrivier, Rooiberg, Groenefontein, Kwessie, Triangle, Vaalhoek, Paardenberg and Rooiolifantskloof sectors (total size: 39 997.01 ha); and
- **Kammanassie Cluster** consisting of Kammanassie sector only (total size: 27 055.51 ha).

Seweweekspoort peak, located in the Towerkop sector of the Swartberg Cluster is the highest peak in the Western Cape Province and reaches an altitude of 2 324.9 metres above sea level (m.a.s.l.). Mannetjiesberg peak on Kammanassie is 1 955.3 m.a.s.l., while the Rooiberg peak within the Gamkaberg Cluster reaches an altitude of 1 489.6 m.a.s.l.

2.1.4 Municipal jurisdiction

The SCWHS&NR is situated predominantly within the Western Cape Province, with only a small narrow strip of the eastern extent of Swartberg East occurring in the Eastern Cape Province.

In the Western Cape Province the SCWHS&NR falls within the following district and local municipal boundaries:

- Garden Route District Municipality:
 - Oudtshoorn Local Municipality,

- Kannaland Local Municipality, and
- George Local Municipality.
- Central Karoo District Municipality:
 - Prince Albert Local Municipality and
 - Laingsburg Municipality.

In the Eastern Cape Province the northeastern section of Swartberg East occurs in the Sarah Baartman District Municipality and Dr Beyers Naudé Local Municipality.

Municipalities within which the SCWHS&NR occurs are shown in Appendix 2 Map 1.

2.1.5 International, national and provincial listings

UNESCO World Heritage Site

The Swartberg Complex WHS is inscribed as a WHS as part of the CFRPA WHS. The CFRPA WHS comprises a serial property covering a total area of approximately 557 584 ha, and includes a buffer zone of 1 315 000 ha designed to facilitate functional connectivity and mitigate the effects of global climate change and other anthropogenic influences (Department of Environmental Affairs (DEA) 2015).

The Swartberg Complex WHS:

- Represents outstanding examples of significant ongoing ecological and biological processes in the evolution of terrestrial ecosystems and plant communities (Department of Environmental Affairs & Tourism (DEAT) 2003) such as a natural fire regime and natural flow of water through the area, supporting unique indigenous freshwater fish assemblages and agricultural sectors, and connectivity for species migration, gene flow, dispersal, etc.
- Contains important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value (DEAT 2003). The SCWHS&NR is a centre of endemism for plants, amphibians, small mammals and importantly, endemic and threatened freshwater fish.

UNESCO Biosphere Reserve

The Gouritz Cluster Biosphere Reserve (GCBR), a landscape-scale initiative aimed to create a biodiversity corridor along the Gouritz River, where naturally occurring indigenous plants and animals could disperse freely from conservation areas of the inland mountains to the coastal mountains resulted in the designation of South Africa's 7th biosphere reserve in June 2015, totalling 3 187 893 ha. The GCBR is characterised by high levels of plant endemism and is the only area in the world where three global biodiversity hotspots, the Fynbos, Succulent Karoo and Maputoland-Tongoland-Albany Subtropical Thicket biomes, converge.

The SCWHS&NR forms a sizeable part of the Core Areas of the GCBR.

2.2 Biophysical Description

2.2.1 Climate

2.2.1.1 Rainfall

The entire SCWHS&NR falls within the Klein Karoo and is characterized by orographic rainfall gradients and rain shadow effects. The upper slopes and mountain crests receive much higher rainfall (>1000 mm) than the lower lying central valley areas (100–300 mm per year). Cold fronts bring winter rainfall that are associated with low-pressure systems and westerly winds. Summer rainfall is dominated by moisture from the east and convective systems that are less affected by orographic gradients (Le Maitre *et al.* 2009).

Thunderstorms occur during the summer months with lightning striking the high mountain peaks. In terms of global warming, climate modelling studies indicate that summer thunderstorms are likely to become more intense in the future, particularly those areas transitioning towards summer rainfall, thus potentially having a detrimental effect on the natural fire regimes of the protected areas.

High rainfall events normally caused by cut-off low weather systems result in flooding of the lower lying areas of the SCWHS&NR. Such extreme cases of flooding causes erosion and sedimentation downstream affecting the quality of water to the communities that surround the protected areas.

The Klein Karoo is often faced with extensive periods of drought and heat waves. For all three clusters the total annual rainfall figures have dropped during the period of 2015 to 2018, thus highlighting the extensive drought conditions currently experienced in the Klein Karoo.

Rainfall data analysed for the entire SCWHS&NR are documented below. Note the period of rainfall data collected is indicated in brackets behind each station name.

Swartberg Cluster rainfall

The Swartberg Mountain Range spans an impressive east-west gradient of more than 200 km in distance. Due to this extensive range, rainfall data are collected from a total of 15 weather stations to determine the seasonal distribution of rainfall for Towerkop, Groot Swartberg and Swartberg East. The locations of these stations are shown in Appendix 2 Map 2(a-c).

Total annual rainfall measured at all the weather stations on the Swartberg Cluster shows a decline in rainfall. In 1950 rainfall was only measured at two weather stations; on the southern (Albertberg) and northern (De Wetsvlei) sides of the Swartberg along the Swartberg pass. Since 1977 more stations have been added over the years up to the 15 rain gauges that are being read to date. Figure 2.1 shows the total annual rainfall measured from 1979 to 2018, as well as the average annual rainfall and the trendline for this 40 year period. The trendline indicates a decline in the average annual rainfall of 170 mm since 1979. The rainfall appears to peak every 5 or 10 years, but the continual decline is evident. There appears to be a link between the rainfall decline and the increase in fire sizes over the last four decades (see section 2.3.1.5).

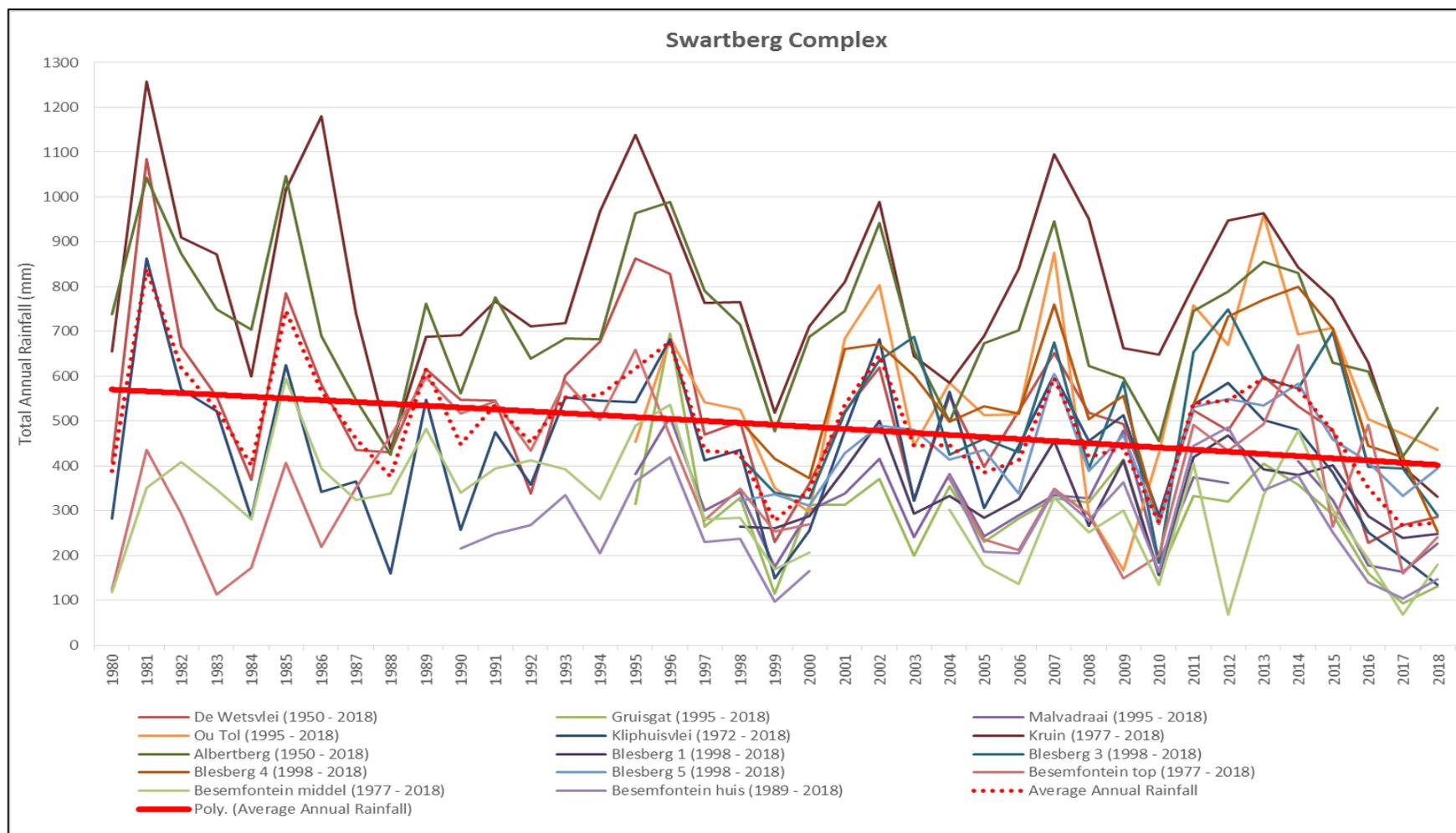


Figure 2.1: Total annual rainfall measured at various weather stations along the Swartberg Mountains from 1979 to 2018. Average annual rainfall and the trendline are also indicated. Note the peaks in rainfall every 5 or 10 years.

For Towerkop, three rainfall stations located within different habitats and at varying altitudes at Besemfontein were analysed to show the monthly averages of rainfall received from 1978 to 2018 (Appendix 2 Map 2(a)). Data show that the rainfall of Towerkop peaks in April, June and October-November (Figure 2.2). Note the peak in rainfall in June.

For the Groot Swartberg, eight rainfall stations were selected to show both altitudinal and north-south variations (Appendix 2 Map 2(a-b)). Rainfall peaks occur in autumn and summer with monthly averages being higher during April, October and November.

The Gamkapoort Dam station located on the northern side of the Swartberg Mountains (Appendix 2 Map 2(a)) shows that rainfall is low throughout the year but extremely low during July to November. The Gruisgat and Malvadraai stations are both situated on the northern slopes of the Groot Swartberg and also present lower rainfall compared to the stations situated higher up in the catchment areas (Appendix 2, Map 2(b)). The Kruin station is situated at the highest point in the Groot Swartberg near the Swartberg pass and shows a peak in rainfall during April and November (Figure 2.2).

There are four stations situated in Swartberg East at Blesberg (Appendix 2, Map 2(c)). All four stations' data show that there are two rainfall peaks namely in March-April and October-November (Figure 2.2).

To summarise, the Swartberg Cluster rainfall peaks in April and October, but for Towerkop there is also a peak in June. The northern slopes of the Swartberg Mountain Range are much drier than the southern slopes and the higher altitudes receive markedly more rainfall compared to the stations situated at lower altitudes.

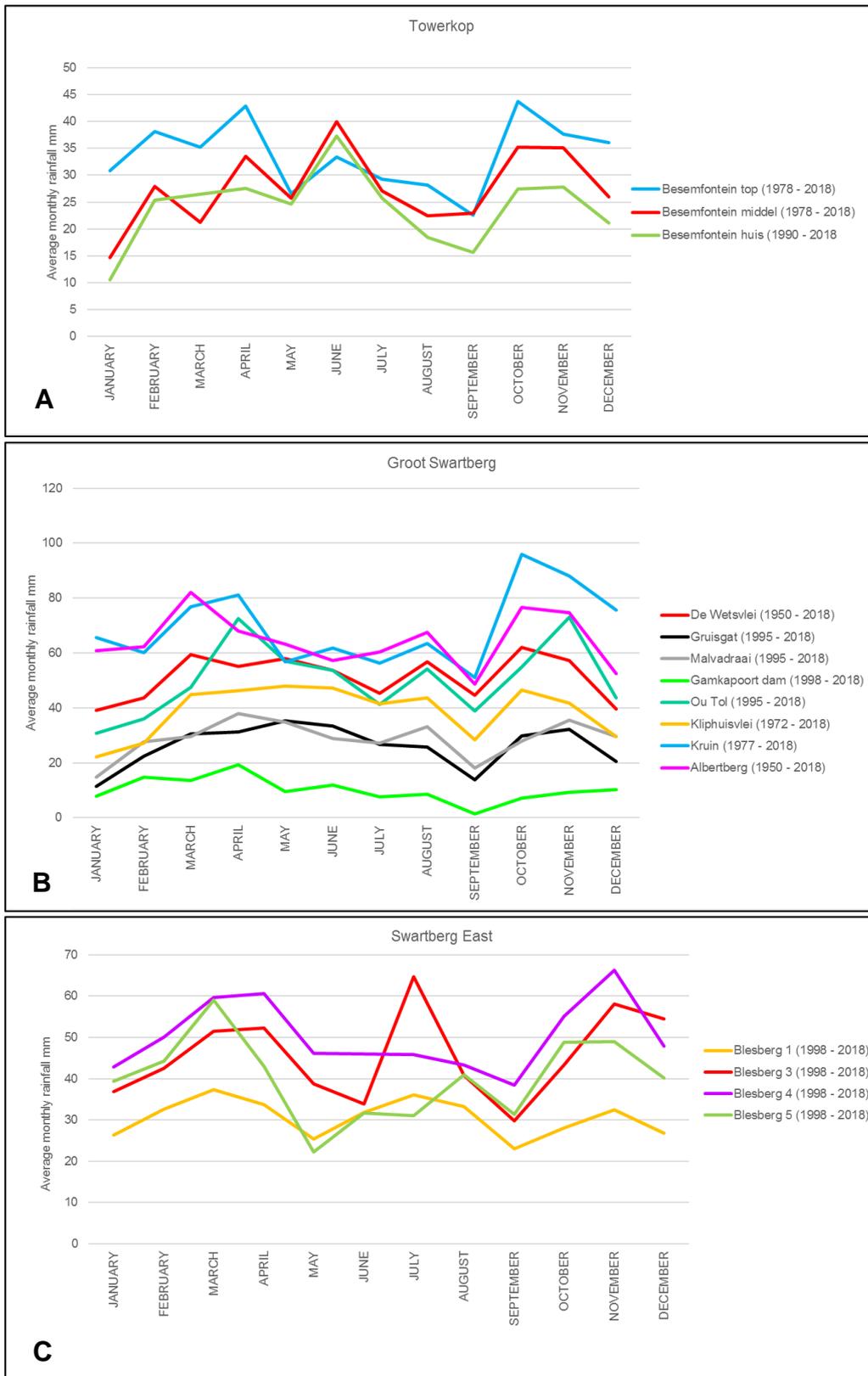


Figure 2.2: Monthly rainfall averages for stations located on Towerkop (A), Groot Swartberg (B) and Swartberg East (C).

Gamkaberg Cluster rainfall

Gamkaberg Cluster is situated between the Swartberg and the Langeberg-Outeniqua Mountain Ranges. Data from six weather stations distributed throughout the Gamkaberg at varying altitudes and in various habitats were used to reflect monthly averages (Appendix 2 Map 2(d); Figure 2.3).

Two stations were analysed for the Gamkaberg sector namely the northern low-lying Gamkaberg Office station and the higher-lying Bakenskop station. Data show that the rainfall at the two stations follow the same trend, but that the higher-lying Bakenskop station receives more rainfall. For the Groenefontein sector the Opstal and Blackburniae stations show altitudinal and aspect differences in rainfall. Blackburniae station situated at 765 m.a.s.l. received more rainfall compared to the lower-lying Groenefontein opstal station (318 m.a.s.l.). For the Rooiberg sector, two high-lying stations at Ararat and Rooiberg hut were added to the data set.

In summary, the higher-lying catchments of the Gamkaberg cluster receive much more rainfall than the lower valley areas, but with peaks in March, June, August and November.

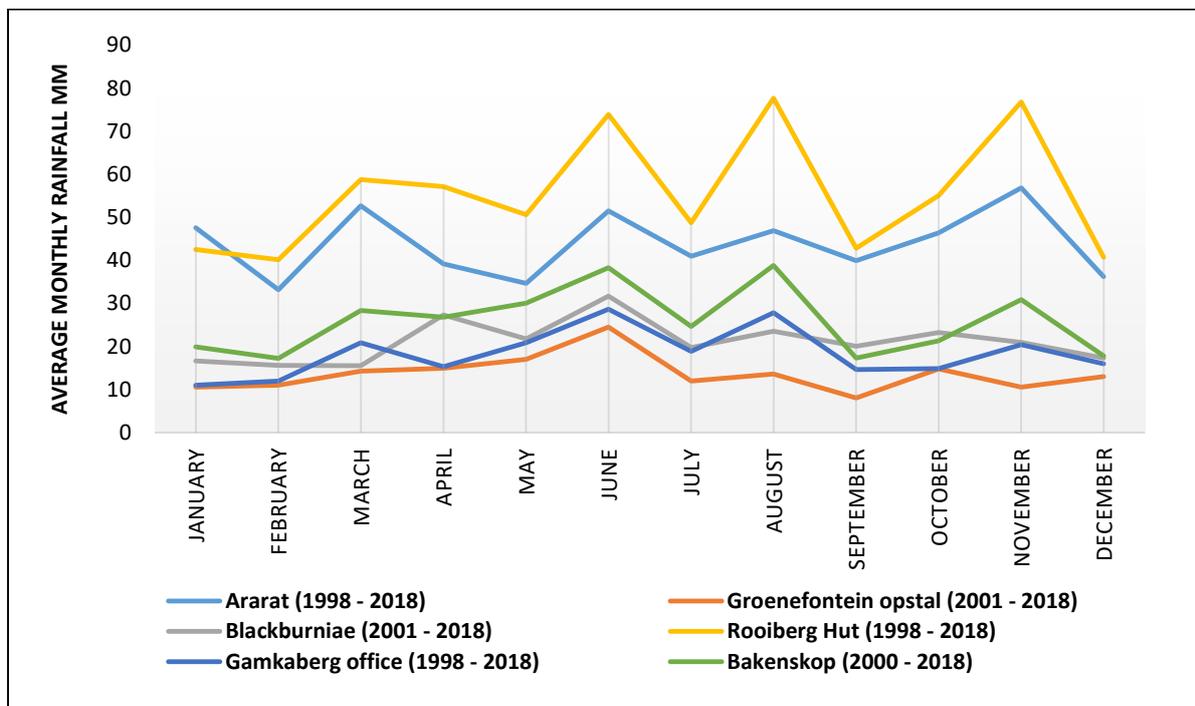


Figure 2.3: Average monthly rainfall for the Gamkaberg Cluster (1998 – 2018).

Kammanassie Cluster rainfall

The Kammanassie is also located between the Swartberg and Outeniqua Mountain Ranges but east of the Gamkaberg. Six weather stations situated at varying altitudes and within different habitats were analysed to present the rainfall pattern for the Kammanassie (Appendix 2 Map 2(c); Figure 2.4). These stations are Paardevlakte 1

and 2, Elandsvlakte, Buffelsklip, Vermaaksrivier on the mountain and at the Kammanassie office in Uniondale. Rainfall on the northern side of the Kammanassie (Buffelsklip) is much less compared to that received in the plateau areas of the catchment (Paardevlakte 1 and 2). Rainfall on the Kammanassie peaks in March, June and October-November.

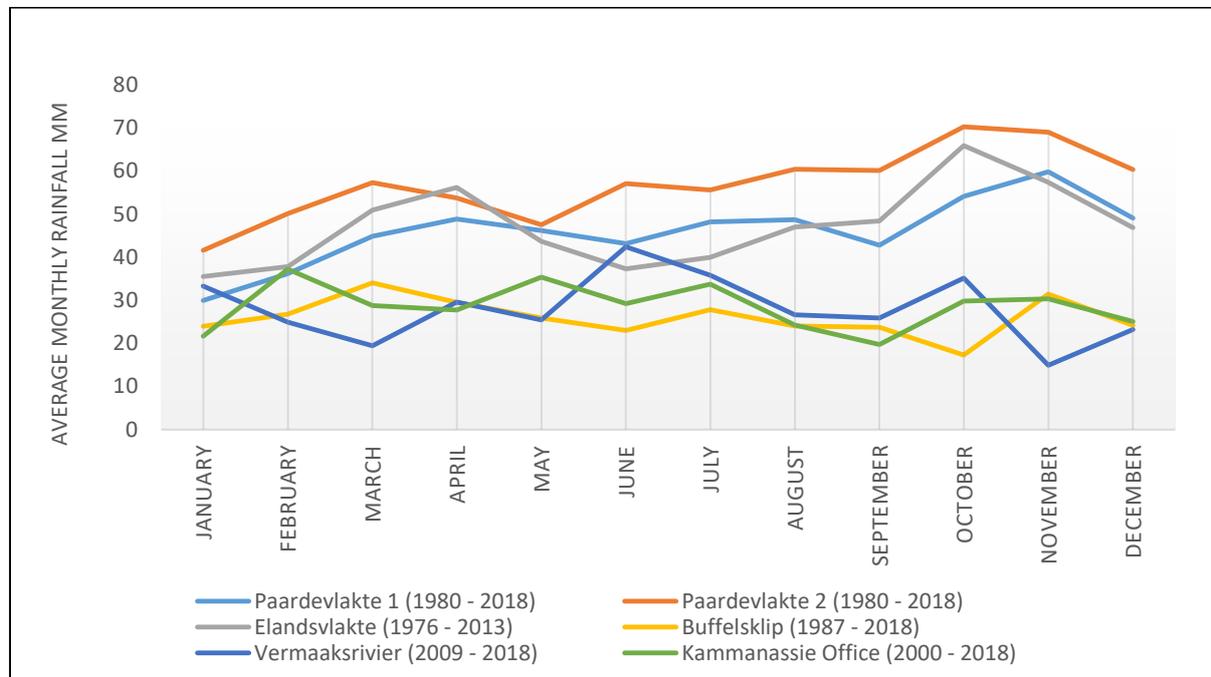


Figure 2.4: Average monthly rainfall for the Kammanassie Cluster (1976 – 2018).

Snowfall events occur mainly from May to September, but mostly in June, July and September.

2.2.1.2 Temperatures

The hottest months for the SCWHS&NR are December to February with maximum temperatures recorded of up to 45°C. The coldest months are June and July with minimum temperatures reaching -4°C. Bergwinds are hot, dry winds that blow from the interior and occur mainly from April to September. Bergwinds are followed by a low pressure system and accompanying cold fronts. Temperatures during bergwinds can exceed 30 °C.

2.2.2 Topography

The SCWHS&NR forms part of the Cape fold belt which is an extensive mountain chain of highly folded landforms formed as a result of continental collisions during the assemblage of Gondwana between 280 and 215 Ma (Bradshaw & Cowling 2014). Over time denudation of the less erosion-resistant lithology exposed the more erosion-resistant lithology and ultimately shaped the topography of the SCWHS&NR through the formation of a rugged mountain terrain characterised by incised valleys and elevated mountain peaks (Figure 2.5; Appendix 2 Map 3(a-d)).



Figure 2.5: The rugged mountainous terrain dominating the landscape of the Swartberg Complex World Heritage Site and Nature Reserves. (Photo: Prof Peter Linder)

The highest peak (i.e. Seweweekspoort peak) stands at an elevation of 2 324.9 m.a.s.l. and is also the highest in the Western Cape Province. Seweweekspoort peak is located in the Towerkop sector of the SCWHS&NR. Mannetjiesberg peak at an elevation of 1 955.3 m.a.s.l. is the highest peak within the Kammanassie Cluster while Rooiberg peak at an elevation of 1 489.6 m.a.s.l. is the highest elevation within the Gamkaberg Cluster. Towerkop peak standing at an altitude of 2 189 m.a.s.l. is the most well-known peak, perhaps most popular amongst the mountain and rock climbing community.

The lowest elevations within the protected area occur along the valley floors of the tributaries of the Gouritz River. These lowest points are at elevations of 139, 289 and 556 m.a.s.l. within the Gamkaberg, Swartberg, and Kammanassie Clusters respectively.

2.2.3 Geology and soils

According to the Council for Geoscience's 1:1 000 000 geological map, the Nardouw sub-group is the most extensive geology of the SCWHS&NR covering an area of 90 807 ha followed by the Table Mountain Group (TMG) covering 73 386 ha, the Cango caves group covering 13 856 ha, and the Ceres sub-group with an area coverage of 12 013 ha. The Nardouw sub-group comprising of metamorphic rock (i.e. quartzitic sandstone) and sedimentary rock (i.e. shale) is relatively less erosion-resistant compared to the TMG that is mainly composed of quartzitic sandstone. The Ceres

sub-group consisting mainly of sedimentary rocks such as sandstone and shale is the second least erosion-resistant of the four most extensive geology of the SCWHS&NR. The least erosion-resistant geology is the Cango caves group that is mainly composed of sedimentary rocks such as sandstone, shale, limestone, and conglomerate lenses (Appendix 2 Map 4(a-d)).

The highest peaks within the protected area network coincide with the more erosion-resistant TMG while most of the lowest peaks are confined within river valleys that coincide with the less erosion-resistant sedimentary rocks of the Ceres sub-group. This suggests that the interaction between the Gouritz River system and the various geological materials within the SCWHS&NR played a fundamental role in shaping local topography.

The rugged mountainous terrain and the geological characteristics of the SCWHS&NR appeared to have played a major role in shaping soil characteristics ultimately influencing the biological diversity of the area. As a result of steep slopes typically of quartzitic sandstones of the TMG, soils generally form a thin (<1 m) veneer of silty sands/sandy silts. Locally clayey soils occur in association with weathered shale horizons, and in particular the Cederberg formation. Lithosols (Mispah and Glenrosa forms) are dominant on the steep slopes. Although they are shallow, infertile, acidic and have minimal B-horizon development, with a low water retention capacity, lithosols support the highly diverse Cape flora. The soil is deeper at the foot of the mountain in kloofs and along the southern aspects where a fairly deep red-yellow sandy to sandy loam soil (Hutton, Clovely and Griffin forms) occurs (Southwood *et al.* 1991).

2.3 Biodiversity Context: Ecosystems

2.3.1 Vegetation

The SCWHS&NR falls within the Core Cape Subregion (previously termed the Cape Floristic Kingdom) of the Greater CFR (Manning & Goldblatt 2012).

The Core Cape Subregion is one of the world's smallest but richest floral kingdoms, encompassing a land area of approximately 90 760 km² (less than 4% of the southern African subcontinent). An estimated 9 383 species of vascular plants (ferns and other spore-bearing vascular plants, gymnosperms, and flowering plants) are known to occur here, of which just over 68% are endemic. The majority of these species are flowering plants.

The SCWHS&NR is located in the heart of the Klein Karoo, where the Fynbos, Succulent Karoo and Maputuland-Tongoland-Albany Thicket (alias Subtropical Thicket) biomes, three globally recognised biodiversity hotspots, come together (Vlok & Schutte-Vlok 2010).

The vegetation of the area has been mapped nationally at a 1:1 000 000 scale (Mucina & Rutherford 2006; SANBI 2006-2018) and regionally at a fine-scale at 1:50 000 (Vlok *et al.* 2005).

2.3.1.1 National Vegetation Map

The original 2006 national vegetation map (Mucina & Rutherford 2006) was recently updated with substantive changes to vegetation types in the Namaqualand area and the Subtropical Thicket vegetation types in the Western Cape and Eastern Cape Provinces (SANBI 2006-2018). According to this map a total of 25 different vegetation types occur within the SCWHS&NR. These are listed in Table 2.1 and illustrated in Appendix 2 Map 5(a-d).

South Africa recognises that different ecosystems have differing species compositions and to effectively conserve biodiversity, the country has set targets for each ecosystem. The biodiversity target is the minimum proportion of each ecosystem type that needs to be kept in a natural or near-natural state over the long term to maintain viable representative samples of all ecosystem types and the majority of species associated with those ecosystems. The biodiversity target is calculated based on species richness, using species–area relationships, and varies between 16% and 36% of the original extent of each ecosystem type (Desmet & Cowling 2004).

Threat status is provided for each ecosystem according to the assessment of criterion A1 (habitat loss), which is considered the best available status for the Western Cape Province (Pence 2017). It is, however, of great concern that the habitat loss transformation layer does not take into account the impacts of over-grazing, especially in the Succulent Karoo and Subtropical Thicket vegetation types, where natural recovery would take decades, if it happens at all.

Table 2.1: Vegetation types conserved by the Swartberg Complex World Heritage Site and Nature Reserves. (VU = Vulnerable; LT = Least Threatened. * Data from vegmap2009_CN_2014stats_gw.xlsx; ** new updates based on Grobler *et al.* 2018.)

Vegetation type	WC Provincial Protection Target (ha) *	% of WC target conserved in SCWHS&NR	Ha conserved in SCWHS&NR	Ecosystem Status
Swartberg Cluster				
Central Inland Shale Band Vegetation	2 658.8	176.0%	4 679.6	LT
Eastern Little Karoo	24 879.2	0.003%	0.8	VU
Gamka Arid Thicket **	27 174.8	6.7%	1 809.7	LT
Kango Conglomerate Fynbos	10 951.4	19.1%	2 095.8	LT
Kango Limestone Renosterveld	14 551.3	8.3%	1 201.4	VU
Koedoesberge-Moordenaars Karoo	68 919.8	2.0%	1 392.5	LT
Matjiesfontein Quartzite Fynbos	34 216.5	2.1%	727.4	LT
Mons Ruber Fynbos Thicket **	5 435.8	359.9%	19 562.0	Unknown
Montagu Shale Renosterveld	5 598.9	0.5%	25.2	LT
North Swartberg Sandstone Fynbos	21 763.3	246.3%	53 609.4	LT

Vegetation type	WC Provincial Protection Target (ha) *	% of WC target conserved in SCWHS&NR	Ha conserved in SCWHS&NR	Ecosystem Status
Oudtshoorn Karroid Thicket **	10 859.2	416.1%	45 188.0	Unknown
Prince Albert Succulent Karoo	25 723.2	21.8%	5 597.8	LT
South Swartberg Sandstone Fynbos	28 433.3	157.3%	44 721.0	LT
Southern Karoo Riviere	47 767.9	1.0%	459.4	LT
Sundays Arid Thicket **	107 531.6	3.4%	3 672.0	Unknown
Swartberg Altimontane Sandstone Fynbos	1 473.2	301.5%	4 441.7	LT
Swartberg Shale Fynbos	2 027.5	33.1%	670.7	LT
Swartberg Shale Renosterveld	6 945.4	32.5%	2 256.0	LT
Willowmore Gwarrieveld	6 883.8	0.2%	10.6	LT
Gamkaberg Cluster				
Central Inland Shale Band Vegetation	2 658.8	47.0%	1 248.7	LT
Gamka Arid Thicket **	27 174.8	0.4%	98.3	LT
Montagu Shale Renosterveld	5 598.9	3.8%	215.1	LT
North Outeniqua Sandstone Fynbos	20 204.5	2.8%	568.6	LT
North Rooiberg Sandstone Fynbos	8 599.5	142.7%	12 275.0	LT
Oudtshoorn Karroid Thicket **	10 859.5	70.8%	7 691.0	Unknown
South Rooiberg Sandstone Fynbos	10 477.8	154.3%	16 165.0	LT
Western Gwarrieveld	12 145.0	14.3%	1 733.0	LT
Kammanassie Cluster				
Central Inland Shale Band Vegetation	2 658.8	33.1%	879.4	LT
Eastern Little Karoo	24 879.2	0.4%	110.0	VU
North Kammanassie Sandstone Fynbos	8 978.9	245.6%	22 053.9	LT
South Kammanassie Sandstone Fynbos	8 211.8	47.4%	3 887.9	LT
Willowmore Gwarrieveld	6 883.8	1.8%	125.5	LT

2.3.1.2 Regional Fine-scale Vegetation Map

A detailed, fine-scale vegetation map was compiled for the Klein Karoo at a 1:50 000 scale by Vlok *et al.* (2005). This map illustrates the complexity in the landscape resulting from the merging of the three biomes and the effect of key environmental

factors, such as the variation in geology, annual rainfall, temperature regimes and the dependence on fire (Vlok & Schutte-Vlok 2010). A total of 369 different vegetation/habitat units are identified and described (Vlok *et al.* 2005). Each of the habitat units consists of a unique assemblage of species, some of which are endemic to the particular habitat unit.

From a management point of view, this fine-scale map is more practical and useful to inform management actions and hence is used here (Appendix 2 Map 6(a-d)).

A brief description (taken from Vlok *et al.* 2005) as well as the conservation status (Reyers & Vlok 2008, Skowno *et al.* 2010) and a note on the current ecological condition of each of the vegetation units occurring within the three clusters are given below. Name changes of species documented in Manning and Goldblatt (2012) and subsequent published papers are included.

Full species lists are not provided in the management plan. If required, these are available on request from CapeNature Head Office.

2.3.1.2.1 Swartberg Cluster

A total of 48 vegetation units occur on the Swartberg Cluster, 42 of which are terrestrial and six aquatic (Appendix 2 Map 6(a-c)).

Terrestrial vegetation units

Fynbos biome (26 units)

- **Bosluiskloof Karroid Renosterveld (LT)** – This unit (744.8 ha) is restricted to Gamkapoort and is mostly dominated by renosterbos (*Elytropappus rhinocerotis*), but other shrubs (e.g. *Dimorphotheca cuneata*, *Eriocephalus africanus*, *Euryops lateriflorus*, *Euryops rehmannii*, *Felicia filifolia*, etc.) are also abundant. Patches of Succulent Karoo vegetation, in which succulents (e.g. *Antimima* spp., *Hererocha* sp., *Ruschia* spp., etc.) are prominent, are also present on north-facing slopes. A number of rare species occur in this unit, e.g. *Lotononis dissitinodis* and *Moraea thomasiae*, and the shrub *Acmadenia fruticosa* seems to be endemic to this unit. **Condition:** <1% infestation of *Prosopis* and *Atriplex*; parts of this unit have been impacted historically due to over-grazing and trampling by domestic stock, when government allowed farmers to use the area for emergency grazing. There is a serious need to address these impacts.
- **Eastern Swartberg Mesic Proteoid Fynbos (LT)** – This unit of 5 975.1 ha occurs only on Swarberg East and has *Leucadendron eucalyptifolium*, *Leucadendron salignum*, *Leucadendron tinctum*, *Protea intonsa*, *Protea neriifolia* and *Protea punctata* present as proteoid shrubs, and its own combination of rare species, such as *Agathosma affinis*, *Erica saxigena*, *Gladiolus nigromontanus*, *Paranomus esterhuyseniae* and *Leucadendron rourkei*. **Condition:** <1% infestation of *Pinus*; a Section of this unit has been subject to short return-interval fires over the past 20 years.

- **Groot Swartberg Mesic Proteoid Fynbos (LT)** - Species such as *Leucadendron eucalyptifolium*, *Leucadendron album*, *Leucadendron spissifolium*, *Protea eximia*, *Protea magnifica*, *Protea punctata* and *Spatalla barbiger* are present to locally dominant in this unit (17 976.7 ha) that is restricted to the Groot Swartberg. Rare and localised endemic species include *Cyclopia burtonii*, *Disa harveiana*, *Disa lineata*, *Geissorhiza nigromontana*, *Gladiolus nigromontanus*, *Liparia myrtifolia*, *Liparia racemosa*, *Otholobium swartbergense*, *Phyllica costata* and *Tritoniopsis apiculata* var. *minor*. **Condition:** <1% infestation of *Hakea* and *Pinus*; over the past 20 years large sections of this unit have burnt at short return-intervals of 10 or less years. Hence there is a need to revise the current natural burning zone management policy that is being implemented.

- **Gamkaskloof Arid Asteraceous Fynbos (LT)** – This unit (4613.7 ha) occurs mainly on the steep south-facing slopes in arid sites around Gamkaskloof, where the soils are shallow, sandy to loamy and usually very rocky, often with large slabs of sandstone prominent. The vegetation is dominated by drought resilient shrubs, with many succulents (e.g. *Aloe comptonii*, *Othonna* spp., *Senecio* spp.) often present in rocky outcrops. Prominent shrubs are *Agathosma capensis*, *Aspalathus hystrix*, *Euryops rehmanii*, *Felicia filifolia* and *Pteronia fascicularis*, with the distinctive *Acmadenia sheilliae* often present, but not abundant. *Elytropappus rhinocerotis* and *Eriocephalus africanus* are usually also present, but never abundant. Proteaceae and Ericaceae are absent or very rare (*Erica maesta*, *Leucadendron salignum*). Grasses (*Capeochloa arundinacea*, *Pentameris distichophylla*, *Pentameris eriostoma*, *Pentameris pallida*, *Themeda triandra*, etc.) are often abundant, but only prominent after fire. Geophytes are uncommon but there are a few rare species present (*Apodolirion lanceolatum*, *Gethyllis transkarooica*, *Gethyllis verrucosa* and *Moraea vlokii*). **Condition:** Good; <1% infestation of *Pinus*.

- **Gamkaskloof Arid Proteoid Fynbos (LT)** - Proteas, ericas and restios are all abundant in this unit (20 800.9 ha), with *Cannamois scirpoides*, *Erica cerinthoides*, *Erica melanthera*, *Hypodiscus aristatus*, *Hypodiscus striatus*, *Protea lorifolia*, *Protea repens*, *Leucadendron barkerae*, *Leucadendron salignum*, *Paranomus dregei* and *Thamnochortus rigidus* typical species. It is mainly restricted to the drier north-facing slopes of Groot Swartberg and is unique in having the following localized endemics and rare species present; *Athanasia virides*, *Cannamois grandis*, *Cliffortia aculeata*, *Cliffortia montana*, *Dimorphotheca montana*, *Dimorphotheca venusta*, *Erica insignis*, *Gasteria vlokii*, *Helichrysum simulans*, *Leucadendron cordatum*, *Otholobium swartbergense* and *Romulea vlokii*. **Condition:** Infestation of *Pinus* at <1%; certain parts of this unit have burnt at short fire-return intervals of 10 or less years over the past 20 years and hence, there is a need to monitor the impact on *Protea* indicator species in such areas.

- **Klein Swartberg Mesic Proteoid Fynbos (LT)** – This unit (4 183.6 ha) on Towerkop is easy to distinguish as it has species such as *Leucadendron eucalyptifolium*, *Leucadendron album*, *Protea eximia*, *Protea magnifica*, *Protea punctata* and *Spatalla barbiger* present. The proteoid component is quite unique

in having *Protea subvestita* present. It is furthermore distinct in having the following rare and localised endemic species present, *Brachysiphon microphyllus*, *Erica kirstenii*, *Gladiolus caryophyllaceus*, *Leucospermum secundifolium*, *Moraea exiliflora*, *Muraltia elsiae*, *Nivenia parviflora*, *Nivenia stenosphon* and *Ornithogalum rogersii*. **Condition:** Good; <0.1% infestation of *Pinus* and *Hakea*.

- **Horlosiekrans Fynbos-Renosterveld (LT)** – This unit of 253.6 ha is restricted to Gamkapoort. The matrix vegetation is dominated by renosterbos (*Elytropappus rhinocerotis*), but here the fynbos vegetation occurs mostly only on south-facing slopes of sandstone outcrops. *Erica speciosa*, *Leucadendron salignum*, *Protea canaliculata*, *Protea repens*, *Protea sulphurea* and *Thamnochortus rigidus* are abundant in the fynbos patches. The matrix Renosterveld has a rich assemblage of geophyte species, including the locally endemic *Hesperantha truncatula*. **Condition:** Unknown, but since it falls within the reserve that was subjected to emergency grazing historically, it is assumed to have been affected. This, however, needs to be assessed.
- **Klein Swartberg Arid Proteoid Fynbos (LT)** – This unit (7 788 ha) occurs on Towerkop and can hardly be confused with any other Arid Proteoid Fynbos unit as it has two Proteaceae species endemic, *Paranomus centaureoides* and *Protea aristata*. Other distinctive species present include *Arctotis pinnatifida*, *Cliffortia montana*, *Disa salteri*, *Erica syngenesia* and *Thamnochortus acuminatus*. **Condition:** Fair; <0.1% infestation of *Pinus* and *Hakea*. There is concern about the status of *Protea aristata* populations as certain parts of this area have burnt at short return-intervals which may have resulted in a decline in the populations.
- **Klein Swartberg Fynbos-Gwarrieveld (LT)** – About 401.4 ha of this unit occur on Towerkop. Woody trees (e.g. *Euclea undulata*, *Colpoon compressum* and *Searsia undulata*) are not very abundant. *Diosma prama* is present in the fynbos component, and succulent species (*Aloe comptonii* and *Crassula rupestris*) are abundant on rocky outcrops. Restioids (mostly *Cannamois scirpoides*, *Hypodiscus striatus* and *Restio ocreatus*) are also abundant and proteoid shrubs rare (only some *Leucadendron pubescens*) in the matrix Fynbos. Geophytes are uncommon, but *Boophone disticha* is occasionally locally abundant. Known rare species present in this unit include *Crassula rupestris* ssp. *marnierana* and the localised endemic *Nivenia stenosphon*. An unusual woolly-leaved *Cotyledon* species that was found here may be a localised endemic. **Condition:** Good; <1% infestation of *Hakea*.
- **Klein Swartberg Grassy Fynbos (LT)** - A higher nutrient status of the soils may account for the high graminoid component usually present in this unit (1 147.2 ha) that is restricted to Towerkop. Grass species that are abundant include *Capeochloa arundinacea*, *Cymbopogon pospischilii*, *Ehrharta capensis*, *Ehrharta ramosa*, *Pentameris distichophylla*, *Pentameris eriostoma*, *Pentameris macrocalycina*, *Pentameris malouiensis*, *Pentameris pallida* and *Tenaxia stricta*. The rarity of non-sprouting Proteaceae (only a few *Leucadendron pubescens*) and occasional abundance of *Leucadendron salignum* may be due to frequent fires in

the past, but it may also be due to strong competitive interactions from the graminoid component. Other shrubs (e.g. *Aspalathus rubens*, *Erica plukenetii*, *Erica speciosa*, *Pelargonium fruticosum*, *Struthiola argentea*) are not abundant, but restios (e.g. *Hypodiscus striatus*, *Rhodocoma fruticosa*, *Thamnochortus rigidus*, etc.) are not uncommon. This unit is usually free of alien plant species even though some of it has been exposed to grazing by domestic stock in the past. *Acmadenia argillophila* is the only rare species known from this unit. **Condition:** Good; <1% infestation of *Hakea*.

- **Eastern Swartberg Grassy Fynbos (LT)** – This unit (3 347.2 ha) that occurs on Swartberg East is most similar to the Kammanassie Grassy Fynbos in its structure and common and uncommon species such as *Protea intonsa*, but it differs in having some localised endemics present, such as *Muraltia carnososa*, that are absent from all the other units. **Condition:** Good; <0.1% infestation of *Pinus* and *Opuntia*.
- **Blesberg Grassy Fynbos (status unknown)** - A unique unit (531.7 ha) found only on Swartberg East that is most similar to the Grassy Fynbos that occurs along shale bands on the southern slopes of the Kammanassie Mountain. *Themeda triandra* is often abundant in the first few years after a fire, but thereafter *Capeochloa*, *Tenaxia* and *Pentameris* are the most abundant grasses. *Helichrysum splendidum* and other asteraceous shrubs (especially *Athanasia*) are often abundant in disturbed sites. Proteaceae are virtually absent and Ericaceae are rare. *Kniphofia praecox* and *Ranunculus meyeri* are abundant in locally wet sites, which indicates a relation with a much more eastern flora (Drakensberg). **Condition:** Very good; no aliens have been recorded here.
- **Bosluiskloof Grassy Fynbos (LT)** - This unit (7 686.8 ha) occurring on Towerkop and Groot Swartberg also has the characteristic *Capeochloa arundinacea* dominant in places as the other Grassy Fynbos units. Proteaceae remain sparse, but *Leucadendron salignum* and *Protea canaliculata* occasionally occur on south-facing slopes. The shrub component is well developed in deeper soils with species such as *Acmadenia sheilliae*, *Agathosma ovata*, *Clutia polifolia*, *Cullumia bisulca*, *Erica speciosa*, *Passerina obtusifolia*, *Phyllica axillaris*, *Oedera squarrosa* and *Selago brevifolia* present. The only known uncommon species present is *Satyrium pallens*. **Condition:** Good; <0.1% infestation of *Hakea* and *Pinus*.
- **Groot Swartberg Subalpine Fynbos (LT)** - Dominated by restios, ericas and short (less than 1 meter tall) proteas, this unit (4 990.2 ha) which occurs on Groot Swartberg and Swartberg East, has a unique combination of rare species and many locally endemic species. They include *Acrolophia ustulata*, *Agathosma purpurea*, *Agathosma zwartbergensis*, *Aspalathus congesta*, *Aspalathus patens*, *Aspalathus ramosissima*, *Cliffortia crassinervis*, *Cliffortia cymbifolia*, *Crassula peculiaris*, *Cyclopia alopecuroides*, *Cyclopia bolusii*, *Erica atromontana*, *Erica blesbergensis*, *Erica costatisepala*, *Erica gossypoides*, *Erica lignosa*, *Erica tayloriana*, *Helichrysum saxicola*, *Leucadendron dregei*, *Liparia confusa*, *Phyllica nigromontana*, *Protea pruinosa*, *Protea venusta*, *Psoralea* sp.nov. (cf. *P.ensifolia*),

Staberoha stokoei, *Syncarpha montana*, *Wahlenbergia tenella* var. *montana* and *Watsonia emiliae*. **Condition:** Fair; <1% infestation of *Pinus* and *Rubus*. Parts of this unit have been impacted as a result of short return-interval fires.

- **Klein Swartberg Subalpine Fynbos (LT)** - As in all the other Subalpine Fynbos units, this unit (1 221.9 ha) that is restricted to Towerkop is dominated by restios, ericas and short (less than 1 meter tall) proteas. It can easily be recognised by the local combination of rare and local endemic species present, that includes species such as *Agathosma purpurea*, *Alepidea delicatula*, *Aspalathus patens*, *Audouinia laxa*, *Caesia capensis*, *Cromidon gracile*, *Cyclopia aurescens*, *Erica constantia*, *Erica costatipetala*, *Erica inamoena*, *Erica roseoloba*, *Erica toringbergensis*, *Euryops glutinosus*, *Felicia oleosa*, *Heliophila rimicola*, *Leucadendron dregei*, *Leucospermum secundifolium*, *Liparia capitata*, *Pentameris glacialis*, *Pentameris swartbergensis*, *Phylica costata*, *Phylica stokoei*, *Protea convexa*, *Protea pruinosa*, *Protea venusta*, *Pseudoselago prostrata*, *Restio papyraceus*, *Restio rarus* and *Staberoha stokoei*. **Condition:** Good; <0.1% infestation of *Hakea*.
- **Gamkaskloof Waboomveld (LT)** - The presence to local abundance of *Protea nitida* is the distinctive feature that distinguishes this unit (2 107.6 ha) occurring on Groot Swartberg from the adjacent Fynbos units. The grass component (including sweet grasses such as *Themeda triandra*) is well developed here, but many other shrub species (e.g. *Cullumia decurrens*, *Erica cerinthoides*, *Erica maesta*, *Erica recta*, *Helichrysum lancifolium*, *Heliophila juncea*, *Lobostemon fruticosus*, *Protea canaliculata*, *Protea repens*, *Rafnia capensis*, *Rafnia racemosa*, *Syncarpha ferruginea*, etc.) are also present. Geophytes (e.g. *Babiana sambucina*, *Gladiolus floribundus*, *Gladiolus permeabilis*, *Ixia orientalis*, etc.) are prominent after a fire. **Condition:** Good; <0.1% infestation of *Pinus*.
- **Groot Swartberg Waboomveld (LT)** – This unit (3 814.2 ha) occurs on Groot Swartberg and Swartberg East and is very similar to the Klein Swartberg Waboomveld, but differs in having a different subset of rare and local endemic species present, such as *Aspalathus vermiculata*, *Aulax cancellata*, *Brunsvigia josephinae*, *Crassula latibracteata*, *Diascia patens* and *Disa lugens* var. *lugens*. **Condition:** Good; <1% infestation of *Pinus*, *Hakea* and *Acacia mearnsii*.
- **Klein Swartberg Waboomveld (LT)** - *Protea nitida* is prominent and often abundant in this unit (87.6 ha) restricted to Towerkop. Other prominent proteoid shrubs include *Leucadendron salignum*, *Protea lorifolia* and *Protea repens*. Ericoid shrubs (e.g. *Erica cerinthoides*, *Erica melanthera*, *Erica umbelliflora*, etc.) are common, and sour grasses (such as *Aristida junciformis*, *Ehrharta ramosa*, *Pentameris eriostoma*, *Pentameris malouinensis*, *Pentameris pallida* and *Tenaxia disticha*, etc.) and sweet grasses such as *Cymbopogon marginatus*, *Digitaria eriantha*, *Themeda triandra*, etc.) are often abundant along with restios (e.g. *Hypodiscus striatus*, *Restio capensis*, *Restio triticeus*, *Rhodocoma capensis*, *Thamnochortus rigidus*, etc.). It differs in having species such as *Erica recta*, and *Hymenolepis incisa* present. No rare species are currently known from this unit, but it is likely that there are some present. There is an unusual autumn-flowering

variant of *Gladiolus rogersii* present in this unit. **Condition:** Good; <0.1% infestation of *Pinus* and *Hakea*.

- **Kruisrivier Waboom-Renosterveld** (LT) - This unit of only 7.5 ha on Groot Swartberg consists of a very unusual combination of plant species. Renosterbos (*Elytropappus rhinocerotis*) is the dominant shrub on north-facing slopes and waboom (*Protea nitida*), along with a few other fynbos elements (e.g. *Aspalathus hystrix*, *Hypodiscus striatus*, *Restio gaudichaudianus*, etc.) present on south-facing slopes. Grasses may be prominent after a fire, but no such examples were seen. No rare or localized endemic plants are known from this odd unit, but a very unusual variant of *Podalyria burchellii* seems to be restricted to this unit. Some species may thus be evolving here. **Condition:** Good; <0.02% infestation of *Pinus*.
- **Kliphuisvlei Renosterveld** (LT) – A total of 356 ha of this unit occur on Groot Swartberg. Renosterbos (*Elytropappus rhinocerotis*) is the dominant shrub here, but other shrubs (e.g. *Eriocephalus africanus*, *Euryops rehmanii*, *Lobostemon marlothii*, *Lobostemon stachydeus*, *Polygala fruticosa*, *Polygala microlopha*, *Pteronia incana*, etc.) are also present. Sweet and sour grasses (e.g. *Digitaria eriantha*, *Ehrharta calycina*, *Eragrostis capensis*, *Festuca scabra*, *Pentameris eriostoma*, *Pentameris macrocalycina*, *Pentameris malouiensis*, *Pentameris pallida*, *Themeda triandra*, *Tribolium uniolae*, etc.) are prominent after fire. Unlike most other Renosterveld units, geophytes are not very abundant, but some are present (e.g. *Babiana sambucina*, *Gladiolus permeabilis*, etc.). Shrubby leaf succulents (e.g. *Antimima* spp., *Drosanthemum* spp., *Ruschia* spp., etc.) are not uncommon on north-facing slopes. *Otholobium macradenium* is the only rare species known to occur in this unit, but an unidentified large yellow-flowered *Drosanthemum* species (cf. *D. bicolor*) may be new and endemic here. **Condition:** Good; <0.1% infestation of *Pinus*.
- **Ladismith Fynbos-Sandolienveld** (LT) – Only 24 ha of this unit that is largely restricted to the flat tops of silcrete hills and some of their southern slopes occur on Towerkop. Sandolien (*Dodonaea angustifolia*) is very abundant and prominent, but many fynbos elements are also present, often with *Rhodocoma arida* very prominent. This unit is thus close to an Arid Restioid Fynbos unit, but the relative abundance of sandolien as well as the occurrence of karroid shrubs (such as *Felicia filifolia* and *Pteronia incana*) differentiates it. Other Fynbos elements that are prominent include *Hypodiscus striatus*, *Leucadendron salignum* and *Leucospermum cuneiforme*. *Senecio citrifolius* is the only known local endemic known from this unit. No other rare species are known from this unit, but a very odd, miniature form of *Mimetes cucullatus* is occasionally present. **Condition:** Fair; <1% infestation of *Hakea*.
- **Ladismith Sandolien-Renosterveld** (LT) - Only about 1 ha of this unit occurs on Towerkop. It consists of a patchwork of an amazing number of different plant communities, but *Elytropappus rhinocerotis* and *Dodonaea angustifolia* are prominent in the matrix Renosterveld that occurs on north-facing slopes and in the

valleys of this unit. Small patches of Spekboomveld (with *Portulacaria afra* present) occur on rocky outcrops on north-facing slopes. Grassy Fynbos (with *Capeochloa arundinacea* prominent) often occurs on the upper south-facing slopes. Patches of proteoid Fynbos (with *Leucadendron salignum*, *Protea repens* and *Protea lorifolia* prominent) occur on southern slopes where there are sandstone outcrops, but where the soils are loamy it rapidly changes to Waboomveld (with *Protea nitida* prominent) often with a rather well developed grass component (including *Themeda triandra*). Even patches of Apronveld (with karroid shrubs such as the locally endemic *Blepharis inermis* and *Pteronia paniculata*, etc. prominent) are present on lower slopes where the soils are clayey. No rare or localised endemic species are known from this unit, but uncommon species known from this unit include *Agathosma microcarpa* and robust variants of *Haworthia habdomadis*. **Condition:** Fair; <1% infestation of *Hakea*.

- **Meiringspoort Waboomveld (LT)** – A total of 2 430 ha of this unit occur on the steep slopes adjacent to the river in Meiringspoort; hence linking Groot Swartberg with Swartberg East. Easily identified by having waboom (*Protea nitida*) prominent to locally abundant, with succulents (e.g. *Aloe comptonii*, *Aloe ferox*, *Crassula rupestris*, *Senecio ficoides*, etc.) and occasionally some trees (e.g. *Lachnostylis bilocularis*, *Maytenus oleoides*, *Pterocelastrus tricuspidatus*, *Searsia lucida*, *Searsia undulata*, etc.) prominent in rocky outcrops. In wet, fire-protected sites there are even some Afromontane Forest elements (e.g. *Cunonia capensis*, *Ilex mitis*, *Maytenus acuminatus*, etc.) present. It differs mostly from all the other Waboomveld units in the rare and localised endemic species present, including species such as *Erica primulina* subsp. *redacta*, *Erica* sp.nov. ('dirty boy'), *Haworthia vlokii*, *Pelargonium pseudoglutinosum* and *Tritonia* sp.nov. (cf. *securigera*). **Condition:** Good; <0.1% infestation of *Pinus*, *Opuntia* and *Nicotiana glauca*.
- **Seweweekspoort Waboomveld (LT)** – This unit of 523.6 ha is restricted to Towerkop. Easily identified by having waboom (*Protea nitida*) prominent and often locally abundant. It is arid with succulents (e.g. *Aloe comptonii*, *Aloe ferox*, *Crassula rupestris*, *Haworthia habdomadis*, etc.) prominent on rocky outcrops and occasionally also some trees (e.g. *Lachnostylis bilocularis*, *Maytenus oleoides*, *Pterocelastrus tricuspidatus*, *Searsia lucida*, etc.). A number of rare species occur here, *Berkheya francisci*, *Crassula brachystachya*, *Euphorbia horrida*, *Gladiolus caryophyllaceus*, *Lotononis acocksii* and *Polygala pottebergensis*. **Condition:** Good; <0.1% infestation of *Pinus*.
- **Swartberg Renosterveld (LT)** - Renosterbos (*Elytropappus rhinocerotis*) is the dominant shrub, but other shrubs (e.g. *Eriocephalus africanus*, *Hermannia saccifera*, *Lobostemon fruticosus*, *Oedera squarrosa*, *Pteronia incana*, etc.) are also present in this unit (290.9 ha) on Groot Swartberg. *Otholobium lucens* is endemic to this unit. Sweet and sour grasses (e.g. *Digitaria eriantha*, *Ehrharta calycina*, *Eragrostis capensis*, *Festuca scabra*, *Pentameris eriostoma*, *Pentameris macrocalycina*, *Pentameris malouiensis*, *Pentameris pallida*, *Themeda triandra*, *Tribolium uniolae*, etc.) are also prominent after a fire in this unit. This unit is very

rich in geophytes (e.g. *Babiana sambucina*, *Bartholina burmanniana*, *Gladiolus virescens*, *Satyrium erectum*, *Tritonia securigera*, *Watsonia aletroides*, etc.), of which several (e.g. *Disa lugens*, *Disa spathulata* subsp. *tripartita*, *Gladiolus leptosiphon*, *Tritonia bakeri* subsp. *lilacina*, etc.) are rare and localised endemic species. **Condition:** Good; <1% infestation of *Pinus*.

- **Tafelberg Renoster-Sandolienveld** (LT) – Only 74.9 ha of this unit occur on Swartberg East. Largely restricted to small silcrete capped hills with Renosterveld occurring on the loamy soils of the valleys between these hills. Sandolien (*Dodonia angustifolia*) remains prominent to locally abundant in this unit, but the rare species present (e.g. *Erica vlokii*, *Haworthia bayeri*, etc.) differentiates it from all other comparable units. **Condition:** Good; <0.1% infestation of *Pinus*.

Subtropical Thicket biome (14 units)

- **Kliphuisvlei Arid Spekboomveld** (LT) - Patches typical of the Swartberg Arid Spekboomveld occur on the northern slopes in a matrix of Succulent Karoo vegetation that also predominates on the southern slopes where asbos (*Pteronia incana*) is often the most abundant species in this unit (727.9 ha) on Groot Swartberg. Succulents such as *Aloe ferox* and *Crassula rupestris* are prominent on north-facing slopes and geophytes are not uncommon, with species such as *Veltheimia capensis* present in the Thicket communities and a seemingly localised endemic *Gethyllis* species present in the Succulent Karoo communities. The rare fern *Pellaea rufa* occurs sporadically on rocky outcrops. Another oddity present in the Thicket clumps is *Gasteria carinata*, a species better known from much further west. **Condition:** Good; <0.1% infestation of *Pinus*.
- **Eastern Swartberg Fynbos-Gwarrieveld** (LT) - Woody trees (e.g. *Euclea undulata*, *Colpoon compressum* and *Searsia undulata*) are quite abundant in this unit (478.9 ha) on Swartberg East, but here the matrix Fynbos vegetation consists of species typical of the Eastern Swartberg Grassy Fynbos. Proteoid shrubs are absent or very rare with only *Agathosma ovata* and *Aspalathus hystrix* being abundant ericoid-leaved shrubs. Geophytes are uncommon but two rare species, *Apodolirion lanceolatum* and *Geissorhiza roseoalba*, are known from this unit. Succulents are abundant on rocky outcrops, including two rare species, *Carruanthus peersii* and *Carruanthus ringens*. **Condition:** Good; <0.5% infestation of *Pinus* and *Opuntia*.
- **Groot Swartberg Fynbos-Gwarrieveld** (LT) – Koeniebos (*Searsia undulata*) is the most abundant woody tree, with only a few gwarrie (*Euclea undulata*) trees present in this unit (13 693.9 ha) on the northern slopes of Groot Swartberg and Swartberg East. It differs in often having the localised endemic Klipkoolhout (*Lachnostylos bilocularis*) tree abundant on rocky slopes. In the shrub component of the matrix Fynbos vegetation species such as *Diosma apetala* are present and the restioids (*Cannamois scirpoides*, *Restio ocreatus* and *Hypodiscus striatus*) are abundant. Proteoid shrubs are also uncommon, but *Protea canaliculata* and *Protea lorifolia* are sometimes present on the upper slopes. The rare *Erica insignis* occurs on rocky outcrops in this unit with succulent species (*Aloe comptonii* and

Crassula rupestris) often abundant on rocky outcrops. Two rare succulents (*Crassula brachystachya* and *Gasteria vlokii*) are present. **Condition:** Good; <0.1% infestation of *Pinus pinaster* and *P. radiata*.

- **Gamkaskloof Fynbos-Gwarrieveld** (LT) - This unit (972.8 ha) occurs in Gamkaskloof and is similar to the Groot Swartberg Fynbos-Gwarrieveld in having koeniebos (*Searsia undulata*) the most abundant woody tree, with gwarrie (*Euclea undulata*) trees uncommon and the localised endemic klipkoolhout (*Lachnostylos bilocularis*) tree often abundant on rocky slopes. Other tree species (such as *Gymnosporia buxifolia*, *Maytenus acuminata*, *Maytenus oleoides* and *Pterocelastrus tricuspidatus*) are often abundant in water drainage lines. Proteoid shrubs are also uncommon in the matrix Fynbos, with only a few *Leucadendron salignum* plants present. *Aspalathus hystrix* is often abundant along with shrubs that are typical of the Gamkaskloof Arid Asteraceous Fynbos. On the lower slopes some shrubs more typical of the more inland Nama Karoo region (e.g. *Dimorphotheca cuneata*) are also present. Geophytes and succulents are abundant on the lower rocky outcrops, of which at least one is a rare species (*Moraea vlokii*). **Condition:** Good; <0.1% infestation of *Pinus*.
- **Zoar Fynbos-Spekboomveld** (LT) - This unit (4 255.5 ha) occurs in Gamkaskloof mostly on steep north-facing slopes on outcrops of quartzitic rocks where spekboom (*Portulacaria afra*) is abundant on the lower slopes and Arid- and Grassy Fynbos forming the matrix vegetation on the upper slopes. It has Doppruim (*Pappea capensis*) often abundant and the uncommon *Ficus cordata* present in the Thicket vegetation on the lower slopes. Some rare, localised endemic succulents, such as *Tromotriche baylisii* are also present on rocky outcrops in ravines. **Condition:** Good; <0.5% infestation of *Pinus* and *Opuntia*.
- **Cango Renoster-Thicket** (EN) – Only 14 ha of this quite distinctive unit that cannot be easily confused with any other of the Klein Karoo vegetation units occur on Groot Swartberg. Woody trees and shrubs typical of the Subtropical Thicket, e.g. *Buddleja saligna*, *Calpurnia intrusa*, *Cussonia spicata*, *Olea europaea* subsp. *cuspidata*, *Colpoon compressum*, *Pterocelastrus tricuspidatus*, *Searsia lucida*, *Searsia undulata* and *Tarchonanthus camphoratus*, occur often abundantly in fire protected sites, mostly on south-facing slopes. Succulents (such as *Aloe comptonii*, *Aloe ferox*, *Bulbine frutescens*, *Bulbine latifolia*, *Crassula rupestris*, *Haworthia mucronata*, *Sarcostemma viminale*, *Senecio ficoides*, *Tylecodon cacalioides*, etc.) and geophytes (e.g. *Ornithogalum dubium*, *Tritonia securigera*, *Veltheimia capensis*, etc.) are abundant on rocky outcrops. The matrix vegetation is dominated by renosterbos (*Elytropappus rhinocerotis*) on south-facing slopes with sandolien (*Dodonaea angustifolia*) often also abundant on north-facing slopes. Rare and localised endemic species known from this unit include species such as *Diascia patens*, *Gladiolus leptosiphon*, *Haworthia blackburniae* var. *graminifolia*, *Lessertia lanata*, *Otholobium* sp.nov., *Phyllopodium dolomiticum* and perhaps also an unidentified species of *Kniphofia*. **Condition:** Good; <0.1% infestation of *Pinus*.

- **Matjiesvlei Sandolien-Thicket** (LT) – This unit (5.6 ha) on Groot Swartberg consists of a patchwork of several different vegetation types in a matrix dominated by sandolien (*Dodonaea angustifolia*) and renosterbos (*Elytropappus rhinocerotis*). The Thicket patches have more Fynbos elements (e.g. *Aspalathus hystrix*) present and asbos (*Pteronia incana*) more abundant in the Succulent Karoo communities. No rare or localised endemic species are known from this unit, but some interesting species may be present, especially on the small silcrete-topped hills. **Condition:** Good; <0.1% infestation of *Pinus* and *Hakea*.
- **Perdefontein Fynbos-Gwarrieveld** (LT) - The matrix Fynbos vegetation in this unit (14.5 ha) on Towerkop consists of species typical of the Klein Swartberg Grassy Fynbos and shrubs such as *Aspalathus hystrix* often abundant. Here, *Maytenus oleoides* is less abundant, but *Pterocelastrus tricuspidatus* and *Searsia undulata* are common in drainage lines. Some gwarrie trees (*Euclea undulata*) are present on the lower slopes, but they are never abundant. Members of the Proteaceae are also uncommon in the matrix Fynbos, with only a few *Leucadendron salignum* plants present. No rare or endemic species are known from this unit. **Condition:** Good; <0.6% infestation of *Hakea*.
- **Prince Albert Renoster-Gwarrieveld** (status unknown) – Only 36.9 ha of this unit occur on Gamkapoort. Renosterbos (*Elytropappus rhinocerotis*) and *Montinia caryophyllacea* are usually abundant on the upper south-facing slopes, along with some fynbos elements such as *Restio triticeus*, *Agathosma capensis* and *Erica discolor* subsp. *speciosa*. Succulents (e.g. *Aloe comptonii*, *Aloe microstigma* and *Crassula rupestris*) are abundant in rocky outcrops on north-facing slopes. The uncommon *Gasteria vlokii* occurs in rocky outcrops on south-facing slopes. *Searsia undulata* and gwarrie (*Euclea undulata*) are abundant on north-facing slopes and lower south-facing slopes. At its lower end the unit merges with Gamkapoort Apronveld, where *Pteronia flexicaulis* and/or *Pteronia incana* can be locally dominant. **Condition:** Very good; no invasive alien plants recorded.
- **Faanskraal Renoster-Gwarrieveld** (status unknown) – This is also an arid unit (460.6 ha) that occurs on Groot Swartberg and Swartberg East. Renosterbos (*Elytropappus rhinocerotis*) is only abundant on the upper south-facing slopes, along with other asteraceous shrubs such as *Euryops rehmannii* and *Dimorphotheca cuneata*. Fynbos elements are rare, but species such as *Hypodiscus striatus* and a few *Erica* species sometimes occur in moist sites, usually amongst *Montinia caryophyllacea*. Succulents (e.g. *Aloe comptonii*, *Aloe microstigma*, *Crassula arborescens* and *Crassula rupestris*) are abundant on rocky outcrops on north- and south-facing slopes. Gwarrie (*Euclea undulata*) and *Searsia undulata* are abundant on north- and south-facing slopes in a matrix of communities dominated by small asteraceous shrubs such as *Pentzia incana* and *Pteronia* species. Typically of the unit is the sporadic occurrence of the uncommon *Otholobium macradenium*. **Condition:** Good; <0.02% infestation of *Pinus*.
- **Swartberg Arid Spekboomveld** (LT) – This unit of 4 212.7 ha occurs mostly on north-facing slopes, often on shallow, rocky soils on Gamkapoort, Groot Swartberg

and the eastern part of Towerkop. Spekboom (*Portulacaria afra*) is usually abundant and prominent amongst woody trees and shrubs such as *Carissa haematocarpa*, *Euclea undulata*, *Gymnosporia szyszylowiczii*, *Rhizogonum obovatum*, *Searsia longispina* and *Searsia undulata*, with *Schotia afra* occasionally also present. Other stem- and leaf succulents that are usually common and prominent are *Aloe microstigma*, *Crassula rupestris*, *Dioscorea hemicryptica*, *Euphorbia heptagona*, *Gasteria brachyphylla*, *Pachypodium bispinosum*, *Pachypodium succulentum*, *Pelargonium tetragonum*, and *Sarcostemma viminale*. No rare or localised endemic species are known from this unit. **Condition:** Poor; large parts of this unit in Gamkapoort have been lost as a result of over-grazing when the government allowed emergency grazing in the area previously. Investigate opportunities to implement a spekboom restoration project in this area.

- **Meiringspoort Spekboom Thicket** (LT) – About 110.5 ha of this unit occur on both sides of the river in Meiringspoort. It is somewhat similar to the Swartberg Arid Spekboomveld in the species present, but here the woody trees and spekboom (*Portulacaria afra*) are less prominent, while shrubs (including some fynbos species, such as *Aspalathus*, *Erica*, *Phyllica*, etc.) and grasses (e.g. *Cymbopogon*, *Pentameris*, etc.) are more prominent. Several rare and localised endemic species occur here, including *Gladiolus leptosiphon*, *Haworthia vlokii*, *Lachnostylis bilocularis*, *Nerine peersii* and *Senecio ficoides*. **Condition:** Fair; ca. 1.2% infestation of *Datura*, *Opuntia* and *Nicotiana*.
- **Snyberg Gwarrieveld** (LT) – Only 1.3 ha of this unit occur on Swartberg East. Woody trees such as gwarrie (*Euclea undulata*), spalkpendoring (*Gloveria integrifolia*) and koeniebos (*Searsia undulata*) are abundant in the fairly sandy soils, where the matrix Succulent Karoo communities often have grasses (e.g. *Cymbopogon pospischilii*, *Digitaria eriantha*, *Ehrharta calycina*, *Eragrostis capensis*, *Eragrostis curvula*, *Sporobolus fimbriatus*, etc.) abundant amongst the dominant shrubs (*Lasiosiphon deserticola*, *Helichrysum zeyheri*, *Monechma incana*, *Pentzia incana* and several *Pteronia* species). Succulents (*Aloe ferox*, *Bulbine frutescens*, *Crassula rupestris* and several *Drosanthemum* species) and geophytes (e.g. *Babiana securigera*, *Freesia corymbosa*, *Lapeirousia pyramidalis*, *Moraea polystachya*, *Tritonia securigera*, etc.) are also abundant in this unit. No rare or localised endemic species are known in this unit. **Condition:** Good; <0.1% infestation of *Pinus*.
- **Vondeling Gwarrieveld** (status unknown) - Trees such as gwarrie (*Euclea undulata*) and koeniebos (*Searsia undulata*) are abundant in this unit (190.4 ha) on Swartberg East, but the matrix Succulent Karoo communities differ as they occur mostly on shale. The matrix Succulent Karoo vegetation is dominated by small asteraceous shrubs in which species with a more northern Nama Karoo affiliation (such as *Rosenia oppositifolia*) are present. No rare or localised endemic species are known from this unit. **Condition:** Good; <0.02% infestation of *Pinus*.

Succulent Karoo biome (two units)

- **Gamkapoort Apronveld** (status not accessed) – This unit (2 284.6 ha) in Gamkapoort has several Nama Karoo elements present, but it lacks *Berkeya cuneata*. Large shrubs are rare, with only some *Lycium* species present. *Pteronia* and *Drosanthemum* species are usually dominant, but *Zygophyllum retrofractum* and *Augea capensis* can be abundant in heavily grazed sites. A few small patches of *Pteronia pallens* occur in calcrete outcrops, but they are not extensive enough to be mapped as Scholtzbosveld. A wide range of succulents are present, especially *Crassula* species. Some small quartz patches are present, in which small populations of the uncommon *Bijlia cana* can be found. It is also the habitat of the unusual hybrid between *Aloe ferox* and *Aloe claviflora*, which was once thought to be a unique species. An unusual, virgate member of the Acanthaceae occurs along south-facing slopes - once flowering material can be obtained it may turn out to be an endemic species of this unit. **Condition:** Poor; large sections have been over-grazed as a result of emergency grazing allowed by government previously (J. Vlok 2019, pers. comm.). The status is thus likely to be EN. *Prosopis glandulosa* and *Atriplex lindleyi* subsp. *inflata* infestation at <1% density.
- **Prince Albert Randteveld** (LT) – This unit (2 298.1 ha) occurring in Gamkapoort should be regarded as being part of a large unit that intrudes into the Klein Karoo from the north. Trees are absent, but some small specimens of *Euclea undulata* can be present. Distinctive is the presence of *Searsia burchellii*, which occurs sporadically throughout the unit and also the relative abundance of *Rhigozum obovatum*. Elements typical of Nama Karoo Randteveld types (e.g. *Fingerhuthia africana*, *Pentzia incana*, etc.) are prominent and dominant in this unit. Succulents are occasionally locally abundant (including some distinctive *Rhinephyllum* species). Also distinctive is the accumulation of sands in the lower gullies, where *Stipagrostis* species are dominant. Further north these *Stipagrostis* communities become more extensive and can be mapped as separate units. **Condition:** Poor; ca. 1% infestation of *Atriplex nummularia*; large parts have been over-grazed as a result of emergency grazing allowed by government previously and have not recovered yet (J. Vlok 2019, pers. comm.).

Aquatic vegetation units (include four fresh water and two brack water units)

- **Central Swartberg Perennial stream** (EN) – This fresh water unit (4 673.2 ha) on Groot Swartberg and Swartberg East has *Calopsis paniculata*, *Cannamois virgata*, *Erica caffra*, *Rhodocoma capensis* and several *Psoralea* species as dominant species along the lower streambank. Rare species such as *Brunsvigia josephinae* and *Diascia patens* occur along the lower streambank, while the upper streams and seepage areas have rare localized species such as *Erica astroites*, *Geissorhiza nigromontana*, *Gladiolus aquamontana*, *Liparia racemosa* and *Stirtonanthus taylorianus*. Small patches of Afromontane forests occur in fire-protected sites, often with *Ilex mitis*, *Maytenus acuminata* and *Pterocelastrus tricuspidatus* as the most abundant trees and *Blechnum* species abundant in the understorey. **Condition:** Fair; <1% infestation of *Acacia mearnsii* and *Pinus*

pinaster; parts of this and adjacent units have been subject to repeated short return-interval fires of <10 years over the past 20 years.

- **Seweweekspoort Perennial Stream (LT)** - This fresh water unit (890.2 ha) occurs on Towerkop and in Gamkaskloof and is easily identified as it is the only inland vegetation unit with *Virgilia divaricata* abundant. Typical other tall shrubs and trees include *Hypocalyptus sophoroides*, *Psoralea affinis* and *Salix mucronata*. The seepage areas on the north-facing slopes are unusual in their species combination, but *Calopsis paniculata*, *Erica curviflora*, *Erica quadrangularis* and *Rhodocoma capensis* are reliable indicators. Some rare and localized species may occur in these seepage zones, especially after a fire. **Condition:** Good; <0.1% infestation of *Tamarix*, *Nerium* and *Acacia mearnsii*.
- **Groot Swartberg Perennial Stream North (LT)** – This fresh water unit (4 545.3 ha) occurs on Groot Swartberg and Swartberg East. Although these streams drain northwards the dominant species differ little from those that drain southwards in the Central Swartberg Perennial Stream unit. *Calopsis paniculata*, *Cannamois virgata*, *Erica caffra*, *Erica curviflora*, *Gunnera perpensa*, *Rhodocoma capensis* and several *Psoralea* species are thus also the dominant species here. It differs mostly in having different localized endemic species present, such as *Erica chinodes*, *Erica dolfiana* and *Geissorhiza uliginosa*. *Liparia racemosa* is the only localized endemic that it shares with those streams that drain southwards in the Groot Swartberg. The upper seepage areas contain some rare orchid species such as *Disa elegans*. **Condition:** Good; <0.1% infestation of *Nerium*, *Datura*, *Nicotiana* and *Opuntia*. Prince Albert Municipality has drilled boreholes at the northern base of the Swartberg Pass for bulk supply of potable water to the town. The impact of this abstraction scheme needs to be carefully monitored.
- **Klein Swartberg Perennial Stream (LT)** - The upper seepage zones of this fresh water unit (504.8 ha) on Towerkop are also dominated by short restios and ericas. The unit is most easily recognized by the presence of the localized endemic tall shrub *Stirtonanthus chrysanthus* that is often abundant along the streambanks. *Calopsis paniculata*, *Cannamois virgata* and several *Psoralea* species are reliable indicators along the lower streambank. **Condition:** Good; <0.6% infestation of *Hakea*.
- **Olifants River & Floodplain (VU)** - Many of the upper inland streambeds of this brack water unit (246.7 ha) are still eroding into the landscape with a great many fingers. *Vachellia karroo* (= *Acacia karroo*) is the most prominent species here, often along with herbs such as *Ballota africana*. An interesting feature in this unit is the occasional abundance of *Senegalia caffra*. Many perennial freshwater streams used to feed into the main drainage channel from the Kammanassie and Tsitsikamma Mountains, with periodic floods coming from the eastern Great Karoo during summer. The floodplain of this unit is somewhat different from all the other riverine units, but the shrub *Salsola aphylla* remains abundant and distinctive. Odd species noted in the floodplain include *Chrysocoma oblongifolia* and *Cyperus*

congestus. **Condition:** Fair; <1.15% infestation of *Acacia mearnsii*, *Datura stramonium*, *Ricinus communis*, *Nicotiana glauca* and *Opuntia* in Meiringspoort.

- **Gamka River & Floodplain (VU)** - This brack water unit (2 101 ha) has its main catchment in the Nama Karoo. There are not many freshwater streams feeding into this river and it thus naturally carried less fresh water. Periodic floods deposited deep silt beds from the Great Karoo in the floodplain, where *Vachellia karroo* and grasses such as *Cynodon dactylon* and *Stipagrostis namaquensis* are prominent amongst Ganna (*Salsola aphylla*). Some interesting annuals occur in the floodplain, such as *Manulea chysantha*, some of these annuals and other herbs are more typical of the Nama Karoo from which their seed is periodically washed during floods. It remains a mystery why they are not more abundant in the adjacent river systems. **Condition:** Poor; the main stream is currently badly infested with *Nerium oleander*, *Arundo donax*, *Prosopis* and *Tamarix chinensis* and *Tamarix ramosissima* are also abundant in certain parts; total density 11-21%.

Based on specimens collected and observations recorded within the State of Biodiversity (SOB) database the current plant species list for the Swartberg Cluster and adjacent mountain catchment areas stands at 650 (including subspecies and varieties). This number is an underestimate, but is being updated through baseline data collection by field staff.

At least 94 species are considered of conservation concern or priority species (Table 2.2; Raimondo *et al.* 2009, <http://redlist.sanbi.org>) within the Swartberg Cluster. These include species listed as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DDD or DDT), Rare or Critically Rare. Some of these are illustrated in Figure 2.6. The species are being monitored with the assistance of the Custodians of Rare and Endangered Wildflowers (CREW) groups.

Table 2.2: Plant species of conservation concern recorded from the Swartberg Cluster and on adjacent areas.

Scientific Name	Family	Status according to Raimondo <i>et al.</i> (2009); http://redlist.sanbi.org	Distribution
<i>Bijlia tugwelliae</i>	Aizoaceae	VU (B1ab(iii,v)+2ab(iii,v))	Bosluiskloof to Prince Albert
<i>Mesembryanthemum ladismithiense</i>	Aizoaceae	EN (B1ab(iii,v)+2ab(iii,v))	Ladismith
<i>Boophone disticha</i>	Amaryllidaceae	LC (Decreasing)	Robertson and Bredasdorp to tropical E Africa
<i>Alepidea delicatula</i>	Apiaceae	Rare	Swartberg and Outeniqua Mtns
<i>Gasteria vlokii</i>	Asphodelaceae	Rare	Swartberg to Willowmore
<i>Haworthia vlokii</i>	Asphodelaceae	Rare	Swartberg Mtns

Scientific Name	Family	Status according to Raimondo <i>et al.</i> (2009); http://redlist.sanbi.org	Distribution
<i>Berkheya francisci</i>	Asteraceae	Rare	Swartberg Mtns
<i>Cullumia rigida</i>	Asteraceae	Rare	Kamiesberg, Bokkeveld Mtns and Klein Karoo
<i>Felicia oleosa</i>	Asteraceae	Rare	Witteberg and Swartberg Mtns
<i>Helichrysum saxicola</i>	Asteraceae	Rare	Swartberg Mtns
<i>Pteronia hutchinsoniana</i>	Asteraceae	Rare	Klein Swartberg Mtns and S Karoo
<i>Syncarpha montana</i>	Asteraceae	Rare	Swartberg and Kammanassie Mtns
<i>Heliophila ephemera</i>	Brassicaceae	VU (D1)	Swartberg Mtns
<i>Erica astroites</i>	Ericaceae	Rare	Swartberg Mtns
<i>Erica atromontana</i>	Ericaceae	Rare	Swartberg Mtns
<i>Erica blaerioides</i> subsp. <i>blaerioides</i>	Ericaceae	Rare	Swartberg Mtns
<i>Erica blaerioides</i> subsp. <i>hirsuta</i>	Ericaceae	Rare	Klein Swartberg Mtns
<i>Erica chinodes</i>	Ericaceae	Rare	Swartberg Mtns
<i>Erica costatisepala</i>	Ericaceae	Rare	Robertson, Langeberg: Swellendam, Klein Swartberg to Kammanassie Mtns
<i>Erica dolfiana</i>	Ericaceae	Rare	Swartberg Mtns
<i>Erica elsieana</i>	Ericaceae	EN (D)	Langeberg, Outeniqua and Groot Swartberg Mtns
<i>Erica gossypoides</i>	Ericaceae	EN (D)	Klein and Groot Swartberg Mtns
<i>Erica ingeana</i>	Ericaceae	Rare	Groot Swartberg, Antoniesberg and Kouga Mtns
<i>Erica jananthus</i>	Ericaceae	VU (D1)	Snyberg peaks in the eastern part of the Groot Swartberg range.
<i>Erica jugicola</i>	Ericaceae	Rare	Swartberg Mtns
<i>Erica lignosa</i>	Ericaceae	Rare	Swartberg Mtns
<i>Erica richardii</i>	Ericaceae	Rare	Groot Swartberg Mtns
<i>Erica taylorii</i>	Ericaceae	LC (Decreasing)	Cedarberg and Swartberg Mtns
<i>Erica viridiflora</i> subsp. <i>redacta</i>	Ericaceae	EN (D)	Swartberg Mtns

Scientific Name	Family	Status according to Raimondo <i>et al.</i> (2009); http://redlist.sanbi.org	Distribution
<i>Erica vlokii</i>	Ericaceae	EN (B1ab(iii,v)+2ab(iii,v))	Swartberg, Kammanassie and Outeniqua Mtns
<i>Erica swartbergensis</i>	Ericaceae	Rare	Swartberg Mtns
<i>Aspalathus congesta</i>	Fabaceae	Rare	Swartberg Mtns
<i>Aspalathus patens</i>	Fabaceae	Rare	Swartberg Mtns
<i>Aspalathus ramosissima</i>	Fabaceae	Rare	Swartberg Mtns
<i>Cyclopia alopecuroides</i>	Fabaceae	EN (B1ab(v)+2ab(v))	Swartberg and Kammanassie Mtns
<i>Cyclopia aurescens</i>	Fabaceae	Rare	Swartberg Mtns
<i>Cyclopia bolusii</i>	Fabaceae	VU (D1)	Swartberg Mtns
<i>Cyclopia burtonii</i>	Fabaceae	VU (D1+2)	Swartberg Mtns
<i>Cyclopia intermedia</i>	Fabaceae	LC (Decreasing)	Witteberg and Langeberg to Van Staden's Mtns
<i>Indigofera</i> sp.nov. (Swartberg)	Fabaceae	Rare	Swartberg Mtns
<i>Indigofera thesioides</i>	Fabaceae	EN (D)	Swartberg Mtns
<i>Liparia confusa</i>	Fabaceae	Rare	Swartberg Mtns
<i>Liparia racemosa</i>	Fabaceae	Rare	Swartberg Mtns
<i>Lotononis acocksii</i>	Fabaceae	EN (B1ab(iii,v))	Rooiberg, Gamkaberg and Swartberg Mtns
<i>Lotononis elongata</i>	Fabaceae	EN (B1ab(iii))	Swartberg and Outeniqua Mtns to Langkloof
<i>Otholobium rubicundum</i>	Fabaceae	CR (B1ab(iii,v))	Swartberg Mtns
<i>Otholobium</i> sp.nov. (Stirton, Vlok & Zantovska 11561 NBG)	Fabaceae	VU (D2)	Swartberg Mtns
<i>Otholobium swartbergense</i>	Fabaceae	Rare	Swartberg Mtns
<i>Psoralea sordida</i>	Fabaceae	NT	Swartberg and Langeberg to Outeniqua Mtns
<i>Psoralea elegans</i>	Fabaceae	Rare	Swartberg Mtns
<i>Psoralea</i> sp.nov. (<i>forbesii</i>)	Fabaceae	Rare	Swartberg Mtns
<i>Rafnia rostrata</i> subsp. <i>pluriflora</i>	Fabaceae	Rare	Swartberg Mtns
<i>Stirtonanthus chrysanthus</i>	Fabaceae	EN (B1ab(ii,iii,iv,v))	Swartberg Mtns
<i>Stirtonanthus taylorianus</i>	Fabaceae	VU (D2)	Swartberg Mtns

Scientific Name	Family	Status according to Raimondo <i>et al.</i> (2009); http://redlist.sanbi.org	Distribution
<i>Pelargonium citronellum</i>	Geraniaceae	Rare	Ladismith
<i>Gunnera perpensa</i>	Gunneraceae	LC (Decreasing)	Swartruggens to Cape Peninsula and Klein Karoo, to N Africa
<i>Caesia capensis</i>	Hemerocallidaceae	Rare	Grootwinterhoek Mtns and Du Toit's Peak to Seweweekspoort
<i>Geissorhiza nigromontana</i>	Iridaceae	Rare	Swartberg Mtns
<i>Gladiolus aquamontanus</i>	Iridaceae	VU (D2)	Swartberg Mtns
<i>Gladiolus dolichosiphon</i>	Iridaceae	Critically rare	Rooiberg and Klein Swartberg Mtns
<i>Gladiolus leptosiphon</i>	Iridaceae	VU (C2a(i))	Ladismith to Uitenhage
<i>Gladiolus nigromontanus</i>	Iridaceae	Rare	Swartberg Mtns
<i>Nivenia stenosiphon</i>	Iridaceae	Rare	Touwsberg and Swartberg Mtns
<i>Romulea vlokii</i>	Iridaceae	VU (D1+2)	Montagu to Kammanassie Mtns
<i>Watsonia emeliae</i>	Iridaceae	Rare	Swartberg and Langeberg Mtns
<i>Rapanea melanophloeos</i>	Myrsinaceae	LC (Decreasing)	Cape Peninsula to tropical Africa
<i>Disa linderiana</i>	Orchidaceae	Rare	Cedarberg, Riviersonderend and Swartberg Mtns
<i>Disa spathulata</i> subsp. <i>tripartita</i>	Orchidaceae	EN (C1+2a(i))	Worcester to Tulbagh and Klein Karoo between Oudtshoorn and Joubertina
<i>Brachysiphon microphyllus</i>	Penaeaceae	Rare	Klein Swartberg and Touwsberg Mtns
<i>Leucadendron cordatum</i>	Proteaceae	Rare	Langeberg: Koo to Barrydale and Swartberg Mtns
<i>Leucadendron dregei</i>	Proteaceae	EN (B1ab(iii,iv)+2ab(iii,iv))	Swartberg Mtns
<i>Leucadendron pubibracteolatum</i>	Proteaceae	NT (B1ac(iv)+2ac(iv))	Swartberg East and Outeniqua to Baviaanskloof Mtns
<i>Leucadendron tinctum</i>	Proteaceae	NT (A4c)	Hex River to Hottentots Holland and Langeberg Mtns
<i>Leucospermum secundifolium</i>	Proteaceae	Rare	Klein Swartberg Mtns
<i>Paranomus centaureoides</i>	Proteaceae	NT (A3c+4c)	Klein Swartberg Mtns

Scientific Name	Family	Status according to Raimondo <i>et al.</i> (2009); http://redlist.sanbi.org	Distribution
<i>Protea aristata</i>	Proteaceae	VU (C2a(i))	Klein Swartberg Mtns
<i>Protea convexa</i>	Proteaceae	CR (A3c+4c)	Cedarberg, Witteberg and Swartberg Mtns
<i>Protea magnifica</i>	Proteaceae	VU	Cedarberg to Swartberg and Langeberg Mtns
<i>Protea montana</i>	Proteaceae	VU (A3c+4c; B1ab(iv)+2ab(iv))	Swartberg and Kammanassie Mtns
<i>Protea pruinosa</i>	Proteaceae	EN (B1ab(v)+2ab(v))	Swartberg Mtns
<i>Protea rupicola</i>	Proteaceae	EN (B2ab(iii,v))	Groot Winterhoek, Swartberg and Kammanassie to Winterhoek Mtns
<i>Protea venusta</i>	Proteaceae	EN (A3c+4c; B1ab(v)+2ab(v))	Swartberg and Kammanassie Mtns
<i>Spatalla barbiger</i>	Proteaceae	NT (B1ab(i)+2ab(i))	Langeberg to Outeniqua and Swartberg Mtns
<i>Restio papyraceus</i>	Restionaceae	VU (D2)	Klein Swartberg Mtns
<i>Thamnochortus papyraceus</i>	Restionaceae	VU (D2)	Klein Swartberg Mtns
<i>Phyllica nigromontana</i>	Rhamnaceae	Rare	Swartberg Mtns
<i>Cliffortia aculeata</i>	Rosaceae	Rare	Waboornsberg and Swartberg Mtns
<i>Cliffortia montana</i>	Rosaceae	Rare	Swartberg and Karoo Mtns
<i>Cliffortia nivenioides</i>	Rosaceae	VU (D1)	Swartberg Mtns
<i>Cliffortia verrucosa</i>	Rosaceae	Rare	Swartberg Mtns
<i>Acmadenia fruticosa</i>	Rutaceae	VU (B1ab(iii,v))	Klein Swartberg and Rooiberg Mtns
<i>Agathosma zwartbergense</i>	Rutaceae	VU (D2)	Swartberg and Kammanassie Mtns
<i>Diosma passerinoides</i>	Rutaceae	VU (A2c; C2a(i))	Caledon to Kouga and Klein Karoo Mtns
<i>Pseudoselago prostrata</i>	Scrophulariaceae	Rare	Swartberg Mtns

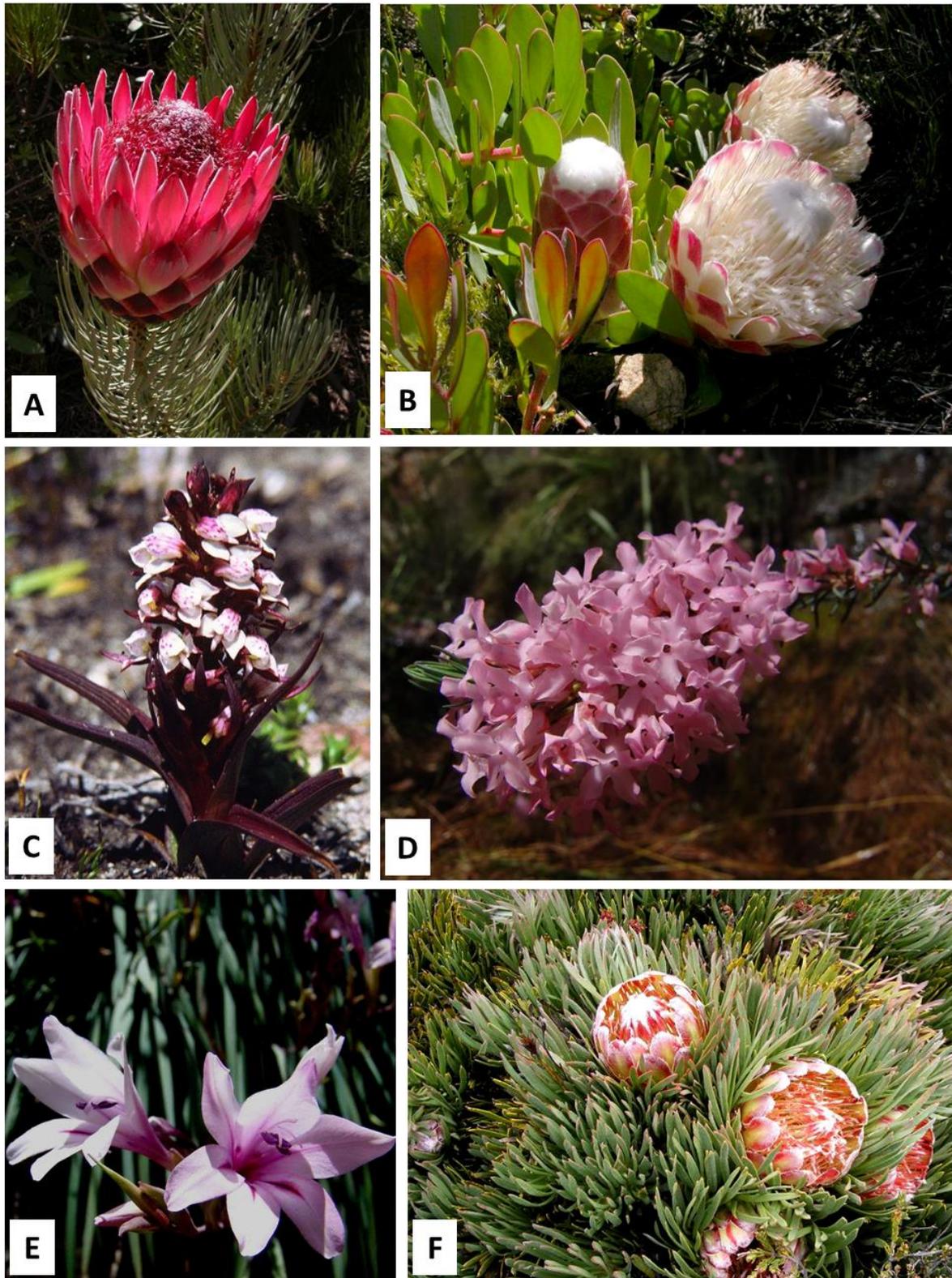


Figure 2.6: Species of conservation concern recorded from the Swartberg Cluster. A: *Protea aristata*; B: *Protea venusta*; C: *Disa linderiana*; D: *Erica astroites*; E: *Gladiolus aquamontanus*; F: *Protea montana*. (Photos: A, B, D, E, F: J&A Vlok; C: EGH Oliver)

2.3.1.2.2 Gamkaberg Cluster

A total of 32 terrestrial and five aquatic vegetation units occur on the Gamkaberg Cluster (Appendix 2 Map 6(d)).

Terrestrial vegetation units

Fynbos Biome (16 units)

- **Rooiberg Mesic Proteoid Fynbos (LT):** 6 861.7 ha occur on the southern slopes of the Rooiberg and can be easily differentiated in having proteoid shrubs such as *Aulax cancellata*, *Leucadendron album*, *Leucadendron eucalyptifolium*, *Mimetes cucullatus*, *Protea eximia*, *Protea neriifolia* and *Protea punctata* present. This unit is also rich in other species: *Acmadenia sheilae*, *Acmadenia wittebergensis*, *Agathosma bifida*, *Agathosma roodebergensis*, *Anthoxanthum ecklonii*, *Arctotis campanulata*, *Aristea pusilla*, *Aristea spiralis*, *Aspalathus aspalathoides*, *Athanasia linifolia*, *Corymbium africanum*, *Dimorphotheca montana*, *Diosma recurva*, *Disa bracteata*, *Disa comosa*, *Dolichothrix ericoides*, *Ehrharta capensis*, *Ehrharta ottonis*, *Elegia filacea*, *Elegia galpinii*, *Erica anguliger*, *Erica calycina*, *Erica maximiliani*, *Erica melanomontana*, *Erica recta*, *Erica spectabilis*, *Ficinia stolonifera*, *Gladiolus floribundus*, *Helichrysum spiralepis*, *Holothrix villosa*, *Hypodiscus albo-aristatus*, *Ixia orientalis*, *Leucadendron salignum*, *Leucospermum cuneiforme*, *Mastersiella purpurea*, *Metalasia massonii*, *Metalasia pungens*, *Paranomus dispersus*, *Paranomus dregei*, *Pelargonium fruticosum*, *Pentameris pyrophylla*, *Phylica axillaris*, *Phylica purpurea*, *Phylica imberbis*, *Phylica mundii*, *Rafnia capensis*, *Restio capensis*, *Selago gracilis*, *Stoebe alopecuroides*, *Struthiola eckloniana*, *Tetraria bromoides*, *Tritoniopsis antholyza*, *Watsonia schlechteri* and *Zyrphelis microcephala*. Rare and localised endemic species known to occur here are: *Acmadenia baileyensis*, *Disa arida*, *Lachnaea glomerata*, *Lampranthus scaber* and *Nivenia argentea*. **Condition:** Very good; <0.05% infestation of *Hakea*, *Pinus*, *Opuntia*, *Echinopsis* and *Agave*.
- **Rooiberg Arid Proteoid Fynbos (LT):** 1 215.8 ha occur on the Rooiberg and Groenefontein. This unit has a quite distinctive combination of species, such as: *Acmadenia sheilae*, *Acmadenia wittebergense*, *Aspalathus hirta*, *Aspalathus hystrix*, *Aspalathus rubens*, *Aulax cancellata*, *Cannamois scirpoides*, *Cliffortia arcuata*, *Diosma apetala*, *Diosma prama*, *Erica melanthera*, *Erica spectabilis*, *Heliophila juncea*, *Hermannia flammula*, *Lachnaea ruscifolia*, *Leucadendron comosum*, *Leucadendron ericifolium*, *Leucadendron rubrum*, *Leucadendron tinctum*, *Leucospermum cuneiforme*, *Leucospermum wittebergense*, *Metalasia massonii*, *Metalasia pulcherrima*, *Muraltia horrida*, *Paranomus dispersus*, *Paranomus roodebergensis*, *Pelargonium fruticosum*, *Pelargonium tricolor*, *Phylica axillaris*, *Polygala fruticosa*, *Protea repens*, *Protea lorifolia*, *Rhodocoma fruticosa*, *Selago pulchra*, *Struthiola argentea*, *Syncarpha ferruginea*, *Syncarpha paniculata*, *Tenaxia stricta* and *Zygophyllum sessilifolium*. Rare and localised endemic species present are *Acmadenia baileyensis*, *Aspalathus karrooensis* and *Nivenia argentea*. **Condition:** Near pristine; < 0.05% infestation of *Hakea*, *Opuntia*, *Pinus* and *Echinopsis*.

- **Rooiberg Arid Restioid Fynbos (LT):** 1 745.4 ha occur on Groenefontein and Gamkaberg. This unit is easy to recognise as it has *Rhodocoma arida* abundant to dominant in places. The following species have been recorded in this unit: *Acmadenia sheilae*, *Agathosma capensis*, *Agathosma mundii*, *Aspalathus rubens*, *Centella virgata*, *Chaenostoma subnudum*, *Cliffortia crenata*, *Diascia patens*, *Diosma apetala*, *Diosma prama*, *Diospyros dichrophylla*, *Euryops erectus*, *Euryops rehmannii*, *Lobostemon decorus*, *Lobostemon paniculatus*, *Muraltia dispersa*, *Muraltia ericaefolia*, *Muraltia scoparia*, *Paranomus roodebegensis*, *Pelargonium caucalifolium*, *Pelargonium tricolor*, *Pentameris airoides*, *Pentameris eriostoma*, *Pentzia dentata*, *Pentzia elegans*, *Phylica lanata*, *Phylica willdenowiana*, *Polygala microlopha*, *Polygala wittebergensis*, *Protea humiflora*, *Pteronia fasciculata*, *Pteronia membranacea*, *Rafnia racemosa*, *Relhania calycina*, *Senecio juniperinus*, *Thamnochortus rigidus*, *Ursinia heterodonta*, *Zygophyllum fulvum* and *Zygophyllum sessilifolium*. Several rare and localised endemic species are known from this unit, including *Agathosma lanata*, *Alonsoa peduncularis*, *Haworthia blackburniae* var. *blackburniae*, *Muraltia cliffortiifolia* and *Senecio muirii*. **Condition:** Very good; <0.05% infestation of *Hakea*, *Opuntia*, *Pinus* and *Agave*.

- **Sandberg Arid Restioid Fynbos (LT):** 2 749.9 ha occur on Paardenberg and Rooilifantskloof. *Rhodocoma arida* is abundant in places, but some *Protea nitida* may be present on south-facing slopes and *Capeochloa arundinacea* can be common on rocky north-facing slopes. The uncommon tree *Lachnostylos bilocularis* often occurs in fire-protected rocky sites and *Aspalathus hystrix*, *Restio ocreatus* and *Restio gaudichaudianus* are sometimes abundant on steep south-facing slopes. **Condition:** Good; <2% infestation of *Hakea*, *Opuntia* and *Pinus*; *Rhodocoma arida* has been harvested as thatch on Rooilifantskloof historically, and currently grazing by stock from Zoar takes place in this veld.

- **Rooiberg Arid Asteraceous Fynbos (LT):** 1 548.7 ha occur on the Rooiberg and Groenefontein. This unit occurs in an arid environment, mostly on north-facing slopes, but occasionally also on south-facing slopes. It is rich in Rutaceae and dominated by drought resistant shrubs, such as *Acmadenia sheilae*, *Agathosma capensis*, *Agathosma mundii*, *Agathosma recurvifolia*, *Aspalathus hystrix*, *Cliffortia crenata*, *Diosma apetala*, *Diosma prama*, *Dolichostrix ericoides*, *Erica maesta*, *Eriocephalus africanus*, *Heliophila glauca*, *Hermannia flammula*, *Metalasia massonii*, *Metalasia pulcherrima*, *Metalasia pungens*, *Muraltia lignosa*, *Oedera imbricata*, *Osteospermum polygaloides*, *Passerina obtusifolia*, *Pelargonium laevigatum*, *Pelargonium tricolor*, *Phylica mundii*, *Phylica purpurea*, *Pteronia fascicularis*, *Selago pulchra*, *Stoebe spiralis* and *Thesium virgatum*. Grasses (*Capeochloa arundinacea*, *Pentameris eriostoma*, *Tenaxia stricta*) are present but uncommon, the same holds for the restios (*Hypodiscus striatus*, *Restio capensis*, *Restio gaudichaudianus*, *Rhodocoma arida*). Succulents (e.g. *Aloe comptonii*, *Cerochlamys pachyphylla* and many *Crassula* spp.) are also abundant in rocky sites, of which two (*Crassula rupestris* ssp. *marnierana* and *Haworthia blackburniae*) are uncommon species. Other rare species known in this unit are *Apodolirion lanceolatum*, *Lotononis dahlgrenii* and *Muraltia cliffortiifolia*. **Condition:** Good; <0.13% infestation of *Hakea*, *Pinus*, *Echinopsis* and *Opuntia*.

- **Rooiberg Grassy Fynbos (LT):** 899.6 ha occur on the Rooiberg only. This unit has *Capeochloa arundinacea* dominant in places and a paucity of other species relative to other fynbos units. It has its own combination of species, with *Centella virgata*, *Cullumia bisulca*, *Diosma apetala*, *Erica speciosa*, *Heliophila glauca*, *Leucospermum wittebergense*, *Muraltia dispersa*, *Muraltia ericaefolia*, *Osteospermum moniliferum*, *Pelargonium laevigatum*, *Pelargonium tricolor*, *Phylica axillaris*, *Phylica lanata*, *Polygala wittebergensis* and occasionally *Tritoniopsis antholyza* present. No rare species are known from this unit. **Condition:** Near pristine; <0.05% infestation of *Hakea*, *Pinus*, *Opuntia* and *Echinopsis*.

- **Gamkaberg Grassy Fynbos (LT):** 514.5 ha occur on Gamkaberg only. The unit also has *Capeochloa arundinacea* dominant in places and has a sparse shrub component present. Here the tall *Heliophila glauca* may be prominent along with other shrubs such as *Cullumia bisulca*, *Erica speciosa*, *Leucospermum wittebergense*, *Muraltia ericaefolia*, *Osteospermum moniliferum* and *Phylica lanata*. An odd feature is the occasional abundance of the geophyte *Boophone disticha*, often along with a few *Aloe ferox* present and a localised abundance of *Themeda triandra*. No rare species are known from this unit. **Condition:** Near pristine; <0.02% infestation of *Hakea*.

- **Gamkaberg Waboom-Grassy Fynbos (LT):** 3 607.1 ha occur on Gamkaberg and Fontein. This unit has waboom (*Protea nitida*) and shrubs such as *Erica cerinthoides*, *Erica speciosa*, *Leucadendron salignum* and *Leucospermum cuneiforme* occasionally prominent on south-facing slopes. *Protea lorifolia*, *Protea repens* and other shrubs such as *Agathosma capensis*, *Anthospermum spathulatum*, *Eriocephalus africanus*, *Oedera imbricata* and *Metalasia massonnii* may also be present in sites where the waboom patches are more extensive. The unit is most easily recognised by a relative abundance and occasionally local dominance of *Aspalathus peduncularis*, a feature not shared with any of the other Grassy Fynbos units. Sweet grasses (C4-grasses such as *Themeda triandra*) are locally abundant where deep loamy soils occur, but they are prominent only for a few years after a fire. Geophytes are often abundant, some of which are uncommon species (e.g. *Geissorhiza roseoalba*, *Romulea jugicola*, *Romulea vlokii*, etc.). Other rare species known from this unit include the seemingly very rare *Harveya roseoalba* and *Asparagus oliveri*, which is often locally abundant here. **Condition:** On Gamkaberg this unit has been subject to controlled burning to stimulate habitat for the Cape mountain zebra population on the reserve and as a result, some sections are no longer in a pristine condition; <0.4% infestation of *Hakea*, *Acacia cyclops*, *Opuntia* and *Eucalyptus*.

- **Gamkaberg Waboomveld (LT):** A total of 2 811.5 ha occur on Gamkaberg only. This unit is most easily identified in having waboom (*Protea nitida*) prominent in the vegetation and possibly best known as it has the relatively recently discovered local endemic *Mimetes chrysanthus* present. It is like most other Waboomveld units also rich in other species. The species thus far recorded in this unit include: *Agathosma*

capensis, *Agathosma ovata*, *Agathosma roodebergensis*, *Albuca glandulosa*, *Amphithalea violacea*, *Anginon difforme*, *Anthospermum ciliare*, *Arctotheca calendula*, *Arctotis virgata*, *Aspalathus hystrix*, *Aspalathus laricifolia*, *Aspalathus pedunculata*, *Aspalathus rubens*, *Aspalathus sceptrum-aureum*, *Asparagus capensis*, *Asparagus oliveri*, *Babiana sambucina*, *Berkheya angustifolia*, *Bobartia orientalis*, *Brachycarpaea juncea*, *Brunia nodiflora*, *Centella virgata*, *Ceterach cordatum*, *Cheilanthes multifida*, *Cheilanthes parviloba*, *Chironia baccifera*, *Chrysocoma valida*, *Cineraria geifolia*, *Cliffortia pulchella*, *Cliffortia ruscifolia*, *Clutia polifolia*, *Crassula biplanata*, *Crassula muscosa*, *Crassula tetragona*, *Cullumia bisulca*, *Cyanella lutea*, *Cyclopia intermedia*, *Cymbopogon pospischilii*, *Diascia parviflora*, *Dimorphotheca acutifolia*, *Dimorphotheca nudicaulis*, *Diosma apetala*, *Diosma prama*, *Disparago ericoides*, *Ehrharta bulbosa*, *Ehrharta calycina*, *Ehrharta ramosa*, *Elegia filacea*, *Elytropappus adpressus*, *Elytropappus rhinocerotis*, *Empodium plicatum*, *Eragrostis curvula*, *Erica anguliger*, *Erica articularis*, *Erica cerinthoides*, *Erica coccinea*, *Erica melanthera*, *Erica speciosa*, *Eriocephalus africanus*, *Euclea polyandra*, *Euryops erectus*, *Euryops rehmanii*, *Felicia filifolia*, *Ficinia nigrescens*, *Ficinia ramosissima*, *Freylinia decurrens*, *Garuleum bipinnatum*, *Gladiolus floribundus*, *Gladiolus patersoniae*, *Gladiolus permeabilis*, *Gomphocarpus cancellatus*, *Harveya capensis*, *Helichrysum anomalum*, *Helichrysum felinum*, *Helichrysum zeyheri*, *Heliophila glauca*, *Heliophila scoparia*, *Hermannia cuneifolia*, *Hermannia filifolia*, *Hermannia flammula*, *Hermannia holosericea*, *Hermannia salviifolia*, *Hermannia vestita*, *Hertia alata*, *Hesperantha falcata*, *Hymenolepis incisa*, *Hypocalyptus sophoroides*, *Hypodiscus striatus*, *Indigofera heterophylla*, *Indigofera mundiana*, *Lachnaea ruscifolia*, *Lachnaea striata*, *Leucadendron rubrum*, *Leucadendron salignum*, *Leucospermum cuneiforme*, *Leucospermum wittebergense*, *Linum africanum*, *Lobelia linearis*, *Lobelia tomentosa*, *Lobostemon fruticosa*, *Lobostemon glaucophyllus*, *Capeochloa arundinacea*, *Tenaxia stricta*, *Metalasia massonii*, *Metalasia pallida*, *Metalasia pulcherrima*, *Microloma saggitatum*, *Mohria caffrorum*, *Montinia carophyllacea*, *Moraea algoensis*, *Moraea gawleri*, *Muraltia ericaefolia*, *Muraltia ericoides*, *Nemesia fruticans*, *Oedera genistifolia*, *Oedera imbricata*, *Oedera squarrosa*, *Oftia africana*, *Osteospermum bolusii*, *Osteospermum glabrum*, *Osteospermum junceum*, *Osteospermum moniliferum*, *Osteospermum pinnatum*, *Osteospermum polygaloides*, *Osteospermum triquetrum*, *Othonna carnosae*, *Othonna parviflora*, *Oxalis attaquana*, *Oxalis depressa*, *Oxalis obtusa*, *Oxalis pes-caprae*, *Paranomus dispersus*, *Paranomus roodebergensis*, *Paranomus spathulatus*, *Passerina obtusifolia*, *Pelargonium abrotanifolium*, *Pelargonium alternans*, *Pelargonium fruticosum*, *Pelargonium glutinosum*, *Pelargonium laevigatum*, *Pelargonium multicaule*, *Pelargonium myrrhifolium*, *Pelargonium scabrum*, *Pelargonium tricolor*, *Pentameris eriostoma*, *Pentameris juncifolia*, *Pentameris malouinensis*, *Pentzia dentata*, *Pentzia elegans*, *Phylica lanata*, *Phylica paniculata*, *Phylica purpurea*, *Polygala fruticosa*, *Polygala garcinii*, *Polygala microlopha*, *Polygala myrtifolia*, *Polygala wittebergensis*, *Printzia polifolia*, *Protea eximia*, *Protea neriifolia*, *Protea repens*, *Pteronia stricta*, *Rafnia capensis*, *Rafnia racemosa*, *Relhania calycina*, *Restio capensis*, *Restio gaudichaudianus*, *Restio triflora*, *Restio triticeus*, *Rhodocoma fruticosa*, *Scabiosa columbaria*, *Selago albida*, *Selago burchellii*, *Selago eckloniana*, *Selago luxurians*, *Senecio coronatus*,

Senecio juniperinus, *Solanum tomentosum*, *Stoebe microphylla*, *Stoebe plumosa*, *Stoebe spiralis*, *Syncarpha canescens*, *Syncarpha ferruginea*, *Syncarpha milleflora*, *Syncarpha paniculata*, *Thamnochortus cinereus*, *Thesium strictum*, *Tribolium uniolae*, *Tritonia pallida*, *Tritonia securigera*, *Ursinia nana*, *Wahlenbergia guthriei*, *Wahlenbergia rubens* and *Watsonia fourcadei*. Other rare species known in this unit include *Felicia esterhuyseniae*, *Gladiolus emiliae*, *Heliophila rimicola*, *Leucadendron tinctum* and *Prismatocarpus cliffortioides*. **Condition:** This unit is heavily utilised by the Cape mountain zebra, especially towards the eastern part of the reserve. A section of this unit towards the eastern side of the reserve was burnt in a controlled burn to stimulate young plant growth for the Cape mountain zebra population. Infestation of *Acacia cyclops*, *Hakea* and *Opuntia* is <0.04%.

- **Rooiberg Waboomveld (LT):** 879.1 ha occur on the Rooiberg and Groenefontein. It also has waboom (*Protea nitida*) prominent in the vegetation, along with most of the common species recorded in the Gamkaberg Waboomveld. It differs in lacking some of the Gamkaberg Waboomveld local endemics (e.g. *Mimetes chrysanthus*) and by having its own local endemic species, such as *Aspalathus karooensis* and *Metalasia tricolor*. It is perhaps most easily distinguished by having other more common species more prominent, such as *Acmadenia sheilae* and *Paranomus dispersus*. **Condition:** Good; <0.05% infestation of *Hakea*, *Pinus*, *Opuntia* and *Agave*.
- **Gamkaberg Waboom-Mesic Proteoid Fynbos (LT):** 698 ha occur on Gamkaberg only. It is somewhat unique in having both Waboomveld and Mesic Proteoid Fynbos present. Here the Waboomveld, characterised by the presence of *Protea nitida*, occurs mostly on the north-facing slope, with the Mesic Proteoid Fynbos mostly restricted to south-facing slopes. *Protea neriifolia* and *Protea repens* are both abundant in the Mesic Proteoid Fynbos, along with ericas (e.g. *Erica cerinthoides*, *Erica demissa*, *Erica melanthera*, etc.) and restios (*Cannamois scirpoides*, *Hypodiscus striatus*, *Thamnochortus cinereus*, etc.). Grasses, including sweet grasses such as *Themeda triandra*, are mostly abundant in the Waboomveld. Rare and localised endemic species known from this unit include *Erica* sp.nov., *Gladiolus emiliae*, *Liparia latifolia*, *Phyllica meyeri* and an unusual form of *Paranomus spathulatus*. **Condition:** The eastern section of this unit has been subject to a controlled burn to stimulate young plant growth for the Cape mountain zebra population on the reserve, as well as lightning-induced and man-made fires, which had taken place at 14, 10 and 5 year intervals. After fires the burnt areas are favoured by the Cape mountain zebra. Infestation of *Hakea*, *Acacia cyclops*, *Opuntia* and *Eucalyptus* is <0.04%.
- **Saffraanrivier Waboom-Renosterveld (VU):** 910.4 ha occur on Gamkaberg, Fontein and Heimersrivier. In this unit renosterbos (*Elytropappus rhinocerotis*) is also the dominant shrub on north-facing slopes, with fynbos elements (e.g. *Cannamois scirpoides*, *Hypodiscus striatus*, *Leucadendron salignum*, *Leucadendron teretifolium*, *Leucospermum cuneiforme*, *Protea repens*, *Rhodocoma fruticosa*, etc.) and especially waboom (*Protea nitida*) prominent on south-facing slopes. A rather unusual feature is the relative abundance of the

otherwise uncommon *Erica tragulifera* in this unit. On the rocky outcrops are sandolien (*Dodonaea angustifolia*) and a few trees (*Maytenus oleoides*, *Colpoon compressum*, *Searsia lucida*, etc.) present, but they are not very abundant. Sour grasses (e.g. *Aristida*, *Capeochloa*, *Pentameris* species) are also present, but not very prominent. Geophytes are quite abundant here, including some rare and localised endemic species such as *Disa salteri*, *Moraea lilacina* and *Tritonia pallida* ssp. *taylorae*. **Condition:** This unit has also been subject to controlled burning to stimulate habitat for the Cape mountain zebra population on the reserve. It is being impacted by grazing and browsing and is therefore not in a pristine condition. Infestation of *Hakea* and *Opuntia* is <0.1%.

- **Dwars-in-die-Weg Sandolienveld (LT):** Only 127.3 ha occur on the Rooiberg. This unit is not very rich in species, but it is nevertheless an interesting unit as it bridges the gap between the Subtropical Thicket of the lowlands and the Fynbos in the uplands of the Rooiberg. It is thus an ecotonal unit in which sandolien (*Dodonaea angustifolia*) is the dominant species but other shrubs such as *Acmadenia sheilae*, *Diosma prama*, *Felicia filifolia*, *Heliophila glauca*, *Metalasia pungens* and *Passerina obtusifolia* are also abundant. Some grasses are present, (e.g. *Cymbopogon validus*) but they are never very abundant. The only known rare species present is *Alonsoa peduncularis*. **Condition:** Very good; <0.04% infestation of *Hakea* and *Pinus*.
- **Gamkaberg Sandolienveld (LT):** 51.3 ha occur on Gamkaberg only. This unit is largely restricted to a series of small silcrete hills with sandolien (*Dodonaea angustifolia*) prominent in the vegetation. Fynbos elements are more prominent with *Leucadendron salignum* and *Leucospermum cuneiforme* often locally abundant. No rare species are known to occur in this unit, but it requires better sampling. **Condition:** Very good; <0.03% infestation of *Hakea* and *Opuntia*.
- **Rooiberg Subalpine Fynbos (LT):** Only 39.4 ha occur on the Rooiberg. This unit is easy to recognise as it is dominated by restios, ericas and short (< 1 m) proteas. It can be recognised by the local combination of rare and local endemic species that includes *Acmadenia baileyensis*, *Erica melanomontana*, *Erica recta*, *Harveya bolusii*, *Leucadendron dregei*, *Nivenia argentea* and *Spatalla confusa*. An unusual prostrate form of *Leucadendron album* present in this unit may be a distinct taxon endemic to this unit. **Condition:** Near pristine; <0.02% infestation of *Hakea* and *Pinus*.

Subtropical Thicket biome (13 units)

- **Rooiberg Fynbos-Spekboomveld (LT):** 2 441.6 ha occur on Groenefontein, Gamkaberg and Rooiolifantskloof. In this unit spekboom (*Portulacaria afra*) is prominent and *Lachnostylis bilocularis* a common species. It has its own uncommon species, such as *Crassula rupestris* ssp. *marnierana* and *Haworthia blackburniae* var. *blackburniae*. **Condition:** Very good; <0.03% infestation of *Hakea*, *Pinus* and *Opuntia*. The spekboom in this unit has been reported to have been very effective in stopping a recent fire (2017) on the northern slopes of Groenefontein, Gamkaberg and Rooiberg.

- **Calitzdorp Valley Spekboomveld (LT):** 2 244.3 ha occur on Groenefontein, Kwessie, Triangle, Rooilifantskloof and Gamkaberg. Spekboom (*Portulacaria afra*) is abundant and prominent amongst woody trees and shrubs, such as *Carissa haematocarpa*, *Euclea undulata*, *Gymnosporia szyszyłowiczii*, *Rhigozum obovatum*, *Searsia longispina* and *Searsia undulata*, but *Pappea capensis* is also abundant. Other stem- and leaf succulents that are abundant include species such as *Aloe ferox*, *Aloe microstigma*, *Aloe speciosa*, *Crassula rupestris*, *Dioscorea hemicryptica*, *Euphorbia heptagona*, *Gasteria brachyphylla*, *Pachypodium bispinosum*, *Pachypodium succulentum*, *Pelargonium tetragonum* and *Sarcostemma viminale*. Grasses are present (e.g. *Agrostis lachnantha*, *Cenchrus ciliaris*, *Fingerhuthia africana*, *Panicum coloratum*, *Panicum deustum*, *Sporobolus africanus*, *Stipa dregeana*, *Tribolium uniolae*, etc.), but they are only prominent after good summer rain. No rare species are known from this unit, but the localised endemic *Tylecodon cacalioides* is present. **Condition:** Poor; this unit has historically been severely impacted due to over-grazing by goats, sheep and ostriches – in certain areas on Groenefontein, Triangle and Kwessie the spekboom has almost been eaten away completely. A spekboom restoration project was implemented on Groenefontein from 2010-2014. In heavily disturbed areas *Atriplex lindleyi* subsp. *inflata* (Blasiebrak) and/or *Augea capensis* (Kinderpieletjies) have infiltrated and become established, resulting in salinification of the soils. Infestation of *Pinus*, *Agave* and *Opuntia* is at <0.02%.

- **Kwessie Arid Spekboomveld (LT):** 831.5 ha occur on Kwessie and Triangle. The northern slopes have spekboom (*Portulacaria afra*) and woody trees and shrubs predominant, but the southern slopes are dominated by Succulent Karoo communities with species such as *Crassula arborescens*, *Euphorbia mauritanica*, *Zygophyllum foetidum* and *Zygophyllum morgsana* abundant on the south-facing slopes. The only two rare species known from the southern slopes are *Freesia speciosa* and *Gasteria brachyphylla* var. *bayeri*. They both indicate a close affiliation with the western Klein Karoo region, despite the location of the unit. **Condition:** Very poor; most of this unit has been transformed through historical over-grazing by goats, sheep and ostriches, with the loss in spekboom very evident and a clear indicator. A spekboom restoration project was started on Kwessie and Triangle in 2017, where 24 ha were planted with spekboom cuttings.

- **Dwars-in-die-Weg Pruimveld (LT):** 668.1 ha of this unit occur on Vaalhoek only. Spekboom (*Portulacaria afra*) is occasionally also abundant amongst the woody trees, such as gwarrie (*Euclea undulata*), spalkpendoring (*Gloveria integrifolia*), koeniebos (*Searsia undulata*) and doppruim (*Pappea capensis*), that are predominant on the north-facing slopes and the south-facing slopes have renosterbos (*Elytropappus rhinocerotis*), sandolien (*Dodonaea angustifolia*), Chinese lantern bush (*Nymannia capensis*) and some Fynbos elements (e.g. *Rhodocoma arida*) as the dominant species. It often has small strips of Gannaveld (with species such as *Salsola aphylla*, *Drosanthemum giffenii*, *Pentzia incana*, etc.) present along the lower water drainage areas. Bitter Aloe (*Aloe ferox*) is often abundant in disturbed sites in this unit. No rare or localised endemic species are

known from this unit. **Condition:** Certain parts of this unit have historically been transformed as a result of over-grazing by domestic stock, where the sections with spekboom have been moderately transformed, especially on the northern slopes. Infestation of *Opuntia* and *Echinopsis* is at <0.02%.

- **Hartbeesvlakte Fynbos-Spekboomveld** (LT): 1 639.4 ha occur on Groenefontein, Rooiolifantskloof and the northwestern Section of the Rooiberg. The Fynbos that is present on southern slopes has species such as *Erica spectabilis*, *Helichrysum cylindriflorum*, *Hertia alata*, *Linum africanum*, *Protea humiflora*, *Pteronia fasciculata* and *Syncarpha ferruginea* often prominent. No rare or localised endemic species are known from this unit. **Condition:** Very good; <0.03% infestation of *Hakea*, *Pinus* and *Opuntia*.
- **Zoar Fynbos-Spekboomveld** (LT): 1 535.6 ha occur on Paardenberg and Rooiolifantskloof. This unit occurs mostly on steep north-facing slopes on outcrops of quartzitic rocks where spekboom (*Portulacaria afra*) is abundant on the lower slopes and Fynbos forms the matrix vegetation on the upper slopes. Doppruim (*Pappea capensis*) is often abundant, and the uncommon *Ficus cordata* is present in the Thicket vegetation on the lower slopes. Some rare, localised endemic succulents, such as *Tromotriche baylisii* are also present on rocky outcrops in ravines. **Condition:** Good; some of the spekboom in the western section of Rooiolifantskloof has been over-grazed by goats. Infestation of *Hakea*, *Pinus* and *Opuntia* is < 2.03%.
- **Vaalhoek Arid Spekboomveld** (LT): 372.4 ha occur on Vaalhoek only. This unit has outcrops of calcrete on the tops of hills where unusual Succulent Karoo communities occur with species of *Aizoon*, *Eriocephalus*, *Jamesbrittenia*, *Muraltia*, *Pentameris*, *Ruschia* and *Selago* prominent. Patches of Gannaveld are also present in the small valleys between the hills. No rare or localised endemic species are known from this unit, but the unit has been poorly surveyed. **Condition:** Poor; large sections of this unit have been severely transformed as a result of past over-grazing by goats and other domestic stock with the loss in spekboom very evident and a clear indicator. Between 2015-2016 a spekboom restoration project was implemented on Vaalhoek, where 78 ha have been planted with spekboom cuttings. Infestation of *Opuntia* and *Echinopsis* is at <0.03%.
- **Blossoms Asbos-Gwarrieveld** (EN): 149.5 ha occur on the Heimersrivier property. The Succulent Karoo communities on the south-facing slopes are dominated by asbos (*Pteronia incana*), with renosterbos (*Elytropappus rhinocerotis*) occasionally also present, but never the dominant species. Woody trees and shrubs (*Carissa haematocarpa*, *Euclea undulata*, *Gloveria integrifolia*, *Gymnosporia szyszyłowiczii*, *Nymannia capensis*, etc.) are most abundant on the north-facing slopes, where a few spekboom (*Portulacaria afra*) may also be present. This unit is rich in succulents and geophytes, of which some are rare or localised endemic species (e.g. *Drosanthemum* sp.nov., *Glottiphyllum linguiforme*, *Haworthia emelyae*, *Pelargonium ochroleucum*, *Tylecodon leucothrix*, etc.). Grasses, especially *Ehrharta calycina*, can also be abundant on south-facing

slopes. Small patches of quartz outcrops occur sporadically in this unit and they are particularly rich in succulent species. **Condition:** Parts of this area were ploughed historically but has been lying fallow for over a decade. Infestation of *Hakea* is at 0.1%.

- **Keurbosch Fynbos-Gwarrieveld (LT):** 147.1 ha occur on the Rooiberg. Woody trees (mostly *Searsia undulata*) are abundant on the lower slopes, but uncommon other species (such as *Calpurnia intrusa*) are also present in water drainage lines. The most common shrubs are *Dodonaea angustifolia*, *Euryops rehmanii*, *Monechma incana* and *Pteronia fasciculata*. Renosterbos (*Elytropappus rhinocerotis*) is also present, but it is never dominant. Succulents, especially *Aloe comptonii*, *Crassula rupestris* and *Senecio ficoides* are abundant on rocky outcrops, but many other species are also present, e.g. *Adromischus caryophyllaceus*, *Crassula biplanata*, *Lampranthus coralliflorus* (= *L. dependens*) and *Ruschia amicorum*. Geophytes are not abundant, but *Strumaria spiralis* may be locally abundant on rocky outcrops. **Condition:** Infestation of *Hakea*, *Pinus*, *Echinopsis* and *Opuntia* is at <0.05%.
- **Calitzdorp Arid Spekboomveld (LT):** A very small section (0.5 ha) of this unit occurs on Paardenberg only. In this unit Noors (*Euphorbia coerulescens*) is present and often locally abundant. It also has a number of other species present that are more typical of the Eastern Cape (e.g. *Barleria obtusa*) and that are absent from all the other Klein Karoo units. Rare and localized endemic species known from this unit include *Crotalaria lebeckioides*, *Eriospermum rhizomatum*, *Huernia guttata* var. *calitzdorpensis* and *Huernia pillansii*. **Condition:** This unit is in a very good condition on Paardenberg; <0.12% infestation of *Hakea* and *Opuntia*.
- **Volmoed Arid Spekboomveld (LT):** 372.4 ha of this unit occur on Fontein. In this unit the spekboom (*Portulacaria afra*) is quite abundant to locally dominant on north-facing slopes, as well as woody trees and tall shrubs (*Carissa haematocarpa*, *Euclea undulata*, *Gloveria integrifolia*, *Rhigozum obovatum*, *Rhus undulata* and some *Pappea capensis*). Sandolien (*Dodonaea angustifolia*) occurs on the crests of hills and can be abundant on the southern slopes. The Succulent Karoo patches present are often dominated by *Pteronia* species (e.g. *Pteronia fascicularis*, *Pteronia flexicaulis*, *Pteronia incana*, *Pteronia paniculata*, etc.) and are often rich in species, with succulents (e.g. *Aloe microstigma*, *Crassula arborescens*, *Gasteria brachyphylla*, etc.) abundant. No rare or localised endemic species are known from this unit, but it is poorly surveyed. **Condition:** Very good.
- **Sandberg Fynbos-Spekboomveld (LT):** 996.8 ha occur on Rooiolifantskloof only. This unit has spekboomveld less prominent on northern slopes and the fynbos better developed on southern slopes, where uncommon species such as *Paranomus roodebergensis* are present. No rare or localised endemic species are known from this unit, but it has been poorly surveyed. **Condition:** Very good; <0.04% infestation of *Hakea*, *Pinus* and *Opuntia*.

- **Hartbeesvlakte Spekboomveld (LT):** 180.8 ha occur on Rooiolifantskloof only. Spekboom (*Portulacaria afra*) and woody trees such as gwarrie (*Euclea undulata*), spalkpendoring (*Gloveria integrifolia*) and koeniebos (*Searsia undulata*) are dominant on the north-facing slopes, but it differs in also having doppruim (*Pappea capensis*) abundant in these communities. The vegetation present on the south-facing slopes also contrasts sharply with those present on the northern slopes, with the communities on the upper slopes dominated by shrubs such as renosterbos (*Elytropappus rhinocerotis*), sandolien (*Dodonaea angustifolia*), *Nymannia capensis*, *Polygala pinifolia* and in having Fynbos elements (such as *Rhodocoma arida*) present. Another quite unusual feature is the presence of species usually abundant in the lower lying Gannaveld (e.g. *Salsola aphylla*) abundant on the lower south-facing slopes. No rare or localised endemic species are known from this unit. **Condition:** Parts of it appear to have been impacted upon as a result of over-grazing. Infestation of *Opuntia* is at 0.01%.

Succulent Karoo biome (three units)

- **Calitzdorp Gravel Apronveld (CR):** 802.2 ha of this unit occur on Groenefontein, Kwessie and Triangle. This unit has a patchy vegetation structure. It has trees less prominent and rare and localised species such as *Aloe longistyla*, *Crassula rupestris* ssp. *marnierana*, *Delosperma calitzdorpense*, *Euphorbia gamkensis*, *Euphorbia tridentata*, *Eriospermum crispum*, *Glottiphyllum regium*, *Haworthia truncata* var. *maughanii*, *Haworthia truncata* var. *truncata* and *Ornithogalum sardinii*. **Condition:** Poor; large parts of this unit have been severely impacted upon by past over-grazing, particularly by ostriches and goats, as the condition of the heuweltjies is in a poor (concave) state.
- **Groenefontein Gravel Apronveld (EN):** 331.7 ha occur on Groenefontein and Rooiolifantskloof. The unit can be easily identified in having other succulent species (than Calitzdorp Gravel Apronveld) abundant in the terrace gravel patches, such as *Gibbaeum heathii* and lacking local endemics, such as *Euphorbia gamkensis*. Other rare species present here include geophytes such as *Freesia speciosa* and *Ornithogalum* sp.nov. **Condition:** Poor to fair; this unit was historically impacted upon as a result of over-grazing by sheep, goats and ostriches. This is still evident from the condition of the heuweltjies, the majority of which are in a poor (concave) state. Since the removal of the stock in 2000 when the property was purchased, the veld has been rested and is currently in a slow state of natural recovery. Infestation of *Opuntia*, *Agave* and *Nicotiana* is at <0.04%.
- **Hartbeesvlakte Gannaveld (VU):** 145.6 ha occur on Rooiolifantskloof only. It has Ganna (*Salsola aphylla*) abundant in the shrub dominated vegetation, but *Pentzia incana* is often very abundant here, with other shrubs like *Eriocephalus ericoides*, *Drosanthemum giffenii*, *Osteospermum sinuatum*, *Pteronia glauca* and *Pteronia pallens*. It differs in often having grasses (*Cenchrus ciliaris*, *Fingerhuthia africana*, *Eragrostis curvula* and *Digitaria argyrograpta*) often abundant in drainage lines, along with Wolwedoring (*Lycium cinereum* and *Lycium ferocissimum*). It also has *Malephora lutea* and *Mesembryanthemum splendens* as the most common succulents, but heuweltjies are more abundant here with *Mesembryanthemum*

crystallinum, *Mesembryanthemum junceum* and *Oncosiphon suffruticosum* the most prominent species. **Condition:** Poor; this unit has been and still is being impacted upon as a result of over-grazing by goats. The heuweltjies are in a poor state. Infestation of *Opuntia* is at <0.01%.

Aquatic vegetation units (include two freshwater and three brack water units)

- **Rooiberg Perennial Stream** (LT): 1 131.2 ha of this fresh water unit occur on the Rooiberg. It has *Cannamois virgata*, *Erica caffra*, *Hypocalyptus sophoroides*, *Restio paniculatus*, *Rhodocoma capensis* and several *Psoralea* species abundant along the streambank. Rare species in the upper seepage area, such as *Nivenia argentea*, indicate a relationship also with the Langeberg flora. Patches of Afromontane forests also occur here in fire-protected sites, with *Ilex mitis*, *Maytenus acuminata* and *Pterocelastrus tricuspidatus* as the most abundant trees, and ferns such as *Asplenium* and *Blechnum* species abundant in the understorey. **Condition:** Near pristine.
- **Seweweekspoort Perennial Stream** (LT): 224.1 ha of this fresh water unit occur on Paardenberg and Rooiolifantskloof. This unit is most easily identified as it is the only inland mountain stream vegetation in which *Virgilia divaricata* is abundant. Typical other tall shrubs and trees include *Hypocalyptus sophoroides*, *Psoralea affinis* and *Salix mucronata*. The seepage areas on the north-facing slopes are unusual in their species combination, but *Erica curviflora*, *Erica quadrangularis*, *Restio paniculatus* and *Rhodocoma capensis* are reliable indicators. Some rare and localized species may occur in these seepage zones, especially after a fire. **Condition:** Infestation of *Acacia mearnsii*, *Nerium*, *Arundo*, *Eucalyptus* and *Nicotiana* is at 18%.
- **Gamka River and floodplain** (VU): 860.6 ha of this brack water unit occur on the Gamkaberg and Rooiolifantskloof. The unit has its main catchment in the Nama Karoo. There are not many freshwater streams feeding into this river and it thus naturally carried less fresh water. Periodic floods deposited deep silt beds from the Great Karoo in the floodplain, where sweet thorn trees (*Vachellia karroo*) and grasses such as *Cynodon dactylon* and *Stipagrostis namaquensis* are prominent amongst Ganna (*Salsola aphylla*). Some interesting annuals occur in the floodplain, such as *Manulea chrysantha*, some of these annuals and other herbs are more typical of the Nama Karoo from which their seed is periodically washed during floods. It remains a mystery why they are not more abundant in the adjacent river systems. *Tromotriche choanantha* is a rare succulent that occurs on the vertical cliffs where this river cuts through the Rooiberg. **Condition:** The main stream is currently badly infested with *Nerium* and *Arundo*, *Ricinus*, *Nicotiana* and *Eucalyptus* in Sections. *Tamarix chinensis* and *Tamarix ramosissima* are also abundant in certain areas.
- **Gouritzrivier River and floodplain** (VU): 332.8 ha of this brack water unit occur on Vaalhoek and Gamkaberg. This unit is the recipient of all the waters from the other riverine units and it is thus no surprise that it shares characters and species with all the other riverine units. In pre-European days it had a perennial flow of

fresh water, only periodically punctuated with floods from the Nama Karoo. In places the vegetation on the riverbanks still contain typical fresh-water dependant plants such as *Cliffortia strobilifera* and *Salix mucronata*, but they are now uncommon. The floodplain vegetation is often dominated by *Vachellia karroo*, *Salsola aphylla* and *Suaeda fruticosa*, but many of the embankments are sandy with a fairly well-developed grass cover (*Cynodon dactylon*, *Ehrharta ramosa*, *Stipagrostis namaquensis*, etc.). These sandy embankments are often rich in annual species after rain. The steep cliff embankments just above the 1:100 year floodline have a rich assemblage of succulent species, some being local endemics such as *Cotyledon tomentosa* ssp. *ladismithiensis* and it probably also harbours a number of interesting *Haworthia* species. **Condition:** Much of this unit has been impacted upon as a result of the construction of dams upstream, the presence of invasive alien plants, water abstraction, pollution, bulldozing of river embankments and beds, cultivation in the floodplain area, etc. Infestation of *Tamarix*, *Nerium* and *Arundo* is at 1.53%.

- **Olifants River and floodplain (VU):** 235.8 ha of this brack water unit occur on the Gamkaberg and Fontein. The unit differs from most of the other riverine units in that many of its upper inland streambeds are still eroding into the landscape with a great many fingers. *Vachellia karroo* is the most prominent species here, often along with herbs such as *Ballota africana*. An interesting feature in this unit is the occasional abundance of *Senegalia caffra*. Many perennial fresh-water streams used to feed into the main drainage channel from the Kammanassie and Tsitsikamma Mountains, with periodic floods coming from the eastern Great Karoo during summer. The floodplain of this unit is somewhat different from all the other riverine units, but the shrub *Salsola aphylla* remains abundant and distinctive. Odd species noted in the floodplain include *Chrysocoma oblongifolia* and *Cyperus congestus*. **Condition:** This unit has been transformed due to agricultural activities, upstream dams, water abstraction, invasive alien vegetation, mining activities, etc. Infestation of *Ricinus* and *Populus* is at 0.02%.

Based on specimens collected and observations recorded on the Gamkaberg cluster and adjacent areas, the current plant species list stands on at least 936 plant species (including subspecies and varieties). This list is by no means complete and is constantly being updated through baseline data collection, especially with the addition of the WWF-SA and Dept of Public Works land.

At least 40 of these plant species are of conservation concern (Table 2.3; Raimondo *et al.* 2009; <http://redlist.sanbi.org>). These include species listed as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DDD or DDT), Rare or Critically Rare. Figure 2.7 illustrates some of the species recorded from the Gamkaberg Cluster. The species are being monitored with the assistance of the CREW groups.

Table 2.3: Plant species of conservation concern recorded from the Gamkaberg Cluster and adjacent areas.

Scientific Name	Family	Threatened Status according to Raimondo <i>et al.</i> (2009); http://redlist.sanbi.org	Distribution
<i>Delosperma calitzdorpense</i>	Aizoaceae	EN A2c; B1ab(iii,v)+2ab(iii,v)	Calitzdorp.
<i>Glottiphyllum regium</i>	Aizoaceae	EN(B1ab(iii,v))	Calitzdorp.
<i>Mesembryanthemum strictum</i>	Aizoaceae	EN(B1ab)	Ladismith.
<i>Aloe longistyla</i>	Asphodelaceae	DDD	Calitzdorp to Grahamstown and Graaff-Reinet, Cradock and Middelburg.
<i>Haworthia blackburniae</i> var. <i>blackburniae</i>	Asphodelaceae	LC	Swartberg and Klein Karoo Mts.
<i>Haworthia truncata</i> var. <i>maughanii</i>	Asphodelaceae	CR B1ab(iii,v)+2ab(iii,v)	Calitzdorp.
<i>Haworthia truncata</i> var. <i>truncata</i>	Asphodelaceae	VU B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)	Calitzdorp to De Rust.
<i>Felicia esterhuyseniae</i>	Asteraceae	Rare	Kammanassie Mts.
<i>Metalasia tricolor</i>	Asteraceae	Critically Rare	Rooiberg Mts.
<i>Senecio muirii</i>	Asteraceae	Rare	Calitzdorp to Gouritz River.
<i>Heliophila rimicola</i>	Brassicaceae	Rare	Rooiberg to Swartberg Mts.
<i>Crassula rupestris</i> var. <i>marnieriana</i>	Crassulaceae	Rare	Calitzdorp.
<i>Erica madida</i>	Ericaceae	Rare	Rooiberg Mts.
<i>Euphorbia gamkensis</i>	Euphorbiaceae	CR B1ab(iii,v); C2a(i)	Calitzdorp.
<i>Amphithalea flava</i>	Fabaceae	VU D2	Outeniqua, Gamkaberg and Rooiberg Mts.
<i>Aspalathus karrooensis</i>	Fabaceae	Critically Rare	Rooiberg.
<i>Aspalathus pedunculata</i>	Fabaceae	Rare	Outeniqua Mts between Robinson Pass and Montagu Pass
<i>Lotononis acocksii</i>	Fabaceae	EN(B1ab(iii,v))	Rooiberg and Swartberg Mts.
<i>Lotononis dahlgrenii</i>	Fabaceae	VU(D2)	Rooiberg Mts.
<i>Lotononis rigida</i>	Fabaceae	VU(B1ab(ii,iii,iv,v))	Worcester to Robertson, Gamka to Outeniqua Mts.
<i>Pelargonium denticulatum</i>	Geraniaceae	Rare	Gamkaberg and Outeniqua Mts.
<i>Freesia speciosa</i>	Iridaceae	VU C1	Anysberg to Calitzdorp.
<i>Gladiolus dolichosiphon</i>	Iridaceae	Not listed	Rooiberg and Klein Swartberg Mts.
<i>Gladiolus emiliae</i>	Iridaceae	NT(B1ab(iii,v))	Riviersonderend to George and Gamkaberg.
<i>Moraea lilacina</i>	Iridaceae	EN(B1ab(ii,iii,iv,v))	Gamkaberg to the Kammanassie.

Scientific Name	Family	Threatened Status according to Raimondo <i>et al.</i> (2009); http://redlist.sanbi.org	Distribution
<i>Syringodea saxatilis</i>	Iridaceae	VU B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v)	Ladismith.
<i>Disa arida</i>	Orchidaceae	EN(B1ab(ii,iii,v))	Rooiberg and Outeniqua Mts.
<i>Holothrix grandiflora</i>	Orchidaceae	DDD	Olifants River Mouth, Lambert's Bay, Ladismith and Port Elizabeth.
<i>Harveya roseoalba</i>	Orobanchaceae	Rare	Gamkaberg and Attaquasberg.
<i>Muraltia cliffortiifolia</i>	Polygalaceae	VU(D2)	Rooiberg Mts and the area between Riversdale and Mossel Bay.
<i>Muraltia karroica</i>	Polygalaceae	VU(B1ab(v))	Klein Swartberg to Rooiberg Mts.
<i>Leucadendron tinctum</i>	Proteaceae	Near Threatened (A4c)	Hex River Mts to Hottentots Holland and Langeberg Mts.
<i>Leucospermum pluridens</i>	Proteaceae	NT(B1ab(v))	Rooiberg Mts to Robinson's Pass.
<i>Mimetes chrysanthus</i>	Proteaceae	VU(D2)	Gamkaberg and Herold: Perdeberg.
<i>Paranomus roodebergensis</i>	Proteaceae	Rare	Touwsberg to Rooiberg Mts.
<i>Paranomus spathulatus</i>	Proteaceae	Near Threatened (A3c+4c)	Gamkaberg and Langeberg Mts between Tradouw and Garcia's Pass.
<i>Acmadenia baileyensis</i>	Rutaceae	DDT	Rooiberg Mts.
<i>Alonsoa peduncularis</i>	Scrophulariaceae	Rare	Touwsberg, Rooiberg Mts and Uitenhage?
<i>Freylinia vlokii</i>	Scrophulariaceae	EN(D)	Rooiberg Mts.
<i>Selago rubromontana</i>	Scrophulariaceae	Rare	Rooiberg Mts.



Figure 2.7: Plant species of conservation concern recorded from the Gamkaberg Cluster. A: *Leucospermum pluridens*; B: *Paranomus roodebergensis*; C: *Mimetes chrysanthus*; D: *Glottiphyllum regium*; E: *Delosperma calitzdorpense*; F: *Aloe longistyla*. (Photos: A, B, D, E, F: J&A Vlok; C: CapeNature)

2.3.1.2.3 Kammanassie Cluster

Twelve vegetation units occur on the Kammanassie, nine of which are terrestrial and three aquatic (Appendix 2 Map 6(c)).

Terrestrial vegetation units

Fynbos biome (six units)

- **Kammanassie Arid Proteoid Fynbos (LT):** This unit (4 402.5 ha) has species such as *Agathosma capensis*, *Agathosma ovata*, *Aspalathus hystrix*, *Erica versicolor*, *Erica speciosa*, *Ficinia deusta*, *Hypodiscus aristatus*, *Hypodiscus striatus*, *Restio capensis*, *Leucadendron salignum*, *Leucospermum cuneiforme*, *Pentameris eriostoma*, *Pentameris macrocalycina*, *Pentameris malouinensis*, *Pentameris pallida*, *Protea lorifolia*, *Protea repens*, *Rhodocoma fruticosa*, *Schoenus cuspidatus*, *Tetraria ustulata* and *Thamnochortus rigidus* prominent and abundant, but it differs in having uncommon species such as *Cliffortia dispar*, *Cliffortia polita*, *Cliffortia robusta*, *Lampranthus diffusus* and *Leucospermum royenifolium* present. The orange-red variant of *Leucadendron salignum* is quite abundant here, indicating that there is a shift in genetic material of this species in this unit. **Condition:** 0.5% infestation of *Hakea*; certain areas towards the east have burnt repeatedly at less than 10 year return-intervals.
- **Kammanassie Arid Restioid Fynbos (LT):** This unit (1 867.8 ha) is largely restricted to rocky, sandy soils (often underlain by silcrete) on north-facing slopes. Succulents (e.g. *Adromischus triflorus*, *Aloe comptonii*, *Bulbine frutescens*, *Crassula rupestris*, *Euphorbia heptagona*, *Gasteria brachyphylla*, *Haworthia arachnoidea*, *Pelargonium alternans*, *Pelargonium carnosum*, etc.) are often prominent on rocky sites, along with some stunted trees (e.g. *Euclea undulata*, *Maytenus oleoides*, *Colpoon compressus* and *Searsia undulata*). Geophytes (*Boophone disticha*, *Drimia anomala*, *Haemanthus albiflos*, etc.) are occasionally abundant, but grasses (e.g. *Cymbopogon marginatus*) are uncommon. The only rare species known to occur in this unit is the localized endemic *Erica kammanassieae*. **Condition:** Good; <1% infestation of *Hakea*.
- **Kammanassie Grassy Fynbos (LT):** It (3 720.7 ha) is very similar to the Rooiberg Grassy Fynbos in its structure and common species present, but it differs in having some more eastern elements present, such as the grass-like *Protea intonsa*. No rare or endemic species are known to occur in this unit. **Condition:** <1.2% infestation of *Hakea*; <0.1% *Populus canescens* infestation in declared Mountain Catchment Area at Kleinfonteinsberg which has possibly contributed to the drying up of the two springs that are being monitored; parts affected by short return-interval fires of <10 years.
- **Kammanassie Mesic Proteoid Fynbos (LT):** This unit (2 421.7 ha) can be easily recognised by its proteoid shrub component. Here *Leucadendron eucalyptifolium*, *Protea eximia*, *Protea punctata* and *Protea neriifolia* are abundant to locally dominant. It has the following rare and local endemic species present: *Agathosma affinis*, *Amphithalea axillaris*, *Bobartia paniculata*, *Cyclopia alopecuroides*,

Cyclopia plicata, *Disa lugens* var. *lugens*, *Erica costatisepala*, *Erica inordinata*, *Geissorhiza elsiae*, *Gladiolus fourcadei*, *Lachnaea glomerata*, *Leucadendron rourkei*, *Liparia genistoides*, *Oxalis fourcadei*, *Paranomus esterhuyseniae*, *Protea grandiceps* and *Romulea vlokii*. **Condition:** 0.1-1.1% *Hakea* and *Acacia mearnsii* infestation; part of this unit is being impacted by cattle and game species escaping from neighbouring properties; certain parts have burnt repeatedly at short fire return-intervals of <10 years.

- **Kammanassie Subalpine Fynbos** (LT): This unit (521.3 ha) is dominated by restios, ericas and short (less than 1 m) proteas. It can be recognised by the local combination of rare and local endemic species, that includes *Alepidea delicatula*, *Aspalathus patens*, *Disa neglecta*, *Disa pillansii*, *Elegia juncea*, *Erica inordinata*, *Erica montis-hominis*, *Erica valida*, *Leucadendron singulare*, *Protea venusta* and *Syncarpha montana*. **Condition:** 0.1-1.1% *Hakea* infestation.
- **Kammanassie Waboomveld** (LT): *Protea nitida* is abundant and prominent in this unit (9 766.8 ha). Other species recorded: *Agathosma capensis*, *Agathosma ovata*, *Artemisia afra*, *Aspalathus alpestris*, *Aspalathus laricifolia*, *Babiana sambucina*, *Bulbinella cauda-felis*, *Cannamois scirpoides*, *Osteospermum moniliferum*, *Cineraria alchemilloides*, *Cliffortia linearifolia*, *Cliffortia neglecta*, *Cliffortia ramosissima*, *Cliffortia ruscifolia*, *Clutia polifolia*, *Ehrharta bulbosa*, *Elegia filacea*, *Eragrostis chloromelas*, *Erica cerinthoides*, *Erica maesta*, *Erica melanthera*, *Eriocephalus africanus*, *Felicia filifolia*, *Ferraria divaricata*, *Ficinia nigrescens*, *Freylinia densiflora*, *Haemanthus albiflos*, *Helichrysum cylindriflorum*, *Helichrysum teretifolium*, *Hermannia diffusa*, *Hermannia multiflora*, *Hypodiscus striatus*, *Restio capensis*, *Restio hystrix*, *Restio unispicata*, *Leucadendron salignum*, *Leucospermum cuneiforme*, *Lobostemon fruticosus*, *Lobostemon marlothii*, *Muraltia dispersa*, *Oedera squarrosa*, *Othonna auriculifolia*, *Othonna lobata*, *Oxalis obtusata*, *Oxalis punctata*, *Passerina obtusifolia*, *Pelargonium scabrum*, *Pelargonium suburbanum*, *Pelargonium tricolor*, *Pentzia dentata*, *Phyllis paniculata*, *Polygala microlopha*, *Polygala myrtifolia*, *Protea neriifolia*, *Protea repens*, *Restio multiflorus*, *Restio triticeus*, *Rhodocoma fruticosa*, *Ruschia lineolata*, *Senecio cotyledonis*, *Senecio ilicifolius*, *Spiloxene trifurcillata*, *Struthiola macowanii*, *Chaenostoma campanulata*, *Tephrosia capensis*, *Schoenus cuspidatus* and *Willdenowia teres*. The combination of rare and localised endemic species are unique and include *Acmadenia maculata*, *Agathosma affinis*, *Cliffortia arcuata*, *Erica passerinae*, *Gladiolus leptosiphon*, *Lachenalia haarlemensis*, *Lachnostylis bilocularis*, *Lampranthus scaber*, *Paranomus esterhuyseniae*, *Pelargonium denticulatum* and *Romulea jugicola*. **Condition:** 0.1-1.1% *Hakea* infestation; preferred habitat of Cape mountain zebra.

Subtropical Thicket biome (three units)

- **Pietslaagte Asbos-Gwarrieveld** (LT): In this small unit (23.1 ha) *Euclea undulata* (gwarrie) and *Searsia undulata* (koeniebos) are the only common woody trees. Some spekboom may be present on the north-facing slopes, but there is no indication that it was abundant before. *Aloe ferox* is the only common succulent,

with species usually abundant in other similar units (e.g. *Cotyledon* and *Tylecodon* species) being quite rare here. The matrix Succulent Karoo communities are dominated by *Pteronia incana* (asbos) and *Eriocephalus* species (kapokbos), indicating that parts of this unit may be subjected to periodic fires. Geophytes, such as *Freesia verrucosa* and *Lachenalia haarlemensis* are uncommon species present. **Condition:** Unknown.

- **Stompdrif Arid Spekboomveld (LT):** The northern slopes of this unit (19.7 ha) has spekboom (*Portulacaria afra*) and woody trees and shrubs (*Carissa haematocarpa*, *Euclea undulata*, *Gloveria integrifolia*, *Gymnosporia szyszylowiczii*, *Nymania capensis*, *Rhigozum obovatum* and *Searsia undulata*) abundant, but here the southern slopes differ in having *Pteronia incana* (asbos) abundant to locally dominant. No rare or localised endemic species are known from this unit. **Condition:** Unknown.
- **Voorsorg Fynbos-Spekboomveld (LT):** This unit (1 362.5 ha) has uncommon species such as *Lachnostylis bilocularis* and *Senecio ficoides*, but *Euclea natalensis*, *Euclea polyandra*, *Salvia africana-lutea*, etc. are common. Some rare species (e.g. *Cyrtanthus inaequalis*) are restricted to this unit. The latter common and uncommon species oddly seems to bridge a distribution gap for species normally better known from coastal environments. **Condition:** 0.1-1.1% *Hakea* infestation; impacted as a result of grazing by neighbouring landowner's cattle.

Aquatic vegetation units (include two fresh water and one brack water unit)

- **Kammanassie Perennial Stream (LT):** This freshwater unit (549.3 ha) is indicated by an abundance of *Cannamois virgata*, *Calopsis paniculata* and *Rhodocoma capensis*, along with *Erica caffra*, *Erica curviflora*, several *Psoralea* species and *Pteronia camphorata*. *Gunnera perpensa* is another typical element and reliable indicator of this unit, as well as the tree, *Virgilia divaricata* that is often present along the mid slopes of the mountain. Small patches of forest may occur in fire-protected kloofs, often with an abundance of ferns (mostly *Blechnum* species.) A number of localized endemic species such as *Geissorhiza elsiae* and *Liparia genistoides* and some rare orchids (e.g. *Disa elegans*) occur in the upper seepage areas. **Condition:** 0.1% *Pinus* infestation; at least 11 of the 20 springs that are being monitored and feed into this unit have dried up or are standing, presumably as a result of groundwater abstraction.
- **Kammanassie Northern Perennial Stream (LT):** The vegetation in this freshwater unit (2 241.4 ha) is easily recognized in having reliable indicators of wet sites, such as *Cannamois virgata*, *Calopsis paniculata*, *Carpha glomerata*, *Cliffortia strobilifera*, *Erica caffra*, *Erica curviflora*, *Mentha longifolia*, *Psoralea affinis* and *Rhodocoma capensis* common and abundant. It differs from all the other similar units in the uncommon species present, which include ferns such as *Asplenium platyneuron*, *Histiopteris incisa* and *Osmunda regalis* in cool, shady sites with *Pelargonium pseudoglutinosum* sometimes abundant in sunny open sites. The uncommon tree *Lachnostylos bilocularis* and *Cyrtanthus inaequalis* occur on

vertical rock faces flanking this unit. **Condition:** <0.1% *Acacia mearnsii* infestation; all the springs that are being monitored and feed into this unit have dried up over the past 15 years.

- **Olifants River & Floodplain (VU):** This brack water unit (160 ha) differs from most of the other riverine units in that many of its upper inland streambeds are still eroding into the landscape with a great many fingers. *Vachellia karroo* is the most prominent species here, often along with herbs such as *Ballota africana*. An interesting feature in this unit is the occasional abundance of *Senegalia caffra*. Many perennial freshwater streams used to feed into the main drainage channel from the Kammanassie and Tsitsikamma Mountains, with periodic floods coming from the eastern Great Karoo during summer. The floodplain of this unit is somewhat different from all the other riverine units, but the shrub *Salsola aphylla* remains abundant and distinctive. Odd species noted in the floodplain include *Chrysocoma oblongifolia* and *Cyperus congestus*. **Condition:** <1% infestation of *Arundo donax*.

A total of 423 plant species have been recorded in the SOB database for the Kammanassie and the adjacent mountain catchment area to date. This number is not at all complete and is being updated through baseline data collection, especially by the field staff.

At least 50 of these plant species are priority species or of conservation concern (Table 2.4; Raimondo *et al.* 2009, <http://redlist.sanbi.org>). These include species listed as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Declining, Rare or Critically Rare, and are being monitored with the assistance of local CREW teams. Figure 2.8 shows some of the species of conservation concern.

Table 2.4: Plant species of conservation concern recorded from the Kammanassie Cluster and on adjacent areas.

Scientific Name	Family	Threatened Status according to Raimondo <i>et al.</i> (2009); http://redlist.sanbi.org	Distribution
<i>Alepidea delicatula</i>	Apiaceae	Rare	Swartberg, Kammanassie and Outeniqua Mtns.
<i>Hoodia pilifera</i> subsp. <i>pilifera</i>	Apocynaceae	NT (B1ab(iii,v))	Montagu to Uniondale, Matjiesfontein to Laingsburg and and Klaarstroom
<i>Felicia esterhuyseniae</i>	Asteraceae	Rare	Kammanassie Mtns
<i>Hymenolepis calva</i>	Asteraceae	VU	Barrydale and Kammanassie S foothills.
<i>Relhania decussata</i>	Asteraceae	Rare	Swartberg to Kouga Mtns
<i>Syncarpha montana</i>	Asteraceae	Rare	Swartberg and Kammanassie Mtns
<i>Syncarpha sordescens</i>	Asteraceae	VU (B1ab(ii,iii,iv,v))	Port Elizabeth to Alexandria
<i>Dioscorea elephantipes</i>	Dioscoreaceae	Rare	Springbok to Clanwilliam to Grahamstown
<i>Erica annalis</i>	Ericaceae	Critically Rare	Kammanassie Mtns

Scientific Name	Family	Threatened Status according to Raimondo <i>et al.</i> (2009); http://redlist.sanbi.org	Distribution
<i>Erica costatisepala</i>	Ericaceae	Rare	Klein Swartberg and the Kammanassie Mtns
<i>Erica inamoena</i>	Ericaceae	Rare	Swartberg and Kammanassie Mtns
<i>Erica ingeana</i>	Ericaceae	Rare	Groot Swartberg, Antoniesberg and Kouga Mtns
<i>Erica inordinata</i>	Ericaceae	Rare	Uniondale
<i>Erica kammanassiae</i>	Ericaceae	Critically Rare	Kammanassie Mtns
<i>Erica montis-hominis</i>	Ericaceae	VU (D1+2)	Kammanassie Mtns
<i>Erica valida</i>	Ericaceae	Rare	Kammanassie and Groot Winterhoek Mtns.
<i>Erica vlokii</i>	Ericaceae	EN (B1ab(iii,v)+2ab(iii,v))	Herold and George.
<i>Erica zwartbergensis</i>	Ericaceae	Rare	Swartberg, Kammanassie to Outeniqua Mtns.
<i>Amphithalea axillaris</i>	Fabaceae	Rare	Langeberg and Outeniqua Mtns
<i>Aspalathus congesta</i>	Fabaceae	Rare	Swartberg and Kammanassie Mtns
<i>Aspalathus patens</i>	Fabaceae	Rare	Swartberg and Kammanassie Mtns
<i>Cyclopia alopecuroides</i>	Fabaceae	EN (B1ab(v)+2ab(v))	Swartberg to Kammanassie Mtns
<i>Cyclopia intermedia</i>	Fabaceae	Declining	Witteberg and Langeberg to Van Staden's Mtns
<i>Cyclopia plicata</i>	Fabaceae	EN (B1ab(iii,v)+2ab(iii,v))	Kammanassie and Kouga Mtns
<i>Liparia genistoides</i>	Fabaceae	EN (B1ab(iii)+2ab(iii))	Kammanassie and Kouga Mtns
<i>Otholobium racemosum</i>	Fabaceae	Rare	Kammanassie and Outeniqua Mtns
<i>Psoralea asarina</i>	Fabaceae	NT (B1ab(ii,iii,iv,v))	Cape Peninsula to Knysna
<i>Psoralea kougaensis</i>	Fabaceae	Rare	Kouga Mtns
<i>Lachenalia haarlemensis</i>	Hyacinthaceae	VU (B1ab(ii,iii,iv,v); C1)	Kammanassie Mtns to Langkloof
<i>Bobartia paniculata</i>	Iridaceae	Rare	Kammanassie Mtns
<i>Geissorhiza elsiae</i>	Iridaceae	Rare	Kammanassie and Baviaanskloof Mtns.
<i>Geissorhiza uliginosa</i>	Iridaceae	Rare	Swartberg and Kammanassie Mtns.
<i>Gladiolus fourcadei</i>	Iridaceae	EN (B1ab(i,ii,iii,iv,v))	Uniondale to George and Knysna.
<i>Gladiolus leptosiphon</i>	Iridaceae	VU (C2a(i))	Swartberg to Baviaanskloof Mtns.
<i>Romulea jugicola</i>	Iridaceae	VU (B1ab(ii,iii,v))	Kammanassie Mtns
<i>Romulea vlokii</i>	Iridaceae	VU (D1+2)	Montagu to Kammanassie Mtns
<i>Disa lugens</i> var. <i>lugens</i>	Orchidaceae	VU (C2a(i))	Cape Peninsula to Somerset East and Cathcart

Scientific Name	Family	Threatened Status according to Raimondo <i>et al.</i> (2009); http://redlist.sanbi.org	Distribution
<i>Oxalis fourcadei</i>	Oxalidaceae	Rare	Kammanassie to Humansdorp
<i>Leucadendron singulare</i>	Proteaceae	VU (A3c+4c; D2)	Kammanassie Mtns
<i>Leucadendron tinctum</i>	Proteaceae	NT (A4c)	Hex River to Hottentots Holland and Langeberg Mtns
<i>Paranomus esterhuyseniae</i>	Proteaceae	NT (A3c+4c)	Swartberg to Kammanassie Mtns
<i>Protea grandiceps</i>	Proteaceae	NT (B1ac(iv)+2ac(iv))	Cape Peninsula and Paarl to Great Winterhoek Mtns
<i>Protea montana</i>	Proteaceae	VU (A3c+4c; B1ab(iv)+2ab(iv))	Swartberg and Kammanassie Mtns
<i>Protea rupicola</i>	Proteaceae	EN (B2ab(iii,v))	Groot Winterhoek to Groot Swartberg Mtns
<i>Protea venusta</i>	Proteaceae	EN (A3c+4c; B1ab(v)+2ab(v))	Groot Swartberg and Kammanassie Mtns
<i>Thamnochortus kammanassiae</i>	Restionaceae	Rare	Kammanassie Mtns
<i>Phylica floccosa</i>	Rhamnaceae	Rare	Kammanassie Mtns
<i>Acmadenia maculata</i>	Rutaceae	NT (B1ab(ii,iii,iv,v))	Outeniqua and Kammanassie Mtns
<i>Agathosma spinosa</i>	Rutaceae	Rare	Uniondale.
<i>Agathosma zwartbergensis</i>	Rutaceae	VU (D2)	Swartberg and Kammanassie Mtns

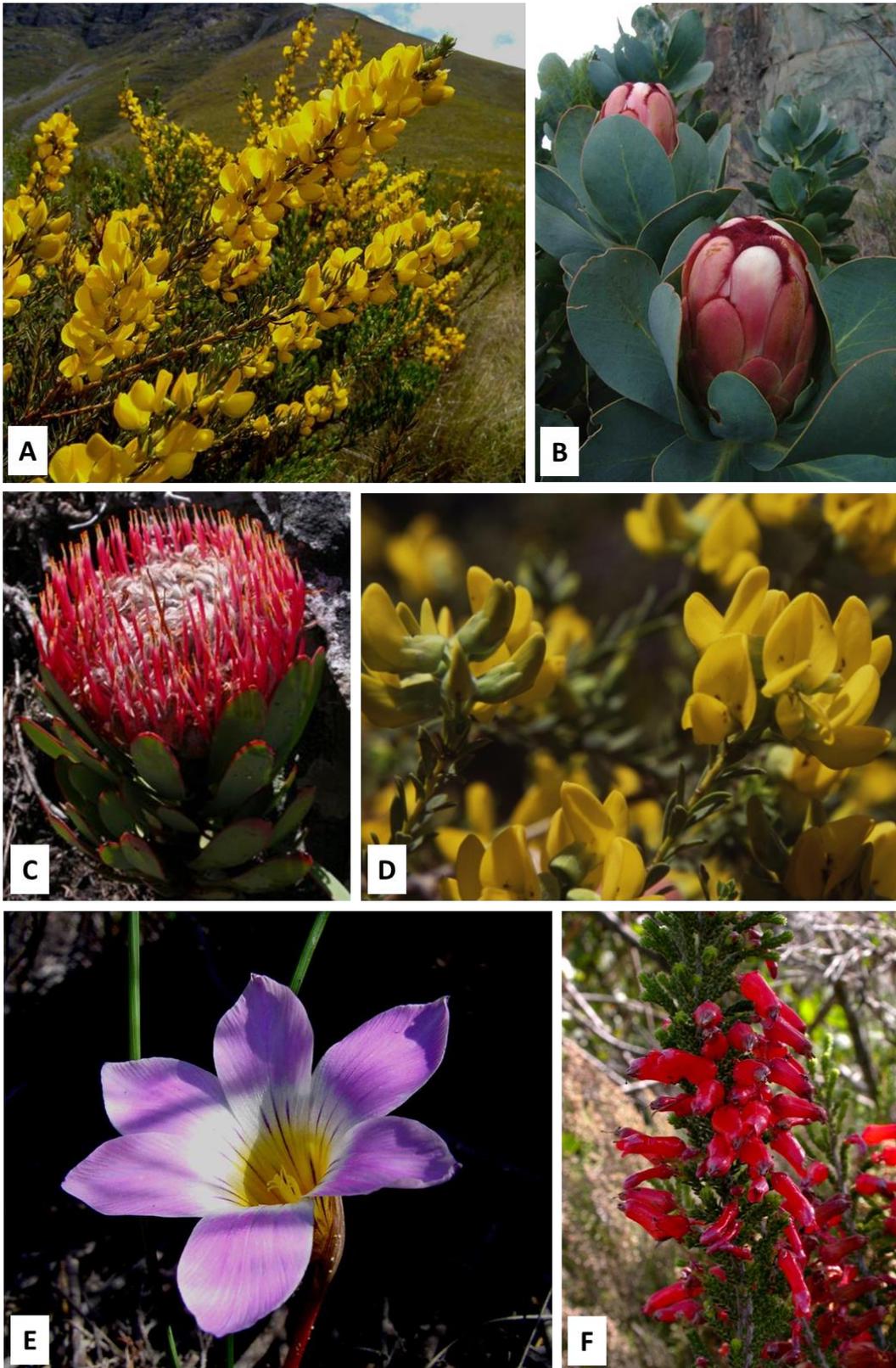


Figure 2.8: Plant species of conservation concern recorded from the Kammanassie Cluster. A: *Cyclopia plicata*; B: *Protea grandiceps*; C: *Protea rupicola*; D: *Liparia genistoides*; E: *Romulea vlokii*; F: *Erica inordinata*. (Photos: J&A Vlok)

2.3.1.3 Invasive Alien Vegetation

Several species listed as invasive alien plant species have been recorded in the SCWHS&NR. These are listed in Table 2.5. The invasive status, category and distribution are also indicated.

Invasive alien species plans have been completed for each of the clusters addressing not only invasive alien plant species, but also invasive alien animals (CapeNature 2016a, b, c). The current extent and density classes of invasive alien vegetation in each of the clusters are presented in Appendix 2 Map 7(a-d). Note the relative low infestations in the clusters.

Alien vegetation is eradicated by reserve management according to priorities set during the annual Integrated Work Planning (IWP) sessions and which are included in the Integrated Annual Plan of Operations (IAPO). For the Swartberg and Kammanassie Clusters funding for implementation is obtained through DEFF Natural Resource Management (NRM) and for the Gamkaberg Cluster through the CapeNature Integrated Catchment Management (ICM) programme.

Augea capensis (bobbejaankos, kinderpieletjies) is an indigenous species which never used to occur in the Klein Karoo, but has spread into the area from the east (J. Vlok 2018, pers. comm.). It tends to invade heavily overgrazed Succulent Karoo communities and has been recorded within the Gamkaberg and Swartberg Clusters.

Table 2.5: Invasive alien plant species recorded for the Swartberg Complex World Heritage Site and Nature Reserves.

Scientific name	Vernacular name	Family	Invasive Status	Category (NEMBA: Alien Invasive Species Regulations, 2014)	Distribution
<i>Agave americana</i>	Sisal/Garingboom	Agavaceae	Declared invader	Category 3	Groenefontein, Triangle, Kwessie
<i>Schinus molle</i>	Pepper tree/Peperboom	Anacardiaceae	Declared invader	Category 3	Gamkaberg, Groenefontein
<i>Schinus terebinthifolius</i>	Brazilian Pepper tree/Braziliaanse Peperboom	Anacardiaceae	Declared invader	Category 3	Gamkaberg
<i>Nerium oleander</i>	Oleander / Selonsroos	Apocynaceae	Declared weed	Category 1b	Gamka & Gouritz Rivers, Groot Swartberg
<i>Xanthium spinosum</i>	Spiny cocklebur/Boetebos	Asteraceae	Declared weed	Category 1b	Vaalhoek
<i>Echinopsis spachiana</i>	Torch cactus/Orrelkaktus	Cactaceae	Declared weed	Category 1b	Vaalhoek
<i>Opuntia ficus-indica</i>	Prickly pear/ Turksvy	Cactaceae	Declared weeds	Category 1b	Gamkaberg, Groenefontein, Triangle, Kwessie, Vaalhoek, Swartberg East
<i>Atriplex lindleyi</i> subsp. <i>inflata</i>	Sponge fruit saltbush/ Blasiebrak	Chenopodiaceae	Declared invader	Category 1b	Groenefontein, Gamkaberg, Vaalhoek
<i>Atriplex nummularia</i> subsp. <i>nummularia</i>	Old man saltbush	Chenopodiaceae	Declared invader	Category 2	Gamkapoort

Scientific name	Vernacular name	Family	Invasive Status	Category (NEMBA: Alien Invasive Species Regulations, 2014)	Distribution
<i>Salsola kali</i>	Russian tumbleweed/ Perdeskrikbos	Chenopodiaceae	Declared invader	Category 1b	Widespread along roadsides
<i>Acacia cyclops</i>	Red eye/Rooikrans	Fabaceae	Declared invader	Category 1b	Gamkaberg
<i>Acacia mearnsii</i>	Black wattle/Swartwattel	Fabaceae	Declared invader	Category 2	Rooiberg, Paardenberg, Groot Swartberg,
<i>Alhagi maurorum</i>	Camelthorn/ Kameeldoring	Fabaceae	Declared weed	Category 1b	Vaalhoek, Gouritz River
<i>Prosopis glandulosa</i>	Honey mesquite	Fabaceae	Declared invader	Category 1b	Swartberg cluster
<i>Ricinus communis</i>	Caster oil Plant/Kasterolieboom	Euphorbiaceae	Declared invader	Category 2	Gamkaberg, widespread
<i>Melia azedarach</i>	Syringa/ Sering	Meliaceae	Declared invader	Category 1b	Gamkaberg
<i>Eucalyptus camaldulensis</i>	Red river gum	Myrtaceae	Declared invader	Category 1b	Swartberg cluster
<i>Eucalyptus</i> spp.	Bluegums/Bloekom	Myrtaceae	Declared invader	Category 1b	Groenefontein, Vaalhoek
<i>Phytolacca dioica</i>	Belhambra/ Bobbejaandruifboom	Phytolaccaceae	Declared invader	Category 3	Groenefontein
<i>Pinus canariensis</i>	Canary pine/ Kanariese den	Pinaceae	Declared invader	Category 2	Groot Swartberg (Swartberg pass area)

Scientific name	Vernacular name	Family	Invasive Status	Category (NEMBA: Alien Invasive Species Regulations, 2014)	Distribution
<i>Pinus halepensis</i>	Aleppo pine/Aleppoden	Pinaceae	Declared invader	Category 2	Rooiberg
<i>Pinus patula</i>	Patula pine	Pinaceae	Declared invader	Category 2	Swartberg cluster
<i>Pinus pinaster</i>	Cluster pine	Pinaceae	Declared invader	Category 1b	Towerkop, Gamkapoort, Gamkaskloof, Groot Swartberg, Swartberg East, Kammanassie
<i>Pinus radiata</i>	Radiata pine	Pinaceae	Declared invader	Category 1b	Swartberg cluster
<i>Arundo donax</i>	Giant reed (Spaansriet)	Poaceae	Declared weed	Category 1b	Groenefontein, Vaalhoek, Gamkapoort
<i>Pennisetum clandestinum</i>	Kikuyu grass/ Kikoejoegras	Poaceae	Proposed Declared invader	Category 1b	Gamkaberg
<i>Hakea sericea</i>	Silky Hakea/ Syerige hakea	Proteaceae	Declared weed	Category 1b	Gamkaberg, Rooiberg, Towerkop, Kammanassie
<i>Rubus fruticosus</i>	European blackberry	Rosaceae	Under investigation	Category 2	Swartberg cluster
<i>Populus canescens</i>	Grey poplar/Vaalpopulier	Salicaceae	Declared invader	Category 2	Gamkaberg, Groenefontein, Swartberg East, Kammanassie
<i>Datura stramonium</i>	Common thorn apple	Solanaceae	Declared weed	Category 1b	Watercourses throughout Gamkaberg cluster, Groot

Scientific name	Vernacular name	Family	Invasive Status	Category (NEMBA: Alien Invasive Species Regulations, 2014)	Distribution
					Swartberg & Swartberg East (Meiringspoort)
<i>Nicotiana glauca</i>	Wild Tobacco/ Wildetabak	Solanaceae	Declared weed	Category 1b	Groenefontein, Triangle, Kwessie, Groot Swartberg, Swartberg East
<i>Tamarix ramosissima</i>	Purple tamarisk/Tamarisk	Tamaricaceae	Declared weed	Category 1b	Vaalhoek, Gouritz River, Swartberg cluster

2.3.1.4 Veld Restoration and Rehabilitation

Large sections of Gamkapoort and Gamkaskloof had been severely over-grazed historically, when Cape Nature Conservation took over the management of these properties in the early 1990s. In the case of Gamkapoort, government allowed farmers to utilise the area around the dam as emergency grazing for domestic stock (J. Vlok 2019, pers. comm.) during the late 1960s to early 1980s. In Gamkaskloof, the valley area was intensively farmed with domestic stock (cattle, goats, donkeys) and wheat, rye, fruit and vegetables by the people living there in isolation since the 1830s (Marinowitz 1993). Furthermore, with the acquisition of Vaalhoek, Groenefontein, Triangle, Kwessie, Fontein and Heimersrivier to the Gamkaberg cluster, large areas were also inherited which had historically been heavily over-grazed.

Impacts of over-grazing are visible in the loss of spekboom from areas where it occurred naturally in the past; the invasion of Succulent Karoo vegetation units by *Atriplex lindleyi* subsp. *inflata* (blasiebrak, sponge fruit saltbush) and the indigenous *Augea capensis* (kinderpieletjies); changes to the shape, structure, species diversity and vegetation cover of heuweltjies; the loss of palatable plant species; degradation of the biogenic crust through trampling and compaction; the loss of soil through wind and water erosion and the formation of dongas and erosion gullies.

Over-grazed spekboom areas. Loss of spekboom is particularly noticeable on Groenefontein, Kwessie and Triangle where it has been almost completely eaten out from Calitzdorp Valley Spekboomveld and Kwessie Arid Spekboomveld. On Vaalhoek, the Dwars-in-die-Weg Pruiinveld and Vaalhoek Arid Spekboomveld units have been severely transformed through the loss of spekboom (Vlok *et al.* 2005). In order to restore this, fine-scale maps of areas in need of spekboom restoration were compiled for Groenefontein (Vlok 2010), Vaalhoek (as part of the Vanwyksdorp restoration map; Vlok 2014) and Kwessie and Triangle (as part of the Calitzdorp-Oudtshoorn restoration map; Vlok 2018). These severely transformed areas are indicated in Appendix 2 Map 8.

All the areas identified on Groenefontein were planted with spekboom cuttings from 2010-2014 as part of job creation projects run by CapeNature. Between 2015 and 2016 a spekboom restoration project was implemented on Vaalhoek, where 78 ha were planted with spekboom cuttings and in 2017 a small section (24 ha) of Kwessie and Triangle was also planted with cuttings. These restored areas are indicated with arrows in Appendix 2 Map 8. It is hoped that the remaining areas would be restored as part of the Jobs for Carbon project in the Calitzdorp-Oudtshoorn area. Once restored, these stands of spekboom will enhance natural ecological processes and the water balance of the region. Research has shown that spekboom is an ecosystem engineer that creates a cooler micro-climate and a dense litter layer that supports the recruitment and spontaneous return of other canopy species (Van der Vyver *et al.* 2013).

There is also potential for similar spekboom restoration projects at Gamkapoort and in Gamkaskloof (shown in Appendix 2 Map 8), but funding is required for fine-scale restoration maps and implementation of the planting projects. Such projects could create much-needed jobs for unemployed people in the Prince Albert area.

Historical pine arboretums. A number of arboretums were planted during the 1940s to determine whether and which *Pinus* species grow best on the Swartberg Mountains, with the ultimate aim of establishing large-scale plantations to supply the forestry industry with timber (indicated in Appendix 2 Map 8). Fortunately this plan never realised and after the arboretums were destroyed by fires in 2006 and 2007, all the trees were removed. An experimental plantation that was also established along the road to Gamkaskloof during the 1940s, was cleared during the 1980s. Follow-up clearing of *Pinus* seedlings in and around these previously planted areas is being implemented by reserve management. These areas are in the process of recovering naturally.

Historically ploughed areas. Certain areas were ploughed in the 1970s along the road to Bothashoek hut on the Groot Swartberg (Appendix 2 Map 8) and also on Paardevlakte on the Kammanassie to stimulate and establish grass habitat for the introduction of mountain reedbuck (J. Vlok 2019, pers. comm.). The introductions of these antelope were, however, unsuccessful and the projects were terminated. No active restoration was done and the veld was allowed to recover naturally following fires in the areas.

Heuweltjie condition. The condition of heuweltjies is a very good indicator of veld condition in Succulent Karoo and Subtropical Thicket habitat types. It can be assessed using Google-Earth and looking at Gannaveld, Apronveld or Ranteveld habitat types. Heuweltjies in a poor condition are concave and have very little to no vegetation on them (Figure 2.9), those in fair condition are level and with some cover, those in good to very good condition are convex with more than 50% vegetation cover and those in very good condition also containing a diversity of long-lived perennial plants (Figure 2.9). On good and very good condition heuweltjies there is always clear evidence that the harvester termites are active moving dead plant material underground to their hives and dumping their dung on the soil surface – hence, enriching and churning the soil around. Of great concern is that natural recovery of heuweltjies in poor or fair condition would take decades, if it happens at all. Sadly, most of the heuweltjies on Triangle, Kwessie, Groenefontein, Gamkaskloof and Gamkapoort are in a poor to fair condition.

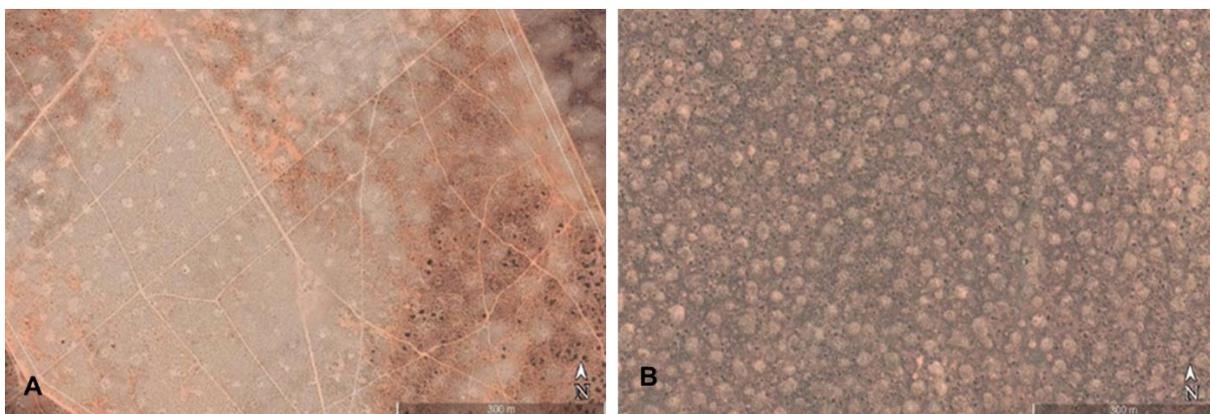


Figure 2.9: Different conditions of heuweltjies found in the Klein Karoo. A: poor; B: very good. Note the white, barren and washed-out appearance of the heuweltjies in poor condition. Those in B are convex and covered with vegetation, including perennial species. Refer to text for an explanation of the various conditions.

***Atriplex* and *Augea* invasions.** As far as the invasion of disturbed areas by *Atriplex lindleyi* subsp. *inflata* and the indigenous *Augea capensis* is concerned, a monitoring project was initiated on Groenefontein in 2003 to determine whether CapeNature needs to actively implement an eradication programme for these species or just leave the veld to recover naturally. Although *Augea capensis* is an indigenous species to South Africa, it never used to occur in the Klein Karoo, but has spread into the area from the east (J. Vlok 2018, pers. comm.). It tends to invade heavily over-grazed Succulent Karoo communities. Both species are known to cause salinisation of the soils, by absorbing and accumulating salt content from the deep soils into its leaves and depositing it onto the soil surface when it dies back.

The monitoring project is still being implemented annually, but indications are that the veld is slowly recovering naturally. On hard clayey soils (*Augea* Sites 1 & 2, *Atriplex* West & East; Figures 2.10, 2.13), the invasive species are gradually being displaced by other species through competitive interactions and leaching of salts from the soils following rainfall events (Figures 2.10, 2.11, 2.12, 2.13). It is, however, pivotal that grazing pressure must be removed from the veld for an extended period. On deep alluvial sandy soils (such as at *Augea capensis* Site 3; Figures 2.10, 2.11) there have been a number of recruitment events, which appear to be correlated with the rainfall (Figure 2.11). The marked decrease in the total density of the *Atriplex* plants is clearly shown in Figure 2.12 and 2.13.

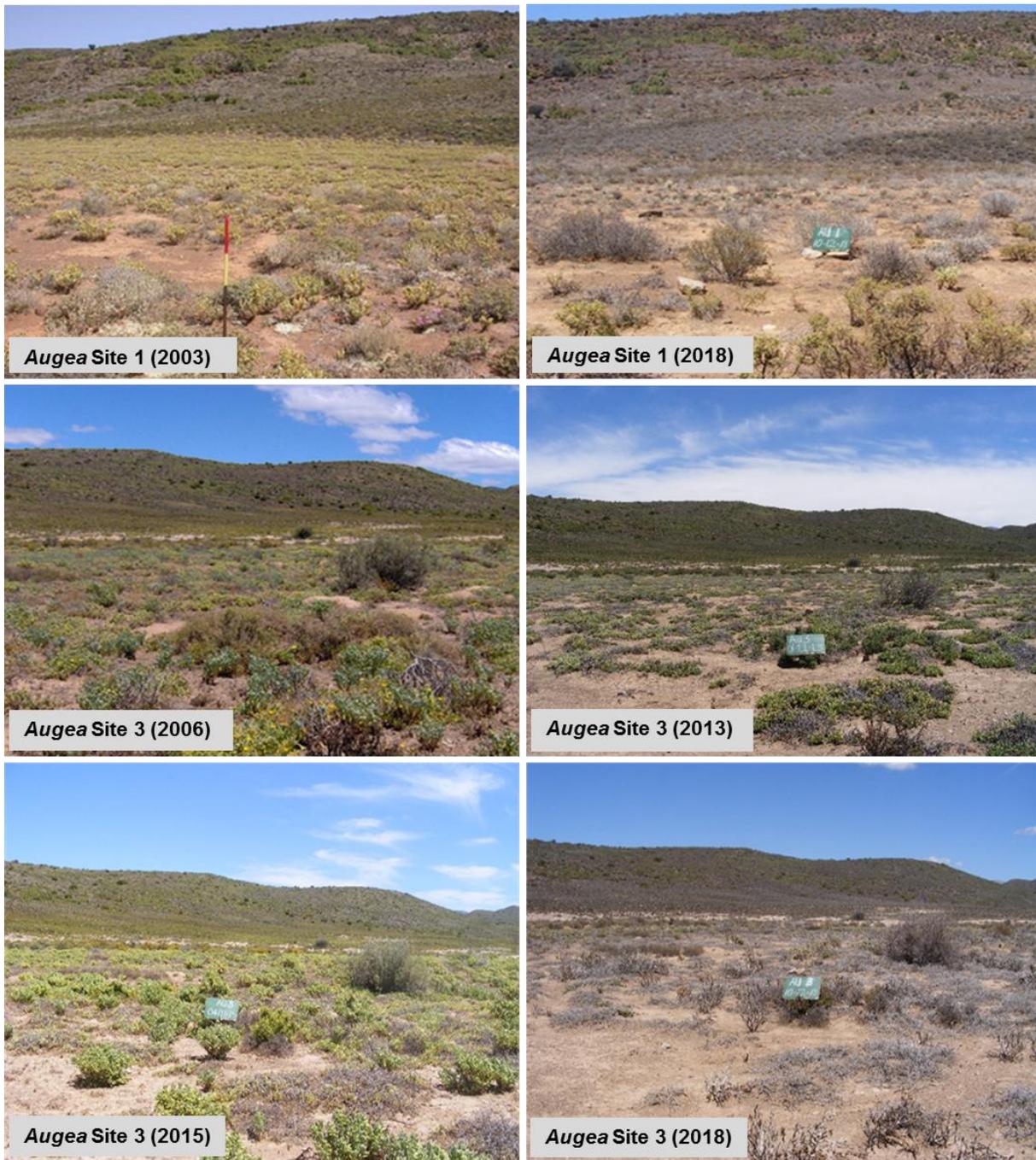


Figure 2.10: *Augea capensis* monitoring Sites 1 (upper two photos) & 3 (bottom four photos). Note the reduction in the density of *Augea* plants (the dominant yellow-green plants) at *Augea* Site 1 (2003 vs 2018). *Augea* Site 3 shows photos for 2006, 2013, 2015 and 2018. Note the recruitment event of *Augea* plants in 2015. This site is more sandy and there is evidence of small mammal activity and disturbance in this area.

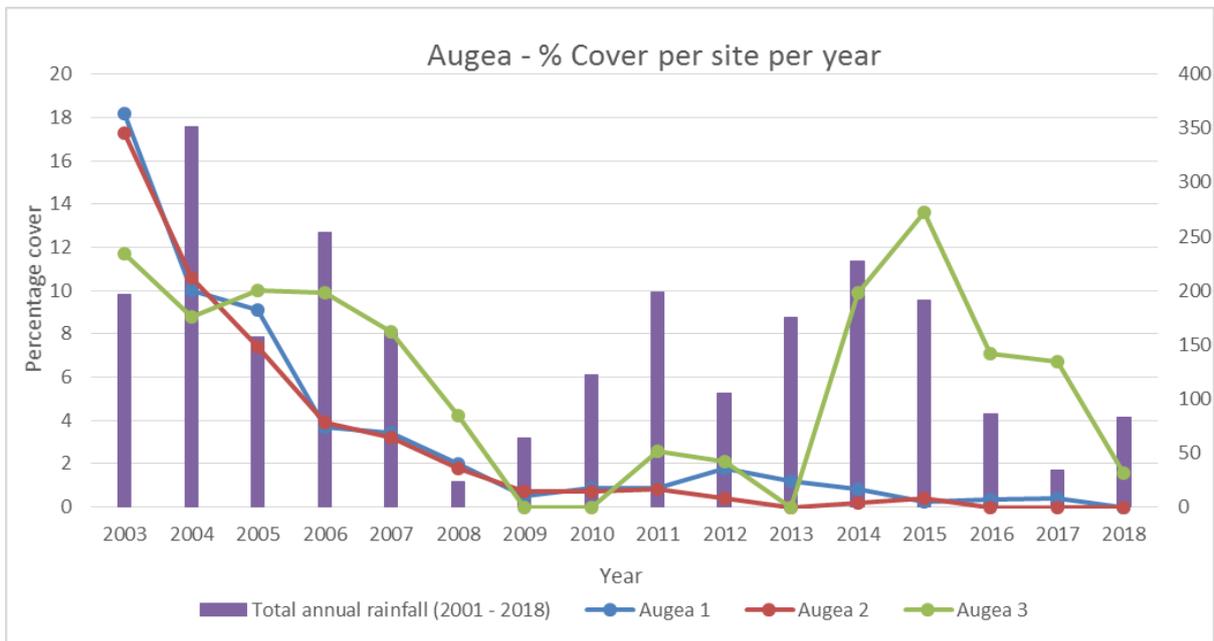


Figure 2.11: Graph showing the changes from 2003 to 2018 in the percentage cover of *Augea capensis* at the two sites on clayey soils (*Augea* Sites 1 & 2) and the site on sandy soils (*Augea* Site 3). The total annual rainfall is also shown for this period. Note the recruitment events at Site 3.

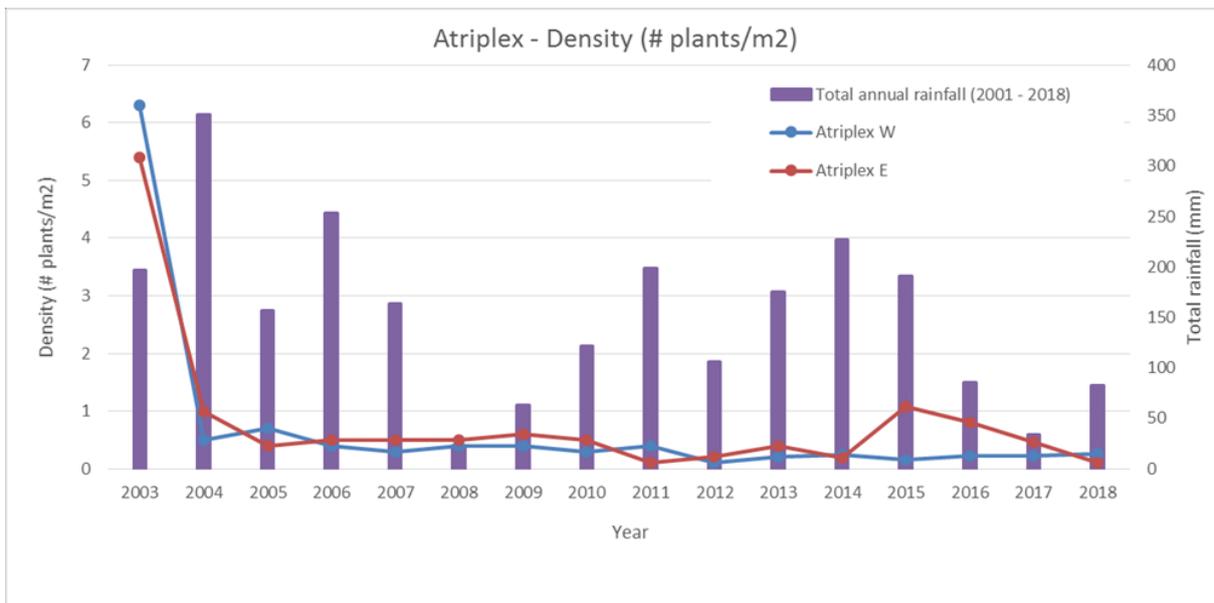


Figure 2.12: Graph showing the change in density of plants per m² at the two *Atriplex lindleyi* subsp. *inflata* monitoring sites (*Atriplex* West & *Atriplex* East) from 2003 to 2018.

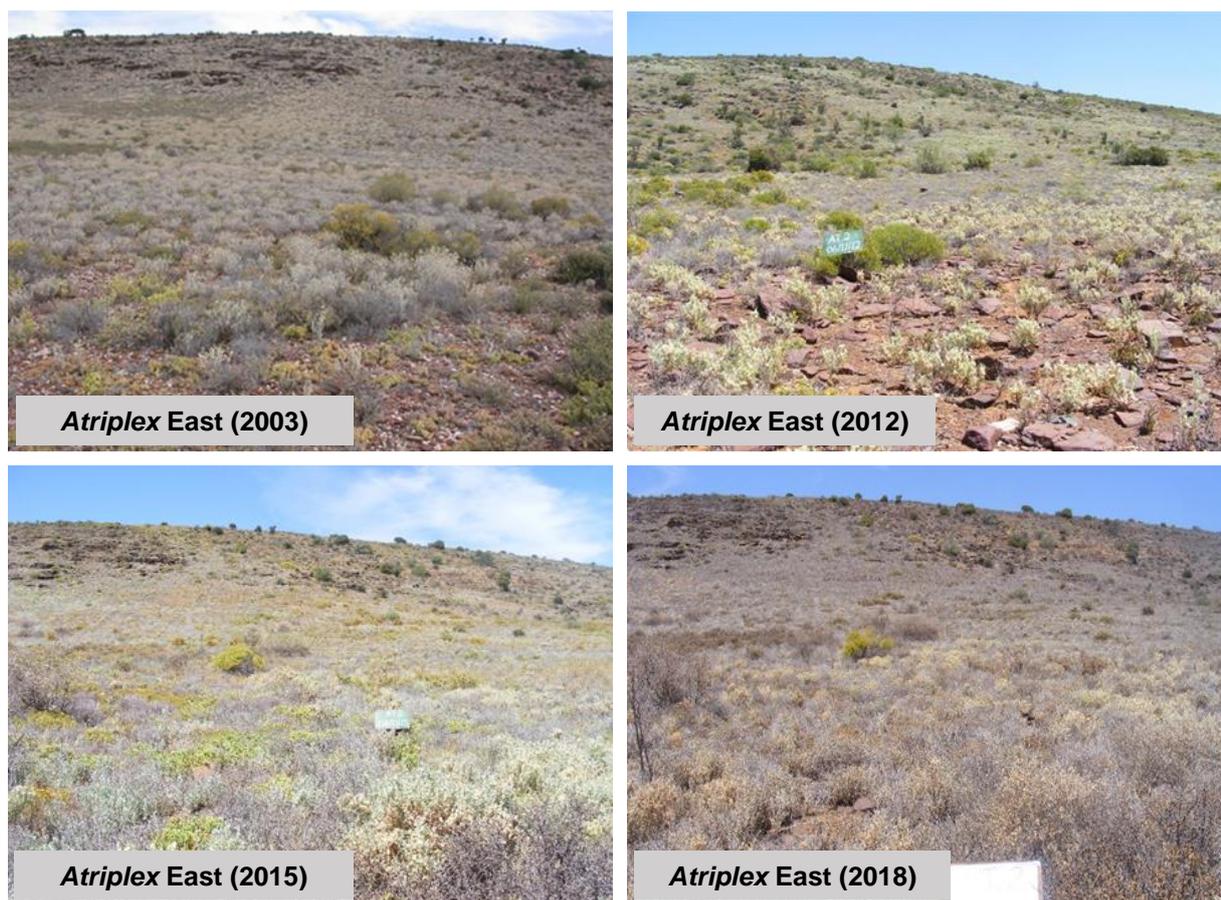


Figure 2.13: Changes in *Atriplex lindleyi* subsp. *inflata* at monitoring Site East from 2003, 2012, 2015 to 2018. Note the reduction in *Atriplex* plants.

Grazing areas. A section of Rooilifantskloof has been made available to the Zoar community for grazing by a maximum of 60 goats for 8 months of the year (no grazing allowed during September-November). This is following requests from the community to being allowed access to the area for cultural heritage activities and traditional grazing. A Memorandum of Agreement (MOA) outlining the rights and responsibilities of the Zoar Community Property Association and CapeNature has been compiled and signed by both parties in 2018. There is concern because the identified and zoned area is already classified as severely transformed because of historical over-grazing and that continued grazing will result in further degradation. Part of the agreement states that CapeNature will assist in setting up and implementing a vegetation monitoring project whereby the impact of the stock on the nature reserve will be evaluated over time.

Erosion areas. In order to address erosion gully problems a restoration project has been proposed on Triangle and Kwessie, which entails the construction of grass fences along contours and across dongas to prevent further soil gully erosion; installing horizontal soil saver material to retain surface soils; and constructing

resource traps (holes with particular edge construction) in level and mild slope areas. This project is, however, highly dependent on the availability of funding.

2.3.1.5 Fire Regimes

Fire is a vital ecological process in fynbos ecosystems. This is one of the key principles identified in the CapeNature Veldfire management policy (CapeNature 2016d). All the species that have evolved within the Fynbos biome are adapted to periodic fires as part of their life cycles – in fact, without fire they would not be able to persist. Fires are essential to stimulate recruitment (regeneration) and maintain species richness (Van Wilgen & Forsyth 2008; Forsyth *et al.* 2010).

Other key principles highlighted in the policy (CapeNature 2016d) include: that fire management is an integral component of programmes aimed at the reduction and control of invasive alien plant species; that the extent of ecologically undesirable or otherwise potentially damaging wildfires must be minimised; that an adaptive management approach to integrated fire management is to be implemented; and that relevant fire management legislation must be complied with.

Ecologically sound fire management is an important function that the conservation manager needs to perform. This involves managing fire regimes, which includes varying the frequency, season, intensity and size of fires, and reconciling ecological and practical requirements. According to the CapeNature fire management guideline (CapeNature 2016e), fire management practices (such as prescribed burning, adaptive intervention management and natural burning zones) can be collapsed into a single model that simply varies with regard to the degree to which intervention (in the form of fire suppression, containment or prescribed burning) is practiced. Fire management should be adapted more to the circumstances a protected area finds itself in than the eco-zone (according to Van Wilgen & Forsyth (2008)) in which it is situated.

Within the SCWHS&NR all the Fynbos habitat types, as well as the Subtropical Thicket units that form a mosaic with Fynbos (listed and described in section 2.3.1.2 above), are dependent on periodic fires to persist. The local fire regime (i.e. the intervals between successive fires, season of fires, intensity and fire size) plays a significant role in the species composition of the fire dependent habitat units (Vlok & Yeaton 1999, 2000; Esler *et al.* 2014).

A natural fire zone management approach has been implemented on the Swartberg Cluster, Kammanassie and Rooiberg since the early 1980s. This entails that fires that are caused through natural ignitions (e.g. lightning strikes, rock falls) are left to burn until they burn out or are extinguished as a result of rainfall. However, if the fire threatens infrastructure or threatens to burn across the reserve boundary onto neighbouring properties, every reasonable effort is made to contain it. For the Gamkaberg Cluster (Groenefontein, Rooilifantskloof, Paardenberg and the western part of Gamkaberg) an adaptive fire management approach has been implemented according to the existing approved management plan for the protected area (Barry *et al.* 2016). Provision is made for controlled burns in the eastern section of Gamkaberg for the management of habitat for the Cape mountain zebra.

Fire size and Fire return interval

The 2019 veld age maps for the SCWHS&NR are shown in Appendix 2 Map 9(a-d) and the proportions of veld in different veld age classes in Figure 2.14 and Table 2.6.

Table 2.6: Summary of total sizes (ha) and proportions (%) of veld in specific veld age classes within each of the clusters of the Swartberg Complex World Heritage Site and Nature Reserves as in June 2019.

Veld age classes	Swartberg	Gamkaberg	Kammanassie
1-10	(104 141.9 ha) - 79.2%	(83 067.0 ha) - 89.1%	(25 253.1 ha) - 94.3%
11-15	(5 984.6 ha) - 4.6%	(1 455.2 ha) - 1.6%	(7.1 ha) - 0.0%
16-20	(1 767.0 ha) - 1.3%	(282.3 ha) - 0.3%	(344.6 ha) - 1.3%
21-25	(5 610.5 ha) - 4.3%	(575.0 ha) - 0.6%	(18.5 ha) - 0.1%
>26	(14 030.7 ha) - 10.7%	(7 819.4 ha) - 8.4%	(1 148.3 ha) - 4.3%

It is clear that large sections of each cluster consist of young veld. For the Swartberg Cluster 74.1% of the veld is up to 6 years old, and close to 80% is 10 years or less. Within the Gamkaberg Cluster 88% is 6 years or less and 89.1% up to 10 years old. Almost the entire Kammanassie (94.3%) is up to 10 years old, with the remaining 5.7% 16 years or older - hence, no veld of 11-15 years old. This goes against the aim of having a more or less equal spread of young, medium and old veld ages.

In addition, an analysis done on the sizes of fires over the past four decades (1980-2019) has found that the sizes of individual fires have increased markedly over the period in all three clusters (Figure 2.15). While most of the area on Swartberg and Gamkaberg burnt as a result of medium-sized fires in the 1980s, the areas burnt in the 1990s were because of very large fires in all three clusters. In the 2000s the areas on the Swartberg burnt mostly as a result of medium-sized fires, while those on the Gamkaberg and Kammanassie burnt because of very large fires. The increase in the proportion of areas burnt in all three clusters from 2010-2019 as a result of very large fires is alarming. In particular, fires of between 10 000 and 22 000 ha per fire have become a frequent phenomenon since 2010, with seven of these fires occurring within the Swartberg, four in the Gamkaberg and three in the Kammanassie Cluster. The increased occurrence of large fires appears to be correlated with the decrease in rainfall in the area (see section 2.2.1).

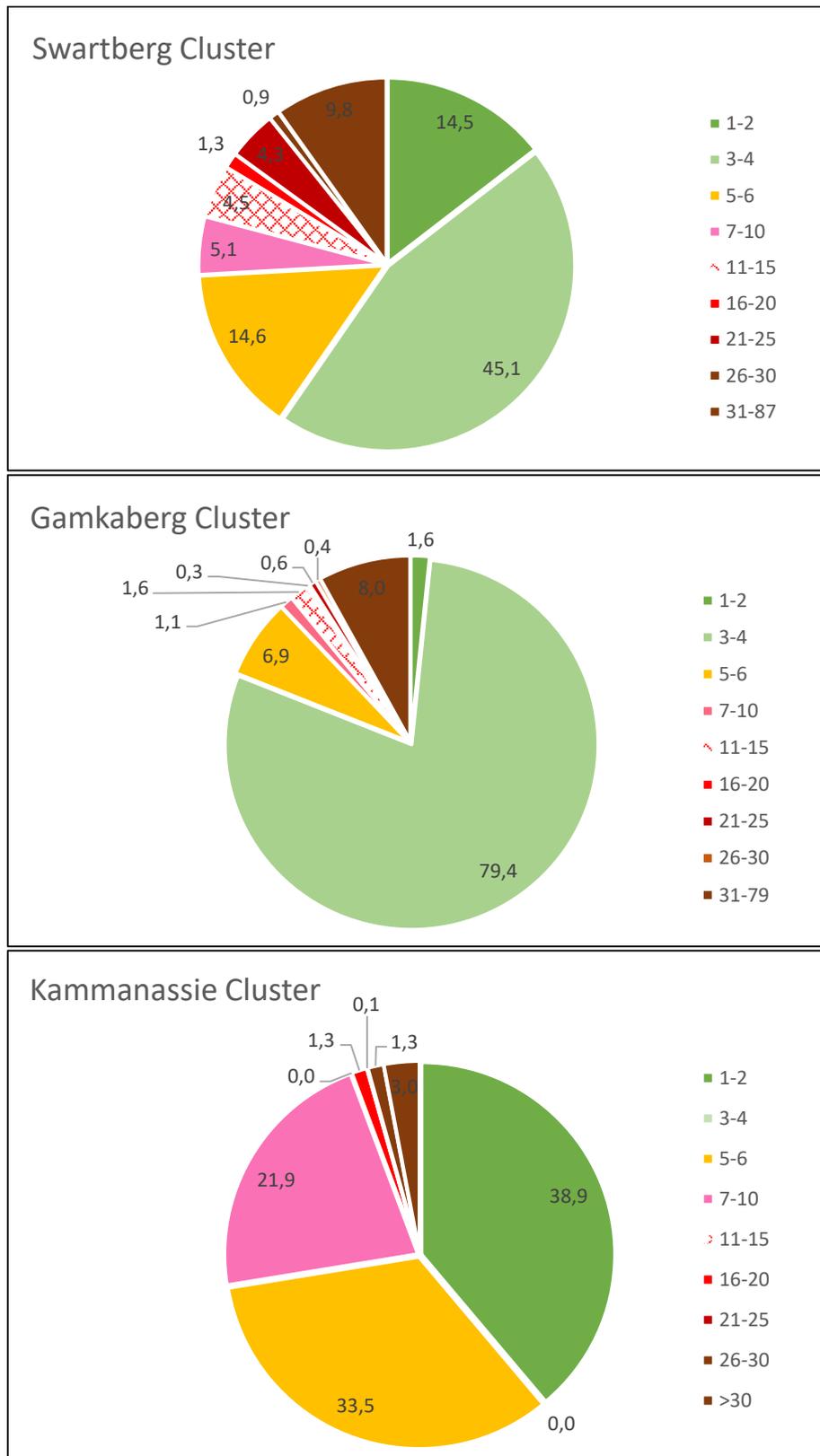


Figure 2.14: Proportion area in each of the veld age classes for the Swartberg, Gamkaberg and Kammanassie Clusters as in June 2019. Note the very high proportions of very young veld (≤ 10 years).

In 2017 an analysis on fire return intervals showed that 28.5% of the Swartberg Cluster burnt twice in 17 years and 15.1% twice in 12 years, whereas 27.1% of the Kammanassie burnt twice in 17 years (Jacobs *et al.* 2017). This trend has been confirmed by recent research that indicates that globally and within the CFR, many areas are experiencing increases in fire frequency and size (Kraaij & Van Wilgen 2014).

The above findings are of great concern, as it is known that fires that are occurring at repeated short return intervals and that are large are detrimental to Fynbos biodiversity and ecosystem health. Fynbos endemic Cape Sugarbirds require flowering proteas (such as *Protea lorifolia*, *Protea neriifolia*, *Protea eximia*, *Protea repens*) as their primary food source, and proteas are also their preferred nesting locations (A. Lee 2019, pers. comm.). Because these non-sprouting overstorey *Protea* species are the slowest to mature and set seed after fires, they are used as indicator species in monitoring to set thresholds of potential concern (TPC) for fire return interval and fire season where they occur (Esler *et al.* 2014; Kraaij & Van Wilgen 2014; Jacobs *et al.* 2017).

Research has indicated that non-sprouting overstorey *Protea* species are not only important for Cape Sugarbirds, but they also play a critical role in maintaining species richness in the landscape (Vlok & Yeaton 1999, 2000). In return, the proteas are also dependent on Cape Sugarbirds for effective pollination of their flowers in order to set proper seed.

As a general rule it is said that fire return intervals between successive fires must not be shorter than the time it takes for 50% individuals of the slowest maturing non-sprouting *Protea* species to have flowered three times (Kruger & Lamb 1978).

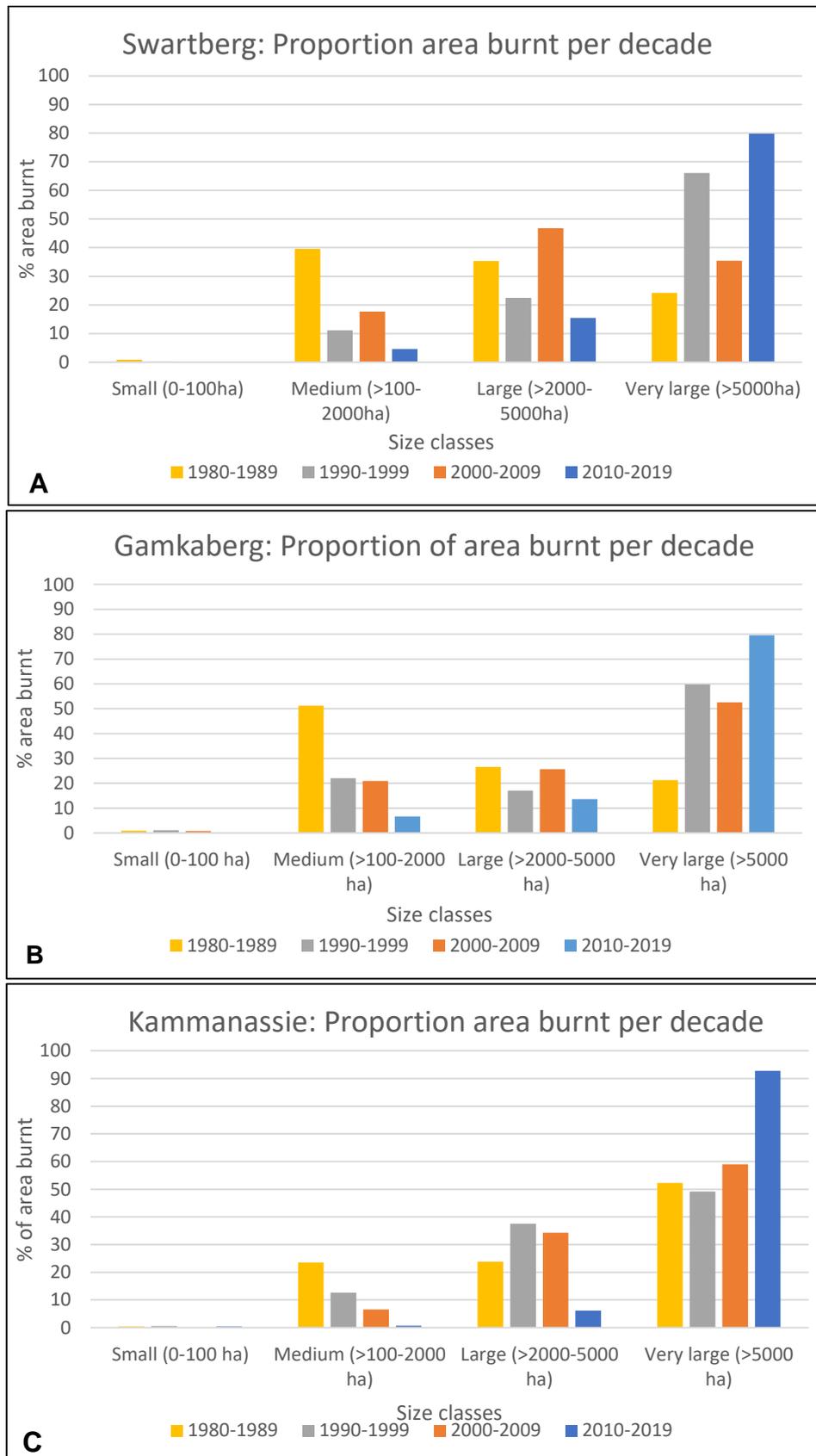


Figure 2.15: Proportion of Swartberg (A), Gamkaberg (B) and Kammanassie (C) Clusters burnt per decade from 1980-2019.

Monitoring results have indicated that the youth phase periods (from seedling to flowering and setting seed) of the indicator *Protea* species vary considerably. Based on the Kruger and Lamb (1978) rule of thumb method results show that *Protea lorifolia* is the slowest maturing indicator species in all the clusters. Young veld threshold for the Swartberg Cluster can be defined as ≤ 18 years on the southern slopes and ≤ 23 years on the northern slopes. For the Gamkaberg Cluster young veld has been suggested to also be ≤ 18 years on the southern slopes and ≤ 21 on the northern slopes. Young veld for the Kammanassie would be veld ≤ 17 years on the southern slopes and ≤ 20 years on the northern slopes. Post-fire monitoring results support these thresholds as the best seedling recruitment takes place when the pre-fire veld age is in the order of 16-25 years. It is anticipated that other slow-maturing, restricted and threatened high-altitude species, such as *Protea venusta*, *Protea pruinosa*, *Protea rupicola*, *Protea grandiceps* and *Leucadendron dregei* would be accommodated within these suggested thresholds, as they occur mostly in rocky habitats, where they are partially protected from fires burning an entire population out. This, however, needs to be carefully monitored. The suggested thresholds are being further refined as more monitoring data are being collected.

Fire season and Fire intensity

In terms of season of fire, post-fire monitoring results have shown that the best recruitment takes place following fires during summer to early autumn (January-April). This is in line with recommendations stipulated in the literature (Bond *et al.* 1984; Esler *et al.* 2014). Fire intensity is closely linked to fire season. When fires occur during summer or early autumn (i.e. the hot, dry months of the year) the fire intensity is high resulting in a clean burn, which is best for proper seedling recruitment. Seedlings then also have the cooler late autumn, winter and spring months to establish and manifest themselves.

Fires and Ecosystem services

Managing and maintaining the Fynbos mosaics in an ecologically sound way is critical to ensure that maximum ecosystem services are delivered from catchment areas. Especially since one of the most valuable functions of Fynbos is the delivery of high, sustained yields of clean water – i.e. contributing significantly towards human wellbeing values. If Fynbos burns at too short fire return intervals the *Protea* indicator species will be eliminated and the density of sprouting species will be enhanced. The latter will replace the non-sprouting species as they are able to grow rapidly after a fire, because of their well-developed underground rootstocks. Sprouters mature rapidly and use much more water than the developing and slow-maturing *Protea* seedlings that may take up to 10 (or mostly more) years to mature. So, if sprouters take over there will be less water run-off from the catchments (Esler *et al.* 2014). Retaining the non-sprouting *Protea* species in the landscape is critical to keep high densities of sprouters at bay (Vlok & Yeaton 1999, 2000) and maintain a sustained water run-off from the catchments. Other ecosystem services gained from intact and ecologically healthy Fynbos mosaics include pollination services, habitat for biological ecosystems and species, carbon storage, soil formation and retention, flood control, natural products, scenic natural landscapes supporting tourism-based livelihoods, and spiritual and physical health.

Based on the above, it has been recommended that the natural burning zone management approach needs to be changed to an adaptive interference management strategy for the foreseeable future until an ecologically healthier veld age mosaic is achieved. Every attempt must be made to try and prohibit fires from burning young veld within the SCWHS&NR.

Compliance with legislation

In terms of fire management and in order to comply with the National Veld and Forest Fire Act, 1998 (Act No.101 of 1998), SCWHS&NR maintains firebreaks in accordance with the firebreak register. There are areas where firebreaks are not really necessary as the veld is not burnable (e.g. the lowland areas where the vegetation consists mainly of Succulent Karoo or dense Arid Spekboomveld). In these areas application for exemption from making a firebreak(s) need to be made to the minister (this is usually done through the FPA). In cases where the vegetation is burnable on the state and adjacent properties, it is recommended that agreements be concluded with neighbouring landowners to move the firebreaks to a position in the landscape where it is practical to fight a fire from (e.g. existing roads). This would significantly reduce the costs of maintaining the firebreaks for both parties.

CapeNature is obliged to be a member of the local Fire Protection Association in terms of the National Veld and Forest Fire Act. SCWHS&NR falls entirely within the Southern Cape Fire Protection Association (C. Wade 2018, pers. comm.). There are a number of Fire Management Units (FMU) in place in the area: Rooiberg FMU for the Gamkaberg Cluster, Kammanassie and De Rust FMUs for the Kammanassie and Matjiesrivier, Calitzdorp, Ladismith, De Rust and Kango Valley FMUs for the Swartberg Cluster. These FMUs are voluntarily managed by the landowners themselves and effectivity varies from one FMU to another. FMUs present an opportunity to CapeNature as an available tool for larger fire management of an area, effectively allowing improved fire management on private land which is currently not well managed in terms of fire. Where landowners are willing, particularly those with extensive natural veld, efforts within the FMU could improve fire management towards the principles outlined above.

2.3.2 Freshwater ecosystems

The land parcels within the SCWHS&NR are located within the Swartberg (comprising of the Klein and Groot Swartberg Ranges), Gamkaberg and Kammanassie Mountain Ranges. In general, these mountain ranges consists mostly of arenite (a sandstone), with at least the catchment included in the Swartberg Cluster land parcels falling into a higher water yield area (see Nel *et al.* 2011a). Consequently, this mountainous catchment area in particular is considered to be one of the provincial Strategic Water Source Areas (WWF 2013a, b; see Appendix 2 Map 10(a-d)). As a result, the Swartberg and all of the other catchments included within the SCWHS&NR, provide good quality water for local urban and rural areas, including amongst others the towns of Vanwyksdorp, Ladismith, Zoar, Calitzdorp, Oudtshoorn, De Rust, Dysseldorp and Prins Albert. The lower-lying areas surrounding the land parcels consist mainly of an underlying shale geology, with some conglomerate intrusions in the Olifants River area between the Swartberg East and Kammanassie sectors.

Furthermore, the catchments contained within the SCWHS&NR include the headwaters for many rivers within the Gouritz Water Management Areas (WMA; now part of the Breede-Gouritz WMA). It also forms part of the catchment for some of the Gouritz WMA major dams. These include the three larger dams, namely Gamkapoort Dam (a flood attenuation dam; Gamkapoort sector), Stompdrif Dam (located between Swartberg East and Kammanassie sectors) and the Kammanassie Dam (downstream of the Kammanassie). A further three smaller dams are also supported by rivers draining from the Groot Swartberg, including the Oukloof, Koos Raubenheimer and Calitzdorp Dams. Moreover, many of the river catchments found within the SCWHS&NR are also considered important for reasons other than water provision to dams. These rivers have been identified as priorities for the conservation of different aspects of the freshwater ecosystem through the National Freshwater Ecosystem Priority Areas (NFEPA) projects (Nel *et al.* 2011a, b).

Few wetlands have been mapped to occur on the land parcels of the SCWHS&NR, possibly due to the semi-arid to arid nature of the general area. Those that have been mapped, however, include sensitive hillslope seeps, bench flats and even some channelled valley-bottom wetlands. Many of these wetlands are dependent on groundwater and/or aquifer water sources and may also contribute to the sustained base flow in many of the perennial rivers of these catchments. These catchments also serve as important recharge zones for the aquifers underlying the mountains and lower lying areas. Generally intact riparian and wetland buffer zones prevail, with a degree of intrusion by alien invasive plant species. The freshwater ecosystems and their buffer zones also provide important refuge areas for the species that utilise these ecosystems. These taxa would include indigenous fish species, mammals, invertebrate and amphibian species, some of which can be used as indicators of ecosystem health/condition. (See also section 2.3.2.3.)

Pressures on the hydrological functioning of the aquatic systems in these catchments include the effects of climate change, such as for example severe drought and flooding events. Over-abstraction of both surface and groundwater, considered to be a threat under normal weather conditions, also exacerbates the effects of the increasingly frequent climate change linked events, as does the presence of invasive alien plant species. However, it is not only the invasive alien plant species that pose a threat to freshwater ecosystems. The presence of invasive alien fish species also poses a threat, to the balanced function of these ecosystems and the presence/absence of indigenous, generally threatened, fish species. Other impacts to freshwater ecosystems would include physical modifications to both the instream and riparian environments as well as any pollution (point source and agricultural run-off) events that might take place, especially in the land parcels located in the lower lying areas. In some cases, rivers are blocked to some degree by the presence of diversion weirs just outside of the protected area boundaries. These weirs tend to block off all the natural flow during the dry summer months and divert it to farm dams.

In light of the current drought conditions, the ever-increasing water demands for the urban and agricultural sectors (*e.g.* the Oudtshoorn and Kannaland Municipal areas) pose a significant threat to freshwater ecosystems, especially the groundwater systems. In fact, groundwater abstraction in particular has received an exponential increase in attention recently (2017-2018) as it is considered the easiest and most

affordable form of water provision to establish during the prevailing drought conditions and beyond.

Mitigation for the effects of climate change is difficult, therefore adaptive management that is informed by thorough monitoring, including the collection of data related to the flow regime of strategically selected rivers, is crucial. Rainfall data in conjunction with flow regime data could inform the establishment of a link between surface water (hydrological), groundwater and aquifers (geohydrological) and rainfall conditions. This in turn will provide insight into for example the possible impacts imposed by water abstraction (surface or ground) on surface or groundwater flows (see also Rose & Conrad 2006).

Appendix 2 Map 10(a-d) show the National Freshwater Ecosystem Priority and High Water Yield Areas of the different clusters.

2.3.2.1 Groundwater and Aquifers

The groundwater systems associated with the SCWHS&NR generally fall within the TMG, Bokkeveld Group and Witteberg Group aquifers, with some intrusion by the Ecca Group (parts of Gamkapoort sector) and the Uitenhage Group near the Gamkaberg and Fontein sectors. There are also Alluvium deposits present in the valleys associated with the Gamka River (Gamkaskloof and Gamkapoort sectors) and the Gouritz River (Vaalhoek sector).

The TMG aquifer system in general is considered to have a fractured nature, with compact arenaceous rock. There is generally a gradual decrease in the density of fractures to depths of more than a 100 m. Furthermore, past geological events have led to the formation of widespread fractures and faults as well as open folds in the more fragile quartzite layers, such as the Peninsula and Skurweberg Formations. In fact, within the TMG, three of the eight formations underlying the land parcels of the SCWHS&NR form the fractured aquifers, namely the Peninsula (mainly on south-facing slopes of mountain catchment), Skurweberg (mainly north-facing slopes) and the Rietvlei Formations (northern lower foothills; see for example Colvin *et al.* 2009). Of these, the Peninsula Formation has the highest potential for recharge due to where it is situated topographically, forming the high mountain ranges and summits in the more southern parts of the mountain catchments, where precipitation levels tend to be higher, as is the case in the Boland Mountains (Colvin *et al.* 2009). The Skurweberg Formation “sub-aquifer” on the other hand receives less precipitation due to its location in the more northern lying lower hillslopes and lower-ranges of the general area. It therefore has a lower recharge potential. In general, the Peninsula aquifer (exposed, unconfined to confined sections) contributes mainly to rivers through surface run-off, hillslope interflow and base flow of larger river systems. In many cases, the springs emanating from the confined sections of this aquifer tend to be perennial and thought to be less impacted by groundwater abstraction and seasonal variation (Colvin *et al.* 2009). In contrast, the Skurweberg “sub-aquifer” is more responsive to precipitation events and has more unconfined sections, leading to lower water volumes and more seasonal springs (e.g. Kammanassie sector). Similar to the case in the Boland Mountains, it is likely that contributions to river base flow from this sub-aquifer would generally be through direct inflow into an overlying river channel (see for e.g. Colvin *et al.* 2009 for Boland Mountains). Other major formations present in the SCWHS&NR

catchments include the Goudini (TMG layer which is sandstone and siltstone dominated, between Skurweberg and Peninsula layers), the Cedarberg (shale band in TMG), as well as several formations from the Witteberg and Ecca Groups (mix of sandstones, shales, siltstones and mudstones; Gamkapoort sector).

When considering water supply, the aquifers found to underlay the land parcels of the SCWHS&NR vary between being minor and major aquifer types (Parsons & Conrad 1998). These classifications are reflected in the Aquifer Classification Map (DWAF (Department of Water Affairs & Forestry), 2012a). According to this map, the aquifers underlying the general area within which Towerkop, Groot Swartberg and Swartberg East is thought to be mostly major (high water yield of good quality water) aquifer types, with some and minor types (moderate yield of varying quality water) near the boundaries of these properties. There is a bit more variation between the two aquifer types in an easterly and southerly direction, however, the major type aquifer areas underlying the Gamkaberg, Rooiberg and the Kammanassie sectors seem to be dominant. No poor aquifer types have been mapped in the general area.

With regards to the vulnerability of aquifers to contamination by pollutants, it seems like sections of the land parcels that form part of the Towerkop (western side), Gamkaberg and Kammanassie fall into those considered to be the most vulnerable to many pollutants (DWAF 2012b). The likelihood of contamination by pollutants for much of the rest of the Gamkaberg Cluster area, together with most of the Towerkop, Groot Swartberg and Swartberg East sectors and most of Kammanassie are thought to be underlain by moderately vulnerable aquifers. A thin sliver of least vulnerable aquifers is thought to be present in the foothill areas of the northern slopes and flats of the Towerkop, Groot Swartberg and Swartberg East, as well as in parts of the Gamkaberg Cluster.

There is much variation in the susceptibility (ease of contamination) to the anthropogenic driven contamination of the aquifers underlying the land parcels of the SCWHS&NR. Here, although most of the aquifers for these land parcels are thought to have a low to medium susceptibility, there are sections within the general area that are considered to be highly susceptible to contamination. These areas include pockets within the Groot Swartberg and Kammanassie sectors (DWAF 2012c). Variation is also present in the overall groundwater quality (with regards to saltiness) within the general area (DWAF 2012d). Most of the SCWHS&NR overlie areas where groundwater is thought to have a limited to no salty (0-70 mS/m) to a slightly salty taste (Gamkaberg and Kammanassie Clusters and sections of Towerkop and Swartberg East). However, the eastern section of Towerkop and a large section of the western side of the Groot Swartberg (including Gamkapoort and Gamkaskloof) fall into an area where the groundwater has been mapped to have a noticeably to marked salty taste.

In summary, it is clear that although there is some variance in the aquifer types contained within the SCWHS&NR, the TMG aquifers are prevalent in the mountain catchments. Additionally, the higher rainfall (linked to water yield) in these upper catchments of most of the SCWHS&NR leads to a moderate to high groundwater recharge in these areas (see Nel *et al.* 2011a). Due to these characteristics, i.e. moderate to high yield of good quality water, together with the pressures imposed by drought events, the use of groundwater to augment water supply for urban areas could

become an increasing threat to this ecosystem in the future. Large scale groundwater abstraction has been taking place within and outside of the boundaries of the Kammanassie (i.e. as part of the Klein Karoo Rural Water Supply Scheme, KKRWSS; see Cleaver *et al.* 2003) since 1993. Analysis of the abstraction rates has indicated that there has been an increase in the volumes abstracted from the wellfields over the years due to an increase in demand for water, especially during the summer months.

There are clear indications that the over-abstraction is already impacting on the freshwater (rivers and wetlands) and terrestrial ecosystems in the catchment. Of the 55 natural springs that are being monitored annually 64% have dried up completely. These springs are vital water points for the unique Cape mountain zebra subpopulation on the Kammanassie. It is known that Cape mountain zebra need access to clean water on a daily basis for their survival. Because of this situation, CapeNature has already had to install artificial watering points, because most of the springs dried up where they used to find water. Other impacts documented include those associated with plant water stress and a reduction in surface water flow (Vermaaks River) (Cleaver *et al.* 2003).

Information such as this is lacking for the other sectors within the SCWHS&NR. As a result, the long-term effects of increased groundwater abstraction in the future can only be guessed at for these areas. These potential impacts, coupled with the effects of climate change does not bode well for the ecosystems that are associated with groundwater and/or aquifers.

Aspects to be monitored within the SCWHS&NR would include primary water levels of boreholes, but could also include monitoring of the physico-chemical variables (including water temperature, pH and Ecological Conductivity) at boreholes where water is abstracted for nature reserve purposes, if relevant. This should be done according to the CapeNature Groundwater Monitoring Protocol. Monitoring data for boreholes where abstraction is taking place for rural and municipal water provision, should include the measurements of abstraction rates, with implementation of a predetermined threshold for low water level from where no further abstraction should take place. This should be done by the municipality or government entity (e.g. Oudtshoorn Municipality which operates the KKRWSS) that is abstracting the water and these updates should be fed back to Conservation Management timeously.

2.3.2.2 Rivers

The SCWHS&NR area generally receives its rainfall throughout the year, where summer thundershowers are common in the parts of the protected area located within the Succulent Karoo biome. The variation in environmental factors in the area result in a number of river types which range from slightly peat-stained, fast-flowing mountain streams with cobble beds, dense riparian zones and closed or semi-closed canopies to more turbid and typical “karoo” type rivers. The south-western section of the Gouritz catchment is especially dry and most of the rivers in this area are ephemeral systems which only flow periodically after heavy rain. Many of the catchment areas of all these rivers have been identified as priorities for conservation and/or rehabilitation according to the NFEPA project (Nel *et al.* 2011a, b; see Table 2.7 for the NFEPA and condition status of these mainstem rivers and their tributaries). Extensive agricultural development in the region, especially in the Olifants River system, has resulted in

many river reaches outside of protected area properties, being severely affected by over-abstraction of water and agricultural pollution. A number of alien invasive plants are common in the general area and many rivers, especially those outside of protected areas, have riparian zones dominated by non-native plants. Similarly, alien and invasive fish species are present in most of the rivers in the region and often dominate foothill and mainstem river reaches.

Table 2.7: The NFEPA status and estimated health condition of the rivers of the Swartberg Complex World Heritage Site and Nature Reserves, from west to east. Health scores are defined as follows; natural (A), good-natural (AB), good (B), fair (C), degraded (D).

Sector	River	Condition*	FEPA status	*River reach/type
Towerkop	Huis	A	Fish Corridor	Mountain stream
	Dwars	A	Upstream Area	Mountain stream - foothills
	Buffelskloof	A	Upstream Area	Mountain stream
	Swartberg	A	Upstream Area	Mountain stream
	Kobus	AB	Fish Support Area	Mountain stream
	Unnamed tributary of Kobus	A	Fish Support Area	Mountain stream
	Seweweeks-poort	AB	Fish Support Area	Foothills (kloof)
	Wilge	A	Fish Support Area	Mountain stream
	Vaarwel	A	Fish support area	Mountain stream
	Willems	AB	Upstream Area	Mountain stream
	Unnamed tributaries of Klein-Swartberg	A	Upstream Area	Mountain stream - foothills
	Sloot (tributary of Bosluiskloof)	A	Fish Corridor	Mountain stream - foothills
	Oshoekshang	A	FEPA fish sanctuary Fish Corridor	Mountain stream
Gamkaskloof	Oshoekshang	AB	Fish Sanctuary Fish Corridor	Foothills
	Unnamed tributaries of Gamka	AB	FEPA fish sanctuary Fish Corridor	Mountain stream
	Gamka	C	Fish Support Area Fish Corridor	Foothills – middle
	Lemoenkloof	AB	Fish Support Area Fish Corridor	Mountain stream - foothills
	Unnamed tributary of Gamka	AB	Fish Support Area Fish Corridor	Mountain stream - foothills
Gamkapoort	Dwyka	C	Upstream Area	Middle - lower
	Gamka	C	Fish Support Area	Foothills - middle
	Bosluiskloof	AB	FEPA Catchment	Foothills
	Elandskloof	AB	FEPA Catchment	Foothills
Groot Swartberg	Elandspad	AB	Fish Support Area	Foothills (Valley bottom)
	Huis (tributary of Gamka)	AB	FEPA fish sanctuary	Mountain stream - foothills

Sector	River	Condition*	FEPA status	*River reach/type
	De Wits	A	FEPA fish sanctuary	Mountain stream
	Tryntjies	A	Upstream Area	Mountain stream
	Dorps	AB	Fish Rehab FEPA Upstream Area	Mountain stream
	Cordiers	A	Upstream Area	Mountain stream
	Upper Groot	AB	Fish Support Area	Mountain stream
	Upper Aaps	AB	FEPA fish sanctuary	Mountain stream
	Gamka	C	Fish Support Area	Middle
	Klein	AB	Fish Support Area	Mountain stream
	Smits	A	Fish Support Area	Mountain stream
	Kleinklaas	A	Fish Support Area	Mountain stream
	Upper Nels	A	Fish Support Area	Mountain stream
	Vlei/Kruis	A	Upstream Area	Mountain stream
	Meul	A	Upstream Area	Mountain stream
	Wynands	A	Upstream Area	Mountain stream
	Olienbos	A	FEPA fish sanctuary	Mountain stream
	Hoeks	A	FEPA fish sanctuary	Mountain stream - foothills
	Boesmans	A	Fish Support Area	Mountain stream
	Upper Klein Le Roux	D	Fish Support Area	Mountain stream - foothills
	Groot (tributary of Kango)	A	Upstream Area	Mountain streams
	Meul (tributary of Kango)	A	Upstream Area	Mountain streams
Nels (tributary of Olifants)	AB	Upstream Area	Mountain stream	
Groot-Abrahams	AB	Upstream Area	Mountain stream	
Huis (tributary of Groot/Meirings)	AB	Fish Support Area	Mountain stream	
Swartberg East	Tributaries of Meirings/ Groot	AB	Fish Support Area	Mountain stream – foothills
	Western tributaries of Olifants	AB	Fish Corridor	Mountain stream
	Kuis/Drink	AB	Upstream Area	Mountain stream
	Traka and tributaries	AB	Upstream Area	Mountain stream - foothills
Rooiberg	Tributaries of Knui	AB	Upstream Area	Mountain stream - foothills
	Huis (tributary of Groot)	AB	FEPA fish sanctuary	Mountain stream
	Tributaries between Huis and Bos	AB	Rehab FEPA Fish Support Area	Mountain stream
	Bos and tributaries	AB	FEPA fish sanctuary	Mountain stream
Paardenberg	Confluence of Kobus and Wilge	C	Fish Support Area	Middle - lower
	Confluence of Kobus and Vaarwel	C	Fish Support Area	Middle – lower

Sector	River	Condition*	FEPa status	*River reach/type
Groenefontein	Tributaries of Kobus	AB	Fish Support Area	Source zone – foothills
	Tributaries of Gamka	AB	Upstream Area	Mountain stream – foothills
	Caledonkloof	AB	Upstream Area	Mountain stream - foothills
	Trutaries of Gamka upstream of confluence with Olifants	AB	Fish Support Area	Mountain stream - foothills
	Rietvlei	AB	FEPa catchment	Mountain stream - foothills
	Waterkloof	AB	FEPa catchment	Mountain stream - foothills
Vaalhoek	Section of Gouritz	C	Fish Support Area	Middle
	Tributaries of Gouritz	B	Fish Support Area	Source zone – foothills
Gamkaberg & Fontein	Doringkloof	AB	Fish Corridor	Mountain stream
	Waterkloof	AB	Upstream Area	Mountain stream
	Tierkloof	AB	Fish Corridor	Mountain stream - foothills
	Jagkloof	AB	Fish Corridor	Mountain stream – foothills
	Klippe se Kloof	AB	Upstream Area	Mountain stream
	Keurkloof	AB	Fish Support Area	Mountain stream - foothills
	Boskloof	AB	Upstream Area	Mountain steam - foothills
	Upper Slang tributaries	AB	Upstream Area	Mountain stream
Kammanassie	Upper Wilge	A	FEPa fish sanctuary	Mountain stream
	Buffelsklip	AB	Upstream Area	Mountain stream
	Rooi	AB	Upstream Area	Mountain stream – foothills
	Marthinus	AB	Upstream Area	Mountain stream – foothills
	Kleinplaas	AB	Upstream Area	Mountain stream
	Witboois	AB	Upstream Area	Mountain stream
	Marnewicks	AB	Upstream Area	Mountain stream – foothills
	Upper Huis (tributary of Kammanassie)	AB	Upstream Area	Source zone
	Klein and other tributaries of Kammanassie	AB	Upstream Area	Source zone
	Klues	AB	Upstream Area	Source zone
	Leeuklip	AB	Upstream Area	Source zone

*Condition estimated through a combination of expected values, real data, desktop study and specialist input.

The Swartberg Cluster (including Towerkop, Gamkapoort, Gamkaskloof, Groot Swartberg and Swartberg East) falls into the Gamka, Olifants and the Groot River sub-catchments of the Gouritz WMA (River Health Programme 2007; also see Figure 2.16). The rivers flowing through and from the sectors drain the mountain catchments included in the sectors, from where they flow into these three major rivers in the sub-catchments. The majority of these rivers ultimately form part of the Gamka and Olifants Rivers, which at their confluence becomes the Gouritz River (total catchment size of 45 702 km²). Much further downstream of this confluence, the Groot River joins the Gouritz River. Only one river that originates in the Towerkop sector flows into the Groot River. All of these major rivers are perennial systems, i.e. they flow throughout the year. Some of the tributaries of these major rivers, however, could be considered seasonal (non-perennial) systems. More specifically, the majority of the tributary rivers associated with the Towerkop sector (i.e. Waterkloof, Huis, Dwars and Swartberg Rivers), originate on the southern slopes of the Towerkop Mountains and flow in a south western direction into the Groot River which has its origins in the upper sections of the Gouritz catchment towards the town of Laingsburg. There are also some tributary rivers (Kobus and Seweweekspoort) flowing into the Huis River which in turn flows into the Gamka River close to the R62 (information taken from Jordaan & Gouws 2015).

To the north-east of Towerkop lies Gamkapoort which includes the Gamkapoort Dam, a gravity type dam located on the Gamka River, which was established in 1969 for flood control. The main rivers feeding the dam are the Dwyka and Gamka Rivers. Downstream of Gamkapoort lies Gamkaskloof, also known as “Die Hel”. This reserve is situated on the Gamka River approximately 7km downstream of the dam. Other rivers in Gamkaskloof include the Elandspad and Lemoenkloof tributaries, as well as the Oshoekshang River which originates on the eastern side of Towerkop and flows into the Gamka River on Gamkaskloof. To the east of Gamkaskloof lies the Groot Swartberg sector which includes the majority of the Swartberg Mountain Range and a number of tributary rivers originating on both the northern and southern side of the mountain range. Along the northern side of the Groot Swartberg the more prominent tributaries are the Huis, Scholtzkloof and Dorps Rivers which are tributaries of the upper Gamka River upstream of the Gamkapoort Dam. Towards the north-eastern side lies the Upper Groot and Aaps Rivers which form the Groot River and meanders through Meiringspoort. It also splits Groot Swartberg from Swartberg East. Several tributary rivers have their source zones along the southern slopes of the Groot Swartberg. These include the Meul, Wynands, Hoeks, Grobbelaars, Kango, Nels and Klein Le Roux’s Rivers (Figure 2.16). Swartberg East has several non-perennial tributaries which feed into the Olifants River upstream of Stompdrift Dam.



Figure 2.16: Examples of typical river types associated with the Gouritz River system. Top left is the Groot River in Meiringspoort. Top right is the Aaps River. Bottom left is the lower Klein Le Roux River and bottom right is the Hoeks River.

The rivers of the Klein Karoo are characterised mainly by clear, fast-flowing mountain streams with cobble beds, dense riparian zones and closed or semi-closed canopies (Figure 2.16). The middle reaches are typically slower flowing rivers with higher turbidity and substrates that consist of mud, sand and cobble. As a result of agricultural and residential impacts on many of the Karoo rivers, excessive nutrient input is a common problem which results in excessive reed growth in the middle and lower reaches of these rivers.

The Gamkaberg Cluster (including Rooiberg, Groenefontein, Paardenberg and Vaalhoek) falls mainly in the lower section of the Gamka and Groot River sub-catchments and ultimately the Gouritz River itself. The Gouritz River passes through Vaalhoek far upstream of its confluence with the Groot River. The rivers draining off the southern and western mountain slopes within the Rooiberg, generally forms part of the Groot River catchment (e.g. the Huis and Bos Rivers), while some drain to the north and east through Groenefontein into the Taais River (tributary of the Gamka River). The Kobus River (also known as the Huis River) originates in Towerkop and flows south and east and along the border between Paardenberg and Groenefontein and into the Gamka River. The tributaries originating from the northern mountain slopes within Gamkaberg (including the Doringkloof, Waterkloof, Tierkloof, Jagkloof and Klippe se Kloof Rivers) on the other hand, flows into the Olifants River. However,

mountain streams draining off the south-facing slopes of this sector (including the Boskloof River), form part of the Slang River catchment, which is a tributary of the Gouritz River. The non-perennial streams draining in a south-easterly direction off the slopes within the eastern section of Gamkaberg into and through Fontein (including the Keurkloof River) is a tributary of the Moeras River, which is a tributary of the Olifants River, upstream of the its confluence with the Wynands River.

The most significant threats identified for the river ecosystems of the SCWHS&NR are those linked to the effects of climate change. Impacts linked to increasingly frequent weather extremes (e.g. droughts, flooding and ambient temperature extremes) pose a major threat to both the instream and riparian zones of rivers and their hydrological function. Other major threats that have been identified for the SCWHS&NR include the presence of invasive alien plant species within the riparian zones, as well as the presence of invasive alien fish species in the instream habitat. The latter will be discussed in section 2.4.3. A long list exists of invasive alien plant species that occur in and along the rivers and wetland ecosystems on the various sectors. Two of these invasive alien species are shared across all three clusters of the SCWHS&NR, namely *Acacia mearnsii* (black wattle) and *Populus canescens* (grey poplar). Some of the other freshwater ecosystem invasive alien species (including reeds, trees and weeds) occur on both the Swartberg and Gamkaberg Clusters, including *Arundo donax* (giant spanish reed), *Eucalyptus* spp. [e.g. *Eucalyptus camaldulensis* (red river gum)], *Ricinus communis* (castor oil plant) and *Tamarix ramosissima* (pink tamarisk). Other invasive alien plant species found to occur along and in rivers and wetlands in the Swartberg Cluster include *Populus alba* (white poplar) and *Rubus fruticosus* (European blackberry). In addition, the Gamkaberg Cluster freshwater systems also house the extra-limital *Alhagi macrorum* (camelthorn), a *Datura* sp. (thorn apple) and *Schinus molle* (pepper tree).

With regards to the maintenance of the riparian zones of rivers, the removal of invasive alien plant species should be prioritised. Especially in the rivers draining the high water yield catchments within the protected area network. Not only will this improve the health of the riparian zones and the instream environments, but it will also allow for the release of more good quality water. Moreover, the establishment of indigenous vegetation after alien clearing should be encouraged to also enable the re-establishment of faunal groups, such as for example aquatic macro-invertebrates (Samways *et al.* 2010).

Other, somewhat less significant threats to rivers on the SCWHS&NR include physical modifications to both the instream and riparian zones as well as the potential of pollution events, specifically in the form of localised oil/diesel spills (e.g. in Meiringspoort) and agricultural run-off. These threats are mainly relevant to the properties containing lower sections of rivers (e.g. the Gamka and Gouritz Rivers), where impacts from upstream sections outside the boundaries of the property as well as historical activities (old farm lands) that altered some physical aspects of the river ecosystem. One exception to this is the presence of weirs on several of the rivers, just outside the boundaries of the protected areas, which lead to upstream inundation of the river channel (possibly within the protected area boundary). Many of the rivers are completely diverted by weirs just outside the boundary of the relevant protected area, with little or sometimes no flow reaching the downstream reaches (see Figure 2.16).

The reduction in river flow, in the form of this over-abstraction of surface water and groundwater, is also a threat, more so within the ZOI surrounding the SCWHS&NR. The over-abstraction of water is often linked to over allocation of water from the relevant authorities, or in the case of the increasing threat of groundwater over-abstraction, unregulated water use.

Consequently, when it comes to the management of rivers, it is important to consider activities in the entire catchment of the river. This is especially important for rivers that are considered priorities, i.e. rivers in FEPA catchments and fish sanctuaries (Nel *et al.* 2011a, b). For these rivers, flow volume, timing and frequency is of particular importance. Therefore, monitoring the flow regime of strategically selected rivers within the SCWHS&NR, would add a lot to tracking flow patterns linked to, for example invasive alien tree clearing in the catchment. This in turn will highlight the importance of adaptive and sustainable management of our freshwater ecosystems, especially in relation to the ecological services the SCWHS&NR provides with regards to water provision. This is particularly important in light of the current drought and future effects of climate change. Here both rainfall and ambient temperature data would add a lot to the assessment of the flow regime data collected through long-term monitoring. Additionally, monitoring of the flow regime, together with water quality assessments (using bio-indicators such as macro-invertebrates) could add a lot with regards to the informed adaptive management of the mostly upper reaches of the rivers originating within the SCWHS&NR. The actual health and seasonal trends of the health condition of these river ecosystems (e.g. see Table 2.7) can also be monitored using certain biomonitoring methods. One such method is the South African Scoring System Version 5 (SASS 5), which uses benthic macro-invertebrates as indicators of water quality and instream habitat diversity. This will be discussed in more detail in section 2.4.1.2.

2.3.2.3 Wetlands

Few wetlands have been mapped to occur within the boundaries of the SCWHS&NR in general (Nel *et al.* 2011a, b). This is likely partly due to the drier climate experienced in the general area of the land parcels located more towards the Karoo. In addition, none of the wetlands that were mapped are considered to be priorities for conservation according to the FEPA assessments (Nel *et al.* 2011a, b). Upon closer inspection of the NFEPA wetland spatial layer, it was found that several of the mapped wetlands were also found to be artificial (i.e. old farm dams; see Table 2.8) and will therefore not be discussed further in this management plan.

There is some variation in the wetland regional vegetation types on the SCWHS&NR properties, with three different types relevant to natural wetlands being present, including Western Fynbos – Renosterveld Sandstone Fynbos, Western Fynbos – Renosterveld Shale Band Vegetation and Rainshadow Valley Karoo (see Table 2.8). The Towerkop, Swartberg East and Paardenberg sectors include wetlands (hillslope seeps and channelled valley-bottoms respectively) of the Western Fynbos – Renosterveld Sandstone Fynbos vegetation type. Here, the hillslope seeps of this wetland vegetation type is considered to be endangered, while the channelled valley-bottom wetlands have a threat status of least concern. Both wetland types are considered to be well protected (see Gouws *et al.* 2012).

The Western Fynbos – Renosterveld Shale Band Fynbos wetland types are located on a section of the Groot Swartberg, where a bench flat wetland was mapped to occur slightly upslope of the Gamka River. This wetland type is considered to be least threatened and well protected. The Rainshadow Valley Karoo regional wetland vegetation type is present on both the Rooiberg and Gamkapoort sectors. Although no wetlands were mapped to occur on the Rooiberg sector, there is a small channelled valley-bottom wetland associated with the Bos River, which has been mapped to occur just outside the boundary. This same wetland type is also present within the Gamkapoort sector, just upstream of the Gamkapoort Dam, and is considered to be critically endangered and not well protected.

No wetlands were mapped to occur on the Vaalhoek, Gamkaberg, Fontein, Gamkaskloof or Kammanassie sectors. Despite the generally arid nature of the surrounding area, it is expected that more, at least seasonal, wetlands would be present on these and the other sectors. These wetlands would likely be located near the many perennial and non-perennial rivers draining off the mountainous areas contained within the sectors and would add at least one regional wetland vegetation type to the list (i.e. Albany Thicket). In fact, several natural springs are known to occur on the Kammanassie (see Cleaver *et al.* 2003). Some of the springs have dried up and collapsed over the years (due to groundwater abstraction and low rainfall conditions), but those that remain could still possibly lead to the presence of wetland habitat in their direct vicinity.

Table 2.8: Threat status, estimated health and protection level of the different wetland types of the Swartberg Complex World Heritage Site and Nature Reserves, from west to east. Threat status is defined as follows; Least Threatened (LT), Vulnerable (VU), Endangered (EN) and Critically Endangered (CR). Note that some of the wetlands are actually dams.

Sector	Wetland type	Natural/Artificial	*Threat status	*Protection level
Towerkop	Western Fynbos – Renosterveld Sandstone Fynbos seeps	Natural	EN	Well protected
	Western Fynbos – Renosterveld Sandstone Fynbos channelled valley-bottom (<i>just outside boundary</i>)	Natural	LT	Well protected
Gamkapoort	Rainshadow Valley Karoo channelled valley-bottom	Natural	CR	Not protected
	Rainshadow Valley Karoo bench flat	Artificial	EN	Not protected
Groot Swartberg	Western Fynbos – Renosterveld Shale Fynbos bench flat	Natural	CR	Not protected
Swartberg East	Western Fynbos – Renosterveld Sandstone Fynbos seeps	Artificial	EN	Well protected
	Western Fynbos – Renosterveld Sandstone Fynbos channelled valley-bottom	Natural	LT	Well protected
Paardenberg	Western Fynbos – Renosterveld Sandstone Fynbos unchannelled valley-bottom	Natural	CR	Poorly protected
Groenefontein	Albany Thicket Valley channelled valley-bottom	Artificial	CR	Not protected

Sector	Wetland type	Natural/Artificial	*Threat status	*Protection level
Rooiberg	Rainshadow Valley Karoo channelled valley-bottom	Natural	CR	Not protected

**Threat status and protection levels could potentially change somewhat with the updated National Biodiversity Assessment of 2018/19.*

According to the NFEPA wetlands spatial layer data, the majority of the wetlands mapped within protected areas are in a good to natural condition, as would be expected. However, wetlands outside of the protected areas are generally considered to be impacted in some way, with either modified, degraded or transformed health conditions.

2.4 Biodiversity Context: Taxa

2.4.1 Invertebrates

2.4.1.1 Terrestrial Invertebrates

The core of the CFR represents a distinct zoogeographic zone, the Cape Faunal Centre (Stuckenberg 1962), characterised by the phylogenetic antiquity of much of its invertebrate fauna. The component species of this Centre represent what is probably the richest known assemblage of post-Gondwanan relict species and is a pronounced hotspot for faunal endemism within southern Africa, where high levels of endemism are characterised for virtually all taxa examined. Invertebrates play vital roles in ecosystems (McGeoch 2002; Samways *et al.* 2010, 2012), such as primary production, nutrient recycling, predation, herbivory and competition. The Cape flora is dependent on specialised pollination guilds. Pollinators are mostly insect pollinators such as bees, (honey bees, solitary bees and carpenter bees), pollen wasps, ants, flies (including bee-flies, hoverflies and mosquitoes), butterflies, moths and flower beetles. Honey bees (*Apis mellifera*) are part of a variety of wild pollinators resident in natural areas and more specifically, protected areas. The SCWHS&NR aims to safeguard healthy, natural and genetically diverse honey bee populations, which will allow the protected area to operate as refugia for locally adapted bee populations and to support a network of healthy source honey bee populations that can disperse naturally into and throughout the rest of the province.

The keeping of managed honey bees in areas outside of protected areas is a relatively large economic activity performed by both small and large scale farmers in South Africa and is supported as long as it is conducted according to standards that promote the long-term sustainability of apiculture as well as wild honey bee populations. It has been found that beekeeping within protected areas not only creates managerial problems (such as an added fire risk due to beekeeping practices), but can also have a negative impact on biodiversity (Geldmann & González-Varo 2019).

Firstly, commercial pollination services move honey bees between localities to pollinate crops that flower at different times of the year. This can result in a decrease in regional genetic diversity as the genetic stock of local bee populations is homogenised as they interbreed with honeybees from other areas. Formal protected areas conserve honey bee populations with any attendant local adaptations and

behaviours. Wild honey bee populations in protected areas are therefore valuable repositories for biodiversity and functioning ecosystems.

Secondly, the introduction of managed honey bee colonies into protected areas can lead to the transmission of diseases and parasites from managed colonies to wild colonies within protected areas. Commercial pollination has spread honey bee diseases around the country and several of these are diseases of international importance, such as American Foul Brood Disease. Introducing infected honey bee hives into protected areas is likely to lead to increased mortality in wild honey bee populations and serve as an infection source for commercial honey bees.

Furthermore, ecosystems and/or ecological processes necessary to sustain and support biodiversity in protected areas can be disrupted by beekeeping practises (Geldmann & González-Varo 2019). Artificially inflated numbers of honey bee colonies exclude other bee species and avian pollinators from floral resources, which may result in the demise of these species if the number of honey bee individuals is artificially increased. Research has shown that in pristine areas there are only 1.1 wild bee colonies per km²; this is important because existing pollinator networks are affected if the number of honey bees is increased artificially by bringing in commercial bees (J. Cullinan & K. Sternberg, Ujube 2019, pers. comm.). Honey bees are not necessarily good pollinators of all plants and sometimes take nectar from flowers without pollinating them. This can result in some bee species and some monolectic (plants with one or a few closely related pollinator species) plant species being threatened by high honey bee densities. The need to establish a suitable buffer area (of up to 10 km wide) around the protected area has been highlighted by researchers in order to safeguard wild bee populations (J. Cullinan & K. Sternberg, Ujube 2019, pers. comm.).

Therefore, CapeNature developed a draft policy for the regulation and management of honey bee colonies in CapeNature protected areas. The primary objective of this policy is to safeguard healthy, natural and genetically diverse honey bee populations in CapeNature protected areas, which will allow these protected areas to operate as refugia for locally adapted bee populations and to build a network of healthy source honey bee populations that can disperse naturally into and throughout the rest of the province. This will provide support to the diverse and hopefully expanding use of apiculture in the province. Therefore, beekeeping or harvesting of bees within the SCWHS&NR will not be considered or approved.

Another vital insect-driven ecological process in the CFR is myrmecochory (seed dispersal by ants) (Le Maitre & Midgley 1992). In South Africa, myrmecochorous plants are mainly restricted to the Fynbos biome and approximately 20% of the strictly Fynbos plant species are dependent on myrmecochory for their survival (Johnson 1992). A total of 29 families and 78 genera of Fynbos plants have been identified as containing species that are ant-dispersed (see Table 1 in Bond & Slingsby 1983).

The presence of a diversity of *Colophon* beetle species in the SCWHS&NR is considered to be indicative of the capacity of this area to provide refuge to biodiversity during periods of climate change. The Swartberg provides habitat for seven of the known *Colophon* species; namely the Critically Endangered *C. primosi* (Figure 2.17), *C. cassoni*, *C. berrisfordi*, *C. montisatris*, the Endangered *C. whitei*, the Vulnerable *C. neli* and *C. endroedyi*, which is not IUCN listed. *Colophon neli* is the smallest known

species in the genus. These flightless stag-beetles are considered to be relictual fauna with Gondwana land linkages, since their closest relatives are today found in Brazil and Australia (Endrödy-Younga 1988).



Figure 2.17: *Colophon primosi*, one of the Critically Endangered species endemic to the Swartberg Cluster. (Photo: Angelica Loots)

The butterflies of South Africa were recently assessed according to the latest IUCN criteria as part of the South African Butterfly Conservation Assessment project (Mecenero *et al.* 2013). There are 38 species of Lepidoptera that are endemic to the Western Cape. Mecenero and others (2013) argued that, in the South African context, it is not just the threatened taxa that are of importance, but also those taxa that are intrinsically rare or localised but not currently threatened. Conservationists should be made aware of these taxa so that future threats can be identified timeously and the species monitored for change. They assigned conservation statuses to butterfly species that were classified as Least Concern during Red Listing but has local rarity (Mecenero *et al.* 2013). These species were either classified as Extremely Rare (known from only one site) or Rare. Rare species were further classified as Rare – Restricted range (those with a range less than 500 km²), Rare – Habitat specialist (species restricted to a specific micro-habitat) or Rare – Low density (species with small subpopulations or single individuals scattered over a wide area). Table 2.9 gives the classification of the 12 Western Cape species that are likely to occur in the SCWHS&NR that are classified as Least Concern with local rarity.

Table 2.9: Conservation status of butterfly species that are likely to occur in the Swartberg Complex World Heritage Site and Nature Reserves that were classified as Least Concern during Red Listing but are locally rare (Mecenero *et al.* 2013).

Species	Common name	Family	Distribution	Conservation status according Mecenero <i>et al.</i> 2013
<i>Aloeides pallida jonathani</i>	Kammanassie giant copper	Lycaenidae	Southern side of the Kammanassie Mountains near Uniondale.	Extremely Rare (known from only one site)
<i>Chrysoritis adonis aridimontis</i>	Adonis opal	Lycaenidae	Elandsberg Mountains north of the Swartberg, near Ladismith. Matjiesfontein Quartzite Fynbos.	Extremely Rare (known from only one site)
<i>Chrysoritis daphne</i>	Daphne's opal	Lycaenidae	Kammanassie Mountains near Uniondale. South Kammanassie Sandstone Fynbos.	Extremely Rare (known from only one site)
<i>Chrysoritis swanepoeli hyperion</i>	Hyperion opal	Lycaenidae	Swartberg to Kammanassie Mountains. Occurring in steep, rocky gullies.	Rare – Habitat specialists (restricted to micro-habitat)
<i>Chrysoritis swanepoeli swanepoeli</i>	Swanepoel's opal	Lycaenidae	Swartberg Mountains, Huis River Pass and Gamkaberg Cluster. Low-lying (800 – 900m) rocky kloofs at the foot of mountains with steep dry gullies and river beds.	Rare – Habitat specialists (restricted to micro-habitat)
<i>Lepidochrysops pringlei</i>	Pringle's blue	Lycaenidae	Swartberg Mountains to Willowmore. Rocky ridges on the upper slopes of mountains in North Swartberg Sandstone Fynbos.	Rare – Habitat specialists (restricted to micro-habitat)
<i>Serradinga kammanassiensis</i>	Kammanassie widow	Nymphalidae	South-eastern portion of the Kammanassie Mountain near Uniondale. High-altitude fynbos (1100 – 1600m) on steep slopes, in vales and along river courses. North and South Kammanassie Sandstone Fynbos.	Rare - Restricted range (Range less than 500 km ²)
<i>Chrysoritis pyramus pyramus</i>	Pyramus opal	Lycaenidae	Swartberg Mountains above 1500 m in North Swartberg Sandstone Fynbos.	Rare - Restricted range (Range less than 500 km ²)
<i>Chrysoritis nigricans rubescens</i>	Dark opal	Lycaenidae	Gamkaberg Cluster in North Swartberg Sandstone Fynbos.	Rare - Restricted range (Range less than 500 km ²)
<i>Orachrysops brinkmani</i>	Brinkman's blue	Lycaenidae	On the southern side of the Kammanassie Mountain in South Kammanassie Sandstone Fynbos.	Rare - Restricted range (Range less than 500 km ²)

Species	Common name	Family	Distribution	Conservation status according Mecenero <i>et al.</i> 2013
<i>Thestor rooibergensis</i>	Rooiberg skollie	Lycaenidae	In the Rooiberg near Ladismith in South Rooiberg Sandstone Fynbos.	Rare - Restricted range (Range less than 500 km ²)
<i>Lepidochrysops balli</i>	Ball's blue	Lycaenidae	Restricted to the southern slopes of the Kammanassie Mountain and the Aasvoëlsberg near Willowmore at an altitude of 1300 m.	Rare – Habitat specialists and Restricted range

Another ecologically important invertebrate group is the Arachnida. The South African National Survey of Arachnida (SANSA) was initiated in 1997 (Dippenaar-Schoeman *et al.* 2015) and is an umbrella project that is implemented at a national level in collaboration with researchers and institutions countrywide dedicated to document and unify information on arachnids in South Africa. SANSA is providing essential information needed to address issues concerning the conservation and sustainable use of the arachnid fauna (Dippenaar-Schoeman *et al.* 2013; Dippenaar-Schoeman *et al.* 2015). Presently 71 spider families, 471 genera and 2240 species are known from South Africa, representing approximately 4.8% of the world fauna. A total of 966 species represented by 365 genera and 68 families have been recorded in the Western Cape (Dippenaar-Schoeman *et al.* 2015) of which 361 species are endemic to the Western Cape (37.4%), with 119 species only known from their type locality. Spiders were collected in the Swartberg Cluster over a 10-year period as part of the National Survey of the Succulent Karoo Biome (Dippenaar-Schoeman *et al.* 2005). A total of 45 families comprising 136 genera and 186 species were collected, all of which were new records for the area (Dippenaar-Schoeman *et al.* 2005). This represents about 9.4 % of the total known South African spider fauna. Ten species are possibly new to science and the family Filistatidae is a first record for South Africa (Dippenaar-Schoeman *et al.* 2005).

2.4.1.2 Freshwater macro-invertebrates

Mountainous and upland catchment areas are considered important not only for the provision of good quality of water, but also because of the substantial contributions they make to biodiversity (Furse 2000; Dallas & Day 2007). Additionally, they often serve as refuge areas for vertebrate and invertebrate species and in some cases serve as habitat for species that are confined to these upland freshwater ecosystems (e.g. Palmer *et al.* 1994; Dallas & Day 2007). This is especially prevalent in the more naturally acidic and low nutrient headwaters of rivers in the CFR, which are underlain by the TMG quartzitic sandstones. These are some of the conditions that have resulted in high aquatic species richness and also high degrees of endemism in the CFR as a whole (De Moor & Day 2013; Gouws & Gordon 2017). There is also a high level of genetic diversity within several invertebrate taxa (i.e. taxonomic disparity; De Moor & Day 2013) and indigenous fish species. Additionally, this so called taxonomic disparity has resulted in the formation of the concept of “catchment signatures” with regards to the invertebrate assemblages present in the different river catchments of the CFR (see King & Schael 2001; Dallas & Day 2007). With the levels of sensitivity that is linked to

many of the endemic invertebrate taxa within these catchment signature assemblages, it is not surprising that this faunal group has been used extensively as indicators of river health (see Dickens & Graham 2002).

Subsequently, biomonitoring of foothill and headwater streams, such as those found within the boundaries of the SCWHS&NR can be used to establish the reference/benchmark conditions for a river system that might be impacted on locally or in the lowland areas. Here benthic macro-invertebrates can be used to monitor both water quality and habitat diversity over the long term, using the SASS 5 (Dickens & Graham 2002) method. This method has been used extensively (e.g. River Health Programme) and is considered cost effective and time efficient. Here, different macro-invertebrate taxa are given a score out of 15, with higher scores being related to more sensitive (in terms of water quality impairments) taxa, and lower scores relating to taxa that are more tolerant to pollution. The final scores take into account the sum of the scores per taxon (SASS Score) observed and the number of different taxa, from where an Average Score Per Taxon (ASPT) is calculated. Both the SASS Score and the ASPT is then used to determine the health of a river site or system, through the ecological banding system that was developed by Dallas (2007). These two scores are plotted against each other (see the figure for the Southern Folded Mountains – upper in Dallas 2007) and each point falls into an ecological category, ranging from natural to critically modified (see Table 2.10; Figure 2.18). Due to the variation in the underlying substrates of the SCWHS&NR, there will be some variation in the value of the relevant ASPT scores between sites located in sandstone rivers for example and those located in shale based rivers. For most sandstone-based rivers, an ASPT score of seven or more would be considered to indicate a good to natural condition ecosystem. The ASPT score for good to natural shale-based rivers would be lower, possibly at a range from six to seven. There is likely to be some variation in scores seasonally as well (e.g. Dallas 2004), so allowances should be made for this. For example, due to varying life history patterns fewer taxa are expected to be collected in the Western Cape rivers during the high flow winter months when compared to spring and summer sampling events (Dallas 2004).

There are other invertebrate assemblage considerations that could be used to add to the river health assessment analyses. This would include consideration of the densities of the Ephemeroptera (mayflies), Plecoptera and Trichoptera (EPT) taxa (see for e.g. Bellingan *et al.* 2015) as well as the recently developed Dragonfly Biotic Index (Samways & Simaika 2016). The latter specifically considers the presence of specifically the odonate taxa (dragonflies and damselflies) when assessing freshwater ecosystem health. As is the case with many of the aquatic and semi-aquatic invertebrates, the odonates have a high level of endemism.

Table 2.10: The biological bands/ ecological categories for interpreting SASS 5 data (adapted from Dallas 2007).

Biological Band/ Ecological Category	Category Name	Description
A	Natural	Unmodified, natural
B	Good	Largely natural with few modifications

Biological Band/ Ecological Category	Category Name	Description
C	Fair	Moderately modified
D	Poor	Largely modified
E	Seriously modified	Seriously modified
F	Critically modified	Critically or extremely modified

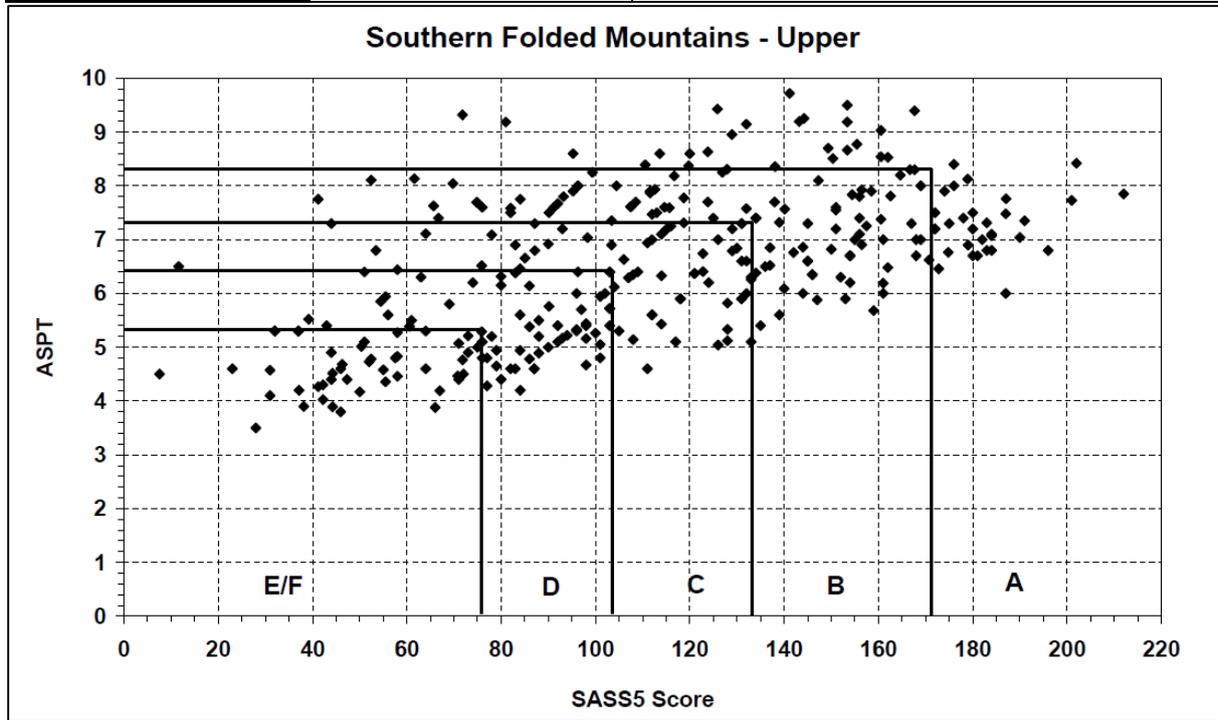


Figure 2.18: An example of the biological bands determined for the upland sites of the Southern Folded Mountains (copied from Dallas 2007).

Benthic Macro-invertebrate baseline survey results

Internal baseline freshwater surveys have been conducted for the SCWHS&NR over the past seven years. The surveys included both fish surveys and SASS 5 assessments, starting with the Kammanassie in 2012 (Jordaan *et al.* draft), followed by the Gamkaberg Cluster in 2014 (Jordaan & Gouws 2015) and concluding with the Swartberg Cluster in 2016 (Jordaan & Gouws 2017). Due to access constraints or probability of fish species distributions, many of the sites were located just off the protected area boundaries. All of the surveys were conducted during spring (October) or early summer (December).

Only three rivers were sampled during the Kammanassie survey, including the Rooi, Wilge and Marnewicks Rivers (Jordaan *et al.* draft). In contrast to current drought conditions, river flows were fairly high during this particular survey. The SASS results at these three sites were fairly similar, with ASPT values ranging between 6 and 8 (i.e. 6.4 for the Marnewicks River; 6.5 for the Wilge River; 7.7 for the Rooi River). Here, the

high flow conditions might have impacted on the presence of certain invertebrate species. Despite these conditions, both the Marnewicks and Wilge River sites showed a fairly high diversity of invertebrate families, with sensitive species within the mayfly (Teloganodidae sp.; a South Western Cape endemic family), damselfly (Platycnemidae sp.) and beetle (Scirtidae sp.) families being collected. Invertebrate family diversity was found to be lower at the Rooi River (seven collected), however the invertebrates collected all scored at least moderately high. Here only the marginal vegetation habitat could be sampled, and the highest scoring taxa collected were individuals from the mayfly family Leptophlebiidae and the beetle family Scirtidae. The Marnewicks River is one of those rivers where water was being diverted from a weir outside the protected area boundary, downstream of the sampling site.

Varying levels of flow was experienced during sampling of the rivers of the Gamkaberg Cluster (Jordaan & Gouws 2015). Here, SASS surveys could only be conducted at six of the 12 river sites visited, as there was no perceptible flow at these sites during this survey. The rivers sampled include the Olifants, Boskloof, Huis (at the R62 road bridge), Nels, Gouritz and Kruis/Vlei Rivers. The ASPT scores here were fairly low in general, ranging from 4.06 (mainstem Olifants River) to the highest of 6.61 (Nels River). The lowest diversity of invertebrate families was collected at the site on the Huis River (total of eight), with the highest scoring taxon being individuals of the mayfly family Leptophlebiidae. The highest number of different invertebrate families collected were from the Nels and Kruis/Vlei Rivers (a total of 23 each). Between these two river sites, the Nels River had the highest number of higher scoring taxa leading to a SASS score of 152, where the highest scoring taxa collected included individuals from the damselfly family Platycnemidae, the caddisfly family Philopotamidae and the beetle family Psephenidae. Other medium to high scoring taxa collected at the various river sites include individuals from the mayfly families Heptageniidae (highest scoring taxon collected; Boskloof River) and Leptophlebiidae (Boskloof and Huis Rivers).

A total of 22 sites were visited along rivers within the Swartberg Cluster properties (Jordaan & Gouws 2017). Here SASS surveys could not be conducted at only three of the 22 sites. Two of these sites were located on mainstream rivers (i.e. the Gamka and Groot Rivers) and although pools were present, they could not be sampled due to the lack of perceptible flow. The site on the Hoeks River was not sampled comprehensively (apart from visual observations) due to the location of the site being wrong and time constraints posed upon moving the site upstream, closer to the protected area boundary. The rivers that were sampled included two sites on the Groot River in Meiringspoort and the Aaps, Nels, Meul (Kango), two sites on the Klein Le Roux, Grobbelaars, Wynands, Elandspad, Lemoenkloof, Oshoekshang, Wolwekloof, two sites on the Klein Swartberg, Seweweekspoort, Bosluiskloof, Buffelskloof, Dwars, two sites on the Kobus and one site on the Huis Rivers. These sites varied significantly from each other in many cases, where ASPT results ranged from the lowest of five (lower site on Kobus River) up to the highest of 9.12 (Buffelskloof River). Other river sites scoring above and ASPT of seven, include the Nels, Meul, upper Klein Le Roux, Elandspad, Lemoenkloof, Wolwekloof, Dwars, upper Klein Swartberg and upper Kobus Rivers. All these higher scoring sites were located in upper, more natural sections of these rivers, which were either within or just outside of the protected area boundaries. The lower lying sites generally had ASPT scores of six and below. The lowest diversity of invertebrate taxa was collected in the Grobbelaars, Elandspad and

lower Klein Swartberg Rivers (total of 13). Of these sites, the taxa collected at the Elandspad River included more taxa with higher SASS scores, including individuals from the mayfly family Teloganodidae, the damselfly family Platycnemidae and the beetle family Scirtidae. Consequently, the ASPT for this river (7.6), was higher than the scores for the Grobbelaars (5.85) and lower Klein Swartberg Rivers (5.2). The highest number of invertebrate families were collected at the site on the Wolwekloof River (total of 28), which also had to highest SASS score as a result (201). However, when averaged out, the ASPT score for this site still came out as just above seven (7.2), which is lower than the ASPT score of 9.12 (SASS score 155; Number of taxa 17) of the Buffelskloof River site. Here the number of higher scoring (more sensitive) families collected in relation to the lower scoring (more tolerant) families in the Buffelskloof River exceeded this same relationship in the Wolwekloof River. High scoring families (10 and up) collected at the Wolwekloof River site, included individuals of the South Western Cape endemic mayfly family Teloganodidae and cased caddisfly families Barbarochthonidae, Glossosomatidae and Petrothrincidae, the cased caddisfly family Pisulidae, the caseless caddisfly family Pisulidae and the beetle family Scirtidae. The highest scoring invertebrate families collected at the Buffelskloof River site included individuals from the very sensitive stonefly family Notonemouridae, together with individuals from the South Western Cape endemic cased caddisfly families Barbarochthonidae and Sericostomatidae. The highest scoring taxon collected, individuals from the true fly family Blephariceridae, was found at the sites on the upper Klein Swartberg and Dwars Rivers. Other higher scoring taxa collected included individuals from the mayfly family Hetageniidae (Nels, Meul, upper Klein Le Roux, Wynands and Oshoekshang Rivers), the beetle family Psephenidae (Wynands River) and the true fly families Dixidae (Groot River) and Athericidae (Nels, Meul, upper Klein Le Roux, Wynands, Elandspad, Lemoenkloof, upper Kobus and Seweweekspoort Rivers).

In conclusion, despite this survey only providing the baseline survey data for the SCWHS&NR, some patterns have already become apparent. Major impacts on the rivers included in these survey have been identified, and include the presence of invasive alien tree and fish species, the effects of the current drought, complete river diversion and over-abstraction of water for domestic and agricultural use. Most of the sites were located outside the borders of the SCWHS&NR, but would still be included within the buffer area that surrounds these borders and the impacts located within them could have knock-on effects upstream. In this way, the upper reaches of the river located within the protected area properties, could allow space for dispersal of aquatic macroinvertebrates under the continued pressures associated with land use practices (Petersen *et al.* 2004) and climate change. Ideally, seasonal monitoring of strategically selected sites should be implemented in the long term, especially related to those rivers that support indigenous fish species. However, for any future proposed SASS monitoring that is not specifically related to the fish species surveys, SASS sites should be located within the boundaries of the relevant protected area properties. Continued monitoring is also considered important here because the SCWHS&NR land parcels conserve most of the mountain catchment which forms part of one of the Strategic Water Source Areas for the Western Cape Province (WWF-SA 2013a, b).

Main threats to invertebrate populations include habitat destruction and invasive alien plants, climate change and illegal collection. This critically important group can be

protected by managing ecosystems according to the required fire regimes and by removal of invasive alien plants, especially in river courses.

2.4.2 Amphibians

Twenty-one amphibian species have been recorded in the SCWHS&NR and this list is considered comprehensive. No species are listed as threatened and no species are endemic to the SCWHS&NR. All the amphibian species in the SCWHS&NR can be conserved by ensuring that the vegetation and surface and groundwater is well managed. This requires that the size of the area burnt, veld age and fire return interval are within the acceptable bounds as determined by the thresholds of potential concern set for the vegetation types in this SCWHS&NR (see section 2.3.1.5). It also requires sustainable water management which includes maintaining rivers in their set management categories (see section 2.3.2) and protecting water source areas (e.g. seeps) from invasive alien plant species (see section 2.3.2.3).

There are 11 amphibian species recorded for the Kammanassie Cluster. None of these are listed as threatened. The status of the ghost frogs (*Heleophryne* spp.) are still to be resolved.

There are seven amphibian species recorded for the Gamkaberg Cluster. None of these are listed as threatened (Minter *et al.* 2004).

2.4.3 Fish

The SCWHS&NR is located entirely within the Gouritz River system which forms part of the Breede-Gouritz WMA. The Gouritz system supports five small-bodied indigenous fish species, and one large native cyprinid. These are the smallscale redbfin (*Pseudobarbus asper*), the chubbyhead barb (*Enteromius anoplus*), the slender redbfin (*Pseudobarbus tenuis*), the Cape galaxias (*Galaxias zebratus*), the Cape kurper (*Sandelia capensis*) and the moggel (*Labeo umbratus*) (Skelton 2001). In addition to these indigenous freshwater species, a number of catadromous species are likely to be present in the lower sections of the main Gouritz River close to the estuary. These include various mullet and eel species, as well as the Cape moony (*Monodactylus falciformes*), Cape silverside (*Atherina breviceps*), and estuarine round herring (*Gilchristella aestuaria*) (Skelton 2001; River Health Programme 2007). Freshwater mullet (*Myxus capensis*) and freshwater eels (*Anguilla* spp.) are marine fish species but migrate significant distances into freshwater systems as juveniles. Here they spend a significant part of their life in freshwater before migrating back to the ocean to breed. In addition to the indigenous fish fauna, a number of alien fish species are also present in the greater Gouritz system. These include rainbow trout (*Oncorhynchus mykiss*), black bass (*Micropterus* spp.), Mozambique tilapia (*Oreochromis mossambicus*), banded tilapia (*Tilapia sparrmanii*), common carp (*Cyprinus carpio*), smallmouth yellowfish (*Labeobarbus aeneus*) and more recent invader, sharptooth catfish (*Clarias gariepinus*).

These alien fish species affect native species through predation and competition for resources and can cause localised extinction of native species. Other threats to indigenous fishes include water over-abstraction, which lead to a loss of habitat; and pollution from various sources (mostly agricultural and urban) that reduce habitat quality and can adversely affect fish health. Threats to migratory species are similar

to those for freshwater species, but for these species, there are the added threats of weirs and associated structures that can block migration routes.

Conservation status & distribution

Historically, the slender redbfin (*Pseudobarbus tenuis*) was known to occur in the Gouritz, Keurbooms and Bitou River systems. Swartz *et al.* (2009) has showed genetic divergence between the populations in the Gouritz and the remaining two systems. The populations in the Keurbooms and Bitou systems are a distinct taxon *Pseudobarbus* sp. nov. “Keurbooms” which awaits formal description. *Pseudobarbus tenuis* is thus endemic to the Gouritz system and is listed as Near Threatened (Jordaan & Chakona 2018b). This species is a headwater specialist and mainly occur high up in headwater streams where it is protected against land use impacts, alien fish invasions and other threats. Currently there are >20 viable populations in the Gouritz system, many of which occur on protected areas. Many populations, especially those associated with Towerkop, occur on land zoned as mountain catchment areas, illustrating the importance of these areas for freshwater fish conservation. Due to the large number of viable populations and their association with protected areas, this species was not identified as a high conservation priority at present. Increased or unsustainable groundwater abstraction in or near the SCWHS&NR may threaten these populations in future.

The smallscale redbfin (*Pseudobarbus asper*) is listed as Vulnerable (Jordaan & Chakona 2018a) with 12 known subpopulations in the greater Gouritz. This species prefers mainstream and large tributary habitat, thus making it very vulnerable to human-induced threats such as loss of habitat, pollution and over-abstraction of water. All these impacts are likely to be exacerbated by climate change. The vulnerability of this species is increased by the fact that many populations are located outside of formally protected areas. The biggest viable on-reserve population is in the Groot River in Meiringspoort within the Groot Swartberg sector. Historical SOB records exist for Paardenberg, Groenefontein and Gamkaskloof, however the smallscale redbfin was not detected during surveys conducted in 2016 in these areas and the current status of these populations are uncertain. It is recommended that management focuses monitoring and conservation interventions on this species where it occurs within the SCWHS&NR as well as within the ZOI.

The Chubbyhead barb (*Enteromius anoplus*) is currently listed as Least Concern (Woodford *et al.* 2017) given its large distribution range across many parts of South Africa. Within the Gouritz system, historical SOB records exist for a number of protected areas including Towerkop (Seweweekspoort River), Paardenberg, Groenefontein (Kobus River), Rooiberg, Gamkapoort (Gamkapoort Dam) and Swartberg Cluster. There is a viable chubbyhead population in the lower Groot River in Meiringspoort which co-occur with smallscale redbfin so even though this is off-reserve it warrants some monitoring especially given the risk of catfish invasion into the Groot River from downstream.

The Cape kurper (*Sandelia capensis*) is listed as Data Deficient due to taxonomic uncertainty (Chakona 2018). Genetic research has presented evidence for the existence of a number of distinct lineages, of which the exact distribution ranges are unknown (Tweddle *et al.* 2009; Ellender *et al.* 2017). The status of populations in the

Gouritz system is unknown and requires further study. Cape kurper occurs in a wide range of habitats, with a preference for lowland habitat and low gradient streams (Chakona & Swartz 2012). As a result, this species mainly occurs outside of the SCWHS&NR with SOB records limited to Paardenberg (Huis River), Gamkaskloof (Oshoekshang River) and Swartberg Cluster (upper Groot River). The Bos River on Rooiberg has records just outside the protected area boundary but this species likely extends into the Gamkaberg Cluster. Recent surveys confirmed the presence and viability of the Huis and Bos River populations, while the Oshoekshang and upper Groot records need verification. Additional populations exist in the Nels, Kruis, Grobbelaars, Wynands and Rooi Rivers.

Similar to the Cape kurper, the Cape galaxias (*Galaxias zebratus*) are listed as Data Deficient due to taxonomic uncertainty. Skelton and Swartz (2011) reported that the currently described *G. zebratus* consists of at least 14 unique lineages, many of which are highly threatened and range restricted. The genetic status of the galaxias in the Gouritz River system is uncertain and requires further study. Their distribution within the SCWHS&NR is limited based on current information, but this could be a result of insufficient sampling. For Towerkop, Cape galaxias were detected in the Huis, Waterkloof and Seweweekspoort tributaries during a 2016 survey. Historical SOB records exist for the Dwars River, but these were not detected during the surveys conducted in 2016 and requires further investigation.

Historical distribution records also exist just downstream of the Groot Swartberg boundary for the small tributaries flowing off the south of the mountain into the Nels River upstream of the Calitzdorp Dam. The Nels River population is relatively large, but these tributary sites are worth investigating to determine whether these populations persist and whether the distribution ranges of *Galaxias zebratus* extend into the SCWHS&NR. The Bos and Assegaaibos Rivers on Rooiberg have records just outside the protected area boundary, however, it is likely that this species extends into the Gamkaberg Cluster.

The moggel (*Labeo umbratus*) is listed as Least Concern as it occurs across six river systems and is widespread and abundant in most (Swartz & Impson 2007). This species is abundant in slow-flowing reaches of rivers and thrives in dams (Mulder 1973). According to Ramoejane (2016), extensive genetic divergence exists between the populations from the southern-flowing systems in the Eastern and Western Cape and that from the Orange-Vaal System is extensive. For the SCWHS&NR, moggel was detected in the upper Gamka River in Gamkaskloof and in the lower Gouritz River in Vaalhoek. The fish detected in the upper Gamka River were subadults, which is indicative of a recruiting population. The conservation status of the estuarine species known to occur in the Gamkaberg Cluster is Least Concern for *Myxus capensis* (Swartz *et al.* 2007) while *Myxus falciformes* has not yet been assessed (IUCN 2019).

Proposed monitoring

The monitoring priority for the SCWHS&NR in terms of species is the smallscale redbfin. The priority sites include the Groot River in the Meiringspoort as this is one of the largest populations and the population is extremely vulnerable to impacts. Examples include a recent (2017) diesel spill into the Groot River as well as an early phase catfish invasion from the mainstream Olifants into the Groot River. Table 2.11

summarises the proposed baseline collections and/or monitoring for freshwater fish of the SCWHS&NR. The monitoring of the Cape kurper and Cape galaxias populations should be informed by the outcome of the taxonomic research. If any of the populations are unique and / or range restricted, their conservation and monitoring should be prioritised. Until this information exists, the focus should be on baseline collection of distribution records and genetic and voucher specimens.

Table 2.11: Summary of proposed baseline data collection and monitoring for the Swartberg Complex World Heritage Site and Nature Reserves.

Sector	River(s)	Monitoring/Baseline	Species
Towerkop	Seweweekspoort	Population monitoring	<i>Pseudobarbus tenuis</i> <i>Galaxias zebratus</i>
	Dwars	Baseline survey to confirm species presence	<i>Galaxias zebratus</i>
Gamkaskloof	Oshoekshang	Baseline survey to confirm species presence	<i>Pseudobarbus asper</i> <i>Sandelia capensis</i>
Swartberg	Tributaries upstream of Calitzdorp Dam	Baseline survey to confirm species presence	<i>Galaxias zebratus</i>
	Upper Groot	Baseline survey to confirm species presence /population monitoring	<i>Pseudobarbus tenuis</i> <i>Pseudobarbus asper</i> <i>Sandelia capensis</i>
	Groot (Meiringspoort)	Population monitoring	<i>Pseudobarbus tenuis</i> <i>Pseudobarbus asper</i> <i>Enteromius anoplus</i>
	Nels	Population monitoring	<i>Pseudobarbus tenuis</i> <i>Pseudobarbus asper</i> <i>Enteromius anoplus</i> <i>Galaxias zebratus</i> <i>Sandelia capensis</i>
Kammanassie	Rooi	Population monitoring – pending outcome of taxonomic revision	<i>Pseudobarbus tenuis</i> <i>Sandelia capensis</i>
	Marnewicks	Population monitoring – pending outcome of taxonomic revision	<i>Pseudobarbus tenuis</i> <i>Sandelia capensis</i>
Rooiberg	Bos	Population monitoring – pending outcome of taxonomic revision	<i>Pseudobarbus tenuis</i> <i>Galaxias zebratus</i> <i>Sandelia capensis</i>
	Assegaaibos	Population monitoring – pending outcome of taxonomic revision	<i>Galaxias zebratus</i>
Groenefontein/ Paardeberg	Huis	Baseline survey to confirm species presence	<i>Sandelia capensis</i> <i>Enteromius anoplus?</i> <i>Pseudobarbus tenuis?</i> <i>Pseudobarbus asper?</i>

2.4.4 Reptiles

The SCWHS&NR has a good diversity of reptile species with at least 78 species recorded. The known list is quite comprehensive for the area.

There is one reptile species listed as threatened (Bates *et al.* 2014), namely the Karoo padloper (*Chersobius boulengeri*) which is listed as Endangered and occurs marginally within the area. The primary action required for this species is surveillance to ascertain where it occurs. Once we have a better understanding of the current status of this species, specific management actions may become necessary.

Another species of interest is the tented tortoise (*Psammobates tentorius*) from the Oudtshoorn-Uniondale area (Figure 2.19). Results from recent genetic studies confirmed that this tortoise differs considerably from populations in the western Klein Karoo and the Prince Albert area and is therefore unique, special and rather scarce in the area (M. Hofmeyr 2018, pers. comm.).



Figure 2.19: The genetically unique tented tortoise (*Psammobates tentorius*) recorded from the Oudtshoorn-Uniondale area. (Photo: Prof M Hofmeyr)

Two reptile species are endemic to the SCWHS&NR: the Swartberg gecko (*Ramigecko swartbergensis*) and the Swartberg dwarf chameleon (*Bradypodion atromontanum*). For both these species and all other reptile species in the SCWHS&NR ecologically sound management of the natural veld (see section 2.3.1.5 on fire regimes) should ensure persistence of the reptile diversity.

2.4.5 Avifauna

The Fynbos, Succulent Karoo and Subtropical Thicket biomes contain unique avifaunal elements. In terms of overall species richness, 221 species have been recorded within the SCWHS&NR (BIRP 2019; SABAP2 2019; unpublished CapeNature records). The largest habitat represented in the SCWHS&NR is Fynbos, occurring on the Swartberg, Towerkop, Kammanassie, Rooiberg and Gamkaberg sectors. The Succulent Karoo and Subtropical Thicket is the second largest bird habitat, found mostly on Groenefontein, Gamkapoort and the northern slopes of Swartberg East and Kammanassie sectors. In terms of wetland/riverine habitat there are numerous rivers and various types of wetlands scattered throughout the

SCWHS&NR. The Gamkapoort Dam, and the Gamka and Groot Rivers provide habitat for a range of water-dependent bird species (e.g. African Darter (*Anhinga rufa*) and Reed Cormorant (*Phalacrocorax africanus*)).

The large area of mountain Fynbos provides extensive habitat for the seven species of birds endemic to the Fynbos biome. Habitat preferences of these endemic species vary indicating the importance of maintaining a mosaic of different vegetation age and types within the protected area. Cape Sugarbird (*Promerops cafer*) and Orange-breasted Sunbird (*Anthobaphes violacea*) prefer mature mountain Fynbos (Siegfried & Crowe 1983), while Hottentot Buttonquail (*Turnix hottentottus*) generally occur in young Fynbos, with very little preference for recently burnt and senescent Fynbos (Lee *et al.* 2017). Cape Siskin (*Crithagra totta*) is associated with restio-dominated fynbos (Fraser 1997a), and the Cape Rock-jumper (*Chaetops frenatus*) occurs in high mountain areas with open rocky habitats (Cohen & Frauenknecht 2005). Victorin's Scrub-warbler (*Cryptillas victorini*) are found predominantly in mesic mountain Fynbos (Fraser 1997b), while the Protea Canary (*Crithagra leucopterus*) prefers open arid Fynbos with tall proteas (Milewski 1976).

Threats to the SCWHS&NR identified during the planning workshops include climate change, alien invasive fauna and flora, inappropriate fire regimes, development pressures and over-abstraction of surface and groundwater, habitat fragmentation and alteration, and overstocking and over-grazing. Some of the threats are specific to certain areas or habitats e.g. over-stocking and over-grazing in the Succulent Karoo habitats while others, e.g. climate change and alien invasive plants occur over almost the entire SCWHS&NR. The majority of the threats will have an impact on birds, but only those with a significant impact will be discussed.

Temperature and weather extremes due to climate change have or will have an impact on at least three of the endemic species, the Cape Rock-jumper, Protea Seedeater and Victorin's Warbler (Lee & Barnard 2015; Oswald *et al.* 2019). Declines in both Cape Rock-jumper and Protea Seedeater have occurred to such an extent that they have been listed as Near Threatened in the latest regional assessment (Taylor *et al.* 2015). The reporting rates within the protected area for these and the other fynbos endemic species, with the exception of the Hottentots Buttonquail, suggests that the populations are relatively healthy (SABAP2 2019). Within the SCWHS&NR Hottentot Buttonquail has only been recorded from the Gamkaberg Cluster (Lee *et al.* 2018). This is a cryptic and very difficult to observe species, and is only detected per chance or during flush surveys hence the low recording rates. Ryan and Hockey (1995) suggested that they can occur in higher numbers if suitable habitat is available, but the species is listed as Endangered because of low population numbers and fragmented distribution (Peacock 2015). Lee *et al.* (2018), however, recommended that it be listed as Vulnerable based on new data emanating from flush surveys carried out across the entire distribution range of the species. Despite the relatively healthy populations of endemics within the SCWHS&NR, Lee and Barnard (2015) looking at the difference in the range distribution between the first and second South African Bird Atlas Projects (SABAP), has detected a decline in six species. The Hottentot Buttonquail was excluded from this analysis due to taxonomical changes between the two projects. The largest range declines were for the Cape Rock-jumper and Protea Seedeater. While little can be done at reserve level to counter climate change, good

veld management and reduction of invasive alien vegetation will contribute significantly to the wellbeing of these specialist species.

Table 2.12 provides a list of threatened species that have been recorded within the SCWHS&NR. Those species marked with an asterisk are more common in the habitats (mostly agricultural) adjacent to the protected areas (such as Denham's Bustard (*Neotis denhami*), Ludwig's Bustard (*Neotis ludwigii*), Southern Black Korhaan (*Afrotis afra*), Blue Crane (*Anthropoides paradiseus*), Karoo Korhaan (*Eupodotis vigorsii*) or occur at relatively low numbers (such as Lanner Falcon (*Falco biarmicus*), African Marsh-harrier (*Circus ranivorus*), Black Stork (*Ciconia nigra*), Secretarybird (*Sagittarius serpentarius*)). As these species utilise the protected area sporadically management strategies implemented to improve avifaunal habitat or mitigate threats will not have a significant impact on the species as a whole. Other than the threatened endemic species, the other threatened species recorded fairly regularly within the SCWHS&NR are the Verreaux's Eagle (*Aquila verreauxii*), Black Harrier (*Circus maurus*), Martial Eagle (*Polemaetus bellicosus*), Ground Woodpecker (*Geocolaptes olivaceus*) and Sentinel Rock-thrush (*Monticola explorator*).

Table 2.12: Avifaunal species of conservation concern that occur within the Swartberg Complex World Heritage Site and Nature Reserves. (* species more common on areas adjacent to the protected area.)

Scientific Name	Common Name	2015 Red Data List of Birds of SA, Lesotho & Swaziland Regional status	IUCN Red List of Threatened Species 2016 Global status
<i>Circus maurus</i>	Black Harrier	Endangered	Endangered
<i>Turnix hottentottus</i>	Hottentot Buttonquail	Endangered	Endangered
<i>Neotis ludwigii</i>	Ludwig's Bustard *	Endangered	Endangered
<i>Polemaetus bellicosus</i>	Martial Eagle	Endangered	Vulnerable
<i>Circus ranivorus</i>	African Marsh-Harrier *	Endangered	Least Concern
<i>Sagittarius serpentarius</i>	Secretarybird *	Vulnerable	Vulnerable
<i>Afrotis afra</i>	Southern Black Korhaan	Vulnerable	Vulnerable
<i>Neotis denhami</i>	Denham's Bustard *	Vulnerable	Near Threatened
<i>Ciconia nigra</i>	Black Stork *	Vulnerable	Least Concern
<i>Falco biarmicus</i>	Lanner Falcon *	Vulnerable	Least Concern
<i>Aquila verreauxii</i>	Verreaux's Eagle	Vulnerable	Least Concern
<i>Anthropoides paradisea</i>	Blue Crane	Near Threatened	Vulnerable
<i>Chaetops frenatus</i>	Cape Rock-jumper	Near Threatened	Near Threatened
<i>Crithagra leucopterus</i>	Protea Seedeater	Near Threatened	Near Threatened
<i>Eupodotis vigorsii</i>	Karoo Korhaan *	Near Threatened	Least Concern
<i>Geocolaptes olivaceus</i>	Ground Woodpecker	Least Concern	Near Threatened
<i>Monticola explorator</i>	Sentinel Rock-thrush	Least Concern	Near Threatened

Black Harrier were found in nearly all the portions comprising the SCWHS&NR, with relatively high reporting rates from the Kammanassie and Groenefontein (SABAP2 2019; BIRP 2019). Based on the SABAP2 data the SCWHS&NR falls within the high

density area for the species and is therefore important for its conservation (Taylor 2015a).

Verreaux's Eagle are restricted to the mountainous habitat within the SCWHS&NR which is extensive. The species distribution indicates that it occurs across the entire protected area with relatively high reporting rates especially along the Swartberg and Kammanassie Mountains. This corresponds with the high density area mapped for the species in Taylor (2015b).

The Martial Eagle requires large areas in order to survive. Van Eeden (2016) estimated home range size of territorial eagles in the Kruger National Park area to be 108 km² and non-territorial birds to have home ranges in the vicinity of 44 000 km². Although widespread they can be described as a relatively uncommon species (Cloete 2013). Within the SCWHS&NR, SABAP2 and BIRP data show conflicting results with the former having higher reporting rates, but fewer areas whereas the latter suggests a wider distribution but lower reporting rates. Different methods used to collect the data is possibly the reason for this disparity. Density mapping of the species places the SCWHS&NR on the boundary of high and medium density areas for the species (Taylor 2015c) indicating that the protected area is still relatively important for the conservation of the species. It must, however, be noted that an analysis comparing SABAP1 and SABAP2 reporting rates shows that the species has declined within the grids covering the SCWHS&NR, although overall for the Fynbos biome the species population showed a non-significant increase (Cloete 2013). This species is also associated with the Karoo and habitats with tall trees for nesting or powerline infrastructure, and as a result they are being threatened by electrocution through powerlines and persecution by small stock farmers. Given its territory size it remains a species that is difficult to monitor in terms of population trends (Shaw & Waller 2017).

The Ground Woodpecker and the Sentinel Rock-thrush are both listed as Least Concern on a regional scale (Taylor *et al.* 2015) and Near Threatened on a Global Scale (IUCN 2019). Both species inhabit rocky areas and are found predominantly in mountainous areas. Ground Woodpecker are recorded throughout the SCWHS&NR at relatively high reporting rates. The core area for the Sentinel Rock-thrush is in the Lesotho highlands, but they are found scattered along the mountain ranges of the Western Cape. In the SCWHS&NR they were only recorded from three areas, two in the Swartberg and one in the Kammanassie, but the reporting rates were relatively high, indicating that they are localised but fairly common.

The coverage maps of SABAP2 indicate that the entire SCWHS&NR has been surveyed at least once except for the most eastern section of Swartberg East. However, the linear nature of the mountains and thus the protected area land parcels result in substantial portions of the survey areas (pentads) falling outside the reserve. It is possible that many of the surveys carried out in the areas took place on the easily accessible lower lying areas rather than the relatively difficult mountainous terrain of the protected areas. It is recommended that surveys be continued ensuring that entire pentads are surveyed.

Overall, the SCWHS&NR is extremely important for the protection of South Africa's most important birds (the endemics) as well as the endangered species (A. Lee 2019, pers. comm.).

2.4.6 Mammals

CapeNature focuses its monitoring efforts on endemic, threatened, keystone and alien invasive species, collectively termed “Priority Species”. According to the CapeNature SOB database a total of 82 indigenous mammal species have been recorded for the SCWHS&NR, based on specimen and observation records. Not all of the 82 species are considered “Priority Species” however the importance of them is not disregarded and distribution data is recorded for all indigenous species. It is worth noting that a number of additional species may be present but not recorded within the SCWHS&NR. This could be because they are difficult to observe (e.g. small mammals, especially those that are nocturnal or burrowers). Some of these play important ecological roles and provide valuable ecosystem services but are ignored because identification and monitoring requires specialized skills.

Species conservation statuses of the priority mammals occurring within the SCWHS&NR are summarised based on Child *et al.* (2016) and presented in Table 2.13. Some of the species are shown in Figure 2.20. Comprehensive species lists are available on request and are documented in the Western Cape State of Biodiversity Report (Birss 2017).

Table 2.13: Mammal species of conservation concern that occur within the Swartberg Complex World Heritage Site and Nature Reserves.

Species	Red List of Mammals of South Africa, Lesotho and Swaziland (2016)	Priority Actions	Focal Areas
Riverine rabbit (<i>Bonulagus moticularis</i>)	Critically Endangered	Collect distribution data Develop robust population monitoring methods	SCWHS&NR
Long-tailed forest shrew (<i>Myosorex longicaudatus</i>)	Endangered	Collect distribution data	SCWHS&NR
Southern mountain reedbuck (<i>Redunca fulvorufula fulvorufula</i>)	Endangered	Collect and maintain distribution and population data; Maintain game registers on nature reserves	SCWHS&NR
African clawless otter (<i>Aonyx capensis</i>)	Near Threatened	Collect distribution data Collect biological samples Facilitate research	SCWHS&NR
Spectacled dormouse (<i>Graphiurus ocularis</i>)	Near Threatened	Collect distribution data	SCWHS&NR
Brown hyaena (<i>Parahyaena brunnea</i>)	Near Threatened	Collect distribution data	SCWHS&NR
Grey rhebok (<i>Pelea capreolus</i>)	Near Threatened	Collect and maintain distribution and population data; Maintain game registers on nature reserves	SCWHS&NR

Species	Red List of Mammals of South Africa, Lesotho and Swaziland (2016)	Priority Actions	Focal Areas
African striped weasel (<i>Poecilogale albinucha</i>)	Near Threatened	Collect distribution data.	SCWHS&NR
Cape marsh rat (<i>Dasymys capensis</i>)	Vulnerable	Collect distribution data.	SCWHS&NR
Black-footed cat (<i>Felis nigripes</i>)	Vulnerable	Collect distribution data Population monitoring	Swartberg Cluster
White-tailed mouse (<i>Mystromys albicaudatus</i>)	Vulnerable	Collect distribution data.	Kammanassie Cluster
Leopard (<i>Panthera pardus</i>)	Vulnerable	Collect distribution data Facilitate research	SCWHS&NR
Cape mountain zebra (<i>Equus zebra zebra</i>)	Least Concern	Collect distribution data Population monitoring Collect biological samples	Gamkaberg Cluster Kammanassie Cluster
Honey badger (<i>Mellivora capensis</i>)	Least Concern	Collect distribution data	SCWHS&NR
Klipspringer (<i>Oreotragus oreotragus</i>)	Least Concern	Collect and maintain distribution and population data; Maintain game registers on nature reserves	SCWHS&NR
Chacma baboon (<i>Papio ursinus ursinus</i>)	Least Concern	Monitor repeat offenders in human-wildlife conflict situations; Maintain baboon raiding register	SCWHS&NR Gamkaskloof ('Die Hel') Groenefontein
Aardwolf (<i>Proteles cristata</i>)	Least Concern	Collect distribution data	SCWHS&NR
Steenbuck (<i>Raphicercus campestris</i>)	Least Concern	Collect and maintain distribution and population data; Maintain game registers on nature reserves	SCWHS&NR
Cape grysbok (<i>Raphicercus melanotis</i>)	Least Concern	Collect and maintain distribution and population data; Maintain game registers on nature reserves	SCWHS&NR
Common duiker (<i>Sylvicapra grimmia</i>)	Least Concern	Collect and maintain distribution and population data; Maintain game	SCWHS&NR

Species	Red List of Mammals of South Africa, Lesotho and Swaziland (2016)	Priority Actions	Focal Areas
		registers on nature reserves	
Greater kudu (<i>Tragelaphus strepsiceros</i>)	Least Concern	Collect and maintain distribution and population data; Maintain game registers on nature reserves	SCWHS&NR
Bushbuck (<i>Tragelaphus sylvaticus</i>)	Least Concern	Collect and maintain distribution and population data; Maintain game registers on nature reserves	SCWHS&NR
Black-backed jackal (<i>Canis mesomelas</i>)	Least Concern	Collect distribution data	SCWHS&NR
Caracal (<i>Caracal caracal</i>)	Least Concern	Collect distribution data	SCWHS&NR

More information about the threatened species listed in Table 2.13 is given in the Western Cape State of Biodiversity Report (Birss 2017) and is summarised below. Justification for the inclusion of species that are currently not threatened (i.e. listed as 'Near Threatened' or 'Least Concern') is also presented.

Critically Endangered

The riverine rabbit (*Bonulagus monticularis*) is near endemic to the Western Cape Province and classified as Critically Endangered. Confirmed records of the species north of Meiringspoort within the ZOI of the SCWHS&NR have been documented by Collins and Du Toit (2016). In addition, it has recently been recorded by camera trapping in the Hartebeestrivier area in close proximity to Uniondale. It is possible that they may occur elsewhere within the ZOI. Hence it is important to document any further records of the species.

Endangered

Southern mountain reedbuck (*Redunca fulvorufula fulvorufula*) is listed globally and regionally as Endangered. This subspecies occurs widely throughout South Africa but only marginally in the Western Cape Province. Their patchy and discontinuous distribution indicates that they have specialised habitat requirements (Taylor *et al.* 2016a). Main threats to mountain reedbuck are human settlement expansion which in turn increases the rates of poaching and hunting by dogs. Droughts also have an impact on them as it forces them to move away from suitable habitat in search of suitable food and water resources (Taylor *et al.* 2016a).

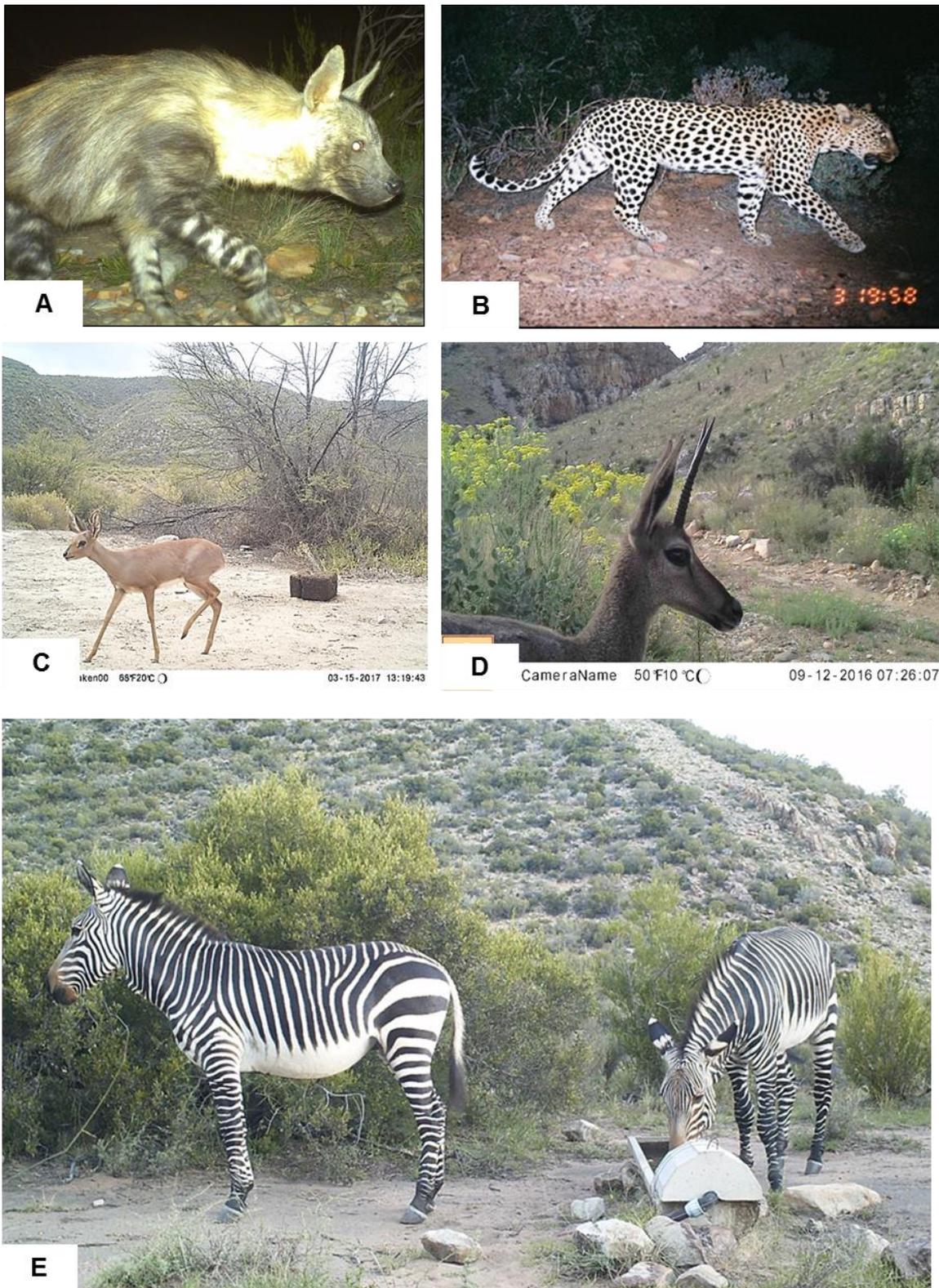


Figure 2.20: Mammal species of conservation concern recorded from the Swartberg World Heritage Site and Nature Reserves. A: Brown hyaena (*Parahyaena brunnea*); B: leopard (*Panthera pardus*); C: steenbuck (*Raphicerus campestris*); D: grey rhebok (*Pelea capreolus*); E: Cape mountain zebra (*Equus zebra zebra*). (Photos: CapeNature)

During the 1980s attempts were made to introduce reedbeek to the Groot Swartberg and Kammanassie, but these efforts were unsuccessful (J. Vlok 2019, pers. comm.). Mountain reedbeek have been observed on the Rooiberg and Gamkaberg in 2015 and 2018, but these observations need to be confirmed. According to species records in the Western Cape Game Database (2018), the majority of subpopulations occur on privately owned game farms in the Klein Karoo. The current population size of southern mountain reedbeek within the SCWHS&NR and ZOI is not presently known and requires intensive reporting efforts by CapeNature staff in future. Neighbouring landowners should also be made aware of the status of this species, and encouraged to submit observations to CapeNature.

Vulnerable

Leopard (*Panthera pardus*) is listed as Vulnerable (Swanepoel *et al.* 2016). Their decline in South Africa is mainly due to the skin trade in KwaZulu-Natal (traditional churches) and trophy hunting in Limpopo Province where they are easier to target due to their marginal ranges. In the Klein Karoo, skin trade, trophy hunting and wildlife conflict are significantly reduced as leopard occupy larger home ranges mainly in rugged terrain of the Cape fold mountains, where they are more difficult to target (G. Mann 2017, pers. comm.).

Studies by the Cape Leopard Trust using camera traps in 2011-2012 showed that there was a healthy population of leopard in the Gamkaberg (Mann 2014). At least 40 individual leopards were recorded within Gamkaberg. A follow-up survey was conducted in June 2017 using fewer camera trap stations set over fewer days in a smaller area. The data were compared to Mann's 2011-2012 data, which covered a larger area using three times more camera stations and longer trap days. The 2017 survey results suggested an increase in the density of leopard from 0.6 (± 0.1) leopards/100km² to 1.1 (± 0.2) leopards/100km².

In the western section of the Kammanassie, leopard have been frequently photographed by camera trap stations specifically set up to record Cape mountain zebra information. Photographic records of leopard cubs confirm breeding success (P. Meyer 2019, pers. comm.). Collared leopard in the Swartberg by the Landmark Foundation in 2013 showed that a male leopard's home range constituted approximately 65 000 hectares (McManus 2013). Collection of distribution data for leopard should continue (Birss 2017).

Black-footed cat (*Felis nigripes*), one of the world's smallest cats is listed as Vulnerable (Sliwa *et al.* 2016). Although they have a wide and patchy distribution range in arid regions they have not yet been recorded within the SCWHS&NR and ZOI. However, these cats lead a solitary existence and are rare and secretive animals. It is possible that they may occur within the ZOI and any distribution data should be collected

Cape marsh rat (*Dasymys capensis*), also referred to as the African marsh rat, is listed as Vulnerable and is endemic to the Western Cape Province. It has not been assessed globally. The Cape marsh rat has been recorded in very few localities in the Western Cape occurring from Wolseley to Knysna. In Gamkaberg they have been listed as one of several potential prey items for leopard and specimens have been recorded in CapeNature's SOB database. Cape marsh rats are dependent on intact rivers and wetland ecosystems. Their current population is declining due to habitat loss and

degradation. According to Pillay *et al.* (2016) the Cape marsh rat is indicative of healthy and intact wetland systems. Distribution data for this species must thus be prioritised.

White-tailed rat (*Mystromys albicaudatus*) is listed as Vulnerable (Avenant *et al.* 2019). They are rare, with low population densities and a patchy distribution. This species is a Highveld grassland specialist, with a marginal distribution into the Klein Karoo and Fynbos biome. Very little is known about this species in the wild, however, they have been recorded as a forage species for owls (Pillay *et al.* 2016). Better data is required in order to understand its distribution within the SCWHS&NR.

Near Threatened

African clawless otter (*Aonyx capensis*) and brown hyaena (*Parahyaena brunnea*) are of conservation concern in that they are indicative of ecosystem functioning outside of formally protected areas (Bussière & Underhill 2016). Both species were once widely distributed throughout the Western Cape Province. The main threat to the African clawless otter is the declining state of freshwater ecosystems in Africa. Otter habitat has been either drastically changed or lost, following bush clearing, deforestation, over-grazing, and siltation, draining of wetlands or water extraction or denudation of riparian vegetation (Jacques *et al.* 2015). Proposed management actions should include the collection of distribution data and biological samples and facilitation of research in the SCWHS&NR and ZOI.

Brown hyaena have been recorded on Gamkaberg. Outside of protected areas, brown hyaena are viewed as a threat to domestic livestock. They suffer from continued persecution and are often shot, poisoned, trapped and hunted with dogs in eradication control programmes or unintentionally killed in non-selective control programs (Jacques *et al.* 2015), thus resulting in low numbers and very limited distribution. Management actions are monitoring and increased public awareness.

The African striped weasel (*Poecilogale albinucha*) is a secretive species that occurs at naturally low densities (Child *et al.* 2016). It is threatened by habitat loss and collection for the traditional medicinal trade. It is a priority species and the collection of further distribution data to determine trends in the extent of its range is required.

Grey rhebok (*Pelea capreolus*), a South African endemic, has been listed as Near Threatened because of declining subpopulations (Taylor *et al.* 2016b). The reasons for the decline are poorly understood. It has been suggested that it is due to increased illegal hunting and predation pressure. There is thus a need to develop a robust population monitoring method and implement the collection of data accordingly.

Threats to the rare spectacled dormouse (*Graphiurus ocellaris*) are habitat loss through agricultural expansion and climate change (Wilson *et al.* 2016). The species has mostly been recorded in protected areas and occurs in all three clusters, but better information on its distribution is needed.

Least Concern

Cape mountain zebra (*Equus zebra zebra*) is considered to be globally and regionally (Hrabar *et al.* 2016) of Least Concern, but is classified as Endangered in the Nature and Environmental Conservation Ordinance, 1974 (Ordinance 19 of 1974).

Cape mountain zebra were distributed throughout mountainous terrain from the Roggeveld and Cedarberg ranges in the Western Cape to the Amatolas in the Eastern Cape. By the 1950s, there were less than 80 individuals left as a result of hunting, habitat destruction, habitat fragmentation, and competition by livestock for grazing (Hrabar *et al.* 2016). The subspecies persisted in three genetically distinct lineages: Cradock (Mountain Zebra National Park), Kammanassie (Kammanassie WHS) and Gamkaberg (Gamkaberg WHS) (Moodley 2002; Moodley & Harley 2005; Smith *et al.* 2008).

Due to public and private conservation efforts, the population recovered steadily over the years. By 2016, there were about 5000 individuals in 75 locations (Hrabar *et al.* 2019). However, metapopulation management is required to ensure that the subspecies is kept off the red list. The first step towards this was the compilation of a Biodiversity Management Plan for Species (BMP-s) (Birss *et al.* 2016). The plan focusses on actions and strategies to strengthen overall population performance, distribution and genetic diversity to ensure overall population fitness and resilience of the metapopulation within the natural distribution range. The reintroduction or relocation of Cape mountain zebras is an essential component of the BMP-s.

The Gamkaberg subpopulation has grown from five founders to about 30 individuals, and the Kammanassie subpopulation from five to 65-70 individuals. Because of the population bottleneck that these subpopulations experienced, inbreeding and genetic drift are concerns (Moodley 2002). Despite this, it has been advised that the unique Gamkaberg and Kammanassie lineages be kept pure since they might be the result of natural evolutionary processes rather than human-induced habitat fragmentation. However, it is recommended that subpopulations outside these reserves should be genetically bolstered. An attempt to mix lineages by bolstering an existing subpopulation outside these reserves was made in 1971, when Kammanassie zebras were introduced to the Cradock lineage zebras at De Hoop Nature Reserve. In 2016, 28 De Hoop zebras were translocated to Sanbona Wildlife Reserve to join the Cradock zebras that were already there. In 2019, the potential for mixing of all three lineages was created for the first time, when an escaped lone Gamkaberg stallion was relocated to Sanbona. However, there is a risk that this stallion might never be able to compete with the Sanbona stallions for mating opportunities. Recent evidence suggests that genetic variability in some subpopulations, including De Hoop and Kammanassie, is lower than ever before (Kotze *et al.* 2019). In order to optimally utilise the unique Kammanassie and Gamkaberg alleles, it is now believed that instead of bolstering existing subpopulations with individuals of these lineages, new subpopulations with optimal conditions to encourage genetic mixing should be created, *e.g.* by introducing Kammanassie males together with Gamkaberg females on a new site with prime Cape mountain zebra habitat (M. de Villiers 2019, pers. comm.).

In Kammanassie, a threat to Cape mountain zebra is inappropriate placement and types of fencing, which prevent natural movement of zebras. This leads to isolation (sometimes in suboptimal habitat) of some individuals in private mountain catchment area from the main subpopulation in the Kammanassie. A 2018 aerial census indicated that most Cape mountain zebras were located in areas outside Kammanassie (Bass Air 2018). There is also a risk of hybridisation with Burchell's zebra (*Equus quagga*) on properties adjacent to the Kammanassie. Water abstraction outside the reserve

has resulted in the drying up of a number of natural springs inside, so that the Kammanassie zebras are now reliant on artificial watering points for survival.

In the Gamkaberg sector a major threat is the lack of suitable zebra habitat. The sector comprises mainly upland fynbos, which has limited suitability for the seasonal migrations that the zebras must make. Progress has been made in increasing the habitat for the zebra into the lowland areas, by acquiring additional habitat (e.g. Fontein and Heimersrivier) adjacent to the protected area. This, however, remains a priority action that needs to be addressed. Water provision is also a key factor for Cape mountain zebra as they need to drink daily. There are two borehole-fed water points on Fontein and two more artificial watering points (supplied by guzzlers) on Gamkaberg in addition to the natural springs within the sector. On Gamkaberg, an excess of males may upset herd dynamics and the associated stress could affect breeding success (Lea *et al.* 2016, 2017).

On protected areas, monthly zebra counts provide information on subpopulation sizes. These and other sightings are recorded in the SOB and Game on Reserves databases. Camera trap and other photographic records feed into the reserves' Cape mountain zebra identikit. In 2018, an aerial game census was conducted on the Kammanassie and Gamkaberg (BassAir 2018). It is important that these censuses are repeated on a regular basis, but this is funding-dependent. The use of drone technology to replace helicopter census has been investigated and found not to be feasible at this stage. Important information on movements, habitat selection and herd dynamics could potentially be obtained by the use of tracking devices such as VHF or satellite collars.

Small antelope species, such as Cape grysbok (*Raphicerus melanotis*), klipspringer (*Oreotragus oreotragus*), steenbuck (*Raphicerus campestris*), common duiker (*Sylvicapra grimmia*), bushbuck (*Tragelaphus sylvaticus*) and grey rhebok (*Pelea capreolus*) occur naturally in the landscape and generally exhibit unimpeded dispersal. These small antelope species are ecotypical, i.e. they have discrete populations below the level of subspecies which can be recognized on genetic, phenotypic or zoogeographic grounds (CapeNature 2011). Main threats to these species are hunting, bush meat and snaring. They are important indicators of the overall ecological state of the SCWHS&NR. Management actions for these species are the collection of distribution and population data.

Greater kudu (*Tragelaphus strepsiceros*) are well represented throughout the protected area and ZOI and listed as Least Concern. They are browsers and can exist for long periods without drinking by obtaining sufficient moisture from their food. The main threats to kudu are illegal trophy hunting and the bush meat trade. Other threats include competition for the same resources by livestock and game farming.

Honey badger (*Mellivora capensis*) is listed as Least Concern because of its wide distribution range. Honey badgers are considered rare or exist at low densities across most of their range. They are opportunistic, generalist carnivores and feed on a range of prey items varying from insect larvae to young ungulates. The main threats to honey badgers are hunting for their body parts (paws, skin, fat and organs) that are commonly used in traditional medicine and direct persecution by means of gin traps and poison by apiculturists and livestock farmers (Do Linh San *et al.* 2016). Distribution data is required for this species.

Aardwolf (*Proteles cristata*) is also listed as Least Concern as it is reasonably widespread and present in numerous protected areas (Green 2015; De Vries *et al.* 2016). The aardwolf just like the honey badger has also fallen victim to unethical trapping as it has been mistakenly identified as a predator to livestock, chicken and eggs. This species feeds primarily on nasute harvester termites (genus *Trinervitermes*) and poses no threat to domestic livestock. Management priorities are the collection of distribution data and awareness raising in the ZOI.

2.4.7 Game and domestic animals

Eight components of the SCWHS&NR maintain registers for monitoring population trends of game and domestic species. Although population trend data are not yet available, the registers adequately reflect the presence of the listed species (Table 2.14).

Domestic animals that roam onto the SCWHS&NR from neighbouring properties must be addressed through the Reserve Management Committee and the local municipal authority must be engaged to address the problem through the draft National Animal Pounds Bill.

Table 2.14: Game and domestic species that have been recorded in the sectors of the Swartberg Complex World Heritage Site and Nature Reserves. (X: species recorded as present with total number(s) not being known.)

Species	Gamkaberg	Groenefontein, Kwessie & Triangle	Vaalhoek	Paardenberg	Rooilifantskloof	Rooiberg	Kammanassie	Towerkop	Swartberg Cluster (including Groot Swartberg, Gamkapoort, Gamkaskloof & Swartberg East)
Game species									
Cape mountain zebra	42						70		
Southern mountain reedbuck	X					X		X	X
Red hartebeest	14								
Bushpig		15		X			13		X
Eland	70	50		5	40				
Springbuck									X
Cape grysbok	8	10	X	X	2	X	2		
Common duiker	20	30	X	X	15	X	20	2	2
Greater kudu	12	30	13		10		80		32
Grey rhebok	20	20	X	X	12	X	23	16	16
Klipspringer	30	50	4	X	30	X	60	16	16
Southern bushbuck						X			

Species	Gamkaberg	Groenefontein, Kwessie & Triangle	Vaalhoek	Paardenberg	Rooilofantskloof	Rooiberg	Kammanassie	Towerkop	Swartberg Cluster (including Groot Swartberg, Garkapoort, Garkaskloof & Swartberg East)
Steenbuck	5	20	X	X	10	X	15	X	X
Domestic species									
Cattle			X				X		X
Donkey		X			10				X
Sheep									X
Goats			X		100				
Ostrich		X							X

Game farming within the ZOI is becoming increasingly popular and erecting 2.4 m game and predator proof fences is becoming a threat to ecotypical game species and their dispersing offspring. These impermeable barriers prevent the movement of other natural occurring wildlife species in search of suitable habitat and water. A total of 26 private game farms are situated within the ZOI with 12 of these game farms adjoining the protected areas (Table 2.15; Appendix 2 Map 11).

Table 2.15: Introduced game species adjoining the Swartberg Complex World Heritage Site and Nature Reserves as recorded in the Western Cape Game Database (2019). (Extra-limital species are marked with ‘*’)

Game Farm Name	Adjoining protected area	Species												
		Nyala*	Impala*	Black wildebeest*	Blue wildebeest*	Red lechwe*	Giraffe*	Gemsbuck*	Waterbuck*	Cape mountain zebra	Burchells zebra	Sable antelope*	Roan Antelope*	Blesbuck*
Oudekloof	Rooiberg	X	X	X	X		X	X			X			
Assegaaibosch Private Game Reserve	Rooiberg	X	X				X		X		X	X		
Oudehoutkloof	Swartberg										X	X	X	
Gamkaberg Eco estates	Swartberg						X							
Weltevrede	Swartberg						X				X			
Swartberg Private Wildlife Estate	Swartberg	X	X		X	X	X	X	X	X				X

Game Farm Name	Adjoining protected area	Nyala*	Impala*	Black wildebeest*	Blue wildebeest*	Red lechwe*	Giraffe*	Gemsbuck*	Waterbuck*	Cape mountain zebra	Burchells zebra	Sable antelope*	Roan Antelope*	Blesbuck*
Buffelsvalley 18	Swartberg			X			X		X		X			
Snyberg	Swartberg		X	X				X		X				X
Kammanassie Blue	Kammanassie						X	X			X			

Extra-limital species, such as impala (*Aepyceros melampus melampus*), nyala (*Tragelaphus angasii*), black wildebeest (*Connochaetes gnou*), blue wildebeest (*Connochaetes taurinus taurinus*), red lechwe (*Kobus leche leche*), giraffe, waterbuck, sable antelope, roan antelope, blesbuck and gemsbuck have been introduced to a number of game farms falling within the ZOI.

Impala and nyala are species that have invasive potential and the impacts of their introduction to various game farms in the ZOI need to be monitored. Studies on the impacts of impala on Subtropical Thicket vegetation have found that they have a significant negative effect on the thicket vegetation as a result of browsing and trampling (Gerber 2006). These impacts lead to loss of vegetation and top soil over time. A study in the Eastern Cape suggested that there is significant overlap in resource use by impala and kudu in winter, although this overlap does not necessarily represent competition (Koekemoer 2001).

Based on an opinion survey of landowners and reserve managers in KwaZulu-Natal, it appears that there may be competition between nyala and bushbuck (*Tragelaphus sylvaticus*) (Coates & Downs 2005). Nyala are selective feeders that browse at the bottom. Their preferred diet includes species that are also targeted by eland and kudu, hence nyala would compete with these indigenous species for their habitat (Pienaar 2013). During the current drought there has been very high mortalities of kudu recorded. One of the farms has reportedly lost over 150 kudu (T. van der Westhuizen 2019, pers. comm.) and this is on a farm where both impala and nyala have been introduced.

Historically CapeNature allowed the introduction of impala and nyala into a variety of habitats in the Western Cape. Now, because of potential negative impacts of these extra-limital species, CapeNature recommends that applications to introduce these species must be accompanied by a risk assessment, and that monitoring data on impacts following introductions must be submitted.

Giraffe (*Giraffa camelopardalis*) are becoming increasingly popular to introduce to the Klein Karoo region for ecotourism purposes. A recent study by Marais (2019) showed that browsing increases the levels of poisonous tannins in *Vachellia karroo*, and a combination of browsing and reduced water decreases nitrogen content and

palatability. Giraffe are better able to tolerate tannins than other game, thus browsing by giraffes in the Karoo may negatively affect other species. During drought periods, introduced giraffe may also be at risk of poisoning through the ingestion of other toxic plant species (Marais 2019).

All large game species in the ZOI will be dealt with according to the following principles:

- All game farms that adjoin the SCWHS&NR that have extra-limital or alien animals, must be adequately enclosed to the standards as stipulated in the CapeNature fencing policy. Reserve personnel must conduct regular inspections on the reserve side of the fence and report escapees to the owner immediately.
- If the owner is in possession of a Certificate of Adequate Enclosure, they must be given reasonable time to remove the animals as soon as possible. Game animals escaping from properties without a valid Certificate of Adequate Enclosure or without legal documentation proving ownership of such game are *res nullius* and must be dealt with accordingly. Conservation managers must stipulate and regulate the actions to remove the animals.
 - In cases where *res nullius* game animals enter the protected areas, the Conservation Manager must report this immediately and a decision must be taken to either have the animals removed or culled, or allow them to remain on the protected area.
 - Conservation Managers that wish to remove surplus animals, must follow protocol which includes approval at landscape level (i.e. ecological meetings) and approval at corporate level.
 - Alien game species that have been located in the Swartberg, Gamkaberg or Kammanassie Clusters must be removed immediately.
 - If game species that belongs to CapeNature escape from a protected area, Conservation Managers must inform surrounding landowners and take steps as soon as possible to return the animals to the protected area.

2.4.7.1 Veld sensitivity for game and domestic animals

Groenefontein, Kwessie, Triangle, Vaalhoek, Gamkapoort and parts of Fontein have large areas that are in the process of recovery from historic over-grazing. After purchase, all domestic stock were removed from the respective properties and the veld was allowed to rest. Monitoring implemented on Groenefontein in the early 2000s using the invaders, *Atriplex lindleyi* subsp. *inflata* and *Augea capensis* as indicator species, showed that natural recovery is possible, but is very slow and highly dependent on successive good rainfall years (see section 2.3.1.4). Unpalatable species are slowly being replaced by palatable species. However, it is critical that these areas must be allowed to recover naturally and without the added pressure of large game or domestic stock.

The sensitivity of the vegetation units for grazing based on the species targeted and their availability has been incorporated into the sensitivity analysis (Tables 5.5 & 5.6; Appendix 2 Map 12(a-d)). Particularly the renosterveld, apronveld and gannaveld and the river and floodplain habitat types are highly to very highly targeted and thus sensitive to the impacts of grazing, and therefore need to be carefully monitored. As indicated in Table 2.14 above, large antelope species do occur in certain sectors, and

on Rooilifantskloof there is a MOA with the Zoar community to utilise a specific section of the reserve for traditional grazing (see section 7.6).

Therefore it is recommended that:

- The impact of the animals on the veld, including their food resource must be monitored.
- Collect information about where the animals spend most of their time foraging and keep accurate records of numbers of animals.
- Photo-monitoring sites must be established in areas around water points.
- Monitoring of numbers, age, sex, mortalities and natalities of species must be carried out and reported in the SOB population database.
- Aerial counts need to be carried out according to set protocol every two years.
- Decisions regarding harvesting/removal of game species, such as springbok, kudu and eland must be based on ecological considerations.
- Methods of capturing or removal of game to control numbers of species must be informed by ecological, practical and ethical consideration.
- Actions need to be identified to remove individual ostriches and other domestic animals that have been recorded within the relevant sectors.

2.4.7.2 Damage causing wildlife

Black-backed jackal (*Canis mesomelas*), caracal (*Caracal caracal*) and chacma baboons (*Papio ursinus ursinus*) are not known to be threatened with extinction at an international or regional (national) scale, but their importance in the maintenance of ecosystem functioning and exhibition of local variation and adaptation, coupled with their proneness for human-wildlife conflict, warrant their consideration for conservation concern. (See section 3.5.5.)

2.5 Heritage Context

Section 5 of the National Heritage Resources Act (NHRA), 1999 (Act No. 25 of 1999) outlines general principles for heritage resources management while Section 9 of the Act outlines responsibilities of the state and supported bodies.

2.5.1 Palaeontological and Geological Heritage

The vast, topographically-varied SCWHS&NR is a conservation area of outstanding geo-heritage as well as palaeontological interest in the context of the geological history of southern Gondwana as well as its rapidly evolving aquatic and terrestrial wildlife. Although numerous fossil sites and informative rock exposures are known from the Klein Karoo, the Swartberg Range as well as the southern Karoo areas immediately to the north, much of the region is seriously under-recorded in palaeontological terms. A comprehensive review of the geoheritage and palaeontological riches of the entire SCWHS&NR is needed for effective heritage management, conservation, education, research and ecotourism purposes. Such a study has already been completed for the Gamkaberg Cluster (Almond 2005). It is recommended that comparable palaeontological and geological heritage reviews of the Swartberg and Kammanassie Clusters be undertaken in the near future.

Swartberg Cluster. The northern (Great Karoo) sector of the Swartberg Cluster spans the contact between the Cape Fold Belt and the Main Karoo Basin of South Africa. It is underlain by between 30 and 40 different sedimentary formations. Most of these rock units are of Palaeozoic age (c. 480 to 260 Ma = million years old) and contain fossils of some sort, some of which are exceptionally well-preserved. Notable fossil occurrences in the region include: (1) Devonian marine invertebrates in the Bokkeveld Group, (2) Early Carboniferous fish and giant water scorpions in the Witteberg Group, (3) glacially-reworked fossil sponges in the Late Carboniferous- Early Permian Dwyka Group, (4) aquatic mesosaurid reptiles, primitive bony fish and petrified wood in the Early to Middle Permian Ecca Group *plus* (4) rhino-sized herbivorous therapsids (“mammal-like reptiles”) and true reptiles in the Middle Permian Lower Beaufort Group. The last mentioned ancient Karoo megafauna preceded the first known dinosaurs by some 60 million years; true dinosaurs are *not* recorded in this area.

The southern (Klein Karoo) sector of the Swartberg Cluster shares many of the geological units seen to the north, but spans an even greater time range. Tantalizingly rare fossils of “ediacarans” - puzzling soft-bodied organisms from the dawn of multicellular animal life in latest Precambrian period (c. 550-600 Ma) - as well as age-diagnostic microfossils have been found in the Cango Group near Oudtshoorn. Late Devonian fish remains, vascular plants and shelly invertebrates are recorded from the Witteberg Group near Ladismith and further to the northwest. Late Jurassic to Early Cretaceous continental sediments were laid down during the early stages of Gondwana break-up by major new rivers and in lakes in the Oudtshoorn Basin. These distinctive “red beds” crop out from Calitzdorp in the west to beyond De Rust in the east. They contain significant skeletal remains of early herbivorous and carnivorous dinosaurs; further finds of vertebrate fossils can be expected here in future. The Calitzdorp area is also known for its rich record of subterranean calcretised termitaria (termite nests) preserved within ancient (probably Pleistocene) alluvium near the confluence of the Gamka and Olifants Rivers (Almond 2005).

Gamkaberg Cluster. Essentially an elongate “island” of rugged TMG rocks surrounded by a “sea” of younger sediments, the Gamkaberg Cluster is representative of several other TMG mega-anticlines embedded within the Klein Karoo region. Highlights of its geology and fossils have been documented by Almond (2005). Palaeontological sites recorded here include (1) the best-known shelly fossil assemblages from the top of the TMG succession (c. 410 Ma), (2) rich shallow marine shelly faunas - including trilobites, brachiopods, molluscs and crinoids (sea lilies) - from the Lower Bokkeveld Group (c. 400 Ma) along both northern and southern margins of the TMG massif (Groenefontein and Vanwyksdorp areas), and (3) fossil termitaria of probable Pleistocene age (<2.5 Ma). Excellent, but largely unstudied, exposures of Uitenhage Group fluvial sediments along the northern flanks of the Gamkaberg contain fossil plant remains, including charcoal from Cretaceous wildfires. They can be expected to yield other Mesozoic fossils once they are thoroughly explored.

Kammanassie Cluster. The Kammanassie compares broadly with the Gamkaberg – Rooiberg range in geological terms but is largely *terra incognita* as far as palaeontology is concerned. Few fossil sites have been recorded here so far, but, given the varied geological make-up of the area, there is a tantalizing possibility of exciting new finds. Anticipated fossil assemblages include Early Devonian marine

invertebrate faunas within the Lower Bokkeveld Group rocks along the southern margins of the central massif as well as Middle Devonian marginal marine to estuarine fish-plant assemblages within the Upper Bokkeveld Group cropping out between Uniondale and Willowmore. Striking exposures of continental “red beds” (Uitenhage Group) seen along the Olifants River Valley north of the Kammanassie have the potential for Late Jurassic or Early Cretaceous dinosaur remains. Numerous well-developed silcrete pediments (silicified superficial deposits) on the flanks of the Kammanassie range could well contain moulds of wetland plants, as seen elsewhere in the Western Cape.

2.5.2 Cultural heritage

According to Rust (2008), the occurrence of numerous Khoisan rock art sites in the mountains of the Klein Karoo suggests that the SCWHS&NR exhibits an important part of national heritage worthy of conservation effort. Throughout the SCWHS&NR, the number of unrecorded sites is uncertain due to the rugged and inaccessible nature of the terrain. Rock art in general is in danger of disappearing due to the degree of natural weathering, water seepage, fire, damage by stock using sites for shelter and the most immediate threat, that of people. Where public have unsupervised access, paintings or engravings are often damaged due to disrespect and a lack of knowledge of their meaning and value. It is essential that all known sites within the SCWHS&NR are managed for preservation for future generations to understand the significance of their cultural heritage. Special mention must be made of the Gamkaskloof settlement or “Die Hel”, which lies in a secluded valley within the Swartberg Mountain Range that is jointly managed by CapeNature and private landowners (Marincowitz 1993). Numerous books, studies and reports have been drawn up through the years about this historical settlement and therefore needs to be consolidated into a Cultural Heritage Management plan.

In addition, there are a number of historical buildings, grave sites, cairns (Rooiberg pass) and structures such as ancient water furrows in the SCWHS&NR, particularly in Groenefontein, Vaalhoek and in Gamkaskloof. Little work has however been done with regard to the location, purpose and status of these historical features and this should be earmarked as a future research project.

Numerous passes and poorts located in the SCWHS&NR have been documented in various books and articles. Seweweekspoort, Swartberg pass, Rooiberg pass, Bosluiskloof, Huisrivier pass, Caledonskloof, Buffelspoort, Gamkapoort, Meiringspoort and Toorwaterpoort also deserve special mention as these were all used by early travellers including the Khoi and San before the 1800s.

In addition, the Cango Caves and Boplaas Caves are located within the ZOI adjacent to the Groot Swartberg. The Cango Caves are world-renowned and a National Monument.

2.5.3 Living heritage

An ethnobotanical study for the Klein Karoo was undertaken by Hulley (2018) to determine the traditional uses of medicinal plants revealing that an enormous wealth of traditional knowledge exists amongst local inhabitants of the Klein Karoo which had never been officially documented. Formal interviews were carried out with many local people from nine towns situated within the ZOI of the SCWHS&NR to gain an

understanding of the main uses of the Klein Karoo's plants. Subsequently a total of 287 medicinal, 772 grazing, 119 edible and 45 craft species have now been formally documented thus clarifying any uncertainties found in previous species checklists and allowing for many theoretical and practical uses. The results emanating from this study contributes significantly to the cultural heritage of South Africa (Hulley 2018).

2.6 Socio-Economic Context

In terms of the Municipal Systems Act, 2000 (Act No. 32 of 2000), municipalities are required to use integrated development planning to plot future development in their mandated management areas. The municipal Integrated Development Plan (IDP) sets the strategic and budget priorities for development and aims to co-ordinate the work of local and other spheres of government. The IDP should also address how the environment will be managed and protected, and is supplemented by a Spatial Development Framework (SDF).

IDPs and SDFs are tools for integrating social, economic, and environmental issues. As biodiversity is a fundamental component of sustainable development, IDPs and SDFs offer an opportunity to ensure that biodiversity priorities are incorporated into municipal planning processes through consultation. In turn, the identification of biodiversity-related projects for the IDP can support local economic development and poverty alleviation. Municipalities within which the SCWHS&NR occur are indicated in Appendix 2 Map 1.

The SCWHS&NR spans across two District Municipalities namely the Central Karoo District Municipality to the north and the Garden Route District Municipality (previously Eden District Municipality) to the south. At a local municipal level the sectors are spread across five municipalities, namely Laingsburg, Prince Albert, Kannaland, Oudtshoorn and George (see section 6.1).

The Klein Karoo, in which the SCWHS&NR lies, is defined as a semi-desert area with a unique and sensitive natural environment. It was once the indigenous home of the Koi-San people and the rock paintings on the walls of caves in the surrounding area sends a message that survival in this area requires respect for the natural environment.

Land use of the areas surrounding the SCWHS&NR, is predominantly farming, with ostrich farming and sheep and cattle farming forming the bulk of these activities. The Klein Karoo's climate is ideal for the production of apricots, peaches, plums, nectarines, and grapes, as well as vegetable seed. Approximately 30% of the total apricot export market comes from the Kannaland district, whilst agriculture's contribution to the Gross Domestic Product of the Oudtshoorn municipality is 17.3%. The well-known Parmalat- and Ladismith dairy products come from the Kannaland area. Several wine cellars produce top quality wines, port and brandy. In this respect, the quaint little haven of Calitzdorp is known as the port-wine capitol of South Africa by virtue of the top quality wines produced mainly by Boplaas, De Krans, Axehill and Calitzdorp Wine Cellar. The communities are thus predominantly employed through agriculture. Around the Kammanassie, land use is focussed primarily on intensive agriculture in the south while extensive farming takes place to the north. The well-known African Aloe factory situated in the town of Uniondale is a key role player in job creation and community upliftment.

A study on enterprise development and dynamics was carried out focussing on all the towns situated within the boundary of the GCBR (Toerien undated). The findings of the study indicated that Ladismith and Oudtshoorn are leaders in trade services. In terms of agricultural products and services Oudtshoorn, Swellendam, Mossel Bay and Riversdale are the leaders illustrating that providing services to their farming communities are important parts of their business communities. Prince Albert, Ladismith (cheese and wine producers), Calitzdorp (range of wine producers) and Uniondale (Aloe products) lead the processor sector. Ladismith, Calitzdorp, Oudtshoorn, De Rust, and Prince Albert are well-placed in the tourism and hospitality sectors and have benefitted greatly as a result of the founding and marketing of the R62. Although Prince Albert is not situated on the R62, it benefits because of the impressive and popular Swartberg pass that links Prince Albert with Oudtshoorn.

Local people, visitors and tourists, have found the Klein Karoo to be a place where you can experience the harshness and beauty of nature simultaneously. The natural environment of the area creates a natural hospitality towards the tourism industry and related boom in accommodation. The discovery of the Cango Caves and continual allure of the unique natural heritage have drawn people to this region. Oudtshoorn serves as a regional centre for the surrounding agricultural area. An important role and function of both municipalities is to balance the need for development with the need to conserve/protect the fauna and flora which is an important leverage within the agriculture and tourism industry. The area is very popular amongst artists, cyclists and off-road enthusiasts who come here for the untouched natural beauty (Gelderblom 2006). The municipalities have a difficult task to balance the interest of the natural environment with the need to promote development which will address the social under-development, infrastructural backlogs and the need to promote investment inflows to the area.

According to the Department of Social Development's 2018 projections, Oudtshoorn Municipality currently has a population of 98 026, rendering it the second largest municipal area by population within the Garden Route District. In and around the SCWHS&NR this is followed by Kannaland Municipality covering areas such as Calitzdorp, Ladismith, Vanwyksdorp and Zoar with a population size of 23 897 as recorded in 2018. Uniondale falling under the George Municipality only contains a population of 4 525. The average population density in local municipalities surrounding the protected areas is 14 people km², however the Garden Route District Municipality's population density is at 26 people km². Concentrations of populations are located near major towns and traditional authority areas. The future population growth in the Garden Route District is estimated at 2% per year and poverty headcounts levels are at 40.5%. In terms of employment figures, only 21.4% of the 15-65 year age group are employed in Oudtshoorn, 17.3% in Kannaland and details for Uniondale are unknown. Over 40% of the population is under the age of 25 and this puts strain on educational, healthcare and recreational facilities, as well as future employment opportunities. The Garden Route IDP (2017/18 – 2021/22) states that without sustainable approach between development, economic and population growth, the pressures on natural assets are likely to increase. It further states that it is essential that the Garden Route's Environmental Management Section provides dynamic, relevant and adaptive environmental management services in the face of complex, socio-economic challenges.

3 POLICY FRAMEWORK

CapeNature is subject to the framework of the Constitution of the Republic of South Africa (1996), national legislation including the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEM:PAA), National World Heritage Convention Act, 1999 (Act No. 49 of 1999) and all associated regulations and norms and standards for the Management of Protected Areas in South Africa and all other relevant requirements as set out in the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA).

3.1 Purpose of Protected Area Management

The declaration of protected areas is part of a strategy to manage and conserve South Africa's biodiversity. Accordingly, the object of the management plan is to ensure the protection, conservation and management of the natural and cultural historic heritage in a manner that is consistent with the objectives of the NEM:PAA, and for the purpose for which protected areas were declared.

3.2 Guiding Principles

The following guiding principles underpin the management plan for the SCWHS&NR:

- Articulate desired results in terms of conservation outcomes, not actions.
- Articulate how management responses will lead to desired results.
- Monitor progress towards achieving desired results.
- Consider monitoring programme design at the onset of planning.
- Consider expected outcomes of management at the outset of planning.
- Invest in management response appropriate to the risk.
- Adapt strategies based on lessons learnt understanding that measuring effectiveness alone may not resolve uncertainty; data and analyses are necessary to guide management towards doing more of what works and less of what does not work.
- Share results to facilitate learning, acknowledging that although success is not a given, learning can be, through honest appraisal of efforts.

The SCWHS&NR is also subject to the principles and provisions of relevant international treaties and conventions, national and provincial legislation and policy, and any local contractual or co-management agreements.

3.3 Strategic Adaptive Management

Strategic Adaptive Management integrates planning, management and monitoring to provide a framework for:

- Testing assumptions;
- Learning through monitoring and evaluation; and
- Adapting strategies or assumptions.

Strategic adaptive management bridges management and decision science by systematically evaluating results and using this information in a community of practice (CMP 2013) enabling management to change course when it becomes evident that it is necessary, rather than waiting until the end of a strategy to determine whether an intervention worked (Conservation Coaches Network 2012).

CapeNature has adopted, and applies, the Open Standards for the Practice of Conservation adaptive management framework (CMP 2013) as illustrated in Figure 3.1. The Open Standards facilitates strategic adaptive management through a systematic evidence based participatory process with stakeholders (CMP 2013). The systematic approach makes explicit the links between goals, focal values, threats, strategies and actions, enabling management to define and measure success of their actions in the protected areas over time.

The Open Standards framework is comprised of five stages (Figure 3.1):

- Conceptualising the protected area (i.e. defining the purpose of the protected area, establishing scope and vision; selecting focal values and assessing threats, and analysing the conservation situation (i.e. assessing contributing factors in terms of opportunities and challenges);
- Planning actions and monitoring (i.e. drafting the plan based on theories of change using results chains);
- Implementing actions and monitoring (i.e. drafting work plans, doing the work and monitoring the work);
- Analysing and using results to adapt (i.e. deciding if what was planned is working); and
- Capturing results, sharing and learning (i.e. learning and sharing what is learned).



Figure 3.1: Strategic Adaptive Management Framework adapted from The Open Standards for the Practice of Conservation (CMP 2013).

The framework works on the rationale that effective conservation of carefully selected focal values will ensure the conservation of all indigenous biodiversity and cultural historic heritage within the SCWHS&NR that in turn contributes to a functional landscape. At the same time, the rationale follows that healthy focal values deliver ecosystem services essential for human wellbeing. An assessment of the current condition of focal values serves as a baseline against which to measure condition over the next 10 years and guides the formulation goals and conservation strategies with associated objectives, indicators and work plans.

As such, step 1 of the adaptive management framework illustrated in Figure 3.1 is foundational to effective management of the area.

Focal values are classified as follows:

- Natural values can be species, habitats or ecological systems, which collectively represent and encompass the biodiversity of the SCWHS&NR. They can include the physical, natural features from which ecosystem services flow, benefitting humans in a variety of ways.
- Cultural historic values are described in terms of the tangible features that collectively represent and encompass the cultural historic heritage of the SCWHS&NR. They can also include the physical, cultural and/or historic features from which human wellbeing values are derived.
- Human wellbeing values are the intangible or non-material values derived from tangible values, and which collectively represent the array of human wellbeing needs dependent on natural and cultural features; they can be defined in terms of the benefits delivered to humans by healthy ecosystems, or by intact cultural or historical features.

3.4 Protected Area Management Effectiveness

Management effectiveness evaluation is the assessment of how well a protected area is being managed, primarily the extent to which management is protecting values and achieving objectives (Hockings *et al.* 2015). The following questions underpin management effectiveness evaluation (Leverington & Hockings 2004):

- Is the protected area effectively conserving the values for which it exists?
- Is management of the area effective and how can it be improved?
- Are specific projects, interventions and management activities achieving their objectives, and how can they be improved?

The monitoring and evaluation framework applied to the SCWHS&NR (illustrated in Figure 3.2 below) measures compliance and management effectiveness of the SCWHS&NR in terms of the NEM:PAA and associated Norms and Standards for Protected Area Management. Management effectiveness is assessed over time using the Management Effectiveness Tracking Tool – South Africa (METT-SA) which is based on the six elements of good management:

- It begins with understanding the **context** of existing values and threats;
- Progresses through **planning**;
- And allocation of resources (**inputs**);
- And as a result of management actions (**processes**);
- Eventually produces products and services (**outputs**);

- That result in impacts or **outcomes**.

Management effectiveness is measured at the strategic level as a percentage, drawing upon the results of fine scale monitoring linked to management actions, objectives, goals and focal values articulated in this plan (Figure 3.2). Management effectiveness includes the measurement of administrative processes such as capacity and budgets that, when adequate, are likely to result in positive conservation outcomes.

Mechanisms for monitoring and evaluation are built into each aspect of the Strategic Plan (see section 10) through the inclusion of verifiable indicators of progress. The protected area monitoring and evaluation programme, supplementary to the management plan, monitors site level implementation of the plan, status of values and effectiveness of strategies. Results contribute to the Western Cape State of Biodiversity report, produced at five-year intervals.

Furthermore, management reports annually on implementation of the plan through CapeNature’s strategic Performance Management System. The Performance Management System ensures that implementation of the management plan is embedded in individual staff performance agreements.

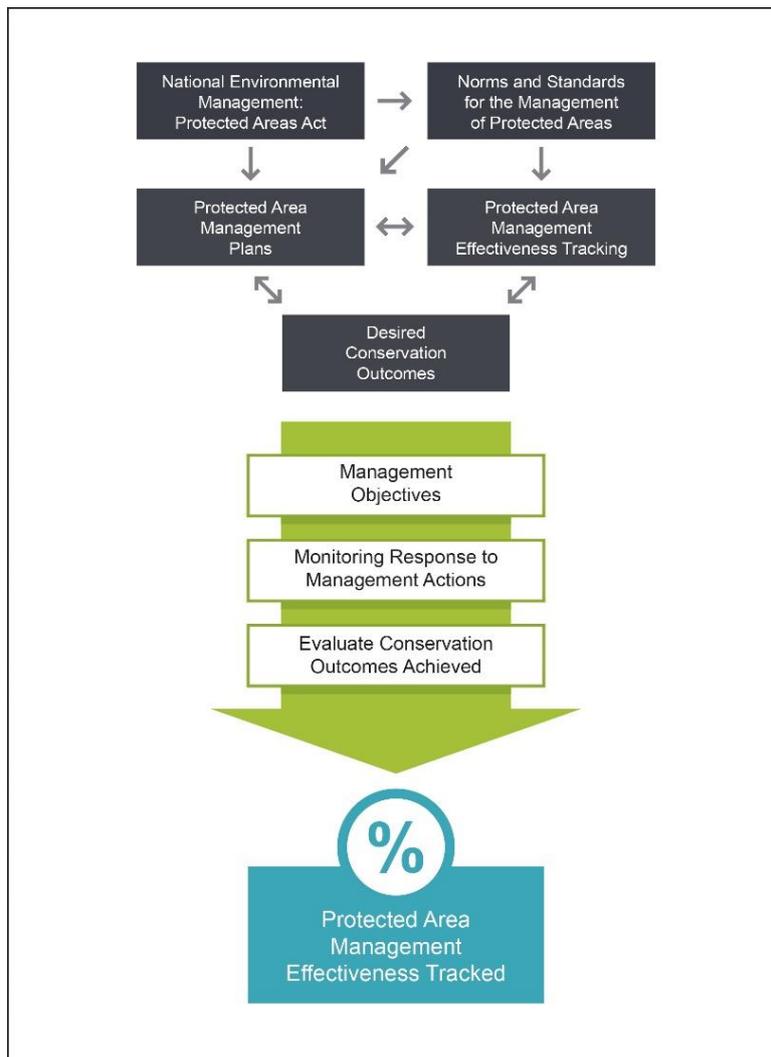


Figure 3.2: Protected Area Monitoring and Evaluation Framework.

3.5 Policy Frameworks

Protected area management is guided by CapeNature policies, procedures and guidelines for use across all of its components. Policies, procedures and guidelines applicable to this management plan are referenced here and in section 10 (Strategic Plan).

3.5.1 Internal rules

In terms of Section 52 of NEM:PAA, as amended, the management authority of a nature reserve may, in accordance with prescribed Norms and Standards, make rules for the proper administration of the area.

In addition to the Regulations for the Proper Administration of Nature Reserves, as gazetted on 12 February 2012 in Government Gazette 35021, and Regulations for the Proper Administration of Special Nature Reserves, National Parks and WHSs, as gazetted on 28 October 2005 in Government Gazette 28181, the SCWHS&NR implements the Nature Conservation Ordinance, 1974 (Ordinance No. 19 of 1974) and Provincial Notice 955 of 1975.

3.5.2 Financial

CapeNature is a Schedule 3C public entity responsible for nature conservation in the Western Cape. CapeNature is the executive arm of the Western Cape Nature Conservation Board, established in terms of the Western Cape Nature Conservation Board Act, 1998 (Act No. 15 of 1998) as amended. The objectives of the Board as per the Board Act shall be:

- To promote and ensure nature conservation and deal pro-actively with related matters in the Province;
- To render services and provide facilities for research and training that would inform and contribute to nature conservation and related matters in the Province; and
- To generate income, within the framework of the applicable policy framework.

Funding for the entity comprises three main revenue streams. The majority of funding, which equates to approximately 80% of funding, is received in terms of a provincial allocation received in terms of Vote 9. Secondary funding, which is approximately the further 20%, is received from external donors and own revenue. Own revenue generation consists mainly of tourism income generated through activities and accommodation available on various nature reserves managed by the entity.

The entity prides itself on its strong internal controls, sound financial management and practicing of good corporate governance. Corporate governance within the entity embodies sound processes and systems and is guided by the Public Finance Management Act, 1999 (Act No. 1 of 1999) and the principles contained in the King 4 Report of Corporate Governance.

3.5.3 Safety and security

The CapeNature Business Continuity Plan establishes and provides emergency response procedures and protocols which need to be implemented should an event significantly disrupt the operations of the organisation or an emergency situation is

declared by management. The plan identifies critical services, how it will be maintained, how to minimise the impact, increase preparedness and initiate effective responses.

3.5.3.1 Integrated compliance plan

The Integrated Compliance Plan for the SCWHS&NR (CapeNature 2017) details how compliance and enforcement should be implemented in order to:

- Prevent biodiversity loss caused by human activities of non-compliance (e.g. poaching, unauthorized access, deliberate setting of fires, damage to property and vandalism) within the SCWHS&NR and ZOI.
- Ensure compliance with legislation through the monitoring of activities.
- Address and combat illegal activities through the institution of criminal proceedings.
- Reports illegal activities to the delegated Authority where activities have a negative impact on the SCWHS&NR (e.g. listed activities in terms of NEMA).

It is a dynamic reference document which is updated regularly and improved, using the data that is gathered in the course of the implementation thereof in order to achieve the management objectives of the SCWHS&NR.

3.5.3.2 Veld Fire Response Plan

The veld fire response plan serves as an operational document for cooperative wildfire management in the SCWHS&NR (CapeNature 2019). This plan is compiled and updated annually by the Integrated Catchment Manager and addresses predictive seasonal weather conditions and suppression resources for the SCWHS&NR, i.e. available manpower, equipment, vehicles, communications, water supply, firebreaks, hotspots and eco-sensitive areas, fire preparedness, fire danger indices, fire reaction assistance and partners. Fire response to any wildfires occurring on CapeNature managed land, or on neighbouring properties, including private Mountain Catchment Areas are implemented by means of the international standard Incident Command System (ICS). Suppression protocols applicable to each protected area within the SCWHS&NR are determined in accordance with the reserve ecological status and vegetation type (CapeNature 2019).

3.5.3.3 Fire Management Plan

The Fire Management Plan is essentially a derivative and part of the protected area management plan. The latter details the objectives of the SCWHS&NR and the Fire Management Plan use this information to detail how fire will be managed to ensure that the ecological objectives of the SCWHS&NR are met. This includes the management of both wild and controlled fires.

3.5.3.4 Fire Protection Associations

CapeNature is obliged in terms of the National Veld and Forest Fire Act to be a member of the local FPA. Within the Western Cape, five large FPAs have been established that cover the whole province. The entire SCWHS&NR falls within the Southern Cape Fire Protection Association. The Gamkaberg Cluster belongs to the Rooiberg Fire Management Unit (FMU). Kammanassie Cluster belongs to the Kammanassie FMU. For the Swartberg Cluster the Calitzdorp, Matjiesrivier, De Rust,

Kango Valley and Ladismith FMUs have been established. FPAs are the primary partnership tool in veldfire management in South Africa.

3.5.4 Resource use

Resource utilisation is governed by CapeNature's Policy on consumptive use of wild flora from CapeNature-managed protected areas (2019). The policy implementation framework and protocol provides a guideline as to how access to the natural resources should be handled. Nationally, the NEM: PAA Section 50 states that management authorities of protected areas, including WHSs may, subject to the management plan of the protected area or site, allow or enter into a written agreement with or authorise a local community inside or adjacent to the protected area or site, to allow members of the community to use in a sustainable manner biological resources in the protected area or site. Section 50, however, also states that an activity allowed in terms of this section may not negatively affect the survival of any species in or significantly disrupt the integrity of the ecological systems of the protected area or site. CapeNature undertakes to build the capacity of Natural Resource Users and other relevant stakeholders on the sustainable utilisation of natural resources and its environmental regulatory framework in and outside protected areas.

3.5.5 Biodiversity management

3.5.5.1 Cape Mountain Zebra Biodiversity Management Plan

The Biodiversity Management Plan for the Cape mountain zebra in South Africa is aimed at identifying, allocating and undertaking the required, identified actions to enable stakeholders to contribute to the overall desired outcome of ensuring the long term survival of the subspecies in nature (Birss *et al.* 2016). Thereby the sustainable, non-detrimental harvest and off-take as an economic incentive for private land owners participating in the metapopulation strategy can be ensured. The plan focusses on actions and strategies to strengthen the overall population performance, distribution and genetic diversity to ensure overall population fitness and resilience of the Cape mountain zebra metapopulation within the natural distribution range. It also includes populations on protected areas outside the natural distribution range.

3.5.5.2 Integrated catchment management strategy

Integrated Catchment Management (ICM) is regarded as improving and integrating the management of land, water and related natural biological resources in order to achieve the conservation, and sustainable and balanced use of these resources. The ICM strategy focuses on three key areas including Catchment, Freshwater and Coastal Management (Cleaver-Christie *et al.* 2016). All of these contribute to socio-economic development and are underpinned by key principles including knowledge, advocacy and awareness and an enabling environment. The ICM strategic plan is aligned to national and provincial priorities and has five strategic objectives to guide implementation namely:

- To integrate the management of the physical, ecological and man-made components of the environment to ensure ecological sustainability and integrity of the ecosystems and the services that they provide in order to ensure long-term climate change resilience.

- Management of biodiversity assets, ensuring their contribution to the economy, rural development, job creation and social wellbeing is enhanced.
- To enhance biodiversity implementation through the development of strategic tools and knowledge management systems.
- People are mobilised to adopt practices that sustain the long-term benefits of biodiversity.
- The required enabling environment (including institutional and professional capacity, policy and legal framework, partnerships, strategic and operational alignment and stakeholder support) is established and sustained.

3.5.5.3 Invasive Species Monitoring, Control and Eradication plans

Invasive Species Monitoring, Control and Eradication Plans for the three clusters are compiled according to the requirements of the NEM:BA and the Alien and Invasive Species Regulations and Lists (October 2014) to ensure a healthy catchment area for protecting water and biodiversity by controlling invasive flora and faunal species in the SCWHS&NR (CapeNature 2016a, b, c). The five year plans are linked to the invasive alien plant database which is updated annually.

3.5.5.4 Western Cape Protected Areas Expansion Strategy

The Western Cape Protected Areas Expansion Strategy (WCPAES) aims to expand the Western Cape Protected Area network to encompass a more representative and resilient suite of areas that support biodiversity and ecological infrastructure, especially those threatened species and ecosystems that remain as yet unprotected.

3.5.5.5 Game Translocation and Utilization Policy

The Game Translocation and Utilization Policy (GTUP 2011) for the Western Cape Province manages translocations and utilization of game species in order to prevent damage to the biodiversity of the Western Cape Province.

3.5.5.6 Damage Causing Wild Animals

CapeNature aims to ensure coexistence of humans and indigenous wild animals and considers human-wildlife conflict as situations where artificially induced interactions between humans and wildlife lead to situations requiring mitigation of loss, disturbance or damage (CapeNature 2015). CapeNature requires that human-wildlife conflict is managed, taking into consideration all legal, ethical and welfare implications and that interventions are carried out within an ecologically sound framework (CapeNature 2015). CapeNature advocates the five-step approach to holistic wildlife management of damage causing wildlife namely (1) understanding the origin of the problem; (2) maintaining the correct attitude and respect towards the animal; (3) the responsible species must be identified correctly; (4) implement suitable mitigation measures; and (5) implement effective selective control as per the information contained in the “The Landowner’s guide: human-wildlife conflict – sensible solutions to living with wildlife” (CapeNature undated). This handbook supplies basic and cost effective mitigation methods to landowners who report damage caused by wildlife. By implementing the suggested interventions and understanding the ecological role of each species, this will enable the Conservation Manager to deal with wildlife conflict situations both on and off protected areas.

All reports of damage causing animals causing losses on neighbouring properties must be reported to and investigated by the relevant Conservation Manager who will assist the landowner with mitigation management in a holistic manner.

Primates. Chacma baboons are one of the main species causing human-wildlife conflict. Sectors within the SCWHS&NR that have tourism and staff accommodation facilities, particularly Gamkaskloof must ensure that human-wildlife conflict situations are managed and mitigated before conflict situations arise. All sources of food and access to such (i.e. fruit trees, oak trees and rubbish bins) must be removed or secured to reduce attraction for primates. A proper waste management plan must be in place and must be viewed as a priority by all staff members to ensure that wild animals cannot access human food sources. Day visitors and tourists entering these protected areas must also be well informed of the relevant regulations that prohibit the feeding of wildlife. Once primates have learnt to acquire food from human-beings they become a nuisance and their natural behaviour of finding and searching for their own food is altered. Where mitigation measures have been unsuccessful at keeping primates away from tourist and staff accommodation facilities and the animal starts to show signs of aggression, a case history for each conflict scenario must be documented by the relevant Conservation Manager. This case history must differentiate between natural behaviour versus conflict behaviour of repeat offenders (raiding bins, entering tourism and staff accommodation facilities and grabbing food from visitors, signs of aggression) which must be channelled through the Landscape Manager before the appropriate management intervention can be made.

Predators. All reports of predators causing stock losses on neighbouring properties must be reported to and investigated by the Conservation Manager (Off-Reserve) who will assist the landowner with mitigation management. All actions against predators must be actioned on the property where the losses occurred and not within the SCWHS&NR. No hunting or pursuing of predators on any protected area is allowed.

Other Wildlife. All other wildlife found on protected areas and causing losses or damage on neighbouring properties must be reported to and investigated by the Conservation Manager who will assist the landowner with mitigation management.

No confiscated, nuisance, damage-causing wildlife or rehabilitated wild animals may be released onto a protected area unconditionally.

3.5.6 Cultural resource management

CapeNature acknowledges that access to protected areas for traditional, spiritual, cultural and historical purposes has major benefits for people and accepts that protected areas have intrinsic and extrinsic use value for the people of the region. CapeNature therefore recognises the need to manage, conserve and promote natural assets for the benefit of all. CapeNature contributes towards the promotion of culture and heritage through the development and conservation of heritage resources as well as the facilitation of access.

Cultural Heritage Management plans are yet to be completed for Swartberg and Kammanassie Clusters and endorsed by heritage practitioners. However, both sites do carry out standardised monitoring as per CapeNature's baseline monitoring manual.

An abbreviated Cultural Heritage Management Plan for the Gamkaberg Cluster has been endorsed by Dr Renee Rust in 2016, addressing the management and monitoring of rock art and cultural heritage sites. This plan also highlights the importance of creating awareness and granting public access to some of the remote sites by means of trained nature and culture tour guides.

Discovery of new sites are either through local contact or by operational staff conducting field work in an area and are recorded in the relevant CapeNature Heritage Inventory database for each protected area. Sites within the SCWHS&NR are monitored on an *adhoc* basis by operational staff.

3.5.7 Neighbour relations

The National Veld and Forest Fire Act, 1998 (Act No. 101 of 1998) places a duty on landowners to prepare and maintain firebreaks. Chapter 4, Section 12 (7) of the Act states that owners of adjoining land may agree to position a common firebreak away from a boundary. Firebreaks that have been repositioned off CapeNature boundaries must be documented in an official firebreak agreement between CapeNature and the relevant landowner. Firebreak agreements bind all parties over a five year period (unless otherwise stated) and are renewable upon joint agreement from both parties.

Within the structure of CapeNature, firebreak registers are used as a management tool to assist with the prioritisation and maintenance schedule for each firebreak. The firebreak register is updated annually and indicates whether a firebreak has been realigned to aid with maintenance or fire suppression operations.

The number of firebreak agreements for the SCWHS&NR are briefly discussed below as per the 2019 firebreak registers for each cluster:

Swartberg Cluster. The firebreak network is extensive and comprises 116 firebreaks. Of these, 17 firebreaks have been realigned to aid with fire suppression and maintenance purposes. Eight firebreak agreements are currently in place which detail reasons for realignment.

Gamkaberg Cluster. Gamkaberg's firebreak network comprises of 52 firebreaks in total. Of these, 14 firebreaks have been realigned for fire suppression purposes. A total of six firebreak agreements are currently in place, which detail reasons for alignment. The remaining eight firebreak agreements are in the process of being finalised.

Kammanassie Cluster. The firebreak network comprises of 31 firebreaks in total. Of these, 22 have been realigned for fire suppression purposes. Outstanding firebreak agreements need to be addressed as a matter of priority.

3.5.8 Research and development

The National Biodiversity Research Development and Evidence Strategy (2015-2025) highlights the increasing demand for knowledge and evidence to support policy and decision making for the protection of biodiversity and the realisation of benefits from our natural resources. In response to this CapeNature developed a biodiversity research and monitoring strategy. The overall goal of this strategy is to provide reliable data and knowledge to inform and facilitate the conservation of the biodiversity and

sustained ecosystem functioning in the Western Cape Province. Structured monitoring programmes need to be put in place and carried out consistently over time to monitor the state of biodiversity and ecosystem functioning. This allows tracking of ecosystem health and allows critical evaluation of management practices by employing an adaptive management cycle. Therefore, there is a focus on applied scientific research that is driven by management requirements. The strategy emphasises research and monitoring that measures biodiversity outcomes so that management can be clearly linked to the biodiversity and ecosystem function targets. The guiding principles of the strategy are good science (robust and defensible), alignment with management requirements, taking an integrated management and ecosystems approach, employing a full monitoring lifecycle approach to planning and implementing monitoring programmes and considered (evidence-based) prioritisation of research and monitoring actions.

The CapeNature Research and Monitoring strategy facilitates research that guides management actions in the SCWHS&NR and the ZOI pertaining to the following:

- Priority species (alien invasive, threatened, endemic species, keystone and indicator species);
- Integrated catchment management (ecologically sound fire management, freshwater and alien invasive species management);
- Impacts of groundwater abstraction on groundwater dependent ecosystems;
- Ecosystem services, functioning and economic value;
- Rehabilitation and restoration of impacted ecosystems;
- Research related to the movement and genetic mixing of Cape mountain zebra subpopulations;
- Conservation management effectiveness;
- Climate change (and weather) on provision of ecosystem services;
- Land use change in the ZOI;
- Human-wildlife conflict including social impact;
- Damage-causing animals;
- Effects of resource use;
- Cultural, historical and heritage sites;
- Social effects of conservation initiatives (indicators of change, awareness, value of nature as place of learning, healing and self-discovery); and
- The socio-economic effects of implementing Expanded Public Works Programme (EPWP) work opportunities and resource economics.

3.5.9 Access

CapeNature strives to establish a differentiated and leading brand of products in outdoor nature-based tourism across the Western Cape for all to enjoy. This is achieved by providing opportunities to the public and interacting in an environmentally responsible and sustainable manner specifically to:

- Optimise income generation for biodiversity conservation;
- Optimise shared growth and economic benefits, to contribute to national and provincial tourism strategies and transform the tourism operations within CapeNature; and
- Strengthening existing and developing new products with special attention to the provision of broader access for all people of the Western Cape.

Furthermore, CapeNature strives to increase and improve stakeholder awareness, understanding and participation in environmental conservation through:

- Developing the capacity of local people to meaningfully and responsibly participate in the management and enjoyment of the protected areas;
- Educating relevant stakeholders and creating awareness around key environmental issues to increase knowledge about the environment, develop a deeper understanding about environmental principals and encourage environmentally conscious values that allow for more informed and environmentally responsible decision making.

As part of its multi-sectoral approach, CapeNature aims to support the Western Cape Education Department's efforts through presenting curriculum aligned Environmental Education Programmes to schools and will endeavour to collaborate with like-minded partners in pursuit of environmental sustainable development goals at platforms for involving citizens and groups with the aim of expressing a "call to action". Behaviour change efforts will be optimised through targeting specific audiences with innovative, transformative, quality-assured programmes and interventions as highlighted in the relevant Environmental Education, Awareness and Interpretation Plans (CapeNature 2018a, b, c).

3.5.10 Administrative framework

The Directorate: Conservation Operations is divided into two Regions, namely East and West. East Region is further subdivided into two landscapes, namely Landscape East and Landscape South. The entire SCWHS&NR falls within Landscape East.

The SCWHS&NR is supported primarily by Head Office, through the Landscape Office located in Oudtshoorn, which also provides limited shared services. All Landscape administrative matters that affect the SCWHS&NR are managed via Head Office.

Conservation Managers report to the Landscape Manager 1 of the Karoo Area, based at Oudtshoorn. The SCWHS&NR has three main operational centres, namely Swartberg, Gamkaberg and Kammanassie.

In addition, based in Oudtshoorn, there is an Off-Reserve (SCWHS&NR Buffer Zones) Conservation Component which deals with compliance of environmental legislation (NEMA, Specific Environmental Management Acts and Provincial Legislation) and a Stakeholder Engagement Component which deals with communities and other partners in the landscape, as well as conducting environmental education and awareness to all stakeholders around conservation matters (Figure 3.3).

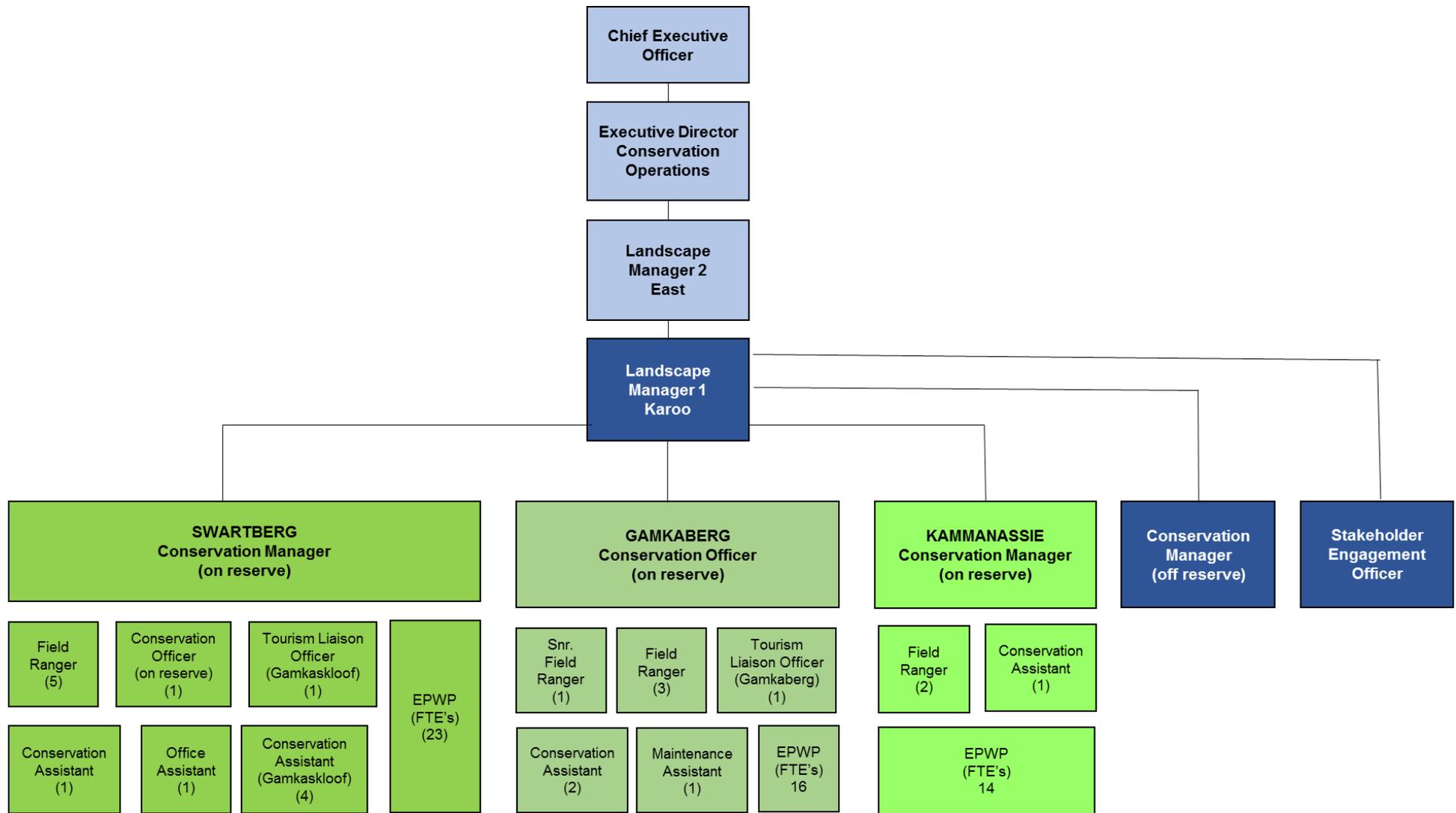


Figure 3.3: Approved organogram for the Swartberg Complex World Heritage Site and Nature Reserves.

A critical part of conservation management is to ensure an adequately resourced staff complement on the protected areas. Currently there are a number of vacancies that need to be filled with adequately skilled staff urgently. These are:

- An additional Field ranger for Kammanassie;
- A Conservation assistant for the Gamkaskloof sector; and
- A Stakeholder Engagement Officer for the Karoo Landscape.

Another important function is to integrate and align organisational and employee performance and to ensure that all the employees on the protected areas are skilled and adequately trained.

4 CONSULTATION

This section outlines procedures for public participation during the development of the management plan, including formal processes for public comment on the draft plan, and establishes procedures for public participation during the implementation phase of this plan as indicated in Figure 4.1.

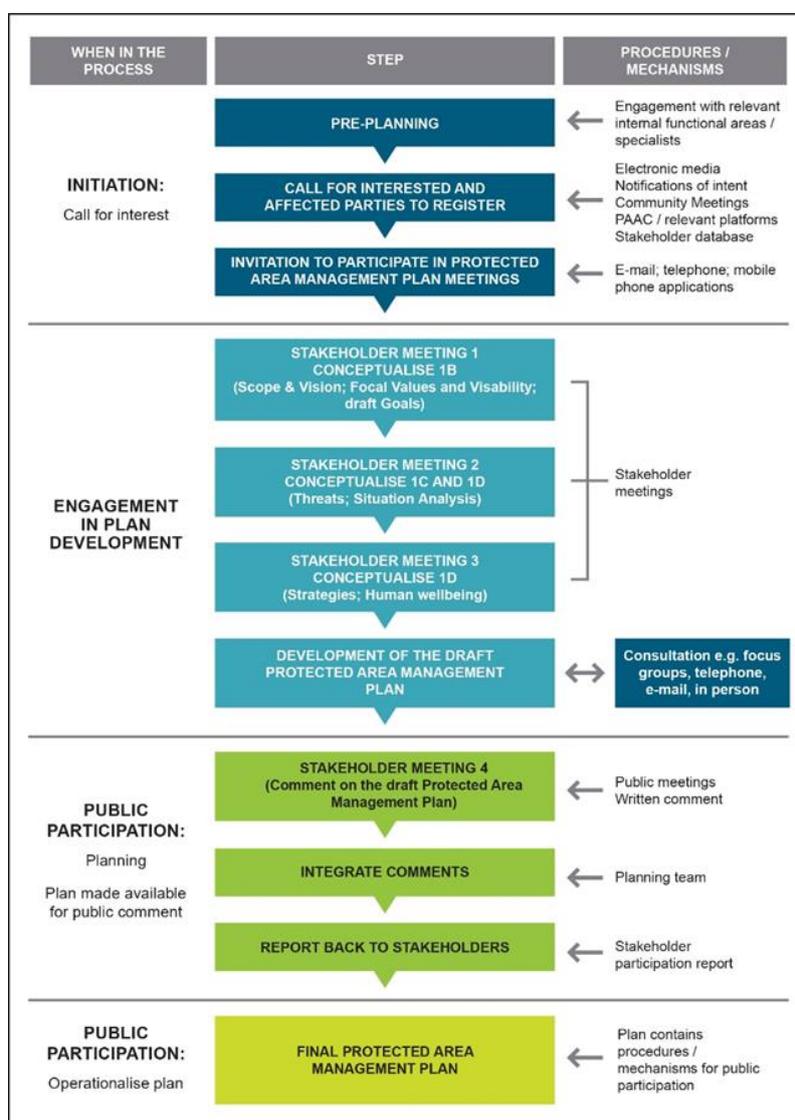


Figure 4.1: Process flow for Protected Area Stakeholder Engagement.

Stakeholder engagement takes place throughout the adaptive management cycle and enables public participation essential for sustainability, builds capacity and enhances responsibility. It promotes communication and the derivation of new information and/or expertise.

At the outset of the planning process for the SCWHS&NR, a stakeholder analysis identified relevant internal and external stakeholders, and defined the scope and purpose of engagement.

4.1 Stakeholder Engagement

4.1.1 Participatory planning

Several approaches to engaging internally and externally with stakeholders were applied, including structured facilitated workshops, focused discussions and correspondence with experts, meetings, and the provision and circulation of information for input. Different stakeholders were engaged using varied approaches during the stages of the planning process, from gathering and sharing information, to consultation, dialogue, working groups, and partnerships.

During 2018 a stakeholder workshop, coordinated and hosted by CapeNature was held. Several stakeholders representing individuals or agencies with an interest in, and / or knowledge / expertise of the landscape, and individuals or agencies with the capability to support the implementation of the SCWHS&NR were invited.

Stakeholders included landowners and land managers (private and communal), and relevant land or resource management authorities. Workshops were aimed at developing a strategic framework for the SCWHS&NR to help coordinate efforts in the landscape towards a common vision. The desired outcomes were to capacitate and involve stakeholders in the understanding of the management of the natural and cultural focal values in the SCWHS&NR landscape and to identify mechanisms to maintain those values over time.

The outcomes of the above-mentioned process informed the management planning process for the SCWHS&NR. The management planning process was carried out by the core planning team comprising of CapeNature Conservation Managers, Landscape Ecologist, Ecological Coordinator, GIS Technician, Community Conservation Manager and Landscape Managers. A series of workshops and core planning team meetings were held with relevant internal (e.g. scientific services) and external stakeholders.

4.1.1.1 Key stakeholder groups engaged

Key stakeholder groups that have been engaged include:

- Department of Agriculture, Forestry and Fisheries;
- Department of Agriculture: LandCare;
- GCBR Forum;
- Southern Cape Fire Protection Association;
- Ujube;
- Conservation At Work;
- Regalis Environmental Services;

- University of Cape Town;
- Nelson Mandela University;
- Community members: PAAC Forums for the Swartberg, Gamkaberg and Kammanassie.

4.1.1.2 Workshops

Stakeholder workshops had the following key themes:

- Planning purpose: introducing stakeholders to planning for adaptive management; planning scope and vision.
- Conceptualisation: capacitating stakeholders in adaptive management planning; selecting focal values and assessing the condition of focal values; threats assessment and conservation situation analysis.
- Planning actions: identifying strategies; developing theories of change and developing objectives and indicators.
- Internal stakeholder engagement: scientific review and component review.

4.1.1.3 Working groups and other input opportunities

In instances where specific input was required or stakeholders and / or experts were unable to participate in workshops, smaller teams engaged and / or public meetings were facilitated to:

- Share workshop outputs and progress; and
- Address relevant knowledge gaps for various key ecological attributes (KEA) and indicators for specific focal values.

4.1.2 Procedures for public comment

Cedarberg Conservation Services (t/a FOOTPRINT Environmental Services) (FES) were appointed by CapeNature in November 2019 to facilitate the Stakeholder Engagement Process for the SCWHS&NR.

The Stakeholder Engagement Process was formally initiated on 28 November 2019 by Footprint Environmental Services whereby members of the public and interested and affected parties were invited to register their interest and provide comment on the draft SCWHS&NR management plan.

Notifications inviting the public and interested and affected parties were distributed electronically via email, CapeNature’s website, CapeNature’s Facebook page and also placed in two local newspapers namely “Die Herrie” and “Die Hoorn” that cover the entire domain of the SCWHS&NR. Notifications in the local newspapers were published in English and Afrikaans.

Hard copies of the draft management plan for the SCWHS&NR were printed and placed at public Libraries in Oudtshoorn, Ladismith, Vanwyksdorp, Prins Albert, Dysseisdorp, Zoar, Uniondale, De Rust and at Calitzdorp. The draft SCWHS&NR management plan was also available at the relevant CapeNature offices in Oudtshoorn and Uniondale.

Electronic copies of the draft SCWHS&NR management plan could be downloaded from CapeNature's website link <https://www.capenature.co.za/care-fornature/biodiversity/protected-area-management-plans> which remained active for the entire Stakeholder Engagement Process that concluded on 15 January 2020.

The opportunity for providing comments and registering as interested and affected parties commenced from 28 November 2019 and concluded on 15 January 2020.

Registered interested and affected parties were invited to attend public meetings held in Uniondale (13 January 2020), Oudtshoorn (14 January 2020) and Ladismith (14 January 2020) and provided the opportunity to provide information and express their opinion. Based on the comprehensive Stakeholder Engagement Process Report compiled by Footprint Environmental Services dated January 2020 outlining the entire public participation process, the SCWHS&NR draft management plan was amended where appropriate and feedback was provided by Footprint Environmental Services to registered interested and affected parties.

Please refer to Appendix 3: Stakeholder Engagement Report for the SCWHS&NR and accompanying Stakeholder Engagement Register.

In addition, representatives of the reserve management committee gave two presentations about the SCWHS&NR management plan at the multi-stakeholder forum meetings of the GCBR held in Ladismith (26 February 2019) and in Great Brak River (20 November 2019). These meetings were well-attended by 76 and close to 90 people respectively. A synopsis of each of these presentations has been drafted and sent to the GCBR stakeholders. The members of the GCBR were also invited via email to provide comments and inputs into the draft management plan. Three presentations were also given at the PAAC meetings held in Oudtshoorn on the 28th February 2019, 31st May 2019 and the 5th December 2019. Minutes of these meetings were compiled and sent to the PAAC members.

4.1.3 Procedures for Participatory Implementation

4.1.3.1 Protected Area Advisory Committee

Participatory management is facilitated through structures such as Protected Area Advisory Committees (PAAC) with the aim of regular interaction with stakeholders and a mechanism to evaluate stakeholder feedback, to promote good neighbour relations and to influence beyond protected area boundaries.

The organisation of the PAAC for the SCWHS&NR is as follows:

- The Swartberg and Gamkaberg PAAC is a joint Advisory Committee and meets once every three months with members serving for a period of five years. Member representation will be allowed as long as it is in the interest of conservation and good governance.
- The Kammanassie PAAC is an independent Advisory Committee and meets annually.

4.1.3.2 Other mechanisms for stakeholder engagement

Enhancing engagement and participation by relevant stakeholders throughout the SCWHS&NR is a key focus area going forward. Current structures for stakeholder engagement, additional to the PAAC, include:

- The GCBR Forum is a voluntary citizen's initiative dedicated to conserving its area's biodiversity while simultaneously ensuring the wellbeing of its community members through knowledge sharing and socio-economic development.
- The National People and Parks Programme implemented by CapeNature has established a regional structure in the area to enable community engagement. The primary objective is to link communities with relevant government departments that can assist with issues such as spiritual, recreational, educational, traditional and other purposes. The programme is also designed to capacitate communities with regard to relevant legislation, policies and regulations.
- The Western Cape Stewardship Reference Group, serves as a platform for conservation implementation by partners.

5 PURPOSE AND VISION

This section makes provision for CapeNature to manage the SCWHS&NR exclusively for the purpose for which it was declared. It presents the vision, purpose, focal values and key threats foundational to developing the desired state for the SCWHS&NR.

The desired state, articulated as goals in this management plan, defines the outcome of management and directs management within and beyond protected area boundaries. This serves as a foundation for appropriate ongoing monitoring and evaluation to assess management effectiveness.

5.1 Management Intent and Desired State

The SCWHS&NR is situated in the Greater CFR. It is the only area representing the Karoo Mountain Phytogeographic Centre of endemism which is very rich in plant species, and protects a significant portion of the Swartberg Mountain Range that forms a junction between the Succulent Karoo and Fynbos biomes in the eastern part of the Cape Floral Region. The vegetation of the protected area is remarkably diverse. It not only conserves large sections of the inland mountain fynbos but also conserves elements of, and importantly significant transition zones between the Fynbos, Succulent Karoo and Subtropical Thicket biomes.

As an important mountain catchment area the SCWHS&NR is further protected to sustain both the quality and surety of supply of water resources that it provides to the nearby agricultural and urban communities in the Klein Karoo and adjoining Central Karoo (DEAT 2003; DEA 2015).

The SCWHS&NR aims to strategically, and adaptively, manage biodiversity towards ensuring the persistence of an intact natural climate change corridor, freshwater ecosystems, and unique cultural and biological diversity of the region through: 1) the prioritised strategic management of threats; 2) improving the condition of natural water supply; 3) ensuring that properties comprising the protected areas are legally secured and protected area design is augmented by expansion through stewardship or other effective means, including the ZOI; 4) cooperative governance to overcome regulatory division in the management of natural resources; 5) managed access to check unregulated access and over-utilisation; and (6) developing infrastructure and operations to enable the transition of the protected area into a world class nature destination.

The primary conservation objective is the management and conservation of natural processes and life support systems typical of the SCWHS&NR, and the management and conservation of the catchment area.

5.2 Purpose

Groot Swartberg, Swartberg East, Towerkop, Paardenberg, Rooiberg and Kammanassie were demarcated as State Forests in Government Notices under various Forest Acts between 1912 and 1978 (refer to section 2.1.1) which have now been replaced by the National Forests Act, 1998 (Act No. 84 of 1998). Gamkapoort and Gamkaskloof are state land. The Western Cape Nature Conservation Board manages all these components as Provincial Nature Reserves. Together the state

ownership and the management by the provincial conservation authority impart a high level of legal protection and conservation management to the area.

Private land in the Swartberg Range, Rooiberg and Kammanassie Mountains were proclaimed as Mountain Catchment Areas (Government Gazette No. 1938 of 29 September 1978) in terms of the Mountain Catchment Areas, 1970 (Act No. 63 of 1970).

Groot Swartberg, Swartberg East, Gamkapoort and Gamkaskloof were inscribed as the Swartberg Complex of the CFRPA WHS in 2004 based on the integrity of the protected areas and the fact that there is appropriate physical, institutional and legal protection, to ensure the long-term conservation of species and natural processes. These protected areas satisfied four criteria that were used to select areas to include into the WHS, namely (i) that it is surrounded by conservation-friendly land, (ii) had high management integrity in terms of conservation and management status, (iii) was relatively large, and (iv) is a biological “hotspot” (e.g. high species diversity, endemism, occurrence of threatened taxa, and operation of supporting natural processes) (DEAT 2003).

In 2015, the Swartberg Complex of the CFRPA WHS was extended to include Towerkop, Paardenberg, Rooiberg, Groenefontein, Gamkaberg and Kammanassie Nature Reserves (DEA 2015). The primary reasons for inclusion of these protected areas into the extension nomination for the CFRPA WHS were to improve representation of vegetation types within the CFRPA WHS, as well as to increase and improve the overall size, connectivity and integrity of the CFRPA WHS, thus ensuring protection of an increased land area within the WHS. The extended Swartberg Complex improves connectivity and form a critical east-west link along the Swartberg Mountain Range, between the proposed CFRPA WHS extensions of the Anysberg, Towerkop, Paardenberg, Groenefontein, Rooiberg, Gamkaberg, Kammanassie and the components of the Langeberg, Garden Route and Baviaanskloof Complexes. The inclusion of these extensions into the inscribed CFRPA WHS increases resilience in the face of global climate change and improves both biodiversity pattern and process of the inscribed CFRPA WHS.

CapeNature manages the SCWHS&NR in accordance with its organisational vision, and in accordance with the vision, goals and strategies derived in consultation with stakeholders, as set out in this section.

According to Section 17 of the NEM:PAA each protected area in the SCWHS&NR is declared for one or more of the following purposes:

- a) to protect ecologically viable areas representative of South Africa’s biological diversity and its natural landscapes and seascapes in a system of protected areas;
- b) to preserve the ecological integrity of those areas;
- c) to conserve biodiversity in those areas;
- d) to protect areas representative of all ecosystems, habitats and species naturally occurring in South Africa;
- e) to protect South Africa’s threatened or rare species;
- f) to protect an area which is vulnerable or ecologically sensitive;
- g) to assist in ensuring the sustained supply of environmental goods and services;
- h) to provide for the sustainable use of natural and biological resources;

- i) to create or augment destinations for nature-based tourism;
- j) to manage the interrelationship between natural environmental biodiversity, human settlement and economic development;
- k) generally, to contribute to human, social, cultural, spiritual and economic development; or
- l) to rehabilitate and restore degraded ecosystems and promote the recovery of endangered and vulnerable species.

The SCWHS&NR were declared for a, b, c, d, e, f, g, h, i, k and l.

5.3 Vision

The vision for the SCWHS&NR is:

The Swartberg Complex World Heritage Site and Nature Reserves conserve living landscapes that represent the region’s biodiversity and ecosystems through integrated management and partnerships for the benefit of all.

5.4 Focal Values

In consultation with stakeholders, natural and cultural historic focal values were identified, explicitly defined, and selected for their ability to represent the full suite of biodiversity and cultural historic heritage within the SCWHS&NR.

Focal values are summarised in Table 5.1. Features considered to be nested within or catered for by the conservation of the focal value, are noted. Key human wellbeing values derived from the tangible natural and cultural focal values are also noted. Since human wellbeing values are those components of wellbeing affected by the status of tangible natural or cultural values, their ‘health’ or status is not assessed separately, but seen as contingent upon the status of the natural and cultural focal values selected.

Table 5.1: Summary of the Swartberg Complex World Heritage Site and Nature Reserves focal values and viability as at 2019.

Focal Value	Description, Nested Values, Key Attributes and Associated Human Wellbeing Values	Current Status
Fynbos Mosaics	<p>Description: Comprising Fynbos and fire-dependant vegetation types and the associated flora and fauna species.</p> <p>Nested values of note: <i>Protea</i> indicator species populations; Cape leopard populations; Cape Sugarbird populations; ecotypical antelope species populations.</p> <p>Associated human wellbeing value(s): Sustained supply of clean, fresh and potable water; habitat for biological ecosystems and species; pollination services; carbon storage; tourism and nature-based values and opportunities (scenic natural landscapes; sense of place; recreational activities); natural (horticultural, medicinal, genetic, food, building materials) products; soil formation and retention; flood control; spiritual and physical health.</p>	Fair
Succulent Karoo and Subtropical Thicket Mosaics	<p>Description: Comprising of Succulent Karoo and Subtropical Thicket vegetation types and associated flora and fauna species.</p> <p>Nested values of note: Cape leopard populations; ecotypical faunal species populations; spekboom restoration potential; heuweltjies condition and health; biogenic crust condition.</p>	Poor to

Focal Value	Description, Nested Values, Key Attributes and Associated Human Wellbeing Values	Current Status
	<p>Associated human wellbeing value(s): Water recharge; carbon sequestration and storage; fodder provision; habitat for biological ecosystems and species; tourism and nature-based values and opportunities (scenic natural landscapes, sense of place); natural (horticultural, medicinal, genetic) products; pollination services; flood control; soil formation and retention; pollution mitigation; spiritual and physical health.</p>	Fair
Freshwater Ecosystems	<p>Description: Comprising of all natural perennial and seasonal streams and rivers, brack water rivers and floodplains, seeps and wetlands.</p> <p>Nested values of note: Groundwater dependant ecosystems and species, lowland and high altitude wetlands and seeps, freshwater invertebrates, fish communities, riparian zone, rivers.</p> <p>Associated human wellbeing value(s): Sustained supply of clean, fresh and potable water; groundwater replenishment; reservoirs for biodiversity; pollination services; nutrient and water cycling; soil formation; flood control; water and erosion regulation; freshwater and natural products; spiritual and physical health; tourism and nature-based values and opportunities (scenic natural landscapes; sense of place; recreational activities); climate change mitigation and adaptation.</p>	Fair to Good to Very good
Cape mountain zebra	<p>Description: Comprising of the genetically unique Cape mountain zebra populations on Gamkaberg and Kammanassie.</p> <p>Nested values of note: Mountain to lowland migratory corridors and connectivity; fresh water availability; habitat expansion.</p> <p>Associated human wellbeing value(s): Knowledge growth opportunity; tourism and nature based values and opportunities; survival of iconic species; spiritual and physical health.</p>	Poor
Heritage Resources and Rural Landscapes	<p>Description: Comprising of tangible heritage features such as rock art, artefacts, palaeontological sites, cultural historical sites, structures and roads, as well as the rural landscapes within the ZOI.</p> <p>Nested values of note: National Monuments (e.g. Cango and Boomplaas Caves), historic buildings (Gamkaskloof) and roads (Swartberg Pass, Rooiberg Pass, Seweweekspoort, Meiringspoort, Toorwaterpoort, Cherridouwpoort), rock art sites, structures (graveyards, old kraals).</p> <p>Associated human wellbeing value(s): Spiritual and physical health and cultural identity; tourism and nature based values and opportunities; access and transport routes.</p>	Good

As the public entity responsible for nature conservation in the Western Cape, CapeNature delivers a suite of core services to the public towards the following outcomes: resilient ecosystems; the promotion of local economic development, job creation and skills development; growing diversified nature-based revenue streams; access to environmental education, advocacy and education, and access to natural and cultural heritage.

Human wellbeing is articulated as an outcome of conservation and is illustrated in Table 5.2. These focus areas are essential to the effective execution of this management plan and achievement of goals.

Table 5.2: Human wellbeing values of the Swartberg Complex World Heritage Site and Nature Reserves.

Human wellbeing Values	Description and Associated Benefits	Current Status
Water security and environmental resilience	Description: Healthy ecosystems protect and enhance the provision of water quality and quantity and contributes to the water resilience for the Breede-Gouritz Catchment Management Area. Key attributes: Access to clean water in sufficient quantity.	Good
Security from natural disasters	Description: A healthy and intact environment provides security from natural disasters such as wild fire, drought and flooding for the benefit of the target communities. Key attributes: Natural protection from flooding, Environmentally sound development, Mechanisms to enable coordinated disaster management.	Good
Freedom of choice and capacity to act independently, tourism and nature-based economic opportunities	Description: Socio-economic development is sustainably facilitated and maintained. Ecosystems are in tact and healthy and thus add economic value to ecotourism products that are in line with zonation. Key attributes: Access to employment opportunities, Access to capacity and skills development opportunities, Tourism infrastructure, Access to environmental awareness and education opportunities, Mechanisms to enable tourism enterprises (e.g. small, medium and micro enterprises), Intact ecosystems and abundant wildlife.	Good

5.5 Threats

Protected area management aims to mitigate threats to values, either through direct threat mitigation, or through mitigation or management of a factor contributing to or driving the threat. Threats to focal values and the relevant contributing factors of key threats need to be described in sufficient detail to support effective planning and management.

Threats assessment influences the direction and effectiveness of management options. Rating threats according to scope, severity and irreversibility of impact facilitates the allocation of limited resources, simplifies SCWHS&NR scenarios and provides a systematic decision support method to focus efforts.

Table 5.3 provides a summary of focal values against key threats for the SCWHS&NR.

Table 5.3: A summary rating of critical threats, highlighting the natural and cultural historic focal values at greatest risk within the Swartberg Complex World Heritage Site and Nature Reserves.

Focal Values	Critical Threats	Threat Rating
Cape mountain zebra (metapopulation)	Hybridisation risk; land clearing (inappropriate agricultural activities); over-abstraction of surface and groundwater; habitat fragmentation and alteration; inappropriate fire regimes.	Very High
Fynbos Mosaics	Inappropriate fire regimes; temperature and weather extremes; harvesting of indigenous flora; hunting and collection of indigenous fauna; illegal mining and quarrying; habitat fragmentation and alteration; alien invasive flora; alien invasive fauna; over-abstraction of	High

Focal Values	Critical Threats	Threat Rating
	surface and groundwater; persecution (loss) of animals related to human-wildlife conflict; over-stocking and over-grazing; commercial bee industry impact on indigenous pollinators.	
Freshwater Ecosystems	Inappropriate fire regimes; temperature and weather extremes; alien invasive fauna and flora; over-abstraction of surface and groundwater; riparian and instream modifications; pollution.	High
Succulent Karoo and Subtropical Thicket Mosaics	Temperatures and weather extremes; harvesting of indigenous flora; hunting and collection of indigenous fauna; Illegal mining and quarrying; alien invasive flora; over-abstraction of surface and groundwater; pollution; persecution (loss) of animals related to human-wildlife conflict; land clearing; over-stocking and over-grazing; flight paths; commercial bee industry impact on indigenous pollinators.	High
Cultural Heritage and Rural Landscapes	Vandalism to cultural heritage sites; littering; inappropriate fire regimes; temperature and weather extremes; harvesting of indigenous flora; recreational activities; hunting and collection of fauna; illegal mining and quarrying; habitat fragmentation and alteration.	Medium

The results of the above threat rating highlighted the following key threats affecting the focal values of the SCWHS&NR as outlined in Table 5.4 below.

- Over-abstraction of surface and groundwater (High):** The extensive drought experienced in the SCWHS&NR from 2015 to the present indicates that the current demand for water is exceeding the available water supply. Although groundwater abstraction is considered the easiest and most affordable form of water provision to the agricultural and urban sectors during periods of drought, over-abstraction from groundwater sources will impact negatively on the recharge of freshwater ecosystems (see section 2.3.2.1). A lack of enforcement and capacity contribute to the exploitation of surface and groundwater supply. The KKRWSS has been abstracting groundwater from within and around the Kammanassie since 1993 for bulk water supply purposes to the town of Dysselsdorp and the rural communities between De Rust and Calitzdorp (see Appendix 2 Map 10c). Increased abstraction of groundwater has had ecological impacts on freshwater (rivers and wetlands) and terrestrial ecosystems in the Kammanassie, resulting in springs completely drying up. Over-abstraction and the associated effects of drawdown (reduction of the hydraulic head in an aquifer / well due to pumping) and impact on groundwater-dependent ecosystems are not yet well-understood. Currently an existing operational wellfield for large-scale groundwater utilisation is situated on the western and around the southern side of the Kammanassie, with plans to upscale. Prince Albert Municipality is abstracting groundwater for urban use from the base of the northern slopes of the Groot Swartberg. A massive groundwater abstraction project (Deep Artesian Groundwater Exploration for Oudtshoorn Supply; DAGEOS) to augment the water supply for the greater Oudtshoorn and possibly Calitzdorp areas is currently being developed. Although the wellfield is situated at Blossoms between Oudtshoorn and George, the potential impact of this scheme is currently uncertain. In addition, a proposal to investigate

groundwater abstraction at Seweweekspoort for bulk supply purposes to the Zoar community is also in the pipeline. It is expected that similar projects will be investigated in order to address water shortages as a result of the impacts of climate change (see section 2.2.1).

- **Inappropriate fire regime (High):** Too frequent, too large and out of season fires have severe ecological impacts. Although most fires are caused through natural ignitions (lightning strikes) the climatic conditions during the current drought period (excessive winds, heat, low rainfall) result in large and uncontrollable fires. Over the past 10 years the size of fires has increased significantly (see section 2.3.1.5), resulting in very large proportions of the SCWHS&NR consisting of young veld. In addition, fires have become more frequent with large areas burning at too short return intervals and this is impacting negatively on indicator species, biodiversity, and potentially also on water supply (Esler *et al.* 2014). There is also a general lack of knowledge about the direct and indirect impacts of uncontrollable fires and enforcement is limited.
- **Invasive alien flora (Medium):** Freshwater ecosystems, Fynbos mosaics, Succulent Karoo and Subtropical Thicket focal values are threatened by invasive alien flora. *Pinus*, *Hakea* and *Acacia* species are amongst the most problematic woody invasive species in all three clusters and the surrounding areas, although several other species, such as *Nerium*, *Tamarix* and *Populus* species, are also problematic in the low-lying drainage areas (see section 2.3.1.3).

Although most of the area is under low infestations it requires sustained active management intervention to prevent it from impacting on species diversity and ecosystem services. Invasive alien trees have a major negative impact on our limited water resources and it is estimated that 6.7% of the water runoff of the entire country is used by these plants (Le Maitre *et al.* 2000; Van Wilgen *et al.* 2008; Van Wilgen & De Lange 2011). Moreover, it has been argued that the future impacts of invasive alien species may be much higher than anticipated, especially on surface water runoff, groundwater recharge and biodiversity (Van Wilgen *et al.* 2008) and will in all likelihood continue to spread faster than they can be cleared (Van Wilgen *et al.* 2016). The water yield from mountain catchments invaded by invasive alien species may reduce by more than 30% over 20 years of invasion (Van Wilgen *et al.* 2001).

The presence of invasive alien plant species within the riparian zones has been identified as a threat to river ecosystems. The removal of invasive alien plants should be prioritised for maintenance of the riparian zones, especially for rivers in the high water yield catchments. Not only will this improve the health of the riparian zones and the instream environments, but it will also allow for the release of high quality water.

- **Invasive alien fauna (Medium):** Invasive alien fish affect indigenous fish species through predation and competition for resources and can cause localised extinction of native species (see section 2.4.3). Other invasive alien (extra-limital) animals (such as impala, nyala, etc.) are a threat as they compete with indigenous animals for habitat and food resources. These species require active interventions to prevent invasions.
- **Harvesting of indigenous flora and hunting/collecting of indigenous wild animals (Medium):** Both threats ranked medium for now and are applicable to biological resource use. International and local demand of indigenous fauna

and flora for commercial, subsistence and valuable collector's items is increasing significantly. According to Vlok and Raimondo (2011), *Cyclopia plicata* found in the Kammanassie is becoming severely threatened due to illegal harvesting and showing no signs of regrowth once harvested. In addition, over-harvesting of *Cyclopia intermedia* (bergtee) in certain areas has resulted in decreased population sizes and poor seedling recruitment following fires. Seven species of the *Colophon* (stag-beetles) that are endemic to specific high altitude areas of the Swartberg Mountains are threatened due to international trade amongst beetle enthusiasts or collectors. Colophons are high in demand because they are so rare. Unfortunately, the excessive demand for specific fauna and flora species and / or their by-products is contributing to the loss of species and/or populations. Ineffective monitoring or the lack of enforcement are contributing factors to indigenous fauna and flora being illegally harvested within the ZOI (see section 2.4.6).

- **Land clearing and inappropriate agricultural activities (Medium):** This includes tourism developments, agricultural expansion, overstocking and over-grazing. Agricultural practices such as commercial ostrich farming, vegetable and fruit production, goats, sheep and game farming lead to habitat alteration. Loss of topsoil, vegetation cover and palatable species, especially in the Succulent Karoo and Subtropical Thicket habitat types, can be severe due to over-grazing. Restoration of these systems are very costly and may take decades to recover, if at all (see section 2.3.1.4).
- **Management shortcomings (hybridisation risk with other equids and lack of genetic mixing) (Medium):** According to Hrabar *et al.* (2019) this includes further loss of genetic diversity in Cape mountain zebra through inbreeding caused by small subpopulation sizes and/or small property sizes and hybridisation with Burchell's zebra. The inability to carry out necessary management actions due to shortfalls in human and financial resources is a constraint. Management recommendations that have been suggested (such as founder population size and reinforcement of existing populations) have not been implemented consistently and this is due to the inability to carry out and enforce such recommendations (Hrabar *et al.* 2019). The constraints associated with the African Horse Sickness movement protocols hamper the translocation of family groups across different zones, thus also contributing to management shortcomings.
- **Commercial bee industry's impact on indigenous pollinators (honey bees, solitary bees and other species) (Medium):** The commercial bee industry for crop pollination is a growing economic activity performed by both small and large scale farmers in South Africa. Commercial pollination services move honey bees between localities to pollinate crops that flower at different times of the year resulting in competition for forage and interbreeding with wild bee populations (see section 2.4.1).
- **Temperature and weather extremes (i.e. climate change) (High):** This affects all the focal values within the SCWHS&NR. It has significant environmental, social, cultural and economic consequences for natural and social systems. There are clear indications of increased fire frequencies and sizes, prolonged drought events (see section 2.2.1.1), extreme temperatures and occurrences of flash flooding in the area. Thus the importance of creating

landscape and ecological corridors as a strategy to mitigate and adapt to the impacts of climate change is crucial.

Table 5.4: Rating of key threats applicable to the Swartberg Complex World Heritage Site and Nature Reserves.

Threats	Associated Focal Values	Summary Threat rating
Inappropriate fire regimes	Fynbos mosaics; freshwater ecosystems; Cape mountain zebra; cultural heritage and rural landscapes.	High
Temperature and weather extremes	Fynbos mosaics; Succulent Karoo and Subtropical Thicket mosaics; freshwater ecosystems.	High
Over-abstraction of surface water	Fynbos mosaics; Succulent Karoo and Subtropical Thicket mosaics; Cape mountain zebra; freshwater ecosystems.	High
Over-abstraction of groundwater	Fynbos mosaics; Succulent Karoo and Subtropical Thicket mosaics; freshwater ecosystems.	High
Harvesting of indigenous flora	Fynbos mosaics; Succulent Karoo and Subtropical Thicket mosaics; cultural heritage and rural landscapes.	Medium
Hunting & collection of indigenous fauna	Fynbos mosaics; Succulent Karoo and Subtropical Thicket mosaics; cultural heritage and rural landscapes.	Medium
Alien invasive fauna	Fynbos mosaics; Succulent Karoo and Subtropical Thicket mosaics; cultural heritage and rural landscapes.	Medium
Alien invasive flora	Fynbos mosaics; Succulent Karoo and Subtropical Thicket mosaics; freshwater ecosystems.	Medium
Land clearing (Inappropriate agricultural activities)	Succulent Karoo and Subtropical Thicket mosaics; Cape mountain zebra.	Medium
Over-stocking and over-grazing (Inappropriate agricultural activities)	Fynbos mosaics; Succulent Karoo and Subtropical Thicket mosaics.	Medium
Management shortcomings (Hybridisation risk with other equids and lack of genetic mixing)	Cape mountain zebra.	Medium
Commercial bee industry Impact on indigenous pollinators (honey bees, solitary bees and other species)	Fynbos mosaics; Succulent Karoo and Subtropical Thicket mosaics.	Medium
Flight paths	Succulent Karoo and Subtropical Thicket mosaics.	Low
Illegal mining and quarrying	Fynbos mosaics; Succulent Karoo and Subtropical Thicket mosaics; cultural heritage and rural landscapes.	Low
Littering	Cultural heritage and rural landscapes.	Low
Recreational activities	Cultural heritage and rural landscapes.	Low
Habitat fragmentation and alteration (roads, fencing etc.)	Fynbos mosaics; Cape mountain zebra; cultural heritage and rural landscapes.	Low
Vandalism to cultural heritage sites	Cultural heritage and rural landscapes.	Low
Riparian and instream modifications	Freshwater ecosystems.	Low
Pollution (oil/diesel spills, agricultural run-off)	Succulent Karoo and Subtropical Thicket mosaics; freshwater ecosystems.	Low

Threats	Associated Focal Values	Summary Threat rating
Persecution (loss) of animals related to human-wildlife conflict (jackal, caracal, leopard, baboons, kudu, eland, bat-eared fox (bycatch), etc.)	Fynbos mosaics; Succulent Karoo and Subtropical Thicket mosaics.	Low

5.6 Goals

Clear and measurable outcome-based goals, strategies and objectives are fundamental for the assessment of protected area management effectiveness and to the whole process of management itself. Based on the viability and threats assessment, a desired future condition was established for focal values and core service areas by setting measurable, time-bound goals directly linked to the values and their key attributes.

Goals of the Swartberg Complex World Heritage Site and Nature Reserves:

To maintain the healthy ecological infrastructure that supports life on earth and climate change resilience, management needs to achieve the following:

1. By 2030 the invasive alien plant infestation will be maintained at less than 2% and all high altitude team (HAT) sites would have been cleared 99%.
2. By 2030 the veld age will be in an ecologically healthy condition and 50% of the *Protea* indicator species have flowered more than three times; 80% of fires have occurred in the correct fire season and the size of 90% of single fires would not have exceeded 5000 ha.
3. By 2030 the ecosystem health condition of all wetlands in the SCWHS&NR will have a near natural condition and have good wetland buffers. (Wetlands include seepage areas.)
4. By 2030 river flow of abstracted rivers is maintained above 80%.
5. By 2030 there will be an established groundwater monitoring programme to improve the understanding of groundwater dependent ecosystems.
6. By 2030 three priority properties will have signed perpetuity stewardship agreements and another two as biodiversity agreements or higher within priority corridors.
7. By 2030 Cape mountain zebra will have 10-20 breeding family groups with a ratio of 1:3 (stallion: mares) and bachelor herds present with no unnatural mortalities and between 5-10% births* per year with the entire population body condition** falling in 2 or above. (* 5-10% of total populations on Gamkaberg and Kammanassie; ** body condition 1 = very thin/poor, 2 = lean/moderate, 3 = healthy/good).

8. By 2030 allelic diversity in some Cape mountain zebra populations is increased.
9. By 2030 no hybrid individuals of Cape mountain zebra would have been recorded and allelic diversity has been restored at meta-population level.
10. By 2030 all rivers within the SCWHS&NR are maintained in a healthy state to support fish species of conservation concern.
11. By 2030 all domestic livestock, extra-limital and invasive faunal species are removed or appropriately managed within the SCWHS&NR.
12. By 2030 an integrated compliance and enforcement programme is being implemented.
13. By 2030 biodiversity and ecosystems, and sustainable and regulated resource use are in accordance with applicable legislation, CapeNature policies and procedures.
14. By 2030 all human disturbance to heritage features within the SCWHS&NR is limited to maintain, or where feasible, improve condition.
15. By 2030 anti-litter, energy and water saving campaigns within the SCWHS&NR are contributing towards a healthy environment.
16. By 2030 the natural and scenic landscapes are recognized and preserved as important landscape features providing ecosystem services that support human wellbeing.

Achieving human wellbeing, derived from healthy responsibly-managed ecological infrastructure and heritage, requires that:

17. By 2030 access to environmentally responsible infrastructure*, intact ecosystems and optimal biodiversity adding economic value to ecotourism products and socio-economic development is sustainably facilitated and maintained. (*Aligned with the zonation scheme.)
18. By 2030 the SCWHS&NR provides managed opportunities for accessing nature and nature-based activities in a manner which is not harmful to the natural environment.
19. By 2030 the coordinated disaster management plan will promote and facilitate security from natural disasters, for example (but not limited to) wild fire, drought and flooding for the benefit of the target communities.
20. By 2030 the SCWHS&NR will, through integrated catchment management, protect and enhance the provision of water quality and quantity contributing to the water resilience for the Breede-Gouritz catchment management area.

5.7 Sensitivity Analysis

Sensitivity analysis based on the SCWHS&NR's biodiversity, heritage and physical environment is a key informant for spatial planning and decision-making in protected areas. Sensitivity analysis aims to:

- Highlight areas containing sensitive biodiversity and heritage features;
- Inform all infrastructure development, e.g. location of management and tourism buildings and precincts, roads, trails, firebreaks;
- Facilitate holistic reserve planning and zonation; and
- Support conservation management decisions and prioritisation of management actions.

At the regional scale, sensitivity mapping also allows for direct comparison of sites both within and between protected areas to support organisational planning across CapeNature's protected areas network. The process elevates:

- Sites with the highest regional conservation value;
- Areas where human access or disturbance will have a negative impact on biodiversity or heritage, and specific environmental protection is required;
- Areas where physical disturbance or infrastructure development will cause greater environmental impacts, and / or increasing construction and maintenance costs;
- Areas where there is a significant environmental risk to infrastructure; and
- Areas that are visually sensitive and need to be protected to preserve the aesthetic quality of the visitor's experience.

Sensitivity analysis provides decision support to ensure that the location, nature and required mitigation for access, utilisation and infrastructure development in the SCWHS&NR are guided by the best possible landscape-level biodiversity and heritage informants. The process is transparent, relying on defensible expert-derived information and scientific data. Sensitivity maps do not replace site-level investigation, although do allow for rapid assessment of known environmental risks, guiding planning to minimise negative impacts.

Sensitivity analysis uses a hierarchical approach. The method uses the premise that if a portion of the landscape is demarcated as highly sensitive in one of the categories considered in analysis then, regardless of the sensitivity in other categories, that portion is elevated as highly sensitive in the overall scoring. The approach thus allocates the highest allocated sensitivity in any of the input categories as the ultimate sensitivity class for that particular portion. As new and improved data become available, these data can be included.

Biodiversity, heritage and physical features are rated on a standard scale of one to five, where one represents 'no' or 'minimal sensitivity' and five indicates 'maximum sensitivity' (see Figure 5.1). Additional features such as visual sensitivity, fire risk and transport costs can be included. Higher scores represent areas that should be avoided for conventional access and infrastructure development, or where a specific strategy is applicable relative to sensitivity. A score of five typically represents areas where mitigation for conventional access or infrastructure development would be extensive, costly or impractical enough to be avoided at all costs, or features so sensitive that they represent a 'no go' area.

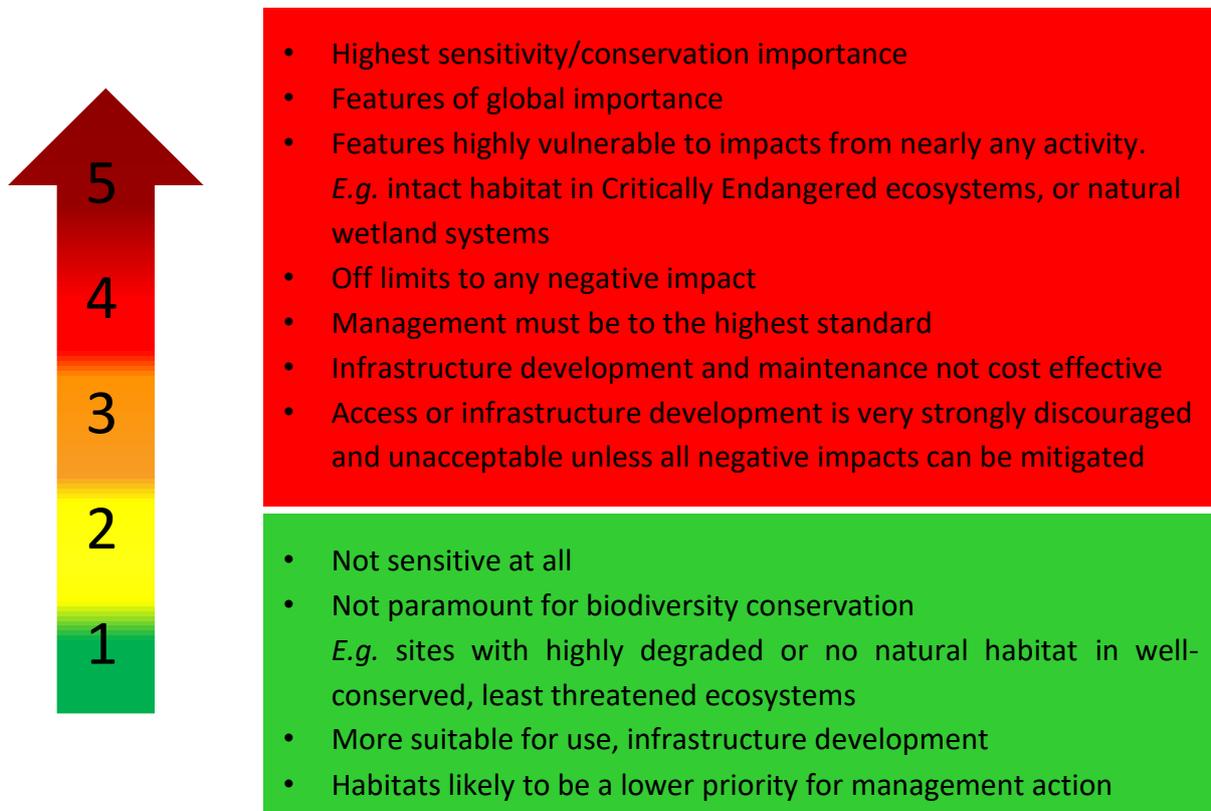


Figure 5.1: CapeNature method for sensitivity scoring and synthesis.

Physical, biodiversity and heritage features included in the sensitivity analysis for the SCWHS&NR are presented in Table 5.5.

Table 5.5: Physical biodiversity and heritage sensitivities included in the sensitivity analysis of the Swartberg Complex World Heritage Site and Nature Reserves.

Category		Dataset	Criteria	Sensitivity score	
Physical	Slope (degrees)	Slope calculated from 20m resolution digital elevation model	> 30° Effectively off-limits for infrastructure development due to extreme risk of erosion and instability, or extreme engineering mitigation and associated construction costs required.	Highest sensitivity	5
			20°-30° Strongly avoid for infrastructure development – cut and fill or other difficult and expensive construction method required. Appropriate engineering mitigation essential to prevent erosion and slope instability. Highest initial and on-going cost due to slope stabilization and erosion management required.	High sensitivity	4
			10°-20° Avoid for road, trail and firebreak construction if possible. Severe erosion will develop on exposed and unprotected substrates. Pave roads and tracks, and ensure adequate drainage and erosion management is implemented. May provide good views.	Moderate sensitivity	3

Category		Dataset	Criteria	Sensitivity score	
			5°-10° Low topographic sensitivity, likely still suitable for built infrastructure. Use of gentle slopes may provide improved views or allow access to higher areas.	Low sensitivity	2
			0°-5° Preferred areas for any built infrastructure, lowest risk of erosion or instability, lowest construction and on-going maintenance costs.	Lowest sensitivity	1
	Soil erodibility/ Geology	None included	No special features identified for inclusion.	Highest sensitivity	5
	Soil erodibility	Soils and erosion were assessed based on major habitat types of Vlok <i>et al.</i> (2005) and Reyers <i>et al.</i> (2009)	Gannaveld is the most vulnerable to soil erosion due to limited soil retention capacity, as a result of sparse vegetation cover and root systems. Soils are fine and silty and stones are generally lacking (J. Vlok 2019, pers. comm.).	Highest sensitivity	5
			Aquatic ecosystems (Freshwater streams and seepage areas; River and floodplains) are highly sensitive to erosion, but are adapted to periodic flooding. Mesic Renosterveld occurs in moist habitats on clayey soils and is highly erodible when disturbed or overgrazed (J. Vlok 2019, pers. comm.).	High sensitivity	4
			Apronveld, Gravel Apronveld, Asbos-Gwarrieveld, Valley Spekboomveld and mosaics with Succulent Karoo, Fynbos or Renosterveld, Subalpine, Mesic Proteoid and mosaics with Waboomveld habitat types are more densely vegetated and/or quite stony to assist with soil retention.	Moderate sensitivity	3
			Arid Mosaic Fynbos, Grassy Fynbos and Mosaic with Waboomveld, Arid Proteoid, Arid Restioid, Waboomveld, Renoster-Sandolienveld, Mosaic Sandolienveld, Arid Spekboomveld with Thicket, Fynbos or Succulent Karoo, and Thicket Mosaic Renosterveld habitat types usually have dense root systems and good vegetation cover to retain soil.	Low sensitivity	2
			Ranteveld, Arid mosaics with Succulent Karoo or Renosterveld, Sandolien, Arid Asteraceous and Renosterveld mosaics with Waboomveld or Succulent Karoo habitat types generally have a good and dense perennial vegetation cover with well-developed root systems that retain soil.	Lowest sensitivity	1
	Biodiversity	Rivers	1: 50 000 NGI Rivers	Within 200m of perennial river	Highest sensitivity
For SCWHS&NR it was decided not to include the non-perennial river buffers due to "over estimation" of sensitivity. Sensitivity captured in the fine-scale vegetation map ratings.				High sensitivity	4

Category		Dataset	Criteria	Sensitivity score	
	Wetlands, Seeps and Springs	Localities of springs monitoring sites (2008-2017) as provided by reserve	Number of wetlands in the SCWHS&NR are just about non-existing. Therefore not included. Springs monitoring sites are highly susceptible by over-abstraction. Buffered the springs locality by 100m.	Highest sensitivity	5
	Grazing / browsing sensitivity	Sensitivity scoring based on major habitat types of Vlok <i>et al.</i> (2005), the species targeted and their availability (J. Vlok 2018, pers. comm.)	Rivers and floodplain and Apronveld habitat types occur on nutrient-rich soils and are rich in palatable species and are therefore highly targeted and thus very sensitive to the impacts of grazing and browsing.	Highest sensitivity	5
			Pruimveld, Valley Spekboomveld, Gravel Apronveld, Gannaveld, Waboomveld, Waboom-Renosterveld and Sandolien Mosaic Renosterveld habitat types occur on nutrient-rich soils and usually have many species that are palatable and targeted by browsers and grazers, and are thus sensitive to over-grazing.	High sensitivity	4
			Grassy Mosaic Waboomveld, Mesic Renosterveld, Mosaic Sandolienveld, Arid Mosaic Renosterveld, Ranteveld, Arid Spekboom with Thicket, Fynbos or Succulent Karoo, Arid Mosaic Asbosveld, Arid Mosaic Succulent Karoo, Mosaic Sandolienveld, Thicket Mosaic Renosterveld and Valley Spekboom with Fynbos or Renoster habitat types have several species that are palatable and targeted by browsers and grazers.	Moderate sensitivity	3
			Perennial streams, Mesic Proteoid Mosaic Waboomveld, Arid Mosaic Fynbos, Grassy Fynbos, Sandolien, Arid Asteraceous, and Mosaic Succulent Karoo habitat types generally occur on nutrient-poor soils and have limited grazing potential.	Low sensitivity	2
			All mountain fynbos (Arid Proteoid, Arid Restioid, Mesic Proteoid and Subalpine) habitat types have low grazing sensitivity as the species are not very palatable and are therefore not heavily targeted.	Lowest sensitivity	1
			Fine-scale vegetation unit statuses	Vegetation unit statuses based on Reyers & Vlok (2008) and Skowno <i>et al.</i> 2010).	Critically Endangered – Calitzdorp Gravel Apronveld.
	Endangered – Nooitgedacht Gwarrieveld, Central Swartberg Perennial Stream, Cango Renoster-Thicket, Calitzdorp Arid Spekboom. Gamkapoort Apronveld (not yet assessed) is likely to be Endangered because of historical over-grazing as a result of emergency grazing allowed by government previously.	High sensitivity			4
	Vulnerable – River and Floodplain vegetation units (Gamka, Gouritz and Olifants), Saffraanrivier Waboom-Renosterveld.	Moderate sensitivity			3

Category		Dataset	Criteria	Sensitivity score	
			Threatened – NONE	Low sensitivity	2
			Least threatened – all the remaining vegetation units within the domain.	Lowest sensitivity	1
	Vegetation status / Ecosystems threat status	Ecosystem Threat Status based on CapeNature's 2016 assessments per vegetation type 2012 (Mucina & Rutherford 2006)	Critically Endangered – NONE.	Highest sensitivity	5
			Endangered – NONE	High sensitivity	4
			Vulnerable – Eastern Little Karoo, Kango Limestone Renosterveld, Montagu Shale Renosterveld.	Moderate sensitivity	3
			Threatened - NONE	Low sensitivity	2
			Least threatened – Central Inland Shale Band Vegetation, Gamka Thicket, Kango Conglomerate Fynbos, Koedoesberge-Moordenaars Karoo, Matjiesfontein Quartzite Fynbos, North- & South Kammanassie Sandstone Fynbos, North- & South Rooiberg Sandstone Fynbos, North- & South Swartberg Sandstone Fynbos, Prince Albert Succulent Karoo, Southern Karoo Riviere, Swartberg Altimontane Sandstone Fynbos, Swartberg Shale Fynbos, Swartberg Shale Renosterveld, Western Gwarrieveld, Willowmore Gwarrieveld.	Lowest sensitivity	1
Rare and endangered plant species	Rare and endangered plant species extracted from CapeNature SOB Database, All threatened Species (www.redlist.sanbi.org)	All plant species rated as Critically Endangered, Critically Rare, Declining, Endangered, Near Threatened, Rare or Vulnerable. Point localities buffered by 5m.	Highest sensitivity	5	
Heritage	Archaeological & cultural sites	Cultural and Heritage Sites (CapeNature Infrastructure register)	Heritage sites as extracted from the reserve's infrastructure register. Files are in point shapefile format and was then buffered by 100m. Also digitized the historic railway route through Toorwater, and buffered the 3 historic road passes by 25m (Meiringspoort, Swartberg, and Seweweekspoort).	Highest sensitivity	5

The sensitivity of the SCWHS&NR is shown in Appendix 2 Map 12(a-d) and the proportions of areas captured by each of the main features contributing to the analysis are summarised in Table 5.6.

A total of 94.7% of the SCWHS&NR has a moderate to very high sensitivity (Table 5.6), with the key driver being slope sensitivity. In this instance therefore, the sensitivity analysis has been dominated by the steep topography of this mostly mountainous terrain, leaving only 14.5% of area scored as “low or lowest sensitivity” on the basis of slope.

Although the sensitivities of, for example, the ecosystem threat status and vegetation status are very low across the protected area (scored 97% and 93% respectively as “lowest sensitivity”), due to the methodology the majority of the protected area (75%) has been scored as “highest sensitivity” largely because of highest sensitivity scorings in the proximity to rivers and the slope categories. Most of the area scored low to lowest for grazing / browsing sensitivity because the habitat types in the mountainous areas occur mostly on nutrient-poor soils and have limited grazing potential.

Table 5.6: Summary of total and percentage area captured by the main features contributing to the sensitivity analysis illustrated in Appendix 2 Map 12(a-d).

Score	Total sensitivity score		Main features								
	Area (ha) = 198 713.4	% of total	Slope sensitivity % of total	Soil erodibility % of total	Perennial rivers % of total	Springs % of total	Ecosystems threat status per vegetation type % of total	Fine-scale vegetation status % of total	Grazing / browsing sensitivity % of total	Spp of special concern % of total	Heritage and cultural sensitive sites
1	0.0	0.0	5.3	5.6	-	-	97.3	93.7	42.5	-	-
2	10 568.6	5.3	9.2	56.7	-	-	-	-	28.2	-	-
3	45 182.5	22.7	25.1	28.0	-	-	0.8	3.6	12.3	-	-
4	72 650.0	36.6	30.2	9.6	-	-	-	2.3	13.9	-	-
5	70 312.4	35.4	30.1	0.1	4.6	0.0	-	0.4	3.1	0.0	0.3

6 ZONING PLAN

This section outlines the zoning plan for the SCWHS&NR. The protected area network forms part of a planning matrix and locating the SCWHS&NR in terms of the municipal integrated development plan is aimed at minimising conflicting development in either the protected area or the neighbouring municipal area.

The primary objective of the zoning plan is to establish a coherent spatial framework within and around the SCWHS&NR to guide and co-ordinate conservation, tourism and visitor experience, access and utilisation, and stakeholder and neighbour relations.

Zoning is intended to minimise user conflict by separating potentially conflicting activities such as wildlife viewing, recreational activities and tourism accommodation, whilst ensuring that activities and utilisation continues in appropriate areas and do not conflict with the goals and objectives of the SCWHS&NR.

6.1 The Swartberg Complex World Heritage Site and Nature Reserves in the context of Municipal Integrated Development Planning

The SCWHS&NR falls within the Garden Route and Central Karoo District Municipalities in the Western Cape Province and a very small section of the Sarah Baartman District Municipality in the Eastern Cape Province. There are six local municipalities covering this protected area network, namely Oudtshoorn, Kannaland, George, Prince Albert and Laingsburg Municipalities in the Western Cape Province and the Dr Beyers Naudé Municipality in the Eastern Cape Province (see Appendix 2 Map 1). Integrated Development Plans are compiled annually and for five year periods by all municipalities in South Africa in order to establish prioritisation and allocation of budget expenditure in terms of development priorities.

SDFs are compiled in order to illustrate current and desired future land uses spatially across the municipality and link in to the IDP in terms of the spatial allocation of the municipal budget. As such, there are two IDPs and five SDFs which need to be taken into consideration for the SCWHS&NR, in terms of alignment between statutory initiatives at the three tiers of government and management of the protected areas and identification of risks and interventions required. The IDP and SDF should be taken into consideration in determining the ZOI and establishing potential threats and opportunities in these areas. There is also the opportunity to identify projects and interventions that need to be included in the IDPs and SDFs where appropriate and within the legislated stakeholder engagement processes.

6.1.1 Garden Route District Municipality Integrated Development Plan and Spatial Development Framework

The Garden Route District Municipality Integrated Development Plan comprises seven local municipalities of which three include parts of the SCWHS&NR. These are the George, Kannaland and Oudtshoorn Municipalities. The inland areas of the Garden Route District Municipality is characterized by rural, farming settlements and small towns. In some cases these areas are rather isolated due to transport and social service delivery costs. The Garden Route District Municipality highlights the impacts of climate change with the frequency of natural disasters increasing such as drought, flooding, fires, animal diseases and environmental degradation. Due to this the Garden Route District Municipality identifies the importance of conserving biodiversity and water resources and aims to:

- Conserve the natural environment and improve disaster risk management of fires and floods;
- Focus on the supply of bulk water storage and improved water management;
- Preserve wetlands which are natural barriers to flooding events; and

- Identify alternative routes for hazardous materials and those that are closed due to disasters.

Biodiversity management projects implemented by the Garden Route District Municipality to prevent the loss of critical biodiversity areas, ecosystems becoming more threatened or a decline in the conservation status of a species are listed in Table 6.1.

6.1.1.1 George Municipality Integrated Development Plan (2017 – 2022)

Uniondale is the only town within the George Municipal Area that falls within the SCWHS&NR. Disaster Risk Reduction plans for fire management purposes and drought are a priority due to the disastrous effects of the 2017 and 2018 fires and specifically mention that CapeNature is one of several responsible agencies other than the municipality to help address and reduce fire risks for the region and ensure that the ongoing processes relating to river health are in place. In addition the need for a multi-faceted/multi-stakeholder conservation plan for all areas of biodiversity must be drawn up to reduce future environmental hazards.

6.1.1.2 Oudtshoorn Municipality Integrated Development Plan (2017 – 2022)

Oudtshoorn Municipality lies at the foot of the Swartberg Mountains in the Klein Karoo, formerly home to the indigenous Khoi-San people whose rock paintings on many cave walls and overhangs are still evident today thus necessitating respect for the region's natural and cultural heritage. Oudtshoorn's natural environment and scenic landscapes has created a booming tourism and hospitality industry. In terms of the SCWHS&NR, Oudtshoorn Municipality includes the towns of De Rust, Dysselsdorp and Oudtshoorn and many smaller rural settlements. Specific reference is made to the Swartberg, Gamkaberg and Kammanassie Nature Reserves and the natural heritage values that these protected areas provide. Budget allocations have been set aside for technical services for the Blossoms groundwater project and to the EPWP allocated to CapeNature for alien vegetation management and protected area management infrastructure to benefit community members from various municipal wards.

6.1.1.3 Kannaland Municipality Integrated Development Plan (2017 – 2022)

Kannaland Municipality encompasses the towns of Ladismith and Calitzdorp. Kannaland is renowned for its cheese factories and the production of world famous dairy and wine products. Protected areas cover approximately 30.4 % of Kannaland's planning domain. The protection of the rural character and sensitive natural environments is important together with implementing mitigation measures against climate change. Kannaland recognizes the important ecosystem services that is provided by biodiversity such as the provision of clean water which also supports local economies such as fishing, tourism, food, medicines, building materials and the overall improvement of human wellbeing. Climate change and the effects thereof are to be incorporated into a Disaster Management Plan and linked to initiatives undertaken by the Garden Route District Municipality. The following risks applicable to the SCWHS&NR have been identified namely veld and structural fires, drought and severe weather. Community development and economic growth are one of the many objectives identified by the municipality with the tourism industry adding significantly to the local economy.

6.1.2 Central Karoo District Municipality Integrated Development Plan and Spatial Development Framework

The Central Karoo District Municipality IDP comprises three local municipalities, namely Beaufort West, Laingsburg and Prince Albert. In the IDP the environmental context is recognized within which integrated development planning should occur and it specifically highlights the need to protect the sensitive ecosystems of the Central Karoo while at the same time trying to address socio-economic needs.

Persistent drought with below average rainfall and very low to empty farm dams is making groundwater provision to the area even more important and ecological infrastructure such as non-perennial streams and periodic drainage lines are viewed as extremely important for the provision of good water quality to many dams.

Shale gas development in the Karoo Basin, otherwise known as “fracking”, is specifically mentioned within the IDP as a contentious issue but is still considered as a theoretical proposal and that the need for information is still a primary aim of the exploration phase in understanding the extent of the shale gas resource as well as the receiving environment. Department of Environmental Affairs and Development Planning (DEA&DP) supports exploration conducted in a phased manner, with evidence-based decision making. Only once this information has been considered will an informed decision to move into the production phase for shale gas development be taken.

Three environmental planning tools have been developed to ensure sound environmental management, namely integrated waste management, air quality and biodiversity assessment plans.

Social development statistics within the IDP reveal alarming information on unemployment, poverty, low levels of education and children on the streets within the Central Karoo. The EPWP has been identified as an important project to alleviate poverty through creating work opportunities and skills for the unemployed. The SCWHS&NR provides job opportunities linked to the IDP.

Aspects of the IDP that are related to biodiversity and the SCWHS&NR are summarised in Table 6.1 below.

6.1.2.1 Laingsburg Municipality Integrated Development Plan (2017 – 2022)

Laingsburg Municipality includes the historic settlement of Matjiesfontein, which was established in 1884. One of the most important sources of income for Laingsburg is passing traffic as it is situated on the N1 between Cape Town and Beaufort West. Rural agriculture, mainly sheep farming and the production of soft fruits characterise this area, however, the potential for fruit production is negatively affected by poor roads and long distances to major centres. Approximately 96% of the land is in a natural state, this being the highest for any other municipality in the Central Karoo District. Towerkop (Klein Swartberg), Gamkaskloof and Gamkapoort Nature Reserves are listed as a Type 1 areas. Laingsburg Municipal area is rich in cultural heritage, but unfortunately those sites situated in the town of Laingsburg were destroyed during the 1981 flood. The South African Heritage Resource Agency (SAHRA) and Heritage Western Cape are in the process of compiling a heritage register. Gamkaskloof settlement is one of many heritage sites that are yet to receive heritage status. In terms of the impact of climate change, water availability is the most important limiting factor

for crop production in the Laingsburg area. Uranium is currently being explored with approximately 7644 hectares of mining applications in process. Mining and quarrying was identified as a threat for the SCWHS&NR (although a low-ranked threat for now).

6.1.2.2 Prince Albert Municipality Integrated Development Plan (2017 – 2022)

Prince Albert is situated on the northern side of the Swartberg Mountain Range. Large areas are under agricultural production, mainly fruit and sheep farming. Many Europeans have purchased property in Prince Albert, thus contributing to the economic growth of the region. The town has lately become known as “the little town with Victorian and Karoo type architecture” with many side walk coffee, art and décor shops. The scenic beauty of the Swartberg valley and Meiringspoort attracts hundreds of visitors to the region annually. In 2016 all areas falling within the Prince Albert Municipality were declared a drought disaster area and this is still applicable at present. Drought mitigation measures were put in place whereby boreholes were sunk at Klaarstroom and Leeu Gamka. The prolonged drought has had negative effects to farming practices, household access to drinking water, vegetation cover and many job losses in the farming sectors. Excessive groundwater abstraction has been identified as a major threat for the SCWHS&NR (see section 2.3.2.1).

6.1.3 Sarah Baartman District Municipality and Dr Beyers Naudé Local Municipality Integrated Development Plans (2017-2022)

The Sarah Baartman District Municipality IDP comprises seven local municipalities in the Eastern Cape Province, only one of which is of relevance here, namely the Dr Beyers Naudé Municipality.

A narrow strip along the north-eastern part of Swartberg East occurs within the Sarah Baartman District and Dr Beyers Naudé Local Municipalities. The closest town is Willowmore, situated approximately 30 km northeast of the Swartberg East boundary. Agriculture is the main land use adjacent to the sector.

Water provision and acquisition are one of the greatest challenges within these municipalities. Groundwater is the primary source of water for human use and agricultural activity, which is one of the drivers of the economy in the district. However, the area has been subject to an extended drought for several years now and groundwater is entirely dependent on rainfall for recharge. Supply boreholes to towns and villages have dried up and water quality has deteriorated to levels that are unsafe for human consumption during these periods. As a result a Local State of Disaster has been declared within the district. A business plan for drought relief interventions for the district was prepared and submitted to Provincial Disaster Management Centre.

Investing in natural capital through protecting and restoring natural resources and ecosystems such as catchments, wetlands, rivers, forests and other natural areas to preserve biodiversity, to ensure sustainable water supplies as well as to exploit the economic potential of such areas is a key strategy identified in the IDP. The growth of tourism in the region is strongly associated with the exceptional and diverse natural assets. Key approaches to this include: promoting and incentivising natural resource restoration and conservation including alien vegetation clearing, developing eco-systems markets that reward land restoration through e.g. carbon credit mechanisms; creating new generation green jobs and local income streams rooted in renewable

energy; and growing the rural tourism economy based on natural capital through agri-adventure- and ecotourism initiatives.

Three environmental planning tools have been developed to ensure sound environmental management, namely integrated waste management, air quality and biodiversity assessment plans.

Table 6.1: Aspects of Integrated Municipal Development Plans applicable to biodiversity and the Swartberg Complex World Heritage Site and Nature Reserves.

Municipality	Aspect in IDP to be addressed	Proposed Intervention by CapeNature
Garden Route District Municipality	Manage increased impacts on threatened ecosystems.	Partner with municipalities and other roleplayers to address impacts collaboratively.
	Invasive alien vegetation clearing.	Integrate with CapeNature operations and raise awareness.
	Manage increased impacts on environment due to land-use change.	Provision of comments through the formal application processes.
	Manage the loss of priority wetlands and river ecosystems.	Address the loss of priority wetlands and river ecosystems through active interventions and involving relevant partners.
	Biodiversity stewardship	Provide support to landowners and raise awareness.
	Prioritisation, valuation, mapping, protection and restoration of critical biodiversity and ecological support areas	Lead and participate in processes and raise awareness.
	Fire risk and Integrated Fire Management	Provision of Regional Fire Response plans and ensure integrated fire management. Actively raise awareness of CapeNature's suite of management products.
Water security, water quality, groundwater capacity, water consumption awareness	Raise awareness of the importance of ecosystem services provided by the SCWHS&NR (i.e. delivery of sustained flow of clean water to communities).	
Central Karoo District Municipality	Shale gas development in the Karoo Basin (fracking)	Identify as a risk. Provision of comments through formal application processes.
	Uranium mining	Identify as a risk. Provision of comments through the formal application processes.
	Cultural and Natural Heritage management	Raising awareness and address management issues where relevant and possible.
	Water security, groundwater abstraction	Identify as a risk. Provision of comments through formal application processes.
	Disaster risks: fires	Integrate with CapeNature operations and raise awareness.

6.2 Protected Area Zonation

The primary function of the SCWHS&NR is to conserve biodiversity. However, other functions such as ensuring access and providing benefits to neighbouring communities and local economies may conflict with this primary function.

The zonation plan is thus a standard framework and set of formal guidelines to balance conservation, access and utilisation within the SCWHS&NR, and is informed by the sensitivity analysis. Zonation:

- Is foundational to planning and development within the SCWHS&NR;
- Provides a framework for development of the SCWHS&NR;
- Recognises the purpose for which the SCWHS&NR is established;
- Ensures ecosystem resilience by limiting human intrusion in the landscape;
- Mitigates user conflict and minimises the impact of utilisation on natural and cultural heritage through access and activity management;
- Accommodates a range of activities ensuring that nature based recreation and experiences for solitude do not conflict with social and environmental requirements or needs; and
- Confines development within the SCWHS&NR to areas deemed appropriate to tolerate transformation without detracting from sense of place.

CapeNature’s zonation categories, illustrated in Table 6.2, are derived from existing protected area zonation schemes worldwide, to develop a coherent scheme that provides for visitor experiences, access and conservation management needs.

Table 6.2: Guide to CapeNature conservation management zones.

Zonation Category	Explanation
Wilderness / Wilderness (declared)	Areas with pristine landscape, sensitive areas or threatened ecosystems. Very limited access.
Primitive	Areas providing natural landscape, solitude and limited access. Normally a buffer area to wilderness zones.
Nature Access	Providing easy access to natural landscape. Includes areas with roads and trails, and access to popular viewing sites and other sites of interest.
Development – Low intensity	Area with existing degraded footprint. Providing primarily self-catering accommodation and camping, environmental education facilities.
Development – High intensity	Area extensively degraded. Providing low and/or higher density accommodation, and maybe some conveniences such as shops and restaurants.
Development – Management	Location of infrastructure and facilities for reserve administration and management.
Development – Production	Commercial or subsistence farming (applicable to privately owned and managed nature reserves).
Development – Private Areas	Private dwellings and surrounds (only applicable to privately owned and managed nature reserve).
Species / Habitat / Cultural Protection	Areas for protection of species or habitats of special conservation concern.
Cultural Species / Habitat Visual Natural Resource Access	Special management overlays for areas requiring specific management interventions within the Species / Habitat / Cultural Protection Zone.

The following underlying decision-making rules are applied in determining zones:

1. Strike a balance between environmental protection and development of the SCWHS&NR to meet broader economic and social objectives of the protected area.
2. Consider existing development footprints and tourism access routes based on:
 - The principle that all else being equal, an existing transformed site is preferable to a green fields site from a biodiversity perspective;
 - Increasing costs the further developments are from existing infrastructure;
 - The socio-economic benefit of existing tourism nodes and access routes; and
 - Infrastructure design and services with due consideration for focal values.
3. Where existing development nodes, tourist sites and access routes occur in areas with high sensitivity-value, associated zonation must aim to confine the development footprint as much as possible and preferably within the existing transformed site.
4. Sites with high biodiversity sensitivity value are put into stronger protection zones and peripheral development is favoured.

A summary of the zonation scheme applicable to the SCWHS&NR is depicted in Table 6.3 and illustrated in Appendix 2 Map 13(a-d).

Table 6.3: Summary of CapeNature zonation categories applicable to the Swartberg Complex World Heritage Site and Nature Reserves.

Category	Description
Wilderness / Wilderness	<p>The entire eastern part of the Groot Swartberg and Swartberg-East (1km east of Swartberg pass) were zoned as wilderness except for the 1km strip along the Meiringspoort pass (primitive zone) and any other areas zoned for nature access and development.</p> <p>For the Gamkaberg Cluster, Paardenberg (complete), Rooiberg (complete) and most of Rooilifantskloof were zoned wilderness except for any areas zoned for nature access and development.</p> <p>An internal area identified through viewshed analyses (as per the PAMP compiled in 2012) for the Kammanassie was zoned wilderness.</p>
Primitive	<p>The following protected areas in the SCWHS&NR are zoned as primitive except for the areas zoned for wilderness, nature access, and development areas:</p> <p>Swartberg Cluster – Towerkop, Groot Swartberg (western section), Gamkapoort, Gamkaskloof ('Die Hel'), Swartberg East (only 1km buffer along Meiringspoort);</p> <p>Gamkaberg Cluster – Fontein, Gamkaberg, Groenefontein, Kwessie, Triangle (complete), Heimersrivier (complete), Vaalhoek (complete);</p> <p>Kammanassie Cluster – remaining section not included in wilderness zone.</p>
Nature Access	<p>For all the reserves within the SCWHS&NR the public roads with unrestricted access (such as the Seweweekspoort, Meiringspoort, the Swartberg and Rooiberg passes and other minor roads) were buffered by 25m, except where the area was zoned for development.</p>

Category	Description
	<p>Towerkop – Seweweekspoort pass buffered by 25m.</p> <p>Gamkaskloof – Otto du Plessis road buffered by 25m except where zoned for low development.</p> <p>Groot Swartberg – Otto du Plessis road and Swartberg pass buffered by 25m.</p> <p>Swartberg East – Meiringspoort pass and Toorwaterpoort railway line buffered by 25m.</p> <p>Rooiberg – Rooiberg pass buffered by 25m.</p> <p>Gamkaberg – road that passes through Heimersrivier buffered by 25m.</p>
Development – Low intensity	<p>Following areas were digitized:</p> <p>Gamkaskloof – four (4) clusters of houses and other infrastructure.</p> <p>Groot Swartberg – Tolhuis and infrastructure next to Swartberg pass, Elandspad campsite and houses.</p> <p>Rooiolifantskloof – radius of 3.5km from western gate access point according to MOA with Zoar Community Property Association.</p> <p>Gamkaberg – Oukraal, 3 eco-lodges (Tierkloof, Fossil Ridge, Sweet Thorn) and Gamkaberg camp site.</p>
Development – Management	<p>Following areas were digitized:</p> <p>All dams, whether private or state owned, were zoned as development management.</p> <p>Towerkop – road to Eskom powerline (at Van Zyls Damme) Buffelskloof, Aristata, Besemfontein and Verlorenhoek to Uitkyk buffered by 2.5m, as well as Besemfontein houses and infrastructure area.</p> <p>Gamkapoort – three (3) clusters of management buildings, all roads buffered by 2.5m and Gamkapoort Dam.</p> <p>Groot Swartberg – Botha’s Hoek road up to Gouekrans hut buffered by 2.5m. Spitskop north and Spitskop south road to Eskom powerline buffered by 2.5m.</p> <p>Swartberg East – Blesberg road to radome and weather station buffered by 2.5m.</p> <p>Gamkaberg Cluster – office complex, management facilities, village and manager’s house, houses at Heimersrivier, five (5) old houses off Rooiberg pass. Various management roads were buffered by 2.5m.</p> <p>Kammanassie Cluster – roads to Vermaaksrivier boreholes and Mannetjiesberg buffered by 2.5m.</p>

6.3 Protected Area Zone of Influence

CapeNature seeks to maximise positive influences and / or minimise direct and indirect negative pressures on values, with the aim of ensuring the persistence of species and biodiversity in general. Activities managed include those that might have direct impacts on values, and those that have only indirect effects, often at considerable distance from the location where the activity takes place.

The ZOI is a mechanism that recognises, and activates the above-mentioned principle. Three key informants (Figure 6.1) used to delineate the zone include:

- Viability of focal values;
- Threats assessment; and
- Protected area sensitivity and zonation.

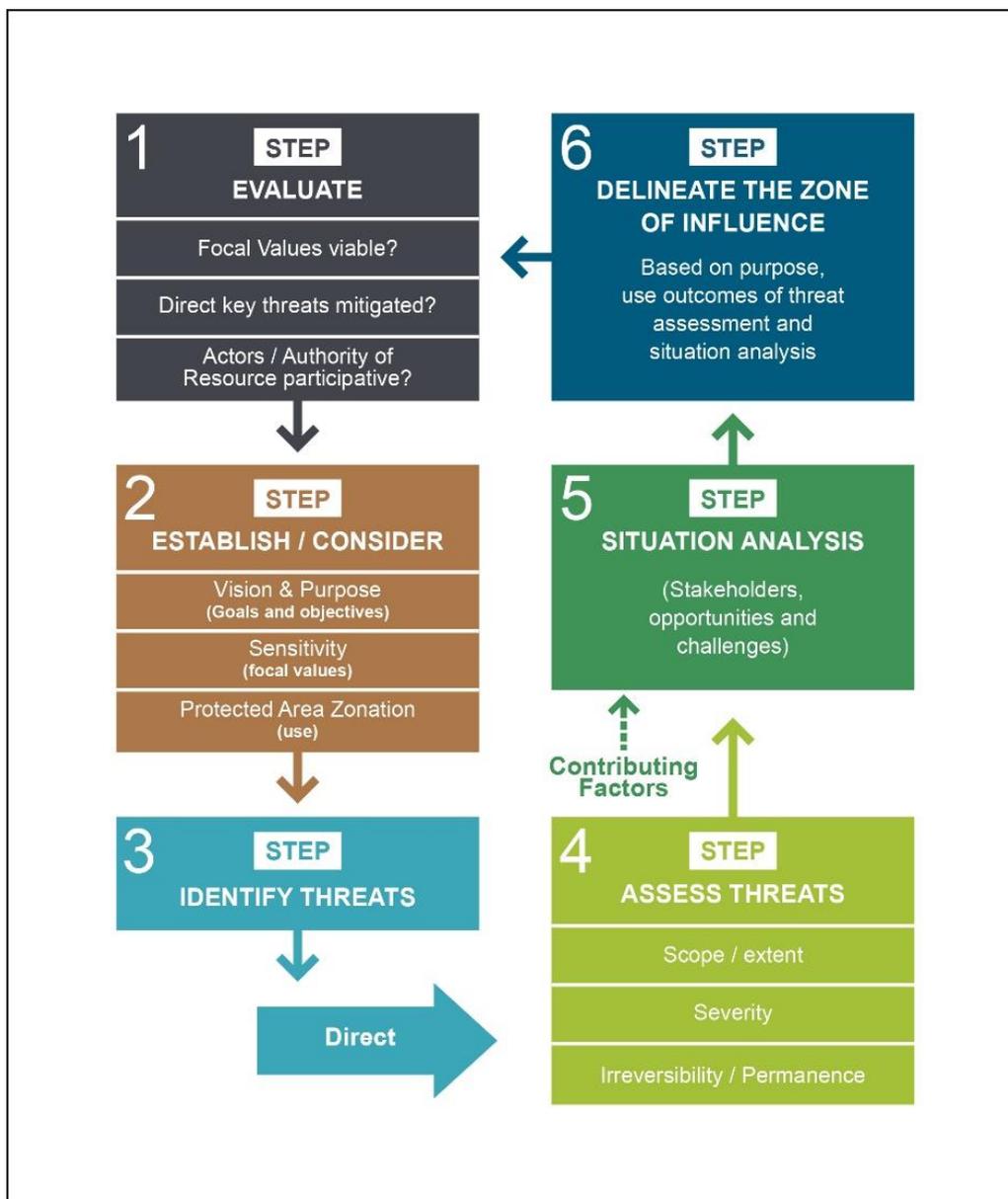


Figure 6.1: Process flow for the delineation of the zone of influence.

The ZOI is a non-legislated area spatially depicted around the SCWHS&NR. The zone ultimately aims to facilitate strategic stakeholder engagement by linking key stakeholders to prioritised influences to promote an ecologically functional landscape that supports goals and objectives of the SCWHS&NR, and enhances the benefits derived from the SCWHS&NR. The process of delineation helps to identify:

- 1) Actions to directly restore a value or mitigate a threat;

- 2) Actions designed for people to continue positive behaviours or halt direct threats; and/or
- 3) Actions to address enabling conditions.

The ZOI is thus:

- A tool to guide resource allocation and investment outside of the SCWHS&NR;
- A tool to marry stakeholder engagement / authorities of resource to activities;
- A spatial prioritisation of where to support compatible land and water use, and positive behaviours;
- A spatial prioritisation of where to collaborate and with whom;
- A mechanism to prioritise support to landowners or managers of priority landscapes; and
- An all-encompassing mechanism that includes all or part of a buffer zone as prescribed in terms of legislative frameworks and conventions.

The spatial features used in the ZOI calculation are rated on a standard scale of one to four: Low (1), Medium (2), High (3), and Very high (4). These ratings are assigned to each input feature within the ZOI. Higher scores represent areas where many features overlap, elevating the necessity to engage stakeholders and positively influence neighbour relations and / or activities.

Table 6.4 lists the features, criteria and rating applied to delineate the ZOI of the SCWHS&NR. Appendix 2 Map 14(a-d) illustrates the ZOI for the SCWHS&NR.

The ZOI for the SCWHS&NR has a total extent of 770 442.2 ha.

Fire hazards and over-abstraction of surface and groundwater are the features that scored a 'high' rating impacting on 18.5% and 1% of the ZOI respectively (Table 6.4). Over-abstraction of water has a high impact on the water sources, recharge areas and aquifers in the mountain catchments.

Factors such as over-stocking and over-grazing, clearing of agricultural land, illegal resource use, stands of invasive alien plants bordering the protected areas (source of reinfestation), management shortcomings in preventing the hybridisation of Cape mountain zebra with other equids on neighbouring land and the lack of genetic mixing between the subpopulations of Cape mountain zebra received a 'medium' rating and affect the largest proportions of the ZOI (Table 6.4).

Table 6.4: Criteria used for defining the zone of influence of the Swartberg Complex World Heritage Site and Nature Reserves.

Feature	Criteria	Rating	Zone area (ha)	% of zone
Fire hazards (high fire frequency)	Inappropriate fire frequency due to anthropogenic fires. Irrespective of the fire hazards (ignition sources), the flammability of the vegetation is what determines the fire hazard for fires moving from outside the reserve into the reserve. For the Swartberg, used the Fynbos Biome extracted from the Vlok <i>et al.</i> (2005) map, clip it to 10km buffer, and subtract transformed areas.	High (3)	142 213.8	18.5
Illegal resource use	Illegal resource use, which include various unregulated human activities such as over-grazing by livestock, illegal harvesting of fauna and flora, informal human settlement encroachment, dumping, and dumpsite management. This also includes people accessing the reserve and causing vandalism and littering. The layer was generated by buffering human settlements by 1500m.	Medium (2)	17 690.4	2.3
Illegal mining and quarrying	Areas where resources are illegally removed from old quarries to fix roads and/or harvesting sand from old quarries or riverbeds.	Medium (2)	18.7	0.0
Fish monitoring areas	Rivers identified for low level of conservation intervention due to the presence of threatened fish species as a preventative measure (for timeous intervention should invasion occur). Rivers included are the Aaps, Assegaaibos, Bos, Buffelsklip, Buffelskloof, Dorps, Dwyka, Gamka, Gouritz, Grobbelaars, Groot, Hoeks, Huis, Kammanassie, Klein-Le Rouxs, Kobus, Kruis, Marnewicks, Marthinus, Moeras, Nels, Olifants, Oshoekshang and tributaries, Rooi, Saffraan, Scholtzkloof, Swartberg, Wilge and Wynands. Buffered by 32m. For the Eastern Cape, the river Matjiesvlei with the NSBA status of critically endangered was added.	Medium (2)	5 515.7	0.7
Invasive alien fauna	Areas of known invasive alien fauna that require remedial actions. Point localities of known domestic / feral animals in proximity to the reserves were used to extract cadastre units where these species occur. Where the domestic species were recorded in the reserve, the adjacent farms in the proximity were also selected as the possible source of these animals.	Medium (2)	21 017.2	2.7
Invasive alien plants	Stands of invasive alien plants or plantations within a radius of the protected area is a source of re-infestation of invasive alien plants that had previously been cleared from reserve. No formal plantations have been recorded within the buffer area. Used the National Invasive Alien Plant Survey, done by Kotze <i>et al.</i> (2010).	Medium (2)	38 590.8	5.0
Over-abstraction of water (surface and groundwater)	The over-abstraction of water has a high impact on the water sources / recharge areas and aquifers in the mountain catchment areas.	High (3)	7 475.4	1.0

Feature	Criteria	Rating	Zone area (ha)	% of zone
	<p>Abstraction of water through boreholes for agricultural purposes is taking place throughout the area, but the volumes of groundwater abstracted are not being monitored. The KKRWSS has been abstracting groundwater from within and around the Kammanassie since 1993 for bulk water supply purposes to urban and rural communities. Data on the volumes abstracted by the scheme are available from Oudtshoorn Municipality. Prince Albert Municipality is abstracting groundwater for urban use from the base of the northern slopes of the Groot Swartberg. A proposal to investigate groundwater abstraction at Seweweekspoort for bulk supply purposes to the Zoar community has been tabled. Agricultural fields layer was used and the irrigated fields were extracted that fall within the water source / recharge area. The assumption is that the irrigation of agricultural fields are the greatest source of water abstraction, other than towns.</p> <p>In addition to the above, used borehole localities information where available and source verified. Buffer the localities by 100m.</p>			
Riparian and instream modification	<p>Illegal activities along rivers such as illegal weirs constructed and bulldozing along riverbanks.</p> <p>Major areas of bulldozing or illegal weirs along rivers are not visible from satellite imagery. Used the 32m buffer for the Kammanassie River and cut out the sections that appears to run through natural areas, leaving the sections that could be impacted by agricultural activities.</p>	Low (1)	302.0	0.0
Water pollution from oil / diesel spill or agriculture activities	<p>Areas where there is possible water pollution due to oil / diesel spill due to an accident near river. The only known river where this occurs frequently is in Meiringspoort.</p> <p>Seweweekspoort is also a possibility, but this is a gravel road which does not carry as much traffic currently.</p> <p>No pollution due to agricultural activities near rivers has been observed at monitored rivers. Buffered the river downstream from Meiringspoort by 50m.</p>	Low (1)	149.1	0.0
Persecution (loss) of animals	<p>Persecution (loss) of animals related to human-wildlife conflict (jackal, caracal, leopard, baboon, kudu, eland, bat-eared fox (bycatch), etc.) also referred to as "damage causing animals".</p> <p>The locality of these reported sites was extracted from the database maintained by conservation managers (off-reserve). Extracted the cadastre units using these localities.</p>	Low (1)	74 305.1	9.6
Land clearing / new agriculture	<p>Identify areas with high potential for both agricultural fields and grazing capacity, adjacent to or within close proximity with the defined buffer. For the SCWHS&NR most agricultural fields are adjacent to river and floodplain areas.</p>	Medium (2)	331 548.7	43.0

Feature	Criteria	Rating	Zone area (ha)	% of zone
	Used the Vlok <i>et al.</i> (2005) vegetation map selecting habitat types “river and floodplain” and “gannaveld”, buffer these habitat types by 1km, and clip with remnants.			
Over-stocking and over-grazing	The inappropriate agricultural practice of over-stocking and over-grazing the veld has severe consequences. The areas of over-stocking, referring particularly to ostrich, was mapped by Forsyth <i>et al.</i> (2008).	Medium (2)	68 833.1	8.9
Management of risk of hybridisation	Management shortcomings regarding hybridisation risk with other equids and lack of genetic mixing. Referring in particular to the prevention of hybridisation with different zebra species introduced on game farms in close proximity to protected areas. Extract game farms within the buffer area that listed Burchell's- and Hartmann's mountain zebra.	Medium (2)	72 506.3	9.4
Noise disturbance	Noise disturbance can have an effect on the pristine environment of the nature reserve and can effect tourism to these reserves. High frequency of low flying aircrafts is a disturbance. A flight school in the vicinity of the Gamkaberg uses flight routes over the protected area. According to the general flight areas (GFA) received (10 areas), only Gamkaberg is affected. None of the other 9 areas overlap with any of the reserves in the SCWHS&NR.	Low (1)	28 798.1	3.7
Recreational activities	Recreational activities along scenic roads leading to the reserve such as fishing, picnicking, illegal entry to hike, etc. These routes include Meringspoort, Swartberg pass, Seweweekspoort, Rust-en-Vrede waterfall, De Hoek resort and hiking trail. Created buffers along these routes on both sides of the reserves that will incorporate areas where possible picnicking occurs. Use imagery to digitize areas.	Low (1)	454.9	0.1
Illegal access along routes	Transportation and service corridors dissect the SCWHS&NR. Illegal access are reported along these corridors. The corridors include major roads, railway lines and powerlines. Extracted these corridors and buffered them by 100m.	Low (1)	10 659.6	1.4
The impact of the commercial bee industry on indigenous pollinators (wild bees, solitary bees & other spp.)	The impact on indigenous honey bees and other pollinators due to horticulture / viticulture within 1km from protected areas. This threat comes from introduced foreign pollinators. The level of threat still needs to be investigated. Extracted all agricultural fields (2013) listed for horticulture / viticulture from the layer provided by the Dept of Agriculture within 3km (1.5km range from either reserve boundary and hives (Couvillon <i>et al.</i> 2015)) of the protected areas boundaries.	Low (1)	3 103.3	0.4
Game farming	The threat of game farming adjacent to reserves can stem from introduction of extra-limited game species, or fencing that limits the movement of natural wild species. Extracted all	Low (1)	66 887.9	8.7

Feature	Criteria	Rating	Zone area (ha)	% of zone
	game farms adjacent to the PA boundary from the Western Cape Game Database, last update July 2019.			
Mountain Catchment Areas	Included all adjacent MCAs into the ZOI.	Low (1)	85 046.7	11.0
Local Authority Nature Reserves	Included all the adjacent local authority nature reserves into the ZOI. Only one, the Ladismith-Kleinkaroo NR, which is now called Naauwklouf was included. Extracted this from the provincial layer.	Low (1)	2 775.3	0.4
Stewardship sites	Select the stewardship sites that have direct land- and/or water management responsibilities and that contribute to PA values and appropriate PA design (connectivity and extent). Extracted all the signed and designated stewardship sites that are adjacent and those connected to them (forming a clump).	Low (1)	17 488.2	2.3
Areas identified in PAES (CAP map)	Include areas identified for the protected areas expansion strategy, called the CAP map. Extracted all the adjacent properties and those connected to them (forming a clump).	Low (1)	53 798.7	7.0
Special projects / areas (adjacent to reserve boundaries or in another province)	Special projects that are listed for this area must be included into the ZOI. For areas where information has been compiled in support of special projects, then these features can be used to delineate the ZOI. One such project is the spekboom restoration project in the Vanwyksdorp-Ladismith and Calitzdorp-Oudtshoorn area, which is an ongoing project (external funding). Areas of severely transformed spekboomveld were mapped for restoration. For the area in the Eastern Cape north of Swartberg East, the Eastern Cape Biodiversity Conservation Plan 2007 was used. Extracted areas selected as terrestrial Critical Biodiversity Areas (CBA) based on STEP vegetation assessment, existing corridors from various studies and mapped corridors done as part of assessment. The 2016 review not available yet.	Low (1)	60 631.0	7.9

7 ACCESS AND FACILITIES

This section describes infrastructure and procedures necessary for management of the SCWHS&NR, inclusive of operations and visitors. It provides information on access facilities, operational facilities, control measures as well as commercial and community use.

7.1 Public Access and Management

The R62 is an arterial road, which is tarred and kept by the Department of Transport. The other public roads are maintained by the District Municipality and the 4X4 tracks by CapeNature.

Swartberg Cluster. The main public access routes to the Swartberg Cluster are via Seweweekspoort cutting through the Towerkop sector between Zoar and Laingsburg; Swartberg Pass between Oudtshoorn and Prince Albert over the Groot Swartberg with the Otto du Plessis road branching off to Gamkaskloof ('Die Hel') on the northern side; Meiringspoort situated between De Rust and Klaarstroom and splitting the Groot Swartberg from Swartberg East; and the railway line through Toorwaterpoort in Swartberg East. There are a number of other controlled access points to specific sites or trails (Table 7.1).

Gamkaberg Cluster. All the main public access routes to the Gamkaberg Cluster are gravel, but accessible by all vehicles. The Rooiberg Pass traverses the Rooiberg and Groenfontein sectors; the road to Gamkaberg office complex; a divisional road around the southern side of Gamkaberg which cuts through Heimersrivier and Fontein. All other tracks are controlled and for 4X4 vehicles only (Table 7.1).

Kammanassie Cluster. For the Kammanassie, there are no public access roads as the stateland on the mountain is completely surrounded by private land. All access points are controlled and only accessible via 4X4 vehicles (Table 7.1).

Access points to the SCWHS&NR for the public are listed in Table 7.1 and spatially mapped in Appendix 2 Map 15(a-d).

Table 7.1: Managed public access points to the Swartberg Complex World Heritage Site and Nature Reserves.

Locality	Name	Type of Access	Activity
Swartberg Cluster			
Prince Albert to Oudtshoorn	Swartberg Pass	Uncontrolled	Public - recreational, spiritual activities, operational and ecological activities
De Rust to Klaarstroom	Meiringspoort	Uncontrolled	Public - recreational, spiritual activities, operational and ecological activities
Lainsburg to Zoar	Seweweekspoort	Uncontrolled	Public - recreational, spiritual activities, operational and ecological activities
Swartberg East	Toorwaterpoort	Uncontrolled	Access point to the railway.
De Hoek Mountain Resort	De Hoek	Controlled	Hiking trail & mountain biking events, operational and ecological activities
Living Waters	Donkey Trail	Controlled	Hiking trail.
Gamkaberg Cluster			
R62 Hartebeesvlakte to access Rooiberg	Pierre De Klerk	Locked Gate (4x4)	Private - Access to Bailey's Peak high site. CapeNature - Access to Rooiberg.
Caledonskloof to access Rooiolifantskloof	Joan Berning/ Roy Stauth	Locked Gate (4x4)	Owners - access to Rooiolifantskloof. CapeNature - Access to Rooiolifantskloof for management purposes.
Triangle	Maretha Fourie	Locked Gate (4x4)	CapeNature - Access to Triangle.
Kwessie	Louis Fourie	Locked Gate (4x4)	CapeNature - Access to Kwessie.
Rooiberg Pass (enter and exit)	CapeNature Groenefontein	Public Road (high clearance 2x4)	Public - Scenic Route. CapeNature - Access to Groenefontein and Rooiberg.
Groenefontein	Kannaland 4x4 Route	Locked Gate (4x4)	Public - Access to Kannaland 4x4 Route. CapeNature - Access to Groenefontein Kwessie and Triangle.
Gamkaberg	CapeNature Gamkaberg Main Entrance Gate.	Public Access Gate (high clearance 2x4)	Gamkaberg Office. Public - Access to Tourism facilities (Accommodation, 4x4 route, hiking trails). CapeNature - Staff accommodation access.
Gamkaberg	CapeNature Gamkaberg Southern Exit Gate.	Locked Gate (4x4)	Public - 4x4 Route exit. CapeNature - Access to Gamkaberg.
Vaalhoek	Kallie Oosthuisen	Locked Gate (4x4)	CapeNature - Access to Vaalhoek. Public - Access to Vaalhoek under tourism concession.

Locality	Name	Type of Access	Activity
Vaalhoek	Niekie Rust	Locked Gate (4x4)	CapeNature access to Vaalhoek.
Ararat	Kannaland Municipality	Locked Gate (4x4)	CapeNature - Access to Rooiberg (Ararat)
Kammanassie Cluster			
Kleingeluk	Kammanassie CapeNature gate	Locked Gate (No access for tourism)	CapeNature management (Operational and Ecological activities)
Buffelsklip	Kammanassie CapeNature gate	Locked Gate (No access for tourism)	CapeNature management (Operational and Ecological activities)
Vermaaksrivier	Kammanassie CapeNature gate	Locked Gate (No access for tourism)	Oudtshoorn Municipality, the Department of Water Affairs and Cape Nature (Operational and Ecological activities)
Bergplaas,	Frikkie du Preez	Locked Gate (No access for tourism)	Restricted to private landowners and CapeNature (Operational and Ecological activities)
Buffelsdrift	Flippie van Rensburg	Locked Gate (No access for tourism)	Restricted to private landowners and Cape Nature (Operational and Ecological activities)
Rooiplaas 1	Willie Woudberg	Locked Gate (No access for tourism)	Restricted to private landowners and Cape Nature (Operational and Ecological activities)
Rooiplaas 2	Willie Woudberg	Locked Gate (No access for tourism)	Restricted to private landowners and Cape Nature (Operational and Ecological activities)

7.2 Airfields and Flight Corridors

Section 47 of the NEM:PAA stipulates prescriptions for the use of aircraft in a WHS. Avic International Flight Training Academy (AIFA) is a sub-division of the Aviation Industry Corporation of China (AVIC) and is a joint operation between China and South Africa established to provide cadet pilot training for various Chinese Airline companies with one of its bases situated in Oudtshoorn. The general flying area in Oudtshoorn is divided into ten flight zones covering an area of approximately 4 500 square nautical miles. Figure 7.1 shows the flight zones spanning the SCWHS&NR and ZOI. One of the flight zones used by AIFA over the Gamkaberg is impacting on the quiet sense of place that visitors should experience when making use of Gamkaberg tourism facilities. AIFA has been made aware of the ecotourism developments and have agreed verbally to avoid the sensitive areas. Pressure on the Klien Karoo flight zones has been reduced due to additional flight zones being established in the Beaufort West area.

Particulars of Oudtshoorn airfield are highlighted in Table 7.2.

Table 7.2: Airfield information for the Oudtshoorn Airport situated within the Zone of Influence of the Swartberg Complex World Heritage Site and Nature Reserves (extracted from internet).

Oudtshoorn Airport IATA Code: OUH	Oudtshoorn Airport ICAO Code: FAOH
Latitude : -33.5981	Longitude : 22.1883
City : Oudtshoorn	Country : South Africa
World Area Code : 562	Airport Type : Medium
Oudtshoorn Airport Address: Oudtshoorn Airport (OUH), Oudtshoorn, South Africa	
Time zone : Africa/Johannesburg	
Oudtshoorn Airport Time zone : GMT +02:00 hours	

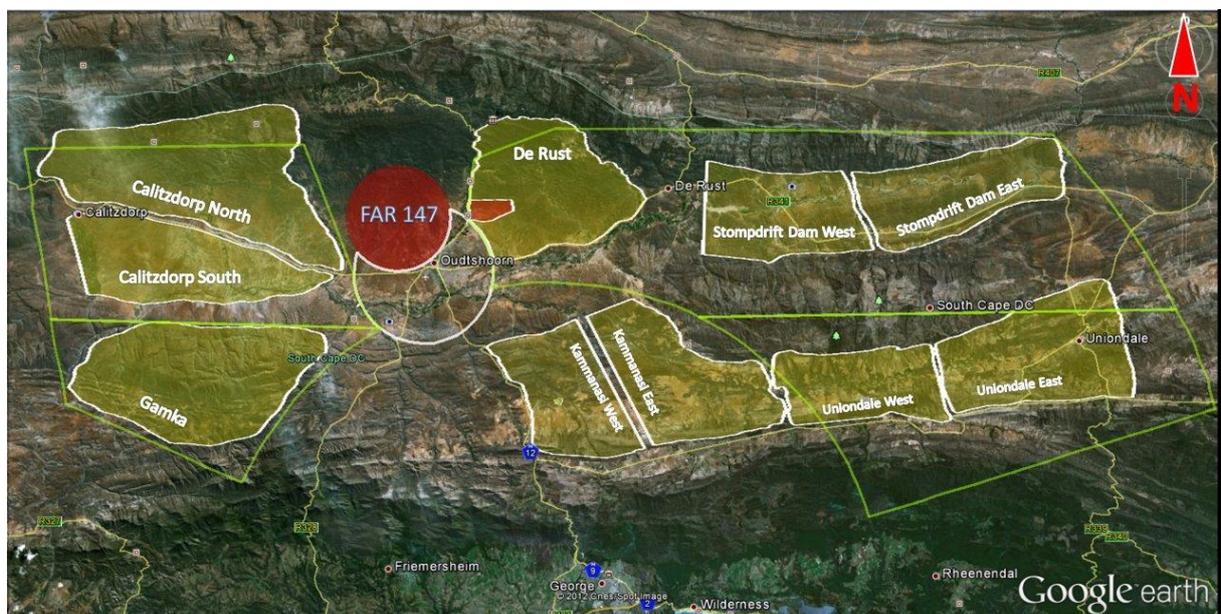


Figure 7.1: Ten flight corridors that span the Zone of Influence of the Swartberg Complex World Heritage Site and Nature Reserves.

7.3 Administrative and Other Facilities

Infrastructure and associated building maintenance requirements are captured and managed in both the protected area infrastructure register and the annual CapeNature User Asset Management Plan (U-AMP), administered in collaboration with the Department of Public Works. Major infrastructure is illustrated in Appendix 2 Map 16(a-d).

7.3.1 Roads / Jeep Tracks

Swartberg Cluster. Most of the gravel roads within the Swartberg Cluster can be utilised by the public and are therefore public roads, such as the Seweweekspoort, Swartberg pass and the Otto du Plessis road to Gamkaskloof, the Gamkapoort road to the Gamkapoort Dam, as well as the tarred road through Meiringspoort. Maintenance of these gravel roads fall under the Provincial and District Roads Authorities.

There are jeep tracks (two tracks with a 'middelmanntjie') to Waterkloof, Besemfontein, Balmoral, Bothashoek and Gouekrans, Blouberg and Blesberg. These tracks are exclusively used for management purposes and are only accessible by four-wheel drive vehicles. Maintenance is done by CapeNature, but in the case of the Blesberg track, there is an agreement with ATNS (owners of the radome on Blesberg peak) that they would maintain the track up the mountain.

In addition, there are tracks servicing the Eskom powerlines traversing the Swartberg Mountains at Buffelspoort (western end of Towerkop sector) and up the northern slopes near Spitskop (Groot Swartberg sector). These tracks are maintained by Eskom.

Gamkaberg Cluster. The Rooiberg pass, which traverses the Groenefontein sector north-south, the access road to the Gamkaberg main office complex (DR489) and the district road (DR1649) that cuts through the south eastern section of Fontein are all gravel public roads that are maintained by the Garden Route District Municipality. The R62 is an arterial road, which is tarred and kept by the Department of Transport.

Most of the other internal roads consist of two tracks with a 'middelmanntjie' which are accessible by four-wheel drive vehicles. These tracks are all four-wheel drive tracks that are maintained by CapeNature. On the recently acquired Kwessie, Triangle, Fontein and Heimersrivier properties, some tracks have been identified for rehabilitation and closure. These will be prioritised during the IWP process and incorporated in the IAPO.

Kammanassie Cluster. Access roads within the Kammanassie Cluster comprise mainly of two tracks that are only accessible by four-wheel drive vehicles. In many instances cement track roads have been constructed at frequently used and key areas to prevent soil erosion and adverse financial implications.

Due to the high risk of soil erosion, mechanical grading of jeep tracks within the SCWHS&NR is not allowed. Regular assessments and maintenance of jeep tracks are prioritised during the IWP process and incorporated into the IAPO.

7.3.2 Hiking trails

Swartberg Cluster. There is a network of day and overnight hiking trails within the Swartberg Cluster, providing access for hikers to the remote mountainous areas and other popular tourist sites, thus promoting the scenic beauty and natural heritage of the area. The total distance of the day hiking trails is 32.3 km and that of the overnight trails 41.6 km. The day hiking trails on Groot Swartberg are the Platberg Circle, Ou Tol Circle and the De Hoek day trail. Day hiking trails in Gamkaskloof are the Koningsgat and Grootkloof trails.

The overnight hike takes two (or four) days with 8.4 km from De Hoek Mountain Resort to Bothashoek, then 12.8 km from Bothashoek to Ou Tol, and if needed, back to Bothashoek and eventually De Hoek. These trails are maintained by CapeNature.

In Meiringspoort there is a short trail to the waterfall site, which is being maintained by the Department of Transport.

Gamkaberg Cluster. There is a two-day hiking trail on the Gamkaberg sector which includes spending one night at the Oukraal shelter on the mountain. There are also other circular day trails/walks starting at the information centre. In September 2018 two short Cultural Heritage interpretive trails were officially opened to members of the public on the Gamkaberg sector. On Groenefontein there is a short interpretive walk with numbered plants and a brochure with a short description of each of the marked plants. Groenefontein can only be visited under guidance of a field ranger.

Kammanassie Cluster. No formal hiking trails are open to the public on the Kammanassie, due to the protected area being surrounded by private landowners. Some of these landowners are not willing to grant access to the public over their properties, thus preventing access to the Kammanassie. Trails are only used by management and maintained on an on-going basis.

In terms of the entire SCWHS&NR, trails are susceptible to erosion due to the steep slopes and sandy substrates. Some of the day trails present popular geological features and carry high tourist traffic requiring regular maintenance. Maintenance and prioritisation of trails is carried out annually during the IWP process.

7.3.3 Buildings

Buildings of the SCWHS&NR are designed and utilised for operations and staff accommodation, and maintained by the Provincial Department of Public Works as per schedules outlined in the U-AMP.

Swartberg Cluster. The main office complex of the Swartberg Cluster is situated in Oudtshoorn. Tourism units include the “Ou Tol” on the Groot Swartberg which consists of two houses that were previously managed as a tourism concession, but are currently vacant due to ongoing vandalism in the area. There are also two hiking trail huts situated at Bothashoek and Gouekrans, of which only the Bothashoek hut is being used at present.

In Gamkaskloof there are 11 historical accommodation units, 10 camping sites and one bush camp, as well an office and an interpretation centre. Staff facilities at Gamkaskloof include four official staff houses, one store room and an engine room.

At Besemfontein (Towerkop sector) there are three buildings, namely a house, a store and a hall, but none of these are open to the public at present.

Gamkaberg Cluster. The office complex, staff houses and the majority of the tourism infrastructure of the Gamkaberg Cluster are situated at the main northern entrance to Gamkaberg. It consists of nine staff houses, an inspection quarter, the manager's residence, field ranger office, information centre (which includes the manager's office), laundry, petrol store, herbicide store and a workshop.

For visitors there are four eco-lodges, the trail hut (known as the 'Stables') and two camp sites situated close-by. The Oukraal shelter and four shepherd's huts are situated 13.2 km further up on the Gamkaberg plateau and is a remote camp for hikers and 4x4 route clients.

Groenefontein sector has the main old farm house with stores, two smaller houses and three labourer cottages. All except one of the smaller houses are in disuse and require maintenance and repairs. On Vaalhoek there are the old opstal and a labourer's cottage, as well as a river camp.

Fontein sector has an old opstal and labourer's house on the southern section of the property. These are located south of the gravel public road (DR1649) between Volmoed and Vanwyksdorp. On the recently acquired Heimersrivier, there is only a dilapidated labourer's cottage.

Infrastructure on the rest of the protected area is limited to a repeater hut on Baileys Peak (Rooiberg). On Triangle and Kwessie there are no buildings, structures or other infrastructure, except for the boundary fences and tracks.

Two artificial water points (guzzlers) have been erected on the southern boundary of the Gamkaberg to provide water for the Cape mountain zebra population.

Kammanassie Cluster: The Kammanassie office building complex is situated in Uniondale. Structures in the Kammanassie are restricted to the two huts at Kleingeluk, two huts at Buffelsdrift and one hut at Perdevlakte. On Mannetjiesberg there is a high site hut.

Maintenance and repairs of buildings and structures are prioritised and included on the schedule of the Department of Public Works as well the CapeNature U-AMP. Minor maintenance and repairs to buildings are identified and attended to by management.

7.3.4 Fences

Swartberg Cluster. The entire Swartberg Cluster remains largely unfenced and occasionally results in tourism, operational or ecological problems. All internal fences have been removed for various ecological processes to occur unhindered. Maintenance of the eastern boundary fence has been prioritised to prevent domestic stock from entering the wilderness areas. Tourism management barriers have been placed at numerous popular tourist sites to restrict unauthorised access.

Gamkaberg Cluster. All internal fences have been removed on the Gamkaberg Cluster. Gamkaberg (including Fontein) is the only adequately fenced (1.4 m high fence) sector. The outer boundaries of Vaalhoek are fenced (1.4 m) but in future fences will either be removed as the surrounding land use becomes compatible with

conservation or upgrades will be necessary. The northern and eastern boundaries of Groenefontein, Triangle, Kwessie and Fontein are fenced to a height of 1.2 m. Their southern and western boundaries abut with the rugged and inaccessible Rooiberg which forms a natural boundary to domestic livestock. Paardenberg, Rooiberg and Rooiolifantskloof are in inaccessible areas and are largely unfenced. The presence of stock from the local communities at Zoar and Amalienstein needs to be carefully monitored, and removed where it is not according to the existing MOA. A process is underway to upgrade the boundary fence around Heimersrivier and construct grid gates along the DR 1649 road in order to create a corridor for the Cape mountain zebra to cross over from Gamkaberg via Fontein to Heimersrivier.

Kammanassie Cluster. Inadequate and/or absence of proper fencing cause major difficulties in the management of the Kammanassie. This is of particular concern in terms of the Cape mountain zebra population. Fence agreements with owners of private mountain catchment land that contains habitat used by the Cape mountain zebra need to be initiated. A database of fences and condition is kept on the reserve.

Boundary fences shared with properties where various game species have been introduced are intact and are being maintained by the relevant landowner. These are mostly 2.4 m high and impermeable to natural occurring species in the area.

7.3.5 High sites

CapeNature monitors all high sites for negative environmental impacts and illegal structures on an annual basis. High sites impact on the scenic landscape and on rare and threatened plant species found only in high altitude areas. A decision has been taken that no new sites will be considered for communication masts or structures.

Swartberg Cluster. Four registered high sites are used as radio repeaters for communication purposes utilised by CapeNature and authorised private users. These sites are located on the top of Blesberg, Blouberg, Kariegasberg and at Besemfontein.

There is an ATNS radome on Blesberg peak which is used for air traffic navigation purposes. It manages air traffic between Johannesburg, Cape Town, George and Port Elizabeth.

Gamkaberg Cluster. A small stone hut and a 10 m high lattice mast is situated on the state land section of Baileys Peak (Hoek 186/1, Alt 1468 m.a.s.l.) on the Rooiberg sector. It is currently used by two permit holders, namely Telkom and the Garden Route District Municipality. Numerous large structures including the Sentech Mast are situated on the immediately adjacent private land (Farm Hart 185).

Kammanassie Cluster. Three registered sites are used as radio repeaters for communication purposes. These are situated at Wildealsvlei (Department of Water & Sanitation), Wildebeesvlakte (Vodacom tower) and Mannetjiesberg (CapeNature).

All high site partners are listed in section 7.7 (Table 7.5).

7.3.6 Signage

Signboards are located at all major vehicle and hiking trail entrance points to the SCWHS&NR. Directional signage to CapeNature reserves are in place on all relevant provincial roads.

Trail information, directional and indemnity signage is in place at all starting points of all overnight and day trails. GPS co-ordinates and km readings are provided at various points along these trails. World Heritage, place descriptor, fire, prohibition, command, general notice and generic safety signs are located at strategic sites on all protected areas. Campsite markers are placed at each campsite as well as a campsite layout sign. Do's and don'ts as well as evacuation signs are placed in strategic places to prevent injury or loss of life.

At the Gamkaskloof office interpretation signage provides information regarding the geology, history, archaeology and cultural information of the Swartberg Cluster. Signage is also located at the Meiringspoort information points and picnic facilities, Swartberg pass and Seweweekspoort. Interpretation boards are located at the Gamkaberg heritage trail, to provide information to visitors about the archaeology and cultural history of the area. Kammanassie signage is at entrance gates and at the office site.

7.3.7 Utilities

7.3.7.1 Water supply

Primary water supply to the Swartberg and Kammanassie offices is via the municipal water supply schemes. Potable water is abstracted from the waterfalls and springs to service the tourism and staff accommodation in Gamkaskloof. The Tollhouse, Bothashoek and Gouekrans huts have pipelines which provide water from the closest springs. The picnic site facilities situated in Meiringspoort are supplied with fresh water from a spring.

For Gamkaberg, potable water is abstracted from two boreholes alongside one another for domestic use at Gamkaberg staff village, tourism accommodation and the office complex. There is a reservoir on the slope south of the manager's house. The Tierkloof Ecolodge is supplied with water from a small weir in Tierkloof. This is also used from time to time to supplement the reservoir which supplies the staff village and office complex. There is a borehole at Groenefontein where low volumes of water are abstracted for domestic purposes and a game watering point. Fontein has three boreholes, two of which are used as game watering points and one which was historically used for irrigation of crops but is not currently in use and it is not likely that it will be used for this purpose again.

Heimersrivier has surface water in the riverbed and when the property is connected with Gamkaberg, this will form an important water supply for the Cape mountain zebra. Currently the majority of water supplied to Cape mountain zebra on Gamkaberg is through groundwater pumped to the surface with solar borehole pumps. These pumps often break down and it is a major challenge to repair at short notice due to procurement regulations, thus creating serious concerns with regards to the wellbeing of the Cape mountain zebra. The inclusion of Heimersrivier with its secure water supply will thus be a major relief.

On the Kammanassie, the two huts at Buffelsklip are supplied with water from the weir below Mannetjiesberg. Water for the hut at Kleingeluk is being provided by rainwater tanks. None of these facilities are being utilised at present.

7.3.7.2 Electricity supply

Eskom supplies electricity to the Swartberg, Gamkaberg and Kammanassie office stations. All visitor facilities are supplied with electricity by means of solar systems.

7.3.7.3 Waste management

Swartberg Cluster. Waste from the Gamkaskloof tourism and staff accommodation is collected daily and kept in a baboon-proof container at the workshop until it is transported out by staff and disposed of at the Oudtshoorn Municipal dump site. The overnight hut situated at Bothashoek is not serviced by CapeNature and relies on the principles of “leave no trace”. Waste removal from the picnic sites along Meiringspoort are all managed by the Department of Transport. Along the Swartberg pass and Seweweekspoort waste management remains a serious concern as visitors often dump waste at viewpoints and rest sites. Hence, an anti-littering campaign run in collaboration with relevant partners is a priority strategy.

Gamkaberg Cluster. No waste disposal sites are available within the Gamkaberg Cluster. All waste is separated at source and plastic, paper, tin and glass are taken into Oudtshoorn for recycling. Non-recycleable waste is disposed of at the municipal refuse site in Oudtshoorn. Littering along the Rooiberg pass is also a problem in certain areas.

Kammanassie Cluster. There are no waste disposal points on the Kammanassie. Office waste disposal is carried out at the registered dumping site in Uniondale. The two sewage tanks, one at the office and one at the conservation manager’s house, are emptied by mobile tanker by the George Municipality as needed.

7.4 Visitor facilities

Swartberg Cluster. Tourism infrastructure includes 11 historical accommodation units, ten camping sites with five ablution blocks, and one bushcamp at Gamkaskloof. The Fonteinplaas property which is privately owned is also located in Gamkaskloof and can accommodate 104 people; and the Boplaas property can accommodate 78 people. Gamkaskloof has two and Groot Swartberg three day trails. Groot Swartberg also has a two to four day overnight trail with three accommodation units, one store room and one ablution facility. Picnic sites are located at Seweweekspoort and in Meiringspoort for day visitors. There is one 4x4 trail on Groot Swartberg.

Gamkaberg Cluster. Tourism infrastructure includes four ecolodges (Tierkloof (sleeps 8 pax), Sweet Thorn (sleeps 6 pax), Fossil Ridge (sleeps 4 pax) and Xami (sleeps 2 pax), the Stables (sleeps 8 pax), two camping sites (sleeps 4 pax each) and Oukraal (sleeps 8 pax) on Gamkaberg. Tom’s Camp (sleeps 12 pax) is situated at the Gouritz River on Vaalhoek. There is also one 4X4 route named Zebra Crossing, the Tierkloof overnight trail (two days: Day 1 = 13 km & Day 2 = 6 km and overnight at Oukraal), and five day trails (Guarrie, Spekboom, Mousebird, Pied Barbet and Overhang), as well as the recently added Cultural Heritage trail. The upgraded office serves as a venue to host corporate meetings and workshops for smaller groups of people, not exceeding 18 workshop attendees.

Kammanassie Cluster. There are no tourism facilities on the Kammanassie.

7.5 Commercial Activities

Due to the scenic and rugged terrain of the Klein Karoo, many adventure companies plan events that criss-cross through the SCWHS&NR appealing to many outdoor enthusiasts. CapeNature is very fortunate to have developed good working relations with many commercial partners that make use of the protected areas, all the while contributing significantly to human wellbeing. Commercial and management agreements are listed in Table 7.3.

Table 7.3: Commercial activities and management agreements applicable to the Swartberg Complex World Heritage Site and Nature Reserves.

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected	Conditions of use
14 /08/2018 -14/06/2020	Sale of hiking permits	The Greater Oudtshoorn Tourism Office	2 years	Swartberg (Ou Tol and Platberg Circle hiking trails)	All terms and conditions as set out in Agreement with Concessionaire.
23/10/2013 – present date	Sale of hiking permits	The Lazy Lizard Restaurant (Prince Albert)	Ongoing until termination is requested	Swartberg (Ou Tol and Platberg Circle hiking trails)	All terms and conditions as set out in Agreement with Concessionaire.
17/03/2018 – 17/12/2028	Donkey guided tours into Gamkaskloof and Wyenek	Calbitz Holding CC	10 years	Swartberg Pass and Gamkaskloof	All terms and conditions as set out in Agreement with Concessionaire.
Middle November	Mountain biking & camping event: <i>“To Hell and Back”</i>	Eco Bound	2 day weekend event (annually)	Swartberg Pass and Gamkaskloof	Terms and conditions set out in Event application.
Adhoc	Mountain biking event: <i>“Cape Pioneer Trek”</i>	Dryland Event Management	Once-off	Kammanassie	Terms and conditions set out in Event application.
Adhoc	Mountain biking and trail running event: <i>“TransCape MTB”</i>	TanJent Events	Once-off	Groenefontein	Terms and conditions set out in Event application.
Adhoc	Mountain biking	Jakhals Events	Once-off	Groenefontein	Terms and conditions set out in Event application.
First weekend of November	Trail running: <i>“Dryland Traverse”</i>	Dryland Event Management	3 day event	Swartberg Pass and Ou Tol to Bothashoek	Terms and conditions set out in Event application.
01/09/2017 – 01/09/2022	Rock climbing	Mountain Club of South Africa	4 years & 11 months	Gamkaberg - Approved area for climbing	Terms and conditions set out in Event application.
Adhoc	Filming of scenic views / 4 x 4 routes	WEG, RSG 4X4, Wild Magazine,	Adhoc	Swartberg Pass and Gamkaskloof	Terms and conditions set

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected	Conditions of use
		Voetspore, Country Life			out in Event application.

7.6 Community Use

In September 2018, CapeNature and the Zoar Community Property Association entered into an agreement whereby access to the Zoar Community Property Association to enter the Rooilifantskloof section of the Gamkaberg Cluster was granted for the purposes of carrying out cultural heritage activities and traditional grazing. The MOA stipulates the rights and responsibilities of each party, indemnifies CapeNature and highlights operational protocol. Part of the agreement states that CapeNature will assist in setting up and implementing a vegetation monitoring project whereby the impact of the stock on the nature reserve will be evaluated over time. This agreement is valid for two years from the date of signatory and is renewable on condition that both parties have complied.

Community management agreements for the SCWHS&NR are listed in Table 7.4.

Table 7.4: Community activities and management agreements applicable to the Swartberg Complex World Heritage Site and Nature Reserves.

Date of Agreement	Type of Agreement	Community	Duration of Agreement (years)	Resource utilised	Conditions of use
20/09/2018	Access	Zoar Community Property Association	2 years (20/09/2020)	Rock art Grave sites Traditional grazing	Refer to MOA

7.7 Servitudes and Management Agreements

A number of servitudes and management agreements exist for the SCWHS&NR where the respective entities are provided access to or through land managed as part of the protected area. This also includes formal agreements with partner organisations in terms of management activities, such as fire fighting, clearing of invasive alien plants and restoration work. Current servitudes and management agreements are listed in Table 7.5 and mapped in Appendix 2 Map 16(a-d) where relevant.

Table 7.5: Servitudes and management agreements applicable to the Swartberg Complex World Heritage Site and Nature Reserves.

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected	User	Conditions of use*
Swartberg Cluster						
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Groot Swartberg (Blouberg)	Department of Transport	Temporary right to attach and use two radio repeaters on the existing pole of the SAPS at the existing accommodation facilities at Blouberg in the Swartberg State Forest.
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Groot Swartberg (Blouberg)	South African National Defence Force (SANDF)	Temporary right to erect and maintain a radio repeater station (antennae only) and to erect and maintain the existing hut and mast on Blouberg in Swartberg State Forest. (REF: 6522/5153/6)
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Groot Swartberg (Blouberg)	Hilbert Electronics	Temporary right for the use of a radio repeater station in the Swartberg State Forest on Blouberg. (CR11 & CR23)
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Groot Swartberg (Blouberg)	Eden District Municipality	Temporary right to attach an antenna on the existing mast of the SAPS and to mount radio equipment in the existing hut at Blouberg in the Swartberg State Forest.
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Groot Swartberg (Blouberg)	Oudtshoorn Municipality	Temporary right for the use of a radio repeater station on the existing radio mast of the SAPS at Blouberg in the Swartberg State Forest.
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Groot Swartberg (Blouberg)	Prince Albert Farmers	Temporary right to install and maintain (co-use) a radio repeater in the existing radio station of WCNCB on Blouberg in the Swartberg State Forest.
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Groot Swartberg (Kariegasberg)	South African Police Services (SAPS)	Temporary right for the erection and maintenance of a radio repeater station (mast and hut) on Kariegasberg in the Swartberg State Forest. (REF: 6542/0432)
Unknown	High Site partner	South African Police	Unknown	Groot Swartberg (Kariegasberg)	Hilbert Electronics	Temporary right to erect and maintain an antenna by use of the mast and hut of the

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected	User	Conditions of use*
		Services (SAPS)				SAPS at Kariegasberg in the Swartberg State Forest. (CR 19)
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Groot Swartberg (Kariegasberg)	J & E Communications	Temporary right for the co-use of the SAPS facilities.
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Groot Swartberg (Kariegasberg)	Cango Valley Farmers Association	Temporary right for the co-use of the SAPS facilities.
Unknown	High Site partner	ATNS	Unknown	Swartberg East (Blesberg)	South African Police Services (SAPS)	Temporary right for the co-use (2 antennas) of the ATNS facilities on Blesberg in Swartberg State Forest.
Unknown	High Site partner	ATNS	Unknown	Swartberg East (Blesberg)	MTN	Temporary right for the co-use of the ATNS facilities on Blesberg in Swartberg State Forest. (Their ref: T5001)
Unknown	High Site partner	Transtel	Unknown	Swartberg East (Blesberg)	Telkom	Temporary Right to erect and maintain a passive reflector mast next to the Spitskop Eskom line in the Swartberg State Forest. As per Agreement.
Unknown	High Site partner	Transtel	Unknown	Swartberg East (Blesberg)	Hilbert Electronics	Temporary right to use and maintain a radio repeater station at the Transnet facility (to whom right for Blesberg, Swartberg State forest has been granted). (CR 6)
Unknown	High Site partner	Transtel	Unknown	Swartberg East (Blesberg)	Vodacom	Temporary right for the co-use of Transtel's infrastructure and the maintenance of a radio repeater station on Blesberg in the Swartberg State Forest. (Your reference: BS 2613)
Unknown	High Site partner	South African Police	Unknown	Towerkop (Besemfontein)	South African Police Services	Temporary right to erect and maintain a radio repeater station on Besemfontein in

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected	User	Conditions of use*
		Services (SAPS)				the Towerkop State Forest. (REF: 6515/5150/1)
N/A	High Site	CapeNature structure	N/A	Gamkaskloof ("Die Hel")	CapeNature	Radio telecommunications.
Unknown	Water Use	D.J. Malan	Unknown		D.J. Malan	Temporary right for the use and maintenance of an existing weir and pipeline over Swartberg State Forest for primary (domestic) use.
Unknown	Water Use	D.P. Barnardt	Unknown		D.P. Barnardt	Temporary right to: (a) withdraw water from a fountain in Klein Perdekloof by means of a pipeline to the payee's farm. B) Withdraw water from a fountain in the Ou Werf se Kloof by means of a pipeline to the payee's farm. Both fountains in the Swartberg State Forest.
Unknown	Access road	Eskom Holdings SOC Limited	Unknown	Groot Swartberg	Eskom	Temporary right to use and maintain a road over the Swartberg State Forest. (Ref: 45A/74/75)
Unknown	Maintenance of a Powerline	Eskom Holdings SOC Limited	Unknown	Groot Swartberg	Eskom	Temporary right to maintain an existing 132KV powerline over 32 ha of State ground in the Swartberg State Forest. (45A/74/74)
Unknown	Water Use	Widgetrade (EDMS) Bpk	Unknown		Widgetrade (EDMS) Bpk	Temporary right to extract water over the Swartberg State Forest by means of laying and maintaining a 76 mm thick pipeline.
Unknown	Water Use	N.C.T. Dames	Unknown		N.C.T. Dames	Temporary right to extract water by means of a pipeline, 50 mm in diameter over a distance of ± 1 000 m along a route that crosses over the Swartberg State Forest.
Unknown	Water Use	P.B. van Wyk	Unknown		P.B. van Wyk	Temporary right to lay and maintain a water pipe of ± 800 m long over the Swartberg State Forest.

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected	User	Conditions of use*
Unknown	Water Use	C.W. Wannenburg (HOWAPJ)	Unknown		C.W. Wannenburg (HOWAPJ)	Temporary right to extract water in the Swartberg State Forest by using an existing weir over a stream and a pipeline 50 mm in diameter.
Unknown	Water Use	W.E. Knuffel (HOKNW)	Unknown		W.E. Knuffel	Temporary right to construct a weir and lay a pipeline over the Swartberg State Forest over a stream to lead water to his property.
Unknown	Water Use	A.J. Joubert (HOJAJ)	Unknown		A.J. Joubert	Temporary right to attach a 25 mm pipe and draw off water from the existing CN pipeline for domestic purposes only on the Swartberg State Forest.
01/08/2019 to 31/07/2022	DEA: Natural Resource Management (DEA: NRM); CapeNature Terrestrial, Ecosystems, Special and Wetlands projects	DEA: NRM	3 years	All sectors of Swartberg Cluster	DEA: NRM and CapeNature	Biocontrol project. Terrestrial invasive plant clearing project.
01/05/2019 to 31/03/2021	Western Cape Nature Conservation Board & Southern Cape Fire Protection Association Memorandum of Agreement	SCFPA	1 year and 10 months	Swartberg Cluster	SCFPA and CapeNature	Provision of fire fighting services to CapeNature.
01/04/2014 to 31/03/2021	FFA Operations (Pty) Ltd and CapeNature Memorandum of Agreement	FFA Operations (Pty) Ltd (trading as Working on Fire)	7 years	Swartberg Cluster	Working on Fire and CapeNature	Assistance with fire fighting operations.

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected	User	Conditions of use*
Gamkaberg Cluster						
15/12/1999	Access road to Gamkaberg Nature Reserve and water servitude	J.V.R Potgieter	Unlimited	Portion 31 of Farm 80	J.V.R Potgieter	Permanent right for access to water.
01/08/2019	DEA: Natural Resource Management (DEA: NRM); CapeNature Terrestrial, Ecosystems, Special and Wetlands projects	DEA: NRM	3 years	All sectors of Gamkaberg Cluster	DEA: NRM and CapeNature	Biocontrol project Terrestrial invasive plant clearing project Working for Ecosystems project
27/08/1999	Groenefontein management lease agreement	WWF-SA	99 year lease	Groenefontein	CapeNature	Conservation management use.
16/06/2012	Vaalhoek management lease agreement	WWF-SA	99 year lease	Vaalhoek	CapeNature	Conservation management use.
2015	Fontein management lease agreement	WWF-SA	99 year lease	Fontein	CapeNature	Conservation management use.
09/11/2011	Triangle management lease agreement	WWF-SA	99 year lease	Triangle	CapeNature	Conservation management use.
21/06/2012	Kwessie management lease agreement	WWF-SA	99 year lease	Kwessie	CapeNature	Conservation management use.
11/12/2013	Rooilifantskloof management lease agreement	Berning-Stauth Families	99 year lease	Rooilifantskloof	CapeNature	Conservation management use.

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected	User	Conditions of use*
01/04/2015 to 31/03/2020	High Site	CapeNature structure	5 year lease	Baileys Peak	Telkom	Temporary right to co-use the radio repeater station of WCNCB on Bailey's Peak in the Towerkop State Forest.
01/07/2020 to 30/06/2021	High Site	CapeNature structure	Annually	Baileys Peak	Garden Route District Municipality	Temporary right to co-use the radio repeater station of WCNCB on Bailey's Peak in the Towerkop State Forest.
01/05/2019 to 31/03/2021	Western Cape Nature Conservation Board & Southern Cape Fire Protection Association Memorandum of agreement	SCFPA	1 year and 10 months	Gamkaberg Cluster	SCFPA and CapeNature	Provision of fire fighting services to CapeNature.
01/04/2014 to 31/03/2021	FFA Operations (Pty) Ltd and CapeNature Memorandum of Agreement	FFA Operations (Pty) Ltd (trading as Working on Fire)	7 years	Gamkaberg Cluster	Working on Fire and CapeNature	Assistance with fire fighting operations.
Kammanassie Cluster						
14/041994	High Site partner	South African Police Services (SAPS)	N/A	Mannetjiesberg	South African Defence Force (SADF)	Permanent right to erect a radio repeater.
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Mannetjiesberg	Uniondale Farmer's Association	Temporary right: Radio telecommunication use.
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Mannetjiesberg	Department of TRAFFIC	Temporary right: Radio telecommunication use.

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected	User	Conditions of use*
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Mannetjiesberg	R & S Communication	Temporary right: Radio telecommunication use.
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Mannetjiesberg	Garden Route District Municipality	Temporary right: Radio telecommunication use.
Unknown	High Site partner	South African Police Services (SAPS)	Unknown	Mannetjiesberg	Emergence Medical Services (EMS)	Temporary right: Radio telecommunication use.
Unknown	High Site partner	Telkom	Unknown	Mannetjiesberg	Telkom	Temporary right: to erect a radio repeater.
Unknown	High Site	CapeNature structure	N/A	Wildealsvlei	J & E Communication	Temporary right: Radio telecommunication use.
Unknown	Road Access	Raldu Nel		Wildealsvlei	R. Nel	Temporary right: Road access use.
01/08/2019 to 31/07/2022	DEA: Natural Resource Management (DEA: NRM); CapeNature Terrestrial, Ecosystems, Special and Wetlands projects	DEA: NRM	3 years	Kammanassie sector	DEA: NRM and CapeNature	Biocontrol project Terrestrial invasive plant clearing project
01/05/2019 to 31/03/2021	Western Cape Nature Conservation Board & Southern Cape Fire Protection Association Memorandum of agreement	SCFPA	1 year and 10 months	Kammanassie Cluster	SCFPA and CapeNature	Provision of fire fighting services to CapeNature. SCFPA is authorised Base partner of Working on Fire team based at Kammanassie office station in Uniondale. Use of Uniondale Working on Fire team for operational tasks on Kammanassie.

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected	User	Conditions of use*
01/04/2014 to 31/03/2021	FFA Operations (Pty) Ltd and CapeNature Memorandum of Agreement	FFA Operations (Pty) Ltd (trading as Working on Fire)	7 years	Kammanassie Cluster	Working on Fire and CapeNature	Assistance with fire fighting operations. Use of Kammanassie office station as a base for Working on Fire team.

8 EXPANSION STRATEGY

Protected area expansion in South Africa is guided by the National Protected Area Expansion Strategy (NPAES) (DEA 2016). In response to the 2010 version of the NPAES (SANBI & DEA 2010), CapeNature has produced a Western Cape Protected Area Expansion Strategy and Implementation Plan 2015-2020 (Maree *et al.* 2015).

Mechanisms for protected area expansion include the promotion of stewardship options on private land in collaboration with landowners, regularising existing private nature reserves, and the consolidation of state land managed by conservation authorities such as municipalities and CapeNature as formal protected areas.

CapeNature's Western Cape Protected Area Expansion Plan aims to conserve 60% of the biodiversity threshold for all terrestrial ecosystems by acquiring 1 046 500 ha of land for conservation between 2015 and 2030 (Maree *et al.* 2015). Mechanisms to achieve this target include land purchase, the consolidation of state land as formal protected areas managed by CapeNature, the verification and validation of private nature reserves and the promotion of stewardship options on private or communal land. Through stewardship, landowners or communities enter into agreements with conservation organisations to protect and manage land in biodiversity priority areas. The landowner retains ownership and acts as the biodiversity custodian and manager of the conservation area. Between 2008 and 2016, 68% of all protected area expansion in South Africa was achieved through stewardship (SANBI Undated). Since its inception in 2003, CapeNature's Biodiversity Stewardship Programme has signed agreements covering about 185 000 ha of land.

Priority expansion areas are identified by systematic conservation planning and stakeholder engagement, and include sites that contain Critical Biodiversity Areas, Ecological Support Areas and corridors that are important for climate change adaptation. Conservation priorities in the SCWHS&NR area are a corridor between the Towerkop and Paardenberg sectors, a corridor between the Swartberg East and Kammanassie sectors, and linking the Groenefontein and Gamkaberg sectors. Aquatic corridors (e.g. along the Gouritz and Gamka rivers), especially those linking the Swartberg Mountain Range with the Langeberg and Outeniqua Ranges are also important.

Expansion plans must also take into account the conservation of habitat for priority species such as Cape mountain zebra. In recent years much progress has been made in establishing a corridor between Gamkaberg and the Outeniqua Mountains, with the acquisition of Fontein and Heimersrivier. Negotiations are currently underway to acquire another property south of Gamkaberg but adjacent to the Outeniqua WHS, which would aid significantly towards the completion of the Gamkaberg-Outeniqua corridor. This property harbours very good habitat for Cape mountain zebra.

Along the southern slopes of the Kammanassie, there is an urgent need to expand the habitat for the Kammanassie Cape mountain zebra into the lowland areas. Several properties have been prioritised for acquisition, but negotiations to date have not yet been successfully concluded.

The SCWHS&NR falls in the core area of the GCBR, which aims to support a system of sustainable living landscapes that is representative of the region's biodiversity. In the past, expansion of the protected area network was largely achieved through land

purchase by the WWF-SA. Now, the predominant mechanism is the signing of stewardship agreements. In the SCWHS&NR and its ZOI, there are 13 stewardship sites totalling 21 719 ha. There are also four private nature reserves, which will be added to the stewardship register if their biodiversity value merits this and if the owners are willing.

The expansion map for the SCWHS&NR is presented in Appendix 2 Map 17(a-d).

9 CONCEPT DEVELOPMENT PLAN

The concept development plan sets out the long-term plan for the development of the SCWHS&NR in keeping with the purpose of the protected area and with due consideration for protected area expansion and the zoning plan.

Tourism products and related infrastructure developments in CapeNature are considered investments and are intended to:

- Harness and enhance the income generation potential of protected areas with a view to achieving long term business sustainability;
- The provision of safe, informative and purpose-built access to protected areas;
- To enhance the operational efficiency and management of the SCWHS&NR.

9.1 Project Selection

Organisationally potential tourism product developments are selected based on internal consultation and approval where factors such as appropriateness, environmental authorisation, financial feasibility and the apparent return on investment are considered. Where external approvals for developments are required, these are sought from the relevant authorities prior to the commencement of any development activities (Figure 9.1).

CapeNature may elect to operate tourism products and services internally, or via other mechanisms described in the Public Finance Management Act, 1999 (Act No.1 of 1999) such as concessions or public private partnerships.

Tourism products and infrastructure within CapeNature protected areas are designed to be sensitive to their locations and are intended as prime examples of responsible and sustainable commercial developments. These include: off-grid bulk water and energy services; passive design efficiencies; enhanced resource utilisation and resource-saving features. Tourism developments aim to comply with prevailing zonation schemes and sensitivity analysis unless approval to the contrary has successfully been sought.

Wherever possible, tourism products, developments and services are intended to provide training and employment opportunities to communities within and surrounding the protected area.

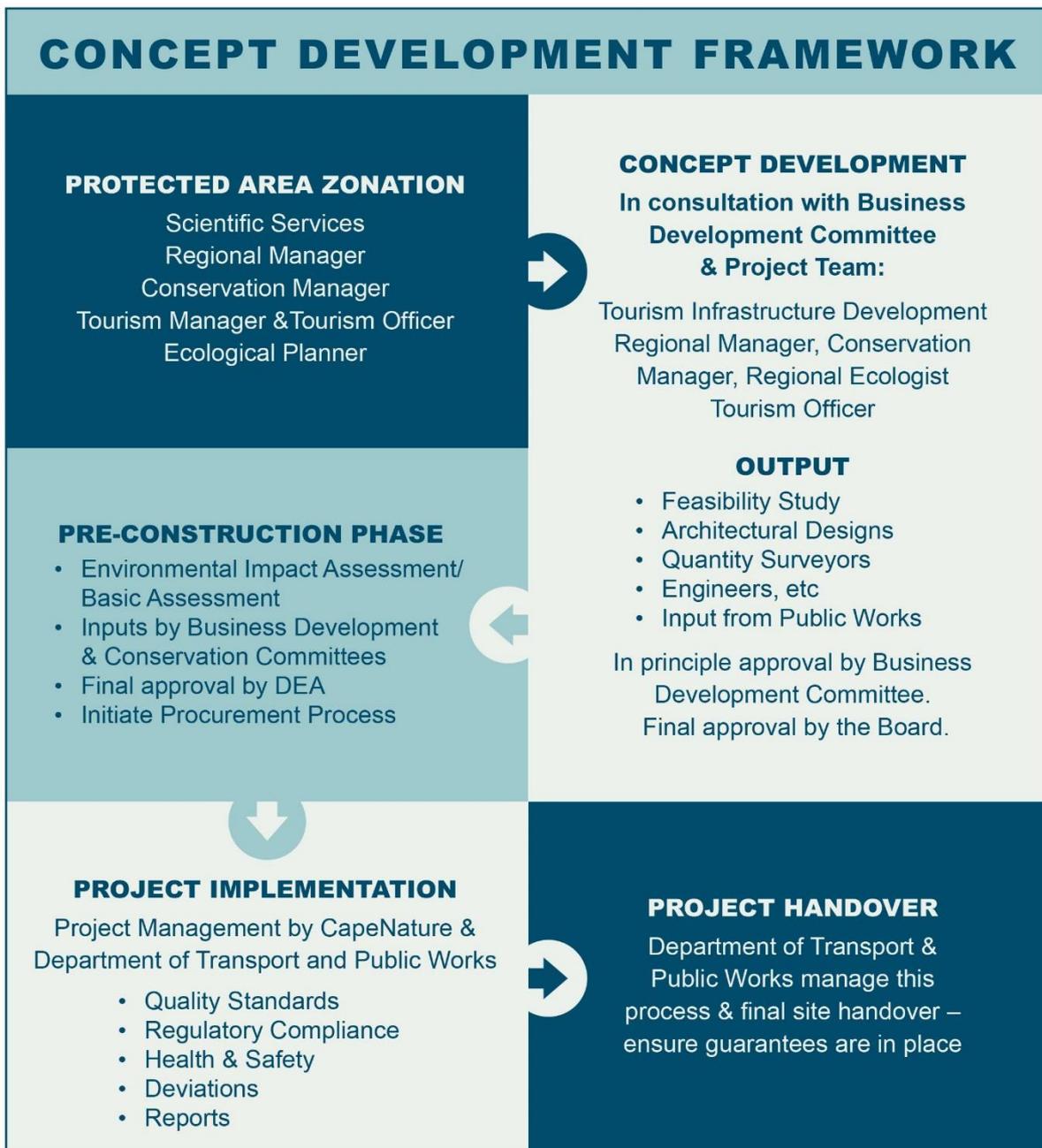


Figure 9.1: Concept Development Plan Framework.

9.2 Infrastructure Management and Development

No new tourism or other infrastructure developments are planned for the time span of this management plan. If new development plans are proposed, an amendment to this management plan will be drafted and approved.

Apart from new developments, existing infrastructure which mainly include boundary fences, jeep tracks, operational and visitor facilities, earth dams and water installations will be maintained and/or upgraded as required. This is set out in the infrastructure register and the annual CapeNature U-AMP.

10 STRATEGIC PLAN

This section presents the Strategic Plan for the SCWHS&NR. The strategic plan was derived from an assessment of the conservation situation, inclusive of the biological environment and the social, economic, cultural and institutional systems that influence values. Strategic intervention points formed the basis for developing strategies; using results chains to test theories of change and establish short to medium term objectives. From these, detailed actions with timeframes were developed to guide implementation, monitoring and evaluation.

Strategies are aimed at:

- Focal value restoration / stress reduction;
- Behavioural change / threat reduction; and
- Establishing / promoting enabling conditions.

A summary of selected strategies and objectives for the SCWHS&NR is provided in Table 10.1. Thereafter the 15 identified strategies with details regarding the associated actions and timeframes are presented.

CapeNature will lead the implementation of the management plan, although achieving the vision requires coordinated effort. Stakeholder groups and organisations identified in the strategic plan are key role players in successful delivery of this management plan.

Table 10.1: Summary of strategies and objectives for the Swartberg Complex World Heritage Site and Nature Reserves.

Threat(s) abated	Strategy Type	Strategy	Objectives
Alien invasive plants	Focal value restoration/threat reduction	Strategy 1: Through partnerships address the negative impacts that invasive alien vegetation has on fire regimes, biodiversity and water availability within the SCWHS&NR and ZOI.	Objective 1.1: By 2021 CapeNature has revised, updated and been implementing the long term alien invasive clearing plan for the SCWHS&NR with relevant management authorities.
Inappropriate fire regimes	Focal value restoration/threat reduction	Strategy 2: In collaboration with partners promote and implement ecologically sound fire management through integrated fire management operations and awareness raising within the SCWHS&NR and ZOI.	Objective 2.1: By 2021 ecologically sound fire management principles inform integrated fire management operations within the SCWHS&NR and ZOI.
			Objective 2.2: By 2021 consistently improve and maintain awareness raising of the direct and indirect impacts of fires with relevant partners (e.g. FPA, District Municipality, Forums, Farmers Associations, Conservancies and Working on Fire).
Over-abstraction and pollution of surface water	Threat reduction/enabling conditions and stress reduction	Strategy 3: Through partnerships address agricultural and urban (including industrial) water use best practice, pollution incidents and compliance within the ZOI.	Objective 3.1: By 2020 and beyond CapeNature in collaboration with partners advocates water use best practice (including agricultural, urban and industrial) and compliance within the ZOI
			Objective 3.2: By 2021 develop an integrated strategy to effectively deal with pollution incidents in collaboration with partners within the SCWHS&NR and ZOI.
Over-abstraction of groundwater	Threat reduction	Strategy 4: Determine through partnerships and collection of empirical evidence the impact of groundwater abstraction on groundwater dependent ecosystems.	Objective 4.1: By 2022 partnerships with relevant monitoring agencies (e.g. South African Environmental Observation Network – SAEON) are established and maintained to obtain relevant data on groundwater dependent ecosystems.
			Objective 4.2: By 2025 groundwater dependent ecosystems (wetlands and seeps) within the SCWHS&NR have been identified and monitoring of these are initiated to determine baseline before abstraction of groundwater commences.
			Objective 4.3: By 2021 and beyond water abstraction quantity and quality of boreholes within the ZOI are being monitored.

Threat(s) abated	Strategy Type	Strategy	Objectives
Habitat fragmentation and alteration	Enabling conditions	Strategy 5: Through partnerships promote the establishment of ecological corridors to allow for seasonal migration and growth of Cape mountain zebra subpopulations.	Objective 5.1: By 2021 identify and secure priority lowland properties adjacent to the SCWHS&NR containing suitable habitat to allow seasonal migration and growth of Cape mountain zebra subpopulations.
			Objective 5.2: By 2021 and beyond CapeNature actively engages with relevant stakeholders to raise awareness regarding the importance and vulnerability of unique Cape mountain zebra subpopulations in the SCWHS&NR and ZOI.
			Objective 5.3: By 2021 identify and facilitate research relevant to achieving management objectives of the Cape mountain zebra metapopulation.
Lack of genetic mixing (contributing to poor population genetic fitness i.e. inbreeding)	Focal value restoration/threat reduction	Strategy 6: Maintain genetic diversity in the Cape mountain zebra metapopulation in collaboration with relevant BMP partners.	Objective 6.1: By 2025 genetic diversity of the Cape mountain zebra metapopulations is reinforced through the mixing of Cape mountain zebra subpopulations and supported by a monitoring and evaluation programme to assess the effects of this action.
			Objective 6.2: By 2025 ensure smaller populations are safeguarded against isolation and limited gene flow.
Hybridisation with other equids	Focal value restoration/threat reduction	Strategy 7: In collaboration with relevant BMP partners, quantify the extent of genetic contamination due to hybridisation with other equine species and safeguard Cape mountain zebra in their natural distribution range.	Objective 7.1: By 2025 in partnership with relevant stakeholders assess and quantify the extent of genetic contamination due to hybridisation with other equine species and safeguard Cape mountain zebra in their natural distribution range.
Alien invasive animals (fish)	Focal value restoration/threat reduction	Strategy 8: Through existing partnerships implement alien invasive fish control and/or removal guided by legislation and policy in priority rivers.	Objective 8.1: By 2030 the SCWHS&NR has implemented alien fish eradication plans that are aligned to legislation informed by risk assessments and surveys.

Threat(s) abated	Strategy Type	Strategy	Objectives
Alien invasive animals (other than fish)	Focal value restoration/threat reduction	Strategy 9: Through partnerships and elevated extension work, address alien invasive, domestic and extra-limital fauna within the SCWHS&NR and its ZOI in line with relevant legislation and policies (LandCare, Agriculture and research institutions).	Objective 9.1: By 2020 and beyond address invasive faunal species control through the development and implementation of an invasive alien species control plan (i.e. domestic animals such as donkeys, goats, horses, cattle, extra-limital game species, etc.).
Persecution (loss) of animals related to human-wildlife conflict (jackal, caracal, leopard, baboons, kudu, eland, bat-eared fox (bycatch) etc.).	Focal value restoration/threat reduction	Strategy 10: Address illegal and unsustainable resource utilisation practices which includes domestic animals, extra-limital game, poaching, over-grazing and land degradation within the SCWHS&NR and its ZOI through partnerships and elevated extension work (LandCare, Agriculture and research institutions).	Objective 10.1: By 2021 competent, knowledgeable and experienced staff members have been identified and capacitated to engage with relevant partner organisations and landowners regarding the value of conservation through raising awareness and encouraging compliance.
Over-stocking & over-grazing (Inappropriate agricultural activities)			Objective 10.2: By 2021 revise and implement the integrated compliance plans in collaboration with partners.
Invasion Risks (e.g. nyala, impala)			Objective 10.3: By 2023 develop ecological carrying capacity guidelines for different habitat types.
			Objective 10.4: By 2021 CapeNature has ensured that non-compliant game farmers identified within the ZOI of the SCWHS&NR are compliant with the relevant legislation and policies.
Biological resource use Hunting and/or collection of indigenous fauna	Enabling conditions	Strategy 11: Ensure the conservation of biodiversity and ecosystems and the sustainable and regulated use of resources	Objective 11.1: By 2025 CapeNature develops and implements a natural resource management and utilisation strategy to ensure sustainable and regulated resource use.

Threat(s) abated	Strategy Type	Strategy	Objectives
Harvesting of indigenous flora		within the SCWHS&NR and its ZOI through the development and strengthening of partnerships.	Objective 11.2: By 2022 and beyond engage with relevant partners and stakeholders regarding the value of conserving biological resources and maintaining healthy ecosystems through raising awareness and encouraging compliance.
Vandalism to Cultural Heritage Sites Fire damage to heritage values General lack of cultural knowledge and understanding	Threat reduction	Strategy 12: Through partnerships share, evaluate and enhance the management and protection of cultural and natural heritage values both internally and externally.	Objective 12.1: By 2025 engage with relevant partners and stakeholders regarding the value of cultural and natural heritage sites through raising awareness and encouraging compliance.
Littering Wastage of water and energy resources	Enabling conditions	Strategy 13: Promote the values of a healthy environment for the benefit of present and future generations within the SCWHS&NR and ZOI through partnerships.	Objective 13.1: By 2021 CapeNature, through awareness raising and partnerships, develops and implements an anti-litter and energy and water-saving campaign (leave no trace) for the SCWHS&NR and ZOI.
Land clearing (Inappropriate agricultural activities and tourism developments) Riparian and instream modification	Threat reduction	Strategy 14: Through partnerships and elevated extension work, address illegal and inappropriate agricultural and development activities (such as land clearing, riparian and instream modification, tourism developments) within the SCWHS&NR and its ZOI (LandCare, Agriculture, research institutions and DEA&DP).	<p>Objective 14.1: By 2022 engage with Department Agriculture-LandCare and DEA&DP to initiate area-wide planning within the ZOI.</p> <p>Objective 14.2: By 2021 the SCWHS&NR and ZOI is integrated into Municipal Land Use Planning products.</p> <p>Objective 14.3: By 2021 water use planning and management operations are aligned with the objectives of the SCWHS&NR.</p>

Threat(s) abated	Strategy Type	Strategy	Objectives
Habitat fragmentation and alternation: degradation of landscapes.	Enabling conditions	Strategy 15: Promote the PAES in collaboration with neighbouring landowners to support ecological processes and maintain living landscapes.	Objective 15.1: By 2021 and beyond identify, secure and protect conservation worthy areas and properties surrounding the SCWHS&NR in line with PAES.

Strategic Action Plan for the Swartberg Complex World Heritage Site and Nature Reserves.

10.1 Strategy 1: Invasive alien species management - Flora

INVASIVE ALIEN SPECIES MANAGEMENT - FLORA					
STRATEGIES:	Strategy 1: Through partnerships address the negative impacts that invasive alien vegetation has on fire regimes, biodiversity and water availability within the SCWHS&NR and ZOI.				
GOALS:	<ul style="list-style-type: none"> By 2030 the invasive alien plant infestation will be maintained at less than 2% and all high altitude team (HAT) sites would have been cleared 99%. 				
THREATS:	<ul style="list-style-type: none"> Invasive alien plants. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
<p>Objective 1.1: By 2021 CapeNature has revised, updated and been implementing the long term alien invasive clearing plan for the SCWHS&NR with relevant management authorities.</p>	<p>Eradicate alien and invasive vegetation species on an on-going basis.</p> <ul style="list-style-type: none"> Revise and update the invasive alien plants database and maps for the SCWHS&NR and ZOI. Ensure that the HAT sites are clearly differentiated and included in the database and maps. Ensure that the Management Unit Clearing Plan is incorporated into the Invasive Alien Plant plan which informs the IWP and IAPO. Prioritise removal in collaboration with partners (Working for Water, Working on Fire, High Altitude Teams, Municipality and Volunteer groups). Ensure that maintenance of relevant infrastructure (roads, trails, 	Landscape Manager (L1); Conservation Manager (On-Reserve); Capability Manager: Integrated Catchments; Natural Resource Manager: Region East; Landscape Conservation Intelligence Manager; Restoration Ecologist.	Annually	IWP; contract tender; contract site visit; invasive alien plant site inspection report; field ranger reports; EPWP production records; monthly/weekly planning and reporting.	Invasive Alien Plant management resource strategy; IAPO; Monthly/weekly planning and reporting

INVASIVE ALIEN SPECIES MANAGEMENT - FLORA					
STRATEGIES:	Strategy 1: Through partnerships address the negative impacts that invasive alien vegetation has on fire regimes, biodiversity and water availability within the SCWHS&NR and ZOI.				
GOALS:	<ul style="list-style-type: none"> By 2030 the invasive alien plant infestation will be maintained at less than 2% and all high altitude team (HAT) sites would have been cleared 99%. 				
THREATS:	<ul style="list-style-type: none"> Invasive alien plants. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	etc.) is addressed in IWP and IAPO. <ul style="list-style-type: none"> Implement the IAPO. 				
	Monitor alien vegetation on and adjacent to the SCWHS&NR to inform adaptive management strategies. <ul style="list-style-type: none"> Update and maintain invasive alien plant database and adapt clearing strategies as needed. Monitor the costs, impact and effectiveness of implementation of clearing and compile progress report. 	Landscape Manager (L1); Conservation Manager (On-Reserve); Capability Manager: Integrated Catchments; Natural Resource Manager: Region East; Landscape Conservation Intelligence Manager; Restoration Ecologist.	Year 1-10	IWP; Updated database and maps; MIS Reports.	Invasive Alien Plant management resource strategy; IAPO; Monthly/weekly planning and reporting
	Implement biological control as a method of invasive alien plant management. <ul style="list-style-type: none"> Monitor the presence and success of existing biological control agents and identify additional release sites where applicable. 	Conservation Manager (On-Reserve); Capability Manager: Integrated Catchments; Natural Resource Manager: Region East;	Year 1-10	Presence/absence monitoring of biological control agents; biodiversity survey sheet reports.	Monthly/weekly planning and reporting, Biocontrol Strategy

INVASIVE ALIEN SPECIES MANAGEMENT - FLORA					
STRATEGIES:	Strategy 1: Through partnerships address the negative impacts that invasive alien vegetation has on fire regimes, biodiversity and water availability within the SCWHS&NR and ZOI.				
GOALS:	<ul style="list-style-type: none"> By 2030 the invasive alien plant infestation will be maintained at less than 2% and all high altitude team (HAT) sites would have been cleared 99%. 				
THREATS:	<ul style="list-style-type: none"> Invasive alien plants. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	<ul style="list-style-type: none"> Release new biological control agents for additional species where and when applicable. Monitor success of releases. 	Landscape Conservation Intelligence Manager; Restoration Ecologist.			
	<p>Prevent the introduction of invasive alien species from neighbouring landowners.</p> <ul style="list-style-type: none"> Ensure surrounding landowners are aware of relevant legislation. Provide guidance to neighbouring landowners regarding the control of invasive alien plants. Promote a buffer zone of 100 m adjacent to protected areas to limit the infestation of invasive alien plants from neighbouring properties. 	Conservation Manager (On Reserve); Conservation Manager (Off-reserve); Compliance & Enforcement Specialist.	Year 1-10	Fence and boundary patrol reports; PAAC meetings; records of engagements with landowners (such as fire-break discussions).	Fence and boundary patrols; PAAC meetings; CapeNature Stakeholder interaction register

10.2 Strategy 2: Fire Management

FIRE MANAGEMENT					
STRATEGIES:	Strategy 2: In collaboration with partners promote and implement ecologically sound fire management through integrated fire management operations and awareness raising within the SCWHS&NR and ZOI.				
GOALS:	<ul style="list-style-type: none"> By 2030 the veld age will be in an ecologically healthy condition and 50% of the <i>Protea</i> indicator species have flowered more than 3x; 80% of fires have occurred in the correct fire season and the size of 90% of single fires would not have exceeded 5000 ha. 				
THREATS:	<ul style="list-style-type: none"> Inappropriate fire regimes. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 2.1: By 2021 ecologically sound fire management principles inform integrated fire management operations within the SCWHS&NR and ZOI.	<p>Compile and implement an ecologically sound integrated fire management plan for the SCWHS&NR and ZOI in collaboration with relevant partners.</p> <ul style="list-style-type: none"> Update and implement Fire Protection and Reaction Plans including risk assessments, Eco sensitive and Special Management Zone mapping and fire management maps. Assess appropriateness of current firebreak network and re-align where appropriate, based on negotiated firebreak agreements with neighbours. Construct priority firebreaks according to firebreak register schedule and keep updated. 	Landscape Manager (L1 & L2); Conservation Manager (On-Reserve); Capability Manager: Integrated Catchments; IC Specialist Disaster & Climate Response; IC Specialist; Landscape Conservation Intelligence Manager.	Year 1-10	Fire reports; veld age maps; firebreak registers; pre-fire audit reports and fire debriefing minutes; maps; meeting minutes; firebreak agreements; portfolio of evidence.	Veldfire Management Policy, Guidelines, SOGs, Fire break register, ICM-APO

FIRE MANAGEMENT					
STRATEGIES:	Strategy 2: In collaboration with partners promote and implement ecologically sound fire management through integrated fire management operations and awareness raising within the SCWHS&NR and ZOI.				
GOALS:	<ul style="list-style-type: none"> By 2030 the veld age will be in an ecologically healthy condition and 50% of the <i>Protea</i> indicator species have flowered more than 3x; 80% of fires have occurred in the correct fire season and the size of 90% of single fires would not have exceeded 5000 ha. 				
THREATS:	<ul style="list-style-type: none"> Inappropriate fire regimes. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	<ul style="list-style-type: none"> Conduct a pre-fire season fire audit. Complete fire reports as stipulated and map all fires on QGIS. Conduct de-briefing sessions after each fire and keep records (including a Portfolio of Evidence). 				
	<p>Allow for adaptive management towards natural fire processes to occur without negatively impacting on safety and infrastructure.</p> <ul style="list-style-type: none"> Determine and incorporate TPCs and related fire-fighting actions towards ecologically sound fire regimes in fire mapping products for use during fire-fighting activities. Update Infrastructure risk assessments and maintenance schedules for incorporation into fire mapping products and IAPO. 	Landscape Manager (L1 & L2); Conservation Manager (On-Reserve); Capability Manager: Integrated Catchments; IC Specialist Disaster & Climate Response; IC Specialist; Landscape Conservation Intelligence Manager; Capability Manager: Conservation Innovation.	Year 1-10	Veld age maps; hotspot and ecological sensitivity maps including infrastructure information and maintenance schedules.	Fire Management Policy and Guidelines; IWP & IAPO.

FIRE MANAGEMENT					
STRATEGIES:	Strategy 2: In collaboration with partners promote and implement ecologically sound fire management through integrated fire management operations and awareness raising within the SCWHS&NR and ZOI.				
GOALS:	<ul style="list-style-type: none"> By 2030 the veld age will be in an ecologically healthy condition and 50% of the <i>Protea</i> indicator species have flowered more than 3x; 80% of fires have occurred in the correct fire season and the size of 90% of single fires would not have exceeded 5000 ha. 				
THREATS:	<ul style="list-style-type: none"> Inappropriate fire regimes. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	<ul style="list-style-type: none"> Implement ICS management principles and processes during veldfires or other disasters. Ensure that ecological principles are incorporated during fire-fighting planning in ICS. 				
	<p>Determine and implement thresholds of potential concern and related mitigating actions and ensure their implementation for fire management on the SCWHS&NR.</p> <ul style="list-style-type: none"> Establish a series of permanent <i>Protea</i> plots in accordance with the ecological matrix. Conduct permanent <i>Protea</i> plot monitoring. Conduct post-fire regeneration monitoring 12-18 months after fires. Set and monitor TPCs based on <i>Protea</i> monitoring data collected and identify hotspot areas where 	Conservation Manager (On-Reserve); Capability Manager: Integrated Catchments; IC Specialist Disaster & Climate Response; IC Specialist; Landscape Conservation Intelligence Manager; Capability; Team Leader: Ecology.	Year 1-10	Permanent <i>Protea</i> and post-fire monitoring data sheets; hotspot and ecological sensitivity maps; veld fire response plan.	Fire Management Policy and Guidelines, Baseline Data Collection and Monitoring Manual, Ecological Matrix.

FIRE MANAGEMENT					
STRATEGIES:	Strategy 2: In collaboration with partners promote and implement ecologically sound fire management through integrated fire management operations and awareness raising within the SCWHS&NR and ZOI.				
GOALS:	<ul style="list-style-type: none"> By 2030 the veld age will be in an ecologically healthy condition and 50% of the <i>Protea</i> indicator species have flowered more than 3x; 80% of fires have occurred in the correct fire season and the size of 90% of single fires would not have exceeded 5000 ha. 				
THREATS:	<ul style="list-style-type: none"> Inappropriate fire regimes. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	fires need to be kept out for ecological reasons. <ul style="list-style-type: none"> Investigate faunal thresholds of potential concern. 				
Objective 2.2: By 2021 consistently improve and maintain awareness raising of the direct and indirect impacts of fires with relevant partners such as FPA, District Municipality, Forums, Farmers Associations, Conservancies and Working on Fire).	Establish and maintain partnerships to improve fire management on the SCWHS&NR and its ZOI. <ul style="list-style-type: none"> Attend and participate in and where necessary facilitate and coordinate FPA and FMU meetings. Implement FPA strategies and FMU action plan where applicable. Ensure compliance with legislation (i.e. firebreaks and agreements in place). Respond to all fires within the SCWHS&NR and the ZOI and according to the fire response plan. 	Conservation Manager (On-Reserve); Capability Manager: Integrated Catchments; IC Specialist Disaster & Climate Response; IC Specialist; Landscape Conservation Intelligence Manager.	Year 1-10	FPA membership and meeting minutes; FMU plans; East Region Veld Fire Response Plan.	Fire Management Policy and Guidelines, FPA Operational Rules and Guidelines.

FIRE MANAGEMENT					
STRATEGIES:	Strategy 2: In collaboration with partners promote and implement ecologically sound fire management through integrated fire management operations and awareness raising within the SCWHS&NR and ZOI.				
GOALS:	<ul style="list-style-type: none"> By 2030 the veld age will be in an ecologically healthy condition and 50% of the <i>Protea</i> indicator species have flowered more than 3x; 80% of fires have occurred in the correct fire season and the size of 90% of single fires would not have exceeded 5000 ha. 				
THREATS:	<ul style="list-style-type: none"> Inappropriate fire regimes. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	Wildfires as a result of human negligence are reduced. <ul style="list-style-type: none"> In collaboration with partners, create and implement a fire awareness programme for neighbouring communities and landowners, visitors and staff members. 	Conservation Manager (On Reserve); IC Specialist; Senior Manager Regional People and Conservation; Compliance & Enforcement Specialist; Landscape Conservation Intelligence Manager.	Annually	Media products (videos, AFIS map, radio broadcasting, posters, etc.).	CapeNature Media Engagement Policy

10.3 Strategy 3: Biodiversity and Ecosystem Management – Surface water

BIODIVERSITY AND ECOSYSTEM MANAGEMENT - SURFACE WATER					
STRATEGIES:	Strategy 3: Through partnerships address agricultural and urban (including industrial) water use best practice, pollution incidents and compliance within the ZOI.				
GOALS:	<ul style="list-style-type: none"> By 2030 the ecosystem health condition of all wetlands in the SCWHS&NR will have a near natural condition and have good wetland buffers. Wetlands include seepage areas. By 2030 river flow of abstracted rivers is maintained above 80%. By 2030 the invasive alien plant infestation will be maintained at less than 2% and all high altitude team (HAT) sites would have been cleared 99%. 				
THREATS:	<ul style="list-style-type: none"> Over-abstraction and pollution of surface water. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 3.1: By 2020 and beyond CapeNature in collaboration with partners advocates water use best practice (including agricultural, urban and industrial) and compliance within the ZOI	Conserve and protect rivers. <ul style="list-style-type: none"> Identify or establish an appropriate forum to engage with relevant partners and landowners. Monitor the health of priority rivers using SASS 5 and record abstraction points. Determine any actions necessary as a result of SASS results and abstraction points (includes fishes). Comment on proposed developments involving water abstraction. 	Landscape Manager (L1); Conservation Manager (On-Reserve); Capability Manager: Integrated Catchments; Landscape Conservation Intelligence Manager; Freshwater Ecologist.	Year 1-10	Annual reports on findings; monitoring reports.	Ecological Matrix, CapeNature Monitoring Protocol for Freshwater Ecosystems, Wetland Ground-truthing Field Form
	Conserve and rehabilitate wetlands. <ul style="list-style-type: none"> Initiate desktop assessment of wetlands that are potentially 	Freshwater Ecologist; Capability Manager: Integrated Catchments; Restoration Ecologist;	Year 1-10	Maps and reports.	

BIODIVERSITY AND ECOSYSTEM MANAGEMENT - SURFACE WATER					
STRATEGIES:	Strategy 3: Through partnerships address agricultural and urban (including industrial) water use best practice, pollution incidents and compliance within the ZOI.				
GOALS:	<ul style="list-style-type: none"> By 2030 the ecosystem health condition of all wetlands in the SCWHS&NR will have a near natural condition and have good wetland buffers. Wetlands include seepage areas. By 2030 river flow of abstracted rivers is maintained above 80%. By 2030 the invasive alien plant infestation will be maintained at less than 2% and all high altitude team (HAT) sites would have been cleared 99%. 				
THREATS:	<ul style="list-style-type: none"> Over-abstraction and pollution of surface water. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	affected by surface water abstraction. <ul style="list-style-type: none"> Start verification process of CBA and NFEPA information for updates of the digital wetland spatial layers for the SCWHS&NR. 	Conservation Planner; Capability Manager: Conservation Innovation.			
Objective 3.2: By 2021 develop an integrated strategy to effectively deal with pollution incidents in collaboration with partners within the SCWHS&NR and ZOI.	Report and monitor pollution incidents in the SCWHS&NR and ZOI. <ul style="list-style-type: none"> Refer problems related to water pollution to relevant authorities (Departments of Transport, Water & Sanitation, Agriculture and DEA&DP). Ensure recommended actions are taken and follow-up monitoring is implemented. 	Conservation manager (On Reserve), Freshwater Ecologist; Team Leader: Ecology; Landscape Conservation Intelligence Manager.	Year 1-10	List and contact details of partner and monitoring agencies; minutes/ summary of discussions/ engagements.	

10.4 Strategy 4: Biodiversity and Ecosystem Management – Groundwater

BIODIVERSITY AND ECOSYSTEM MANAGEMENT - GROUNDWATER					
STRATEGIES:	Strategy 4: Determine through partnerships and collection of empirical evidence the impact of groundwater abstraction on groundwater dependent ecosystems.				
GOALS:	<ul style="list-style-type: none"> By 2030 the ecosystem health condition of all wetlands in the SCWHS&NR will have a near natural condition and have good wetland buffers. Wetlands include seepage areas. By 2030 river flow of abstracted rivers is maintained above 80%. By 2030 the invasive alien plant infestation will be maintained at less than 2% and all high altitude team (HAT) sites would have been cleared 100%. By 2030 there will be an established groundwater monitoring programme to improve the understanding of groundwater dependent ecosystems. 				
THREATS:	<ul style="list-style-type: none"> Over-abstraction of groundwater. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 4.1: By 2022 partnerships with relevant monitoring agencies (e.g. SAEON) are established and maintained to obtain relevant data on groundwater dependent ecosystems.	Engage with relevant partners and monitoring agencies (SAEON, UCT) regarding research projects and obtaining data on groundwater dependent ecosystems. <ul style="list-style-type: none"> Identity relevant partners / monitoring agencies. Initiate engagement sessions to establish a support network. 	Landscape Manager (L2 & L1); Conservation Manager (On Reserve); Capability Manager: Integrated Catchments; Landscape Conservation Intelligence Manager; Freshwater Ecologist.	Year 1-10	List and contact details of partner and monitoring agencies; minutes/ summary of discussions /engagements.	
Objective 4.2: By 2025 groundwater dependent ecosystems (wetlands & seeps) within the SCWHS&NR have been identified and monitoring of these are initiated to	Mitigate the impacts of groundwater abstraction on the reserve. <ul style="list-style-type: none"> Identify and map wetlands and seeps within the SCWHS&NR. Implement monitoring of groundwater dependent 	Conservation Manager (On Reserve); Freshwater Ecologist; Capability Manager: Conservation Innovation; Landscape	Year 1-10	Map of wetlands and seeps; groundwater monitoring protocol and database.	Ecological Matrix, Wetland Ground-truthing Field Form

BIODIVERSITY AND ECOSYSTEM MANAGEMENT - GROUNDWATER					
STRATEGIES:	Strategy 4: Determine through partnerships and collection of empirical evidence the impact of groundwater abstraction on groundwater dependent ecosystems.				
GOALS:	<ul style="list-style-type: none"> By 2030 the ecosystem health condition of all wetlands in the SCWHS&NR will have a near natural condition and have good wetland buffers. Wetlands include seepage areas. By 2030 river flow of abstracted rivers is maintained above 80%. By 2030 the invasive alien plant infestation will be maintained at less than 2% and all high altitude team (HAT) sites would have been cleared 100%. By 2030 there will be an established groundwater monitoring programme to improve the understanding of groundwater dependent ecosystems. 				
THREATS:	<ul style="list-style-type: none"> Over-abstraction of groundwater. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
determine baseline before abstraction of groundwater commences.	ecosystems according to accepted protocol.	Conservation Intelligence Manager.			
Objective 4.3: By 2021 and beyond water abstraction quantity and quality of boreholes within the ZOI are being monitored.	Monitor groundwater abstraction and quality within the SCWHS&NR and ZOI. <ul style="list-style-type: none"> Obtain and analyse abstraction data from Oudtshoorn Municipality for KKRWSS. Obtain groundwater abstraction points and data (quantity and quality) of boreholes situated adjacent to the SCWHS&NR. 	Conservation Manager (On Reserve); Freshwater Ecologist; Landscape Conservation Intelligence Manager; Capability Manager: Integrated Catchments.	Year 1-10	Spring monitoring data sheets and graphs.	CapeNature Groundwater Monitoring Protocol, KKRWSS abstraction rates

10.5 Strategy 5: Wildlife Management – Cape mountain zebra (Habitat expansion)

WILDLIFE MANAGEMENT - CAPE MOUNTAIN ZEBRA (Habitat expansion)					
STRATEGIES:	Strategy 5: Through partnerships promote the establishment of ecological corridors to allow for seasonal migration and growth of Cape mountain zebra subpopulations.				
GOALS:	<ul style="list-style-type: none"> By 2030 three priority properties will have signed perpetuity stewardship agreements and another two as biodiversity agreements or higher within priority corridors. 				
THREATS:	<ul style="list-style-type: none"> Habitat fragmentation and alteration. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 5.1: By 2021 Identify and secure priority lowland properties adjacent to the SCWHS&NR containing suitable habitat to allow seasonal migration and growth of Cape mountain zebra subpopulations.	Secure priority lowland ecological corridors for Cape mountain zebra in line with the PAES. <ul style="list-style-type: none"> Finalise the standard criteria for Cape mountain zebra site selection and habitat expansion in relation to habitat suitability based on evidence of historic distribution, habitat requirements, resource requirements and risk. Finalise the priority corridors in line with the preferred habitat for Cape mountain zebra and CBAs. Assess properties for sale or with stewardship requests for habitat suitability. Engage with relevant private landowners in priority corridors and secure properties for Cape mountain zebra either through purchase of stewardship. 	Landscape Manager (L2 & L1); Conservation Manager (On Reserve); Conservation Manager (Off-reserve); Landscape Conservation Intelligence Manager; Team Leader: Ecology; Conservation Stewardship Specialist.	Year 1 - 10	Cape mountain zebra preferred habitat map combined with provincial CBAs (Vlok & Coetzee, 2008); number of ha added to protected area; Cape mountain zebra expand range into new properties; Cape mountain zebra population increase.	Biodiversity Management Plan for the Cape Mountain Zebra

WILDLIFE MANAGEMENT - CAPE MOUNTAIN ZEBRA (Habitat expansion)					
STRATEGIES:	Strategy 5: Through partnerships promote the establishment of ecological corridors to allow for seasonal migration and growth of Cape mountain zebra subpopulations.				
GOALS:	<ul style="list-style-type: none"> By 2030 three priority properties will have signed perpetuity stewardship agreements and another two as biodiversity agreements or higher within priority corridors. 				
THREATS:	<ul style="list-style-type: none"> Habitat fragmentation and alteration. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 5.2: By 2021 and beyond CapeNature actively engages with relevant stakeholders to raise awareness regarding the importance and vulnerability of unique Cape mountain zebra subpopulations in the SCWHS&NR and ZOI.	Engage with stakeholders and Cape mountain zebra Working Group. <ul style="list-style-type: none"> Revive the Cape mountain zebra Working Group to implement actions stipulated in the Cape mountain zebra-BMP. Develop awareness raising and educational media products to publicise the plight of the Cape mountain zebra. Report back on progress with implementation of BMP. 	Landscape Manager (L1 & L2); Conservation Manager (On Reserve); Conservation Manager (Off-reserve); Landscape Conservation Intelligence Manager; Team Leader: Ecology; Senior Manager Regional People and Conservation.	Year 1-10	Cape mountain zebra Working Group meetings and reports; educational media products produced.	Biodiversity Management Plan for the Cape mountain zebra
Objective 5.3: By 2021 identify and facilitate research relevant to achieving management objectives of the Cape mountain zebra metapopulation.	Identify and facilitate Cape mountain zebra management research. <ul style="list-style-type: none"> Formulate research questions. Identify and engage with research collaborators (e.g. universities). Facilitate and participate in research projects where relevant. Implement research recommendations. 	Landscape Manager (L1); Conservation Manager (On Reserve); Landscape Conservation Intelligence Manager; Team Leader: Ecology.	Year 1-10	MOUs with partners; research project proposals; research reports.	Biodiversity Management Plan for the Cape Mountain Zebra

10.6 Strategy 6: Wildlife Management – Cape mountain zebra (Genetic diversity)

WILDLIFE MANAGEMENT - CAPE MOUNTAIN ZEBRA (Genetic diversity)					
STRATEGIES:	Strategy 6: Maintain genetic diversity in the Cape mountain zebra metapopulation in collaboration with relevant BMP partners.				
GOALS:	<ul style="list-style-type: none"> By 2030 Cape mountain zebra will have 10-20 breeding family groups with a ratio of 1:3 (stallion: mares) and bachelor herds present with no unnatural mortalities and between 5-10% births* per year with the entire population body condition falling in 2 and above. (* 5-10% of total population) 				
THREATS:	<ul style="list-style-type: none"> Lack of genetic mixing (contributing to poor population genetic fitness i.e. inbreeding). 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 6.1: By 2025 genetic diversity of the Cape mountain zebra metapopulations is reinforced through the mixing of Cape mountain zebra subpopulations and supported by a monitoring and evaluation programme to assess the effects of this action.	Assess the reproductive fitness of Cape mountain zebra subpopulations. <ul style="list-style-type: none"> Develop and Implement a central standardised Cape mountain zebra distribution database. Conduct Cape mountain zebra census to monitor population dynamics (e.g. patrol, camera traps, aerial census, satellite collars, Go-pro cameras). Update standardised Cape mountain zebra identikits with photos of individuals. Record all births and mortalities in database. Assess fertility whenever the opportunity arises. 	Landscape Manager (L1 & L2); Conservation Manager (On Reserve); Conservation Manager (Off-reserve); Landscape Conservation Intelligence Manager; Team Leader: Ecology.	Year 1 - 10	SOB/Population database; GoRR; WCGDB.	Baseline Data Collection monitoring manual, Biodiversity Management Plan for the Cape Mountain Zebra, Ecological Matrix

WILDLIFE MANAGEMENT - CAPE MOUNTAIN ZEBRA (Genetic diversity)					
STRATEGIES:	Strategy 6: Maintain genetic diversity in the Cape mountain zebra metapopulation in collaboration with relevant BMP partners.				
GOALS:	<ul style="list-style-type: none"> By 2030 Cape mountain zebra will have 10-20 breeding family groups with a ratio of 1:3 (stallion: mares) and bachelor herds present with no unnatural mortalities and between 5-10% births* per year with the entire population body condition falling in 2 and above. (* 5-10% of total population) 				
THREATS:	<ul style="list-style-type: none"> Lack of genetic mixing (contributing to poor population genetic fitness i.e. inbreeding). 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	<ul style="list-style-type: none"> Investigate methods of indirect assessment of body condition. 				
	<p>Investigate Cape mountain zebra impact on natural vegetation, habitat needs and area preferences.</p> <ul style="list-style-type: none"> Monitor water availability and provide additional water points for Cape mountain zebra where critical. Monitor habitat quality and quantity (palatability of plants and ecological carrying capacity). 	Landscape Manager (L1); Conservation Manager (On Reserve); Landscape Conservation Intelligence Manager; Team Leader: Ecology.	Year 1-10	Map of water points; habitat reports.	Baseline Data Collection monitoring manual, Biodiversity Management Plan for the Cape Mountain Zebra, Ecological Matrix
Objective 6.2: By 2025 ensure smaller populations are safeguarded against isolation and limited gene flow.	<p>Develop assessment guidelines for potential reinforcement and reintroductions and identify priority release sites.</p> <ul style="list-style-type: none"> Use prioritised Cape mountain zebra sites (Strategy 5) to facilitate decision making regarding the movement of small herds/isolated animals. 	Landscape Manager (L1 & L2); Conservation Manager (On Reserve); Conservation Manager (Off-reserve); Landscape Conservation Intelligence Manager; Team Leader: Ecology.	Year 1-10	Number of zebra moved; updated Cape mountain zebra identikit; annual Cape mountain zebra status reports.	Baseline Data Collection monitoring manual, Biodiversity Management Plan for the Cape Mountain Zebra, Ecological Matrix

WILDLIFE MANAGEMENT - CAPE MOUNTAIN ZEBRA (Genetic diversity)					
STRATEGIES:	Strategy 6: Maintain genetic diversity in the Cape mountain zebra metapopulation in collaboration with relevant BMP partners.				
GOALS:	<ul style="list-style-type: none"> By 2030 Cape mountain zebra will have 10-20 breeding family groups with a ratio of 1:3 (stallion: mares) and bachelor herds present with no unnatural mortalities and between 5-10% births* per year with the entire population body condition falling in 2 and above. (* 5-10% of total population) 				
THREATS:	<ul style="list-style-type: none"> Lack of genetic mixing (contributing to poor population genetic fitness i.e. inbreeding). 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	<ul style="list-style-type: none"> Consider the herd dynamics on the release site to facilitate decision making. Monitor movements and herd dynamics of relocated animals. 				

10.7 Strategy 7: Wildlife Management – Cape mountain zebra (Genetic integrity)

WILDLIFE MANAGEMENT - CAPE MOUNTAIN ZEBRA (Genetic integrity)					
STRATEGIES:	Strategy 7: In collaboration with relevant BMP partners, quantify the extent of genetic contamination due to hybridisation with other equine species and safeguard Cape mountain zebra in their natural distribution range.				
GOALS:	<ul style="list-style-type: none"> By 2030 allelic diversity in some Cape mountain zebra populations is increased. By 2030 no hybrid individuals of Cape mountain zebra would have been recorded and allelic diversity has been restored at metapopulation level. 				
THREATS:	<ul style="list-style-type: none"> Hybridisation with other equids. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 7.1: By 2025 in partnership with relevant stakeholders assess and quantify the extent of genetic contamination due to hybridisation with other equine species and safeguard Cape mountain zebra in their natural distribution range.	Determine the risk of hybridisation with other equids. <ul style="list-style-type: none"> Conduct a risk assessment where other equids occur on or adjoining Cape mountain zebra populations. Develop risk mitigation measures (e.g. removal of hybrids and of undesirable species from reserves, upgrading of reserve fencing, and return of escapee pure Cape mountain zebra individuals to reserves). 	Landscape Manager (L1 & L2); Conservation Manager (On Reserve); Conservation Manager (Off-reserve); Landscape Conservation Intelligence Manager; Team Leader: Ecology.	Year 1-10	Risk assessment report; hybrid removal plan; reserve fences upgraded.	Biodiversity Management Plan for the Cape Mountain Zebra

10.8 Strategy 8: Alien invasive species management – Fish

ALIEN INVASIVE SPECIES MANAGEMENT - FISH					
STRATEGIES:	Strategy 8: Through existing partnerships implement alien invasive fish control and/or removal guided by legislation and policy in priority rivers.				
GOALS:	<ul style="list-style-type: none"> By 2030 all rivers within the SCWHS&NR are maintained in a healthy state to support fish species of conservation concern. 				
THREATS:	<ul style="list-style-type: none"> Alien invasive animals (fish) 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 8.1: By 2030 the SCWHS&NR has implemented alien fish eradication plans that are aligned to legislation informed by risk assessments and surveys.	Conduct fish surveys to determine indigenous fish diversity. <ul style="list-style-type: none"> Conduct fish surveys in priority rivers. Record alien fish species occurring within the SCWHS&NR. 	Conservation Manager (On Reserve); Landscape Conservation Intelligence Manager; Team Leader: Ecology.	Every 2 nd year	SOB/Population database.	CapeNature Freshwater Fish Monitoring and Baseline data collection protocol, SASS 5, Ecological Matrix
	Control alien and invasive fish species within the SCWHS&NR. <ul style="list-style-type: none"> Monitor populations of alien fish in priority river systems. Compile and implement control plan. Measure success of control methods utilised. Create awareness and involve external stakeholders. No introduction of alien invasive fish species within catchments and rivers (within SCWHS&NR) will be allowed. 	Landscape Manager (L1); Conservation Manager (On Reserve); Conservation Manager (Off-reserve); Landscape Conservation Intelligence Manager; Team Leader: Ecology.	Every 2 nd year	SOB/Population database; minutes of stakeholder meetings or correspondence received; species control plan.	Invasive Alien Species Monitoring, Control and Eradication Plan

10.9 Strategy 9: Alien invasive species management – Fauna

ALIEN INVASIVE SPECIES MANAGEMENT - FAUNA					
STRATEGIES:	Strategy 9: Through partnerships and elevated extension work, address alien invasive, domestic and extra-limital fauna within the SCWHS&NR and its ZOI in line with relevant legislation and policies (LandCare, Agriculture and research institutions).				
GOALS:	<ul style="list-style-type: none"> By 2030 all domestic, livestock, extra-limital and invasive faunal species are removed or appropriately managed within the SCWHS&NR. 				
THREATS:	<ul style="list-style-type: none"> Alien invasive animals other than fish 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 9.1: By 2020 and beyond address invasive faunal species control through the development and implementation of an invasive alien species control plan (i.e. domesticated animals such as donkeys, goats, horses, cattle, extra-limital game species, etc.).	Prevent the introduction of alien and invasive species. <ul style="list-style-type: none"> No domestic livestock or other alien fauna (including extra-limital game species) will be permitted in the SCWHS&NR and will be removed. 	Conservation Manager (On Reserve); Conservation Manager (Off-reserve); Capability Manager: Biodiversity Conservation;	Year 1-10	SOB/Population database.	Invasive Alien Species Monitoring, Control and Eradication Plan
	Control alien and invasive species within the SCWHS&NR on an on-going basis. <ul style="list-style-type: none"> Record alien fauna (including extra-limital game species) occurring within the SCWHS&NR. Monitor populations of alien fauna and compile removal plan. Implement removal plan. In the case of domestic livestock these will be removed by 	Landscape Manager (L1); Conservation Manager (On Reserve); Conservation Manager (Off-reserve); Capability Manager: Biodiversity Conservation; Compliance and Enforcement Specialist; Senior Manager	Year 1-10	SOB/Population database; Game on Reserves Registers (GoRR); Western Cape Game Database (WCGDB).	Ecological Plan of Operations, Ecological matrix, Biodiversity Surveys.

ALIEN INVASIVE SPECIES MANAGEMENT - FAUNA					
STRATEGIES:	Strategy 9: Through partnerships and elevated extension work, address alien invasive, domestic and extra-limital fauna within the SCWHS&NR and its ZOI in line with relevant legislation and policies (LandCare, Agriculture and research institutions).				
GOALS:	<ul style="list-style-type: none"> By 2030 all domestic, livestock, extra-limital and invasive faunal species are removed or appropriately managed within the SCWHS&NR. 				
THREATS:	<ul style="list-style-type: none"> Alien invasive animals other than fish 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	arrangement with the rightful owner. <ul style="list-style-type: none"> Measure success of control methods utilised. Create awareness and involve external stakeholders. 	Regional People and Conservation.			

10.10 Strategy 10: Integrated compliance and enforcement

INTEGRATED COMPLIANCE AND ENFORCEMENT					
STRATEGIES:	Strategy 10: Address illegal and unsustainable resource utilisation practices which includes domestic animals, extra-limital game, poaching, over-grazing and land degradation within the SCWHS&NR and its ZOI through partnerships and elevated extension work (LandCare, Agriculture and research institutions).				
GOALS:	<ul style="list-style-type: none"> By 2030 an integrated compliance and enforcement programme is in place. 				
THREATS:	<ul style="list-style-type: none"> Persecution (loss) of animals related to human-wildlife conflict (jackal, caracal, leopard, baboons, kudu, eland, bat-eared fox (bycatch), etc.). Over-stocking and over-grazing (inappropriate agricultural activities). Invasion risks (e.g. nyala, impala). 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 10.1: By 2021 competent, knowledgeable and experienced staff members have been identified and capacitated to engage with relevant partner organisations and landowners regarding the value of conservation through raising awareness and encouraging compliance.	<p>Ensure that staff members are capacitated to engage with landowners regarding sustainable resource use practices and compliance.</p> <ul style="list-style-type: none"> Provide training to relevant staff to engage with relevant partner organisations and landowners regarding sustainable resource use and value of conservation. Grow support for the SCWHS&NR by conducting awareness raising programmes aimed at addressing identified issues. 	Landscape Manager (L1 & L2); Conservation Manager (On & Off-reserve); Capability Manager: Biodiversity Conservation; Compliance and Enforcement Specialist; Conservation Stewardship Specialist; Senior Manager Regional People and Conservation; Landscape Conservation Intelligence Manager.	Year 1 - 10	Minutes of meetings; stakeholder engagement database.	PAAC meetings; Farmer's Associations; NRUGS; GCBR Forum; FPA Forum;
Objective 10.2: By 2021 revise and implement the	Implement and revise the integrated compliance plans.	Landscape Manager (L1); Conservation	Year 1 - 10	Number of EMIs trained and appointed;	Criminal Procedure Act, 1977 (Act No.

INTEGRATED COMPLIANCE AND ENFORCEMENT					
STRATEGIES:	Strategy 10: Address illegal and unsustainable resource utilisation practices which includes domestic animals, extra-limital game, poaching, over-grazing and land degradation within the SCWHS&NR and its ZOI through partnerships and elevated extension work (LandCare, Agriculture and research institutions).				
GOALS:	<ul style="list-style-type: none"> By 2030 an integrated compliance and enforcement programme is in place. 				
THREATS:	<ul style="list-style-type: none"> Persecution (loss) of animals related to human-wildlife conflict (jackal, caracal, leopard, baboons, kudu, eland, bat-eared fox (bycatch), etc.). Over-stocking and over-grazing (inappropriate agricultural activities). Invasion risks (e.g. nyala, impala). 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
integrated compliance plans in collaboration with partners.	<ul style="list-style-type: none"> Engage and gain support from judiciary members to strengthen biodiversity cases (magistrates, state prosecutors, etc.). Establish working relations to ensure support for biodiversity related cases. Provide EMI and Peace Officer training to relevant staff applicable to their function and mandate. 	Manager (On & Off-reserves); Capability Manager: Biodiversity Conservation; Compliance and Enforcement Specialist.		Number of Peace Officers trained and appointed.	51 of 1977); Bill of Rights; Constitution of SA; NEMA, NEMBA, NEMPAA; Draft Western Cape Biodiversity Bill 2019; Integrated Compliance Plans (Swartberg, Gamkaberg & Kammanassie)
Objective 10.3: By 2023 develop ecological carrying capacity guidelines for different habitat types.	<p>Develop ecological carrying capacity guidelines for different habitat types.</p> <ul style="list-style-type: none"> Engage with relevant specialists and partners to revise and incorporate ecological carrying capacity based on the fine scale vegetation habitat types into decision support tools. 	Landscape Manager (L1 & L2); Landscape Conservation Intelligence Manager; Conservation Manager (Off-Reserve); Senior Manager Regional People and Conservation.	Year 2	Revised ecological carrying capacity guidelines; stakeholder engagement database.	Cape Farm Mapper; CapeNature Game Stocking Extension Tool; Forsyth <i>et al.</i> (2008), Reyers <i>et al.</i> (2009)

INTEGRATED COMPLIANCE AND ENFORCEMENT					
STRATEGIES:	Strategy 10: Address illegal and unsustainable resource utilisation practices which includes domestic animals, extra-limital game, poaching, over-grazing and land degradation within the SCWHS&NR and its ZOI through partnerships and elevated extension work (LandCare, Agriculture and research institutions).				
GOALS:	<ul style="list-style-type: none"> By 2030 an integrated compliance and enforcement programme is in place. 				
THREATS:	<ul style="list-style-type: none"> Persecution (loss) of animals related to human-wildlife conflict (jackal, caracal, leopard, baboons, kudu, eland, bat-eared fox (bycatch), etc.). Over-stocking and over-grazing (inappropriate agricultural activities). Invasion risks (e.g. nyala, impala). 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	<ul style="list-style-type: none"> Carry out awareness raising of revised guidelines in collaboration with relevant partners (Dept Agriculture: LandCare, GCBR Forum, etc.). 				
Objective 10.4: By 2021 CapeNature has ensured that non-compliant game farmers identified within the ZOI of the SCWHS&NR are compliant with the relevant legislation and policies.	Identify non-compliant game farmers within the ZOI. <ul style="list-style-type: none"> Recommend remedial actions and monitor implementation. 	Landscape Manager (L1); Conservation Manager (Off-Reserve); Capability Manager: Biodiversity Conservation; Compliance and Enforcement Specialist.	Year 1 - 10	List of non-compliant game farmers; remedial action reports.	WCGDB; GTUP

10.11 Strategy 11: Biodiversity and ecosystem management

BIODIVERSITY AND ECOSYSTEM MANAGEMENT					
STRATEGIES:	Strategy 11: Ensure the conservation of biodiversity and ecosystems and the sustainable and regulated use of resources within the SCWHS&NR and its ZOI through the development and strengthening of partnerships.				
GOALS:	<ul style="list-style-type: none"> By 2030 biodiversity, ecosystems, sustainable and regulated resource use are in accordance with applicable legislation, CapeNature policies and procedures. 				
THREATS:	<ul style="list-style-type: none"> Biological resource use. Hunting and/or collection of indigenous fauna. Harvesting of indigenous flora. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 11.1: By 2025 CapeNature develops and implements a natural resource management and utilisation strategy to ensure sustainable and regulated resource use.	Ensure that a biodiversity resource inventory is in place. <ul style="list-style-type: none"> Compile species inventories as prioritised by ecological matrix according to relevant protocols. Identify species of conservation concern and prioritise species for monitoring. 	Conservation Manager (On Reserve); Landscape Conservation Intelligence Manager; Capability Manager: Biodiversity Conservation; Team Leader: Ecology.	Year 5 - 10	SOB database; Threatened species databases.	Ecological matrix; Ecological protocol for collecting data; CapeNature SOB report;
	Identify species that are targeted for resource use. <ul style="list-style-type: none"> Develop and implement a strategy to address the need in collaboration with relevant user groups and partners. Engage with private landowners regarding granting access to local communities for harvesting (e.g. Zimolong). 	Landscape Manager (L1); Conservation Manager (On and Off-reserve); Capability Manager: Biodiversity Conservation; Landscape Conservation Intelligence Manager.	Year 2	SOB database; PAAC engagements and minutes; stakeholder engagement database.	PAAC meetings; Farmer's Associations; NRUGS

BIODIVERSITY AND ECOSYSTEM MANAGEMENT					
STRATEGIES:	Strategy 11: Ensure the conservation of biodiversity and ecosystems and the sustainable and regulated use of resources within the SCWHS&NR and its ZOI through the development and strengthening of partnerships.				
GOALS:	<ul style="list-style-type: none"> By 2030 biodiversity, ecosystems, sustainable and regulated resource use are in accordance with applicable legislation, CapeNature policies and procedures. 				
THREATS:	<ul style="list-style-type: none"> Biological resource use. Hunting and/or collection of indigenous fauna. Harvesting of indigenous flora. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	<p>Ensure that a monitoring programme is being implemented in collaboration with relevant partners (CREW, BirdLife SA, Animal Demography Unit, Endangered Wildlife Trust, etc.).</p> <ul style="list-style-type: none"> Develop and implement monitoring programme in collaboration with partners. 	Landscape Manager (L1); Conservation Manager (On & Off-Reserve); Landscape Conservation Intelligence Manager; Team Leader: Ecology.	Year 1 - 10	SOB database; Threatened species databases; Animal Demography Unit databases.	Ecological matrix; Ecological monitoring protocol
Objective 11.2: By 2022 and beyond engage with relevant partners and stakeholders regarding the value of conserving biological resources and maintaining healthy ecosystems through raising awareness and encouraging compliance.	<p>Implement an awareness raising campaign regarding the value of conserving biological resources and maintaining healthy ecosystems.</p> <ul style="list-style-type: none"> Develop awareness raising information materials and roll-out strategy in conjunction with partners. Implement awareness raising strategy with partners. 	Landscape Manager (L1), Conservation Manager (On & Off-Reserve); Landscape Conservation Intelligence Manager; Senior Manager Regional People and Conservation.	Year 2 - 10	Awareness raising materials; minutes of stakeholder engagements; maps showing degraded areas; restoration protocols.	PAAC meetings; Farmer's Associations; NRUGS; GCBR Forum; FPA Forum;

BIODIVERSITY AND ECOSYSTEM MANAGEMENT					
STRATEGIES:	Strategy 11: Ensure the conservation of biodiversity and ecosystems and the sustainable and regulated use of resources within the SCWHS&NR and its ZOI through the development and strengthening of partnerships.				
GOALS:	<ul style="list-style-type: none"> By 2030 biodiversity, ecosystems, sustainable and regulated resource use are in accordance with applicable legislation, CapeNature policies and procedures. 				
THREATS:	<ul style="list-style-type: none"> Biological resource use. Hunting and/or collection of indigenous fauna. Harvesting of indigenous flora. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	Address degraded ecosystems through restoration projects. <ul style="list-style-type: none"> Identify and ensure that degraded areas are mapped. Develop and implement restoration protocols in collaboration with relevant partners (e.g. spekboom restoration, Working for Land, Working for Water). 	Landscape Manager (L1); Conservation Manager (On & Off-Reserve); Landscape Conservation Intelligence Manager; Restoration Ecologist.	Year 1-10	Maps and restoration protocols.	Ecological Matrix, Integrated Workplans

10.12 Strategy 12: Cultural heritage resource management

CULTURAL HERITAGE RESOURCE MANAGEMENT					
STRATEGIES:	Strategy 12: Through partnerships share, evaluate and enhance the management and protection of cultural and natural heritage values both internally and externally.				
GOALS:	<ul style="list-style-type: none"> By 2030 all human disturbance to heritage features within the SCWHS&NR is limited to maintain or where feasible improve condition. 				
THREATS:	<ul style="list-style-type: none"> Vandalism to cultural heritage sites. Fire damage to heritage values. General lack of cultural knowledge and understanding. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 12.1: By 2025 engage with relevant partners and stakeholders regarding the value of cultural and natural heritage sites through raising awareness and encouraging compliance.	Develop and implement cultural heritage management plans. <ul style="list-style-type: none"> Compile, finalise and implement the cultural heritage management plans for the SCWHS&NR. Include training of local guides to carry out awareness raising as well as to enable them to benefit from tourism opportunities. 	Landscape Manager (L1); Conservation Manager (On-Reserve); Manager Development and Infrastructure: Ecotourism and Access; Senior Manager Regional People and Conservation.	Year 5	Cultural heritage management plans; stakeholder engagement database.	CapeNature Heritage Inventory; Integrated Awareness Work Plan

10.13 Strategy 13: Biodiversity and ecosystem management (Environmental health)

BIODIVERSITY AND ECOSYSTEM MANAGEMENT – ENVIRONMENTAL HEALTH					
STRATEGIES:		Strategy 13: Promote the values of a healthy environment for the benefit of present and future generations within the SCWHS&NR and ZOI through partnerships.			
GOALS:		<ul style="list-style-type: none"> By 2030 anti-litter, energy and water saving campaigns within the SCWHS&NR are contributing towards a healthy environment. 			
THREATS:		<ul style="list-style-type: none"> Littering, wastage of water and energy resources. 			
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 13.1: By 2021 CapeNature, through awareness raising and partnerships, develops and implements an anti-litter and energy and water-saving campaign (leave no trace) for the SCWHS&NR and ZOI.	Develop and implement anti-litter and energy and water-saving projects. <ul style="list-style-type: none"> Promote and advocate leave no trace principles at tourism sites, trails and roads within the SCWHS&NR in collaboration with partners (Municipalities, Department of Transport, tourism bureaus). Ensure that recycling projects are in place throughout the SCWHS&NR (offices, staff housing facilities and tourism facilities). Raise awareness amongst all staff members to lead by example regarding reduction in the using of single use items, waste, energy use and water use ('practice what we preach'). 	Landscape Manager (L2 & L1); Conservation Manager (On-Reserve); Manager Development and Infrastructure: Ecotourism and Access; Senior Manager Regional People and Conservation.	Year 1 - 10	GCBR project - Trapsuutjies (CC); number of clean-up events; electricity use bills.	Leave no trace principles.

10.14 Strategy 14: Regional integrated planning and cooperative governance

REGIONAL INTEGRATED PLANNING AND COOPERATIVE GOVERNANCE					
STRATEGIES:	Strategy 14: Through partnerships and elevated extension work, address illegal and inappropriate agricultural and development activities (such as land clearing, riparian and instream modification, tourism developments) within the SCWHS&NR and its ZOI (LandCare, Agriculture and Research institutions, DEA&DP).				
GOALS:	<ul style="list-style-type: none"> By 2030 the natural and scenic landscapes are recognized and preserved as important landscape features providing ecosystem services that support human wellbeing. 				
THREATS:	<ul style="list-style-type: none"> Land clearing (inappropriate agricultural activities and tourism developments). Riparian and instream modification. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 14.1: By 2022 engage with Department of Agriculture: LandCare and DEA&DP to initiate area-wide planning within the ZOI.	Initiate and implement area-wide planning in priority areas within the ZOI. <ul style="list-style-type: none"> Engage with Department of Agriculture: LandCare and DEA&DP to identify pilot areas for area wide planning. Participate in the area-wide planning process and product development. Assist and review with the implementation of projects. 	Conservation Manager (On & Off-Reserve); Landscape Conservation Intelligence Manager.	Year 1 - 10	Map of identified pilot areas; minutes of engagement meetings.	CapeFarm mapper; GCBR forum; Inter-governmental meetings.
Objective 14.2: By 2021 the SCWHS&NR and ZOI is integrated into Municipal Land Use Planning products.	Conserve the unspoilt natural landscape of the SCWHS&NR and ZOI. <ul style="list-style-type: none"> Ensure that protected areas and priority corridors are incorporated into the Municipal SDFs and other 	Conservation Manager (On-Reserve); Manager Development and Infrastructure: Ecotourism and Access; Landscape	Year 1- 10	SDF; Environmental authorisations; comments submitted on developments; infrastructural development within	Conservation Development Framework; NEMA; IWP; IAPO.

REGIONAL INTEGRATED PLANNING AND COOPERATIVE GOVERNANCE					
STRATEGIES:	Strategy 14: Through partnerships and elevated extension work, address illegal and inappropriate agricultural and development activities (such as land clearing, riparian and instream modification, tourism developments) within the SCWHS&NR and its ZOI (LandCare, Agriculture and Research institutions, DEA&DP).				
GOALS:	<ul style="list-style-type: none"> By 2030 the natural and scenic landscapes are recognized and preserved as important landscape features providing ecosystem services that support human wellbeing. 				
THREATS:	<ul style="list-style-type: none"> Land clearing (inappropriate agricultural activities and tourism developments). Riparian and instream modification. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	Governmental planning initiatives and products. <ul style="list-style-type: none"> Ensure that infrastructure development is legally compliant, non-obtrusive and environmentally friendly within specific identified zones and maintained according to U-AMP schedule. Provide comments on developments that may impact on the SCWHS&NR and ZOI. 	Conservation Intelligence Manager; Mainstream Specialist; Conservation Planning Specialist.		specified zones; U-AMP.	
Objective 14.3: By 2021 water use planning and management operations are aligned with the objectives of the SCWHS&NR.	Ensure the objectives of the SCWHS&NR inform water use planning products and management operations. <ul style="list-style-type: none"> Provide input and comments for Water Use Licence Applications (WULA) and other developments impacting on water resources. 	Conservation Manager (On & Off-Reserve); Landscape Conservation Intelligence Manager; Capability Manager; Integrated Catchment Manager; Freshwater Ecologist.	Year 1 – 10	Comments submitted on WULA & other applications.	National Water Act; Breede Gouritz Catchment Agency, NEMA, WC Biodiversity Bill

10.15 Strategy 15: Legal status and reserve expansion

LEGAL STATUS AND RESERVE EXPANSION					
STRATEGIES:	Strategy 15: Promote the PAES in collaboration with neighbouring landowners to support ecological processes and maintain living landscapes.				
GOALS:	<ul style="list-style-type: none"> By 2030 three priority properties will have signed perpetuity stewardship agreements and another two as biodiversity agreements or higher within priority corridors. 				
THREATS:	<ul style="list-style-type: none"> Habitat fragmentation and alteration: degradation of landscapes. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 15.1: By 2021 and beyond identify, secure and protect conservation worthy areas and properties surrounding the SCWHS&NR in line with PAES.	Ensure all land parcels have legal conservation status in terms of NEM:PAA. <ul style="list-style-type: none"> Formalise legal status of State Forest land. Ensure that all protected areas are listed in the National Protected Areas register as required by NEM:PAA. 	Executive Director: Conservation Management; Landscape Manager (L2); Conservation Stewardship Specialist; Capability Manager: Biodiversity Conservation.	Year 1 – 10	National Protected Areas Register. Government Gazette Notices.	NEM:PAA; Deeds Office; Government Gazette; WCPAES
	Identify priority properties for reserve expansion in line with WC PAES. <ul style="list-style-type: none"> Identify potential stewardship agreements with surrounding landowners in line with priority corridors. Maintain stewardship agreements with relevant landowners. Ensure sufficient staff in place to carry out stewardship responsibilities in the landscape (ZOI). 	Landscape Manager (L1 & L2); Conservation Manager (On & Off-Reserve); Landscape Conservation Intelligence Manager; Conservation Stewardship Specialist.	Year 1 – 10	Total hectares added to conservation estate; number of appointed stewardship staff.	PAES

LEGAL STATUS AND RESERVE EXPANSION					
STRATEGIES:	Strategy 15: Promote the PAES in collaboration with neighbouring landowners to support ecological processes and maintain living landscapes.				
GOALS:	<ul style="list-style-type: none"> By 2030 three priority properties will have signed perpetuity stewardship agreements and another two as biodiversity agreements or higher within priority corridors. 				
THREATS:	<ul style="list-style-type: none"> Habitat fragmentation and alteration: degradation of landscapes. 				
Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
	<p>Ensure that protected area boundaries are demarcated and known by reserve management, neighbouring landowners and public.</p> <ul style="list-style-type: none"> Compile updated map showing reserve boundaries with GPS points. Ensure that boundaries are clearly demarcated. 	Conservation Manager (On Reserve); Capability Manager: Biodiversity Conservation; Manager Development and Infrastructure: Ecotourism and Access.	Year 1 – 3	Map showing reserve boundaries; physical beacons set up in field; signage.	CN boundary verification process; METTs.

11 COSTING

This Section provides an overview of costing and fund allocation for strategies. It outlines the existing financial resources (current budget), funding shortfalls, sources of alternate funding and future financial projections.

11.1 Finance and Asset Management

In line with the legal requirement, the strategies identified for implementation within the SCWHS&NR to achieve the desired state, have been costed below.

The SCWHS&NR will adhere to the guiding principles listed below:

- Responsibly manage the allocation of budget, revenue raising activities and expenditure;
- Ensure solid financial management supporting the achievement of the objectives of this plan; and
- Compliance with the Public Finance Management Act, 1999 (Act No. 1 of 1999) as well as CapeNature's financial policies and procedures.

Using a zero-based budgeting approach, a funding estimate was derived based upon the activities in this management plan. When estimating the costing, the following items were considered:

- Those costs and associated resources which could be allocated to specific activities and which were of a recurring nature;
- Those costs and associated resources which could be allocated to specific activities but which were of a once-off nature;
- Unallocated fixed costs (water, electricity, phones, bank fees, etc.);
- Maintenance of infrastructure; and
- Provision for replacement of minor assets, (furniture, electronic equipment, vehicles, etc.).

11.1.1 Income

CapeNature's budget is funded by the Medium Term Expenditure Framework (MTEF) allocation, other government grants and generated from own revenue sources derived from commercial activities. Any surplus revenue generated is used to fund shortfalls in management costs across the organisation.

CapeNature has overhead costs relating to support services such as human resources, marketing and ecotourism, finance, biodiversity support, conservation services, people and conservation, legal services, etc. which is not allocated to individual protected area complexes and must also be funded through grant funding or own revenue generated.

This management plan is a 10-year plan, and thus straddles multiple MTEF periods that impact on actual budget allocation and projection.

Total budget projected for 2021/2022 for all three clusters combined is budgeted at approximately R16 262 000.84, increasing at an estimated annual rate of 10% from previous years. A summary is presented in Table 11.1.

Table 11.1: A summary of the total projected budget for the Swartberg Complex World Heritage Site and Nature Reserves.

Swartberg Cluster			
Allocation	2019/20 (current year) R'000	2020/21 R'000	2021/22 (projection) R'000
Total Budget	6 403.27	5 790.97	6 065.24
MTEF Allocation	5 280.35	4 607.93	4 818.83
Own Funding	17.43	19.17	21.09
External Funding	1 105.50	1 163.87	1 225.32
Gamkaberg Cluster			
Allocation	2019/20 (current year) R'000	2020/21 R'000	2021/22 (projection) R'000
Total Budget	7 344.18	7 059.39	7 444.59
MTEF Allocation	4 896.15	4 422.79	4 633.73
Own Funding	1 042.25	1 146.47	1 261.12
External Funding	1 405.78	1 490.13	1 549.73
Kammanassie Cluster			
Allocation	2019/20 (current year) R'000	2020/21 R'000	2021/22 (projection) R'000
Total Budget	3 716.48	3 736.96	3 951.82
MTEF Allocation	2 969.07	2 950.08	3 123.40
Own Funding	0	0	0
External Funding	747.42	786.88	828.43

11.1.2 Expenditure

11.1.2.1 Recurring costs

Swartberg Cluster. The annual directly allocated cost (includes staff, transport and travel, stores and equipment) for the Swartberg Cluster is estimated at R5 790 000.97 for 2020/2021. These ongoing costs are split according to strategies as illustrated in Figure 11.1.

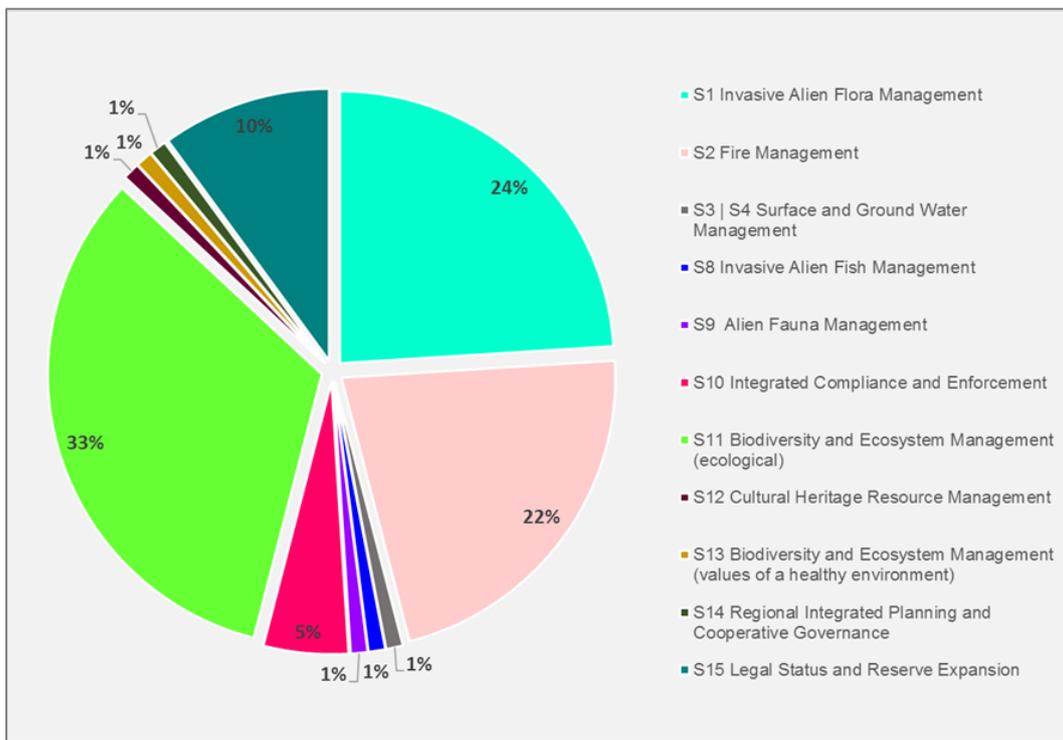


Figure 11.1: The estimated proportion of annual operational costs for the Swartberg Cluster for year 2020/2021 aligned with the identified and prioritised strategies.

Gamkaberg Cluster. The annual directly allocated cost (includes staff, transport and travel, stores and equipment) for the Gamkaberg Cluster is estimated at R7 059000.39 for 2020/2021. These ongoing costs are split according to strategies as illustrated in Figure 11.2.

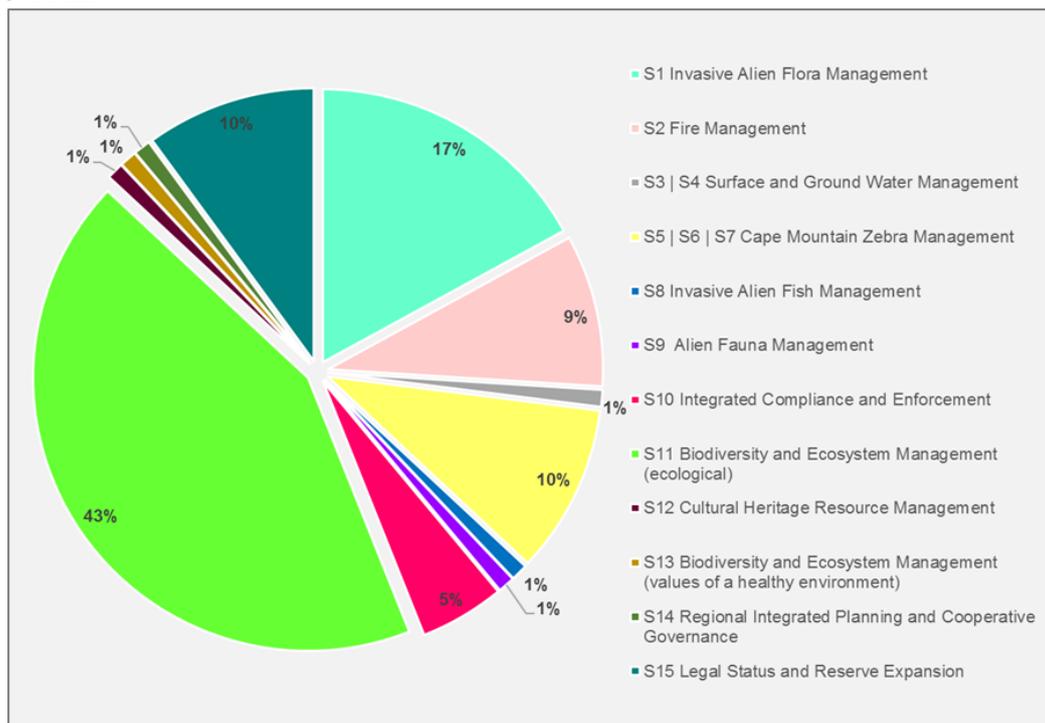


Figure 11.2: The estimated proportion of annual operational costs for Gamkaberg Cluster for year 2020/2021 aligned with the identified and prioritised strategies.

Kammanassie Cluster. The annual directly allocated cost (includes staff, transport and travel, stores and equipment) for the Kammanassie Cluster for 2020/2021 is estimated at R3 736 000.96. These ongoing costs are split according to the strategies as illustrated in Figure 11.3.

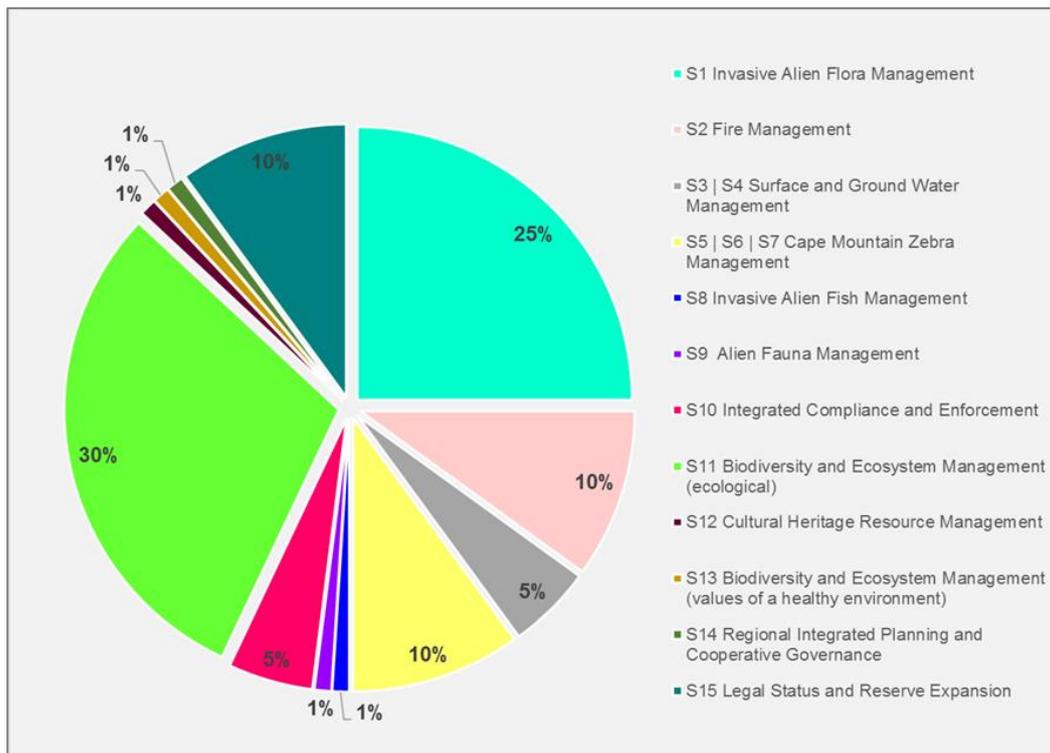


Figure 11.3: The estimated proportion of annual operational costs for Kammanassie Cluster for year 2020/2021 aligned with the identified and prioritised strategies.

11.1.2.2 Once off costs

In addition to the recurring costs there might be once-off replacement costs of assets, e.g. tractor, firefighting equipment, field equipment, etc. that are aligned with the life span of the relevant assets being replaced.

11.1.2.3 Maintenance

The provincial Department of Public Works is responsible for and carries out maintenance on buildings in CapeNature managed protected areas as captured in the U-AMP, governed by the Government Immovable Asset Management Act, 2007 (Act No.19 of 2007).

An annual earmarked allocation is provided for the development of new, and upgrades and maintenance of tourism infrastructure. Tourism projects are prioritised across all CapeNature facilities and maintenance is scheduled accordingly.

11.1.2.4 Summary

It is estimated that the SCWHS&NR will require an annual operating budget of R17 461 000.65 for 2021/2022, increasing at a projected annual rate of 10%.

11.1.2.5 Implications

Unsuccessful securing of external funding and replacement of crucial capital equipment could lead to potential shortfall and will have a negative impact on strategies throughout.

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APPENDIX 1: Table 1: Declarations of the land parcels that comprise the Swartberg Complex World Heritage Site.

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
Swartberg Cluster: Gamkapoort World Heritage Site											
T21850/1964	Roodepunt Wes	149	0	207.044	Prince Albert	C0610000000014900000	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T6651/1965	Roodepunt	210	0	30.299	Prince Albert	C0610000000021000000	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T25847/1967	Weltevrede	150	1	1764.409	Prince Albert	C0610000000015000001	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T21850/1964	Weltevrede	150	3	2059.953	Prince Albert	C0610000000015000003	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T18557/1971	Witpoort	145	2	333.885	Prince Albert	C0610000000014500002	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T21850/1964	Witpoort	145	7	746.964	Prince Albert	C0610000000014500007	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T7943/1967	Witpoort	145	8	24.967	Prince Albert	C0610000000014500008	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T7943/1967	Witpoort	145	9	35.177	Prince Albert	C0610000000014500009	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T7943/1967	Witpoort	145	10	363.551	Prince Albert	C0610000000014500010	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T7943/1967	Witpoort	145	11	67.196	Prince Albert	C0610000000014500011	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
T18557/1971	Wolvehoek	194	0	2704.513	Laingsburg	C0430000000 0019400000	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T7943/1967	Langlaagte	195	1	210.941	Laingsburg	C0430000000 0019500001	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T18557/1971	Rooderand	197	2	40.167	Laingsburg	C0430000000 0019700002	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T18557/1971	Olyvefontein	198	1	366.108	Laingsburg	C0430000000 0019800001	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T18557/1971	Dwijka River	199	1	229.797	Laingsburg	C0430000000 0019900001	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Swartberg Cluster: Gamkaskloof ("Die Hel") World Heritage Site											
T78281/1990	Baviaanskloof	201	0	217.566	Laingsburg	C0430000000 0020100000	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T11193/1991, T59281/1993	Baviaanskloof	201	1 (ptn of)	57.177	Laingsburg	C0430000000 0020100001	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T11193/1991	Baviaanskloof	201	2	95.285	Laingsburg	C0430000000 0020100002	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T11193/1991	Baviaanskloof	201	3	261.750	Laingsburg	C0430000000 0020100003	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T11193/1991	Baviaanskloof	201	4	158.447	Laingsburg	C0430000000 0020100004	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
T59281/1993, T11193/1991	Baviaanskloof	201	5	47.002	Laingsburg	C0430000000 0020100005	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T68064/1990	Baviaanskloof	201	6	122.970	Laingsburg	C0430000000 0020100006	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T68064/1990	Baviaanskloof	201	7	46.163	Laingsburg	C0430000000 0020100007	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T272/2010	Baviaanskloof	201	11	301.391	Laingsburg	C0430000000 0020100011	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T28827/1989	Brandberg	202	0	1259.869	Laingsburg	C0430000000 0020200000	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T11193/1991	Ossenberg	208	0	1855.453	Prince Albert	C0610000000 0020800000	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Swartberg Cluster: Towerkop World Heritage Site (Extension)											
T23558/1970	Bleshoek	55	0	2476.754	Ladismith	C0420000000 0005500000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
T13313/1982	Korrelland	57	2	1067.755	Ladismith	C0420000000 0005700002	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Verlorenhoek A	204	0	1389.243	Laingsburg	C0430000000 0020400000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Verlorenhoek B	205	0	1856.024	Laingsburg	C0430000000 0020500000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
Unregistered	Verlorenhoek C	206	0	1335.341	Laingsburg	C0430000000 0020600000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Ossenhoek	207	0	1005.822	Laingsburg	C0430000000 0020700000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Sewenweekspoort	214	0	2003.373	Laingsburg	C0430000000 0021400000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Farm 215	215	0	21.754	Laingsburg	C0430000000 0021500000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Koudeveldsberg	218	0	1898.804	Laingsburg	C0430000000 0021800000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Toverberg	226	0	2281.534	Laingsburg	C0430000000 0022600000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Annex Buffelsrivier	227	0	1469.054	Laingsburg	C0430000000 0022700000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Annex Baartmansfontein	228	0	991.814	Laingsburg	C0430000000 0022800000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Annex Zuikerboschfontein	229	0	412.125	Laingsburg	C0430000000 0022900000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Annex Doornrivier	230	0	761.116	Laingsburg	C0430000000 0023000000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
Swartberg Cluster: Groot Swartberg World Heritage Site											
T4206/1936	Kriegasberg	1	0	1792.947	Oudtshoorn	C0540000000 0000100000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Plaatberg	2	0	1190.474	Oudtshoorn	C0540000000 0000200000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Waarboomberg	3	0	1311.671	Oudtshoorn	C0540000000 0000300000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Wolvensgatsberg	4	0	865.203	Calitzdorp	C0140000000 0000400000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Albertberg	4	0	1655.130	Oudtshoorn	C0540000000 0000400000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Blomberg	5	0	2003.748	Calitzdorp	C0140000000 0000500000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Oliveberg	5	0	917.624	Oudtshoorn	C0540000000 0000500000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Nelsberg	6	0	1172.791	Calitzdorp	C0140000000 0000600000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Bushmansberg	6	0	1013.142	Oudtshoorn	C0540000000 0000600000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Groeneberg	7	0	1434.818	Calitzdorp	C0140000000 0000700000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
Unregistered	Bothashoek	7	0	2459.944	Oudtshoorn	C0540000000 0000700000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Cangoberg	8	0	2341.787	Calitzdorp	C0140000000 0000800000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Tigerberg	8	0	2982.770	Oudtshoorn	C0540000000 0000800000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Tafelberg	9	0	3138.678	Oudtshoorn	C0540000000 0000900000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
OUC4-9/1911	Annex Spitzkop	10	0	548.305	Oudtshoorn	C0540000000 0001000000	Oudtshoorn Municipality	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Uitkyk	12	0	2128.466	Oudtshoorn	C0540000000 0001200000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
No longer exists	Driepunt	181	0	467.495	Prince Albert	C0610000000 0018100000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
No longer exists	Venterskloof Annex	183	0	1742.105	Prince Albert	C0610000000 0018300000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T11731/1947	Klaarstroom	184	0	2227.012	Prince Albert	C0610000000 0018400000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
No longer exists	Farm 185	185	0	3534.296	Prince Albert	C0610000000 0018500000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
T1393/1939	Hattingskloof	186	0	656.572	Prince Albert	C0610000000 0018600000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Angeliersberg Berg	187	0	1345.887	Prince Albert	C0610000000 0018700000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Gousberg	188	0	1213.749	Prince Albert	C0610000000 0018800000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Witteberg	189	0	1078.103	Prince Albert	C0610000000 0018900000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
G86/1952	Voetpadsberg	190	0	1979.917	Prince Albert	C0610000000 0019000000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
G86/1952	Dorpsrivier	191	0	1620.249	Prince Albert	C0610000000 0019100000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
G154/1950	Dewetsvlei	192	0	1332.871	Prince Albert	C0610000000 0019200000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T14010/1950	Dewetsvlei	192	1	43.649	Prince Albert	C0610000000 0019200001	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Platberg	193	0	1886.111	Prince Albert	C0610000000 0019300000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Paardevlei	194	0	1652.874	Prince Albert	C0610000000 0019400000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
Unregistered	Grootkloof	195	0	1556.760	Prince Albert	C0610000000 0019500000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Waterval	196	0	1483.634	Prince Albert	C0610000000 0019600000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Kliphuisvlei	197	0	2824.872	Prince Albert	C0610000000 0019700000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Grootvlei	198	0	2003.883	Prince Albert	C0610000000 0019800000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Doornkloof	199	0	2244.111	Prince Albert	C0610000000 0019900000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Bushmanskloof	200	0	2282.767	Prince Albert	C0610000000 0020000000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Waterkloof	201	0	1657.975	Prince Albert	C0610000000 0020100000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Botesnek	202	0	2224.277	Prince Albert	C0610000000 0020200000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Grootberg	203	0	2000.063	Prince Albert	C0610000000 0020300000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Elandspad	204	0	2288.489	Prince Albert	C0610000000 0020400000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
Unregistered	Paardekraal	205	0	2689.188	Prince Albert	C0610000000 0020500000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Gamkasberg	207	0	2429.632	Prince Albert	C0610000000 0020700000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
G86/1952	Ossenberg	209	0	1760.174	Prince Albert	C0610000000 0020900000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T18557/1971	Spekboomberg	206	0	2367.135	Prince Albert	C0610000000 0020600000	Provincial Government - Western Cape	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Erin (W of Meiringspoort)	14	0 (ptn of)	638.756	Oudtshoorn	C0540000000 0001400000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Witberg (W of Meiringspoort)	180	0 (ptn of)	1853.279	Prince Albert	C0610000000 0018000000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Swartberg Cluster: Swartberg East World Heritage Site											
Unregistered	Erin (E of Meiringspoort)	14	0 (ptn of)	832.401	Oudtshoorn	C0540000000 0001400000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Witberg (E of Meiringspoort)	180	0 (ptn of)	1769.236	Prince Albert	C0610000000 0018000000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T10902/1947	Oorlogskloof	175	2	179.603	Prince Albert	C0610000000 0017500002	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Blesberg	16	0	2933.741	Oudtshoorn	C0540000000 0001600000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
T10902/1947	Oorlogs Kloof	175	1	195.336	Prince Albert	C0610000000 0017500001	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
T300/1887	Zwartberg	15	0	1637.763	Oudtshoorn	C0540000000 0001500000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Annex Oorlogskloof	173	0	6.967	Prince Albert	C0610000000 0017300000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	De Vlei	176	0	2319.639	Prince Albert	C0610000000 0017600000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Geruste Leven Annex	146	0	189.590	Willowmore	C0830000000 0014600000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Uitnod Annex	149	0	148.472	Willowmore	C0830000000 0014900000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Snyberg	2	0	3917.031	Uniondale	C0770000000 0000200000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Milnersdale West Annex	151	0	766.077	Willowmore	C0830000000 0015100000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Milnersdale	152	0	461.681	Willowmore	C0830000000 0015200000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Forest Reserve (W of Toorwaterpoort)	153	0	1378.290	Willowmore	C0830000000 0015300000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
Unregistered	Forest Reserve (E of Toorwaterpoort)	153	0	926.630	Willowmore	C0830000000 0015300000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Farm 154	154	0	8.521	Willowmore	C0830000000 0015400000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Unregistered	Paardekloofberg	38	0	1237.533	Uniondale	C0770000000 0003800000	Republic of South Africa	2009/01/30	Proc. no. 31832/2009	Government Gazette Notice 72 (2009/01/30)	World Heritage Site
Gamkaberg Cluster: Rooiberg World Heritage Site (Extension)											
T21816/1948	Ezelrand	180	0	1592.724	Ladismith	C0420000000 0018000000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
T17063/1952	Kroon	183	0	2400.678	Ladismith	C0420000000 0018300000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Ararat	187	0	1481.410	Ladismith	C0420000000 0018700000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Melkwater	188	0	2381.585	Ladismith	C0420000000 0018800000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
T3240/1972	Hoek	186	1	1511.564	Ladismith	C0420000000 0018600001	Provincial Government - Western Cape	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
T3240/1972	Keurkloof	189	1	1761.723	Ladismith	C0420000000 0018900001	Provincial Government - Western Cape	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
T17063/1952	Paardenberg	182	0	1704.290	Ladismith	C0420000000 0018200000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
Gamkaberg Cluster: Paardenberg World Heritage Site (Extension)											
T1877/1926	Paardenberg	74	0	1522.361	Ladismith	C042000000 0007400000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Gamkaberg Cluster: Groenefontein World Heritage Site (Extension)											
T85310/1999	Spitskop	56	0	326.434	Calitzdorp	C014000000 0005600000	WWF-SA	2008/08/01	Proc. no 10/2008	Government Gazette Notice 6550 (2008/08/01)	Provincial Nature Reserve
T85310/1999	Spitskop	56	1	162.640	Calitzdorp	C014000000 0005600001	WWF-SA	2008/08/01	Proc. no 10/2008	Government Gazette Notice 6550 (2008/08/01)	Provincial Nature Reserve
T85310/1999	Groenefontein	57	0	3087.920	Calitzdorp	C014000000 0005700000	WWF-SA	2008/08/01	Proc. no 10/2008	Government Gazette Notice 6550 (2008/08/01)	Provincial Nature Reserve
T85310/1999	Rietvally	58	0	1645.584	Calitzdorp	C014000000 0005800000	WWF-SA	2008/08/01	Proc. no 10/2008	Government Gazette Notice 6550 (2008/08/01)	Provincial Nature Reserve
Gamkaberg Cluster: Gamkaberg World Heritage Site (Extension)											
T25135/1980	Rietfontein	154	10	886.711	Oudtshoorn	C054000000 0015400010	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
T49791/1980	Rietfontein	154	12	1332.447	Oudtshoorn	C054000000 0015400012	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
T14862/1972	Rietfontein	154	13	416.187	Oudtshoorn	C054000000 0015400013	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
Unregistered	Rietfontein	154	14	237.012	Oudtshoorn	C054000000 0015400014	Unregistered	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
T16804/1972	Heimersrivier	175	11	117.836	Oudtshoorn	C0540000000 0017500011	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
T9337/1980	Zandberg	176	1	522.701	Oudtshoorn	C0540000000 0017600001	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
T16804/1972	Schneganskop	177	0	1266.216	Oudtshoorn	C0540000000 0017700000	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
T14907/1971	Schneganskop	177	1	436.336	Oudtshoorn	C0540000000 0017700001	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
T7415/1973	Schneganskop	177	2	22.116	Oudtshoorn	C0540000000 0017700002	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
T24080/1971	Schneganskop	177	3	142.950	Oudtshoorn	C0540000000 0017700003	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
T14907/1971	Zoutkloof	187	2	1206.260	Oudtshoorn	C0540000000 0018700002	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
T1950/1972	Zoutkloof	188	1	1068.355	Oudtshoorn	C0540000000 0018800001	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
T13342/1979	Uitvlugt	80	42	1.133	Calitzdorp	C0140000000 0008000042	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
T13342/1979	Uitvlugt	80	43	0.768	Calitzdorp	C0140000000 0008000043	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
Unregistered	Uitvlugt	80	45	102.779	Calitzdorp	C0140000000008000045	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
T11365/1972	Boschkloof	81	0	1929.014	Calitzdorp	C0140000000008100000	Provincial Government - Western Cape	1994/04/12	Proc. no. 37/1994	Government Gazette Notice 4854 (1994/05/06)	Provincial Nature Reserve
Kammanassie Cluster: Kammanassie World Heritage Site (Extension) (also known as 'Langkloof Staatsbos')											
T27831/1985	Upper Diepkloof	6	0	1241.478	George	C0270000000000600000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
T27831/1985	Elandsvlakte	7	0	347.784	George	C0270000000000700000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Kammanassieberg	57	0	2683.216	Uniondale	C07700000000005700000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Buffelsberg	61	0	4456.434	Uniondale	C07700000000006100000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
T18360/1973	Paardeberg	58	0	4601.718	Uniondale	C07700000000005800000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
T16652/1971	Pietslaagte	67	4	3115.293	Uniondale	C07700000000006700004	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
T10693/1985	Solomonskraal	74	1	1304.688	Oudtshoorn	C05400000000007400001	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
OUQ2-3/1883	Vermaaksrivier	125	0	3326.866	Oudtshoorn	C05400000000012500000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest

Title Deed	Farm Name	Farm No.	Portion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
T2372/1962	Roode Els Kloof	126	0	2173.456	Oudtshoorn	C0540000000 0012600000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
T10663/1970	Paardekloof	127	0	1522.011	Oudtshoorn	C0540000000 0012700000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest
Unregistered	Kleinberg	128	0	2282.569	Oudtshoorn	C0540000000 0012800000	Republic of South Africa	2006/05/05	Proc. no. 28797/2006	Government Gazette Notice 596 (2006/05/05)	State land released from State Forest

APPENDIX 1: Table 2: Land parcels that comprise Provincial Nature Reserves in the Swartberg Complex World Heritage Site and Nature Reserves (everything not included above in Appendix 1, Table 1).

Title Deed	Farm Name	Farm No.	Port ion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
Gamkaberg Cluster: Vaalhoek Nature Reserve											
T16603/2002	Grootkloof	176	1	64.300	Ladismith	C0420000000017600001	WWF-SA	2008/08/01	Proc. no. 11/2008	Government Gazette Notice 6550 (2008/08/01)	Provincial Nature Reserve
T16603/2002	Dwars In De Weg	217	4	385.023	Ladismith	C0420000000021700004	WWF-SA	2008/08/01	Proc. no. 11/2008	Government Gazette Notice 6550 (2008/08/01)	Provincial Nature Reserve
T16603/2002	Dwars In De Weg	217	6	225.014	Ladismith	C0420000000021700006	WWF-SA	2008/08/01	Proc. no. 11/2008	Government Gazette Notice 6550 (2008/08/01)	Provincial Nature Reserve
T16603/2002	Pretoriuskraal	218	3	218.014	Ladismith	C0420000000021800003	WWF-SA	2008/08/01	Proc. no. 11/2008	Government Gazette Notice 6550 (2008/08/01)	Provincial Nature Reserve
T16603/2002	Pretoriuskraal	218	4	68.758	Ladismith	C0420000000021800004	WWF-SA	2008/08/01	Proc. no. 11/2008	Government Gazette Notice 6550 (2008/08/01)	Provincial Nature Reserve
T16603/2002	Platterug	219	3	296.295	Ladismith	C0420000000021900003	WWF-SA	2008/08/01	Proc. no. 11/2008	Government Gazette Notice 6550 (2008/08/01)	Provincial Nature Reserve
T16603/2002	Platterug	219	4	17.119	Ladismith	C0420000000021900004	WWF-SA	2008/08/01	Proc. no. 11/2008	Government Gazette Notice 6550 (2008/08/01)	Provincial Nature Reserve
T16603/2002	Platterug	219	5	61.452	Ladismith	C0420000000021900005	WWF-SA	2008/08/01	Proc. no. 11/2008	Government Gazette Notice 6550 (2008/08/01)	Provincial Nature Reserve
Gamkaberg Cluster: Rooilifantskloof Nature Reserve											
T12360/2005	Sandberg	75	0	1871.513	Ladismith	C0420000000007500000	Berning and Stauth (Private)	2013/12/11	Proc. no. 3/2014	Government Gazette Notice 7217 (2014/01/10)	Contract Nature Reserve
T12360/2005	Koeskooro-East	76	0	918.285	Ladismith	C0420000000007600000	Berning and Stauth (Private)	2013/12/11	Proc. no. 3/2014	Government Gazette Notice 7217 (2014/01/10)	Contract Nature Reserve
T12360/2005	Farm 169	169	0	3500.585	Ladismith	C04200000000016900000	Berning and Stauth (Private)	2013/12/11	Proc. no. 3/2014	Government Gazette Notice 7217 (2014/01/10)	Contract Nature Reserve

Title Deed	Farm Name	Farm No.	Port ion No.	Extent (ha)	Registration Division	SG Code	Landowner	Proclamation date	Proclamation No.	Govt. Gazette	Status
Gamkaberg Cluster: Triangle Nature Reserve											
T62913/2011	Triangle	51	0	124.983	Calitzdorp	C014000000 0005100000	WWF-SA	Proclamation underway			
T62913/2011	Triangle	51	7	454.436	Calitzdorp	C014000000 0005100007	WWF-SA	Proclamation underway			
T62913/2011	Danielskraal	54	4	409.103	Calitzdorp	C014000000 0005400004	WWF-SA	Proclamation underway			
Gamkaberg Cluster: Kwessie Nature Reserve											
T30068/2012	Triangle	51	10	424.400	Calitzdorp	C014000000 0005100010	WWF-SA	Proclamation underway			
T30068/2012	Rietvally	58	1	216.908	Calitzdorp	C014000000 0005800001	WWF-SA	Proclamation underway			
T30068/2012	Rietvally	58	2	1.339	Calitzdorp	C014000000 0005800002	WWF-SA	Proclamation underway			
Gamkaberg Cluster: Fontein Nature Reserve											
T11038/2014	Heimersrivier	175	1	338.496	Oudtshoorn	C054000000 0017500001	WWF-SA	Proclamation underway			
T11038/2014	Heimersrivier	175	7	3.746	Oudtshoorn	C054000000 0017500007	WWF-SA	Proclamation underway			
T11038/2014	Zandberg (Portion of)	176	0	450.081	Oudtshoorn	C054000000 0017600000	WWF-SA	Proclamation underway			
Gamkaberg Cluster: Heimersrivier Nature Reserve											
T32743/2004	Heimersrivier (Portion of portion 1)	175	6	300.448	Oudtshoorn	C054000000 0017500006	Western Cape Government - Department of Public Works	Proclamation underway			
T32743/2004	Heimersrivier	175	10	366.371	Oudtshoorn	C054000000 0017500010	Western Cape Government - Department of Public Works	Proclamation underway			
T32743/2004	Heimersrivier	175	2	12.611	Oudtshoorn	C054000000 0017500002	Western Cape Government - Department of Public Works	Proclamation underway			

APPENDIX 2: Maps of the Swartberg Complex World Heritage Site and Nature Reserves.

Map 1: Location and extent of the Swartberg Complex World Heritage Site and Nature Reserves.

Map 2a: Distribution of rainfall stations and the average monthly rainfall graphs for Besemfontein (Towerkop) and at Gamkapoort. (Note: Gamkapoort Dam station is indicated in Groot Swartberg rainfall graph.)

Map 2b: Distribution of rainfall stations and the average monthly rainfall graphs in a north-south transect along the Swartberg pass (Groot Swartberg).

Map 2c: Distribution of rainfall stations and the average monthly rainfall graphs for Blesberg (Swartberg East) and the Kammanassie.

Map 2d: Distribution of rainfall stations and the average monthly rainfall graphs for the Gamkaberg Cluster.

Map 3a: Topography of Towerkop, Gamkapoort and the western section of Groot Swartberg.

Map 3b: Topography of the central part of Groot Swartberg.

Map 3c: Topography of Swartberg East and Kammanassie.

Map 3d: Topography of the Gamkaberg Cluster.

Map 4a: Geology of Towerkop, Gamkapoort, Gamkaskloof and the western section of Groot Swartberg.

Map 4b: Geology of the central part of Groot Swartberg.

Map 4c: Geology of Swartberg East and Kammanassie.

Map 4d: Geology of the Gamkaberg Cluster.

Map 5a: Vegetation of Towerkop, Gamkapoort and the western section of Groot Swartberg based on the National Vegetation Map (2018).

Map 5b: Vegetation of the central part of Groot Swartberg based on the National Vegetation Map (2018).

Map 5c: Vegetation of Swartberg East and Kammanassie based on the National Vegetation Map (2018).

Map 5d: Vegetation of the Gamkaberg Cluster based on the National Vegetation Map (2018).

Map 6a: Fine-scale vegetation map of Towerkop, Gamkapoort and the western section of Groot Swartberg based on Vlok *et al.* (2005).

Map 6b: Fine-scale vegetation map of the central part of Groot Swartberg based on Vlok *et al.* (2005).

Map 6c: Fine-scale vegetation map of Swartberg East and Kammanassie based on Vlok *et al.* (2005).

Map 6d: Fine-scale vegetation map of the Gamkaberg Cluster based on Vlok *et al.* (2005).

Map 7a: Current (2019) extent and density classes of invasive alien vegetation on Towerkop, Gamkapoort and the western section of Groot Swartberg.

Map 7b: Current (2019) extent and density classes of invasive alien vegetation on the central part of Groot Swartberg.

Map 7c: Current (2019) extent and density classes of invasive alien vegetation on Swartberg East and Kammanassie.

Map 7d: Current (2019) extent and density classes of invasive alien vegetation on the Gamkaberg Cluster.

Map 8: Extent of severely transformed spekboomveld in the area around Vanwyksdorp and between Calitzdorp and Oudtshoorn. The sites that have been planted on reserves are indicated with arrows. Future sites to be planted with spekboom, as well as areas that have potential for restoration are encircled. In the insert box the locations of the old pine arboretums, plantation and the ploughed area on the Swartberg are also shown.

Map 9a: Current (2019) distribution of veld age classes and recorded sources of ignition on Towerkop, Gamkaskloof and the western section of Groot Swartberg.

Map 9b: Current (2019) distribution of veld age classes and recorded sources of ignition on the central part of Groot Swartberg.

Map 9c: Current (2019) distribution of veld age classes and recorded sources of ignition on Swartberg East and Kammanassie.

Map 9d: Current (2019) distribution of veld age classes and recorded sources of ignition on the Gamkaberg Cluster.

Map 10a: National Freshwater Ecosystem Priority and High Water Yield Areas of Towerkop, Gamkapoort and the western section of Groot Swartberg.

Map 10b: National Freshwater Ecosystem Priority and High Water Yield Areas of the central part of Groot Swartberg.

Map 10c: National Freshwater Ecosystem Priority and High Water Yield Areas of the Swartberg East and Kammanassie. Springs that are being monitored in and adjacent to the Kammanassie, as well as the location of boreholes and pumpstations of the KKRWSS are shown.

Map 10d: National Freshwater Ecosystem Priority and High Water Yield Areas of the the Gamkaberg Cluster.

Map 11: Existing game farms adjacent to and within the zone of influence of the Swartberg World Heritage Site and Nature Reserves.

Map 12a: Sensitivity of Towerkop, Gamkapoort and the western section of Groot Swartberg.

Map 12b: Sensitivity of the central part of Groot Swartberg.

Map 12c: Sensitivity of Swartberg East and Kammanassie.

Map 12d: Sensitivity of the Gamkaberg Cluster.

Map 13a: Zonation of Towerkop, Gamkaskloof, Gamkapoort and the western section of Groot Swartberg.

Map 13b: Zonation of the central part of Groot Swartberg.

Map 13c: Zonation of Swartberg East and Kammanassie.

Map 13d: Zonation of the Gamkaberg Cluster.

Map 14a: Zone of influence around Towerkop, Gamkapoort and the western section of Groot Swartberg.

Map 14b: Zone of influence around the central part of Groot Swartberg.

Map 14c: Zone of influence around Swartberg East and Kammanassie.

Map 14d: Zone of influence around the Gamkaberg Cluster.

Map 15a: Access points on Towerkop, Gamkapoort and the western section of Groot Swartberg.

Map 15b: Access points on the central part of Groot Swartberg.

Map 15c: Access points on Swartberg East and Kammanassie.

Map 15d: Access points on the Gamkaberg Cluster.

Map 16a: Infrastructure on Towerkop, Gamkaskloof, Gamkapoort and the western section of Groot Swartberg.

Map 16b: Infrastructure on the central part of Groot Swartberg.

Map 16c: Infrastructure on Swartberg East and Kammanassie.

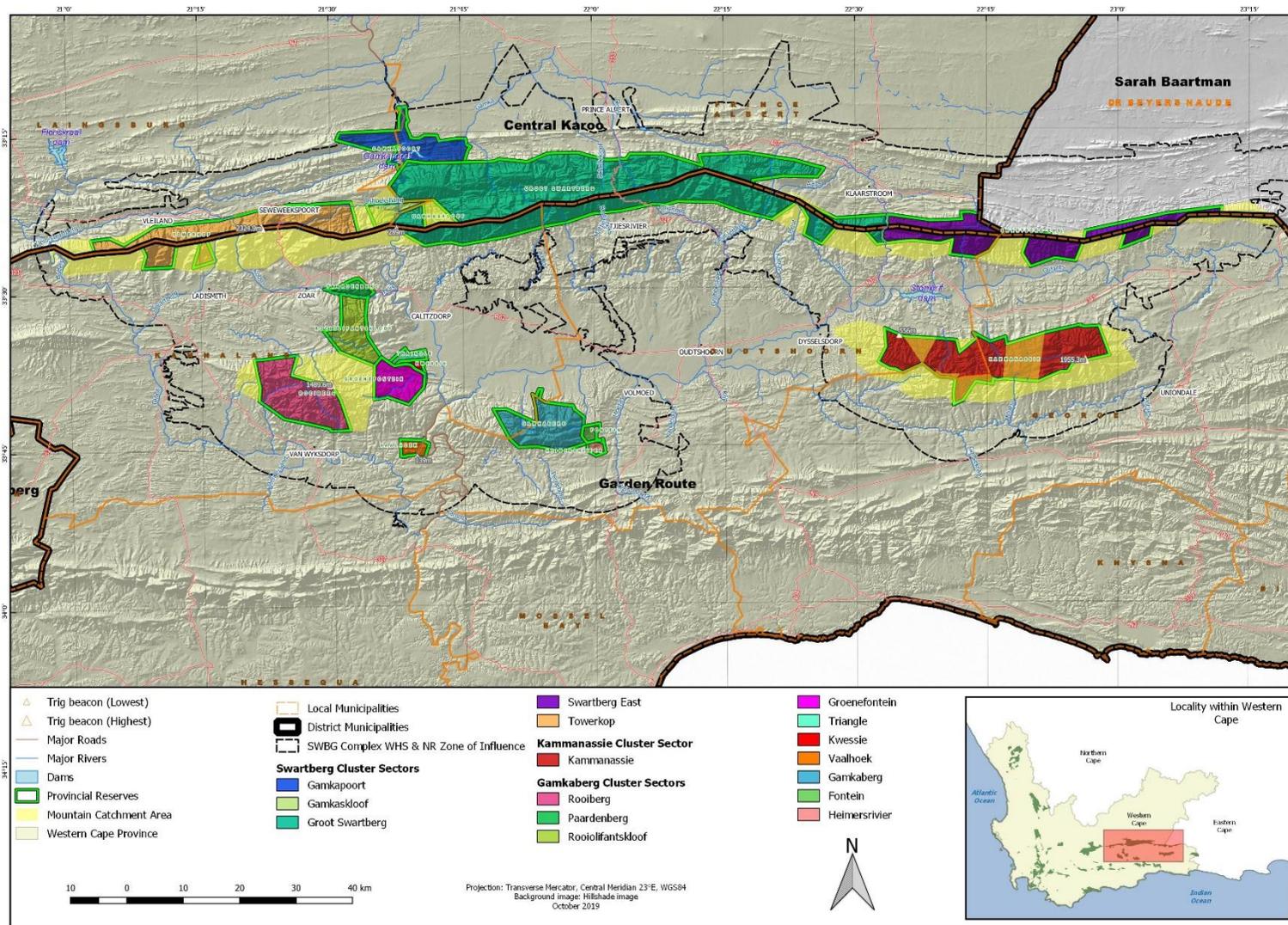
Map 16d: Infrastructure on the Gamkaberg Cluster.

Map 17a: Expansion of Towerkop, Gamkapoort and the western section of Groot Swartberg.

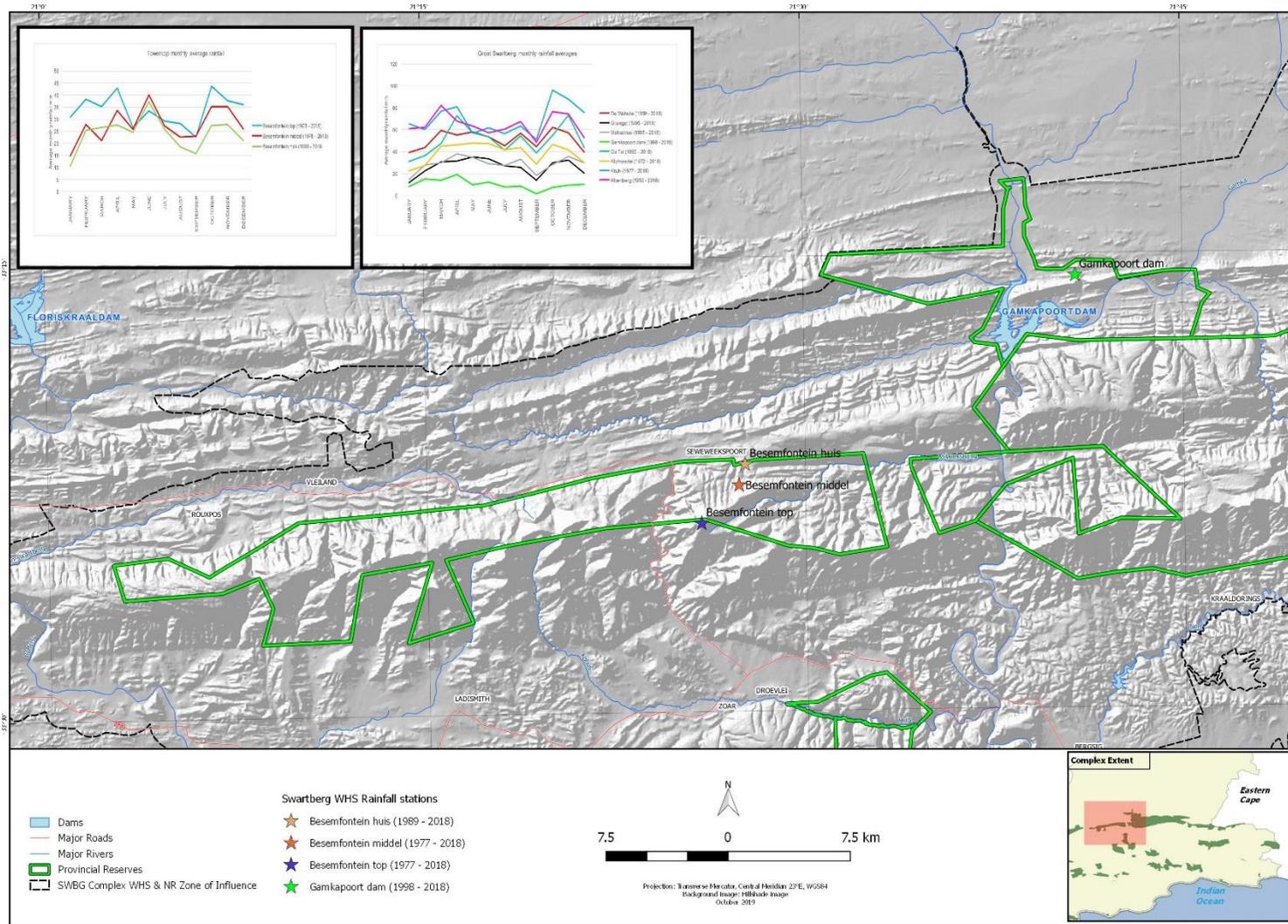
Map 17b: Expansion of the central part of Groot Swartberg.

Map 17c: Expansion of Swartberg East and Kammanassie.

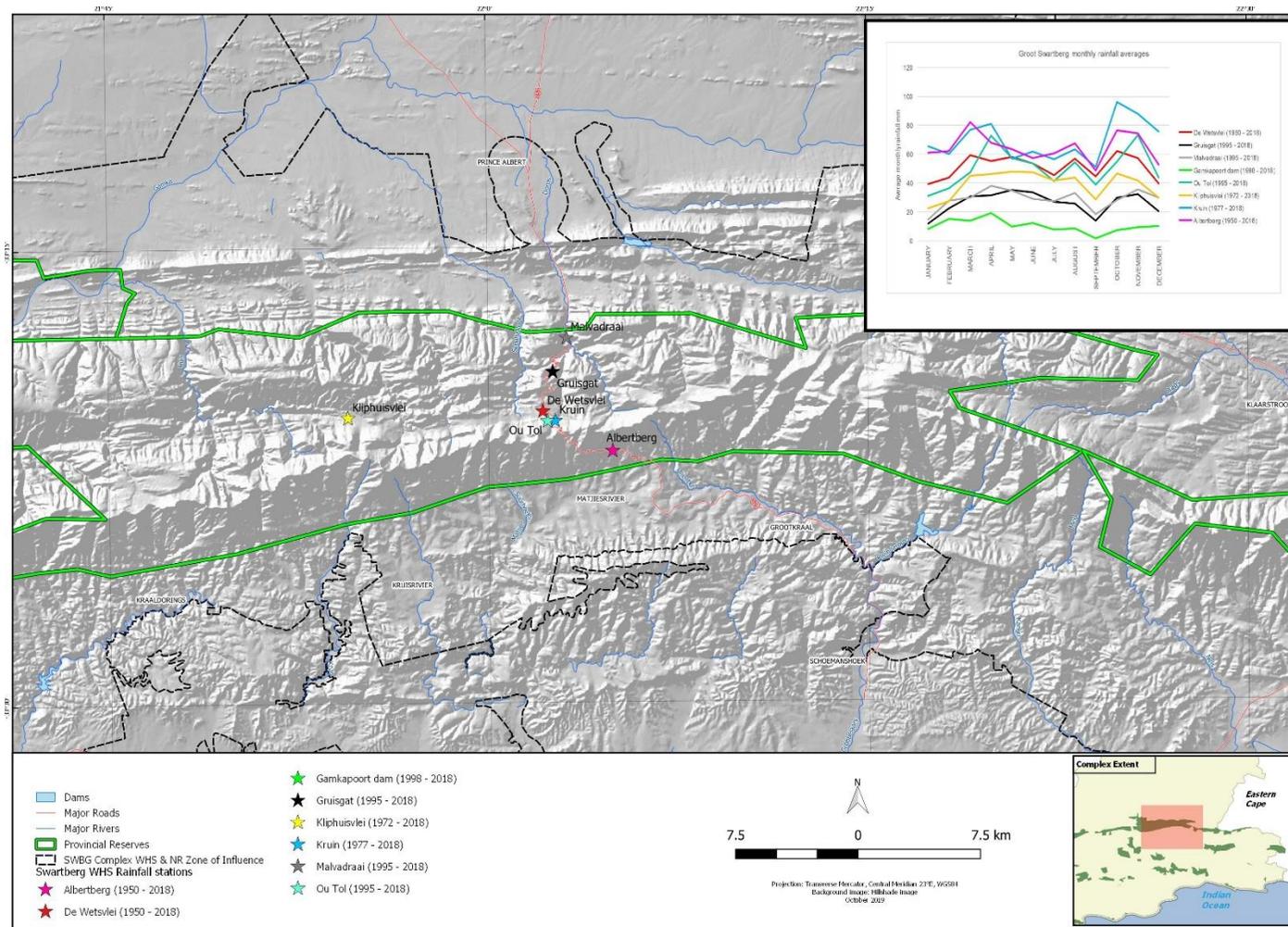
Map 17d: Expansion of the Gamkaberg Cluster.



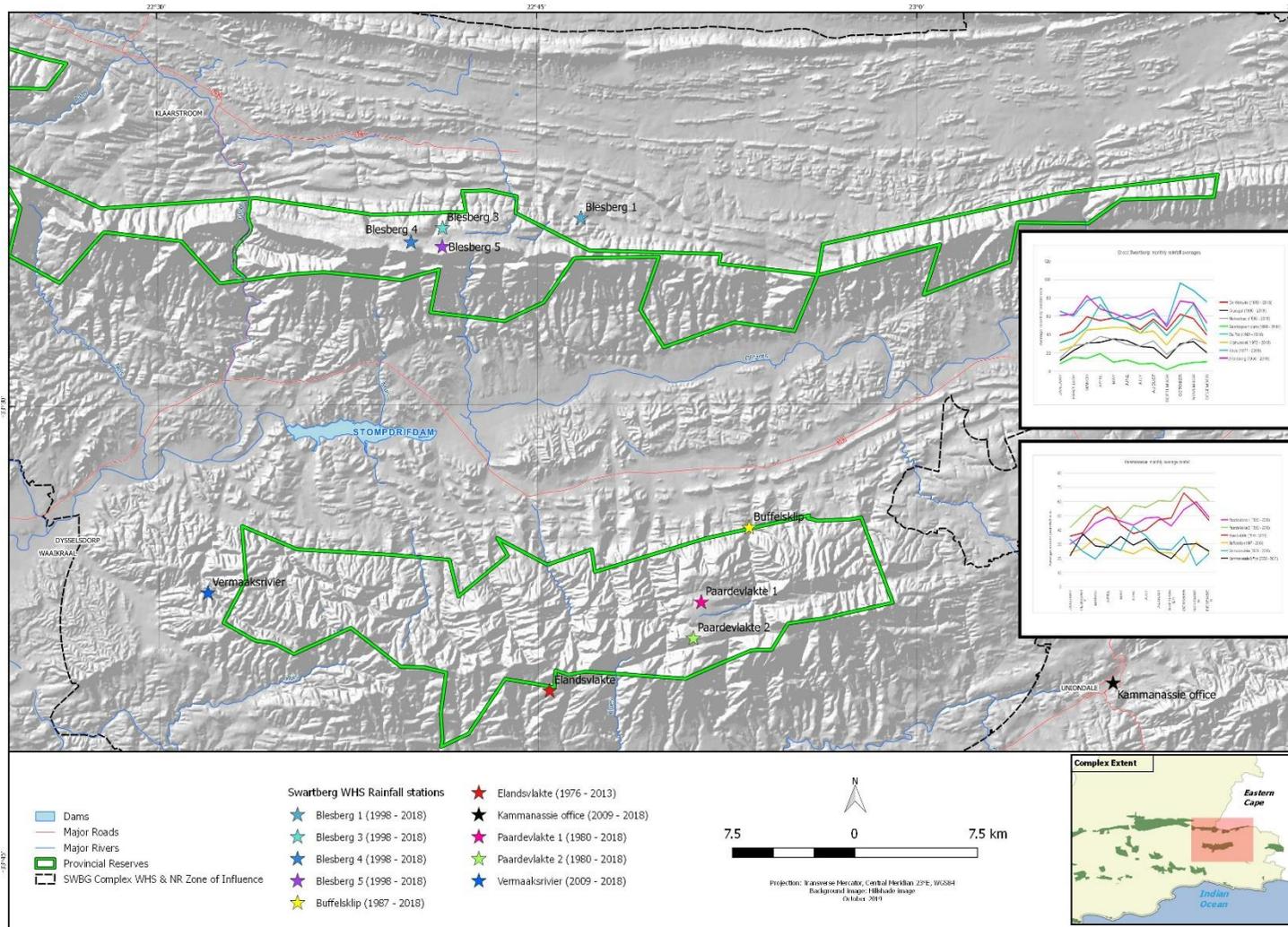
Map 1: Location and extent of the Swartberg Complex World Heritage Site and Nature Reserves.



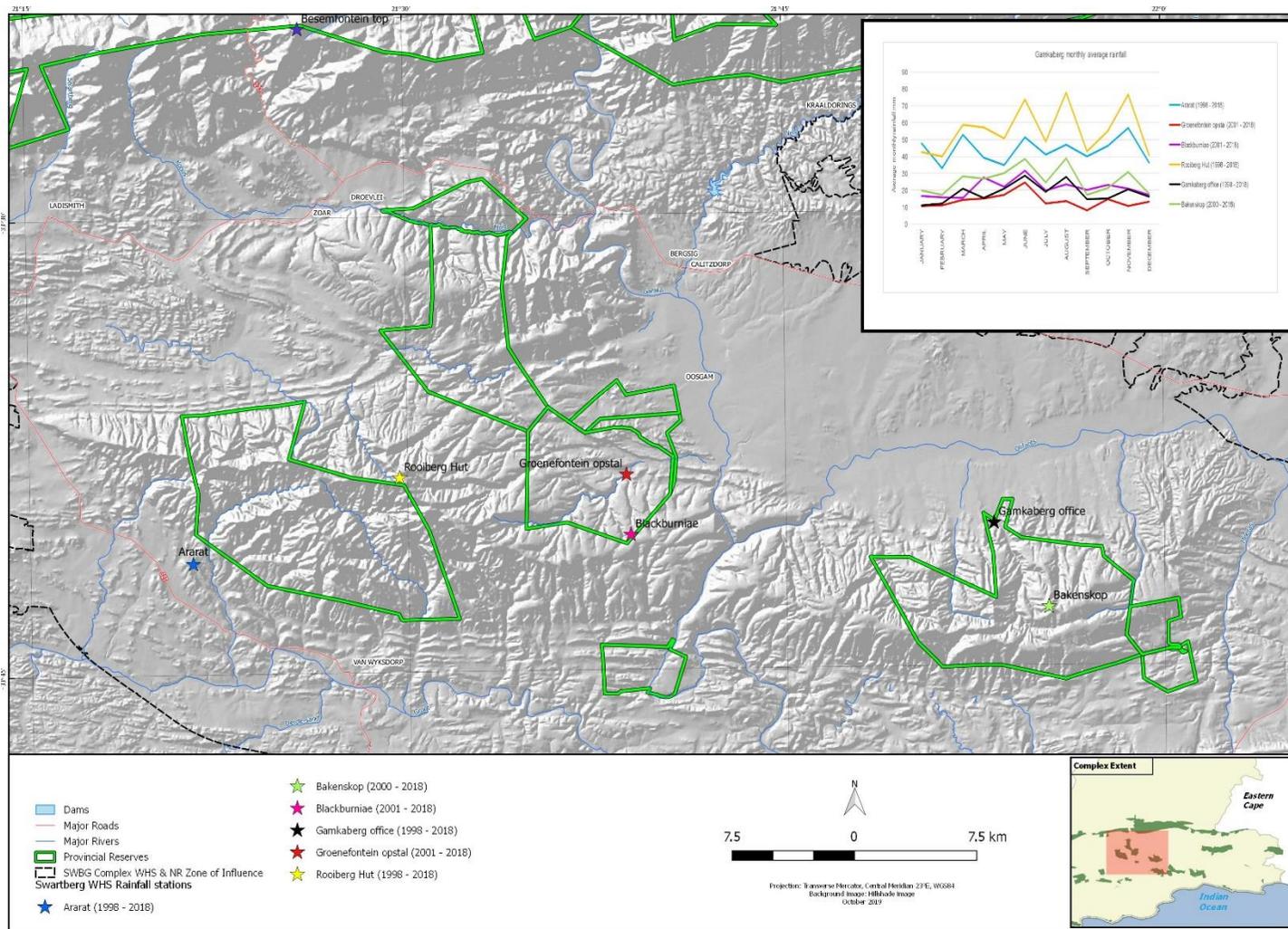
Map 2a: Distribution of rainfall stations and the average monthly rainfall graphs for Besemfontein (Towerkop) and at Gamkapoort. (Note: Gamkapoort Dam station is indicated in Groot Swartberg rainfall graph.)



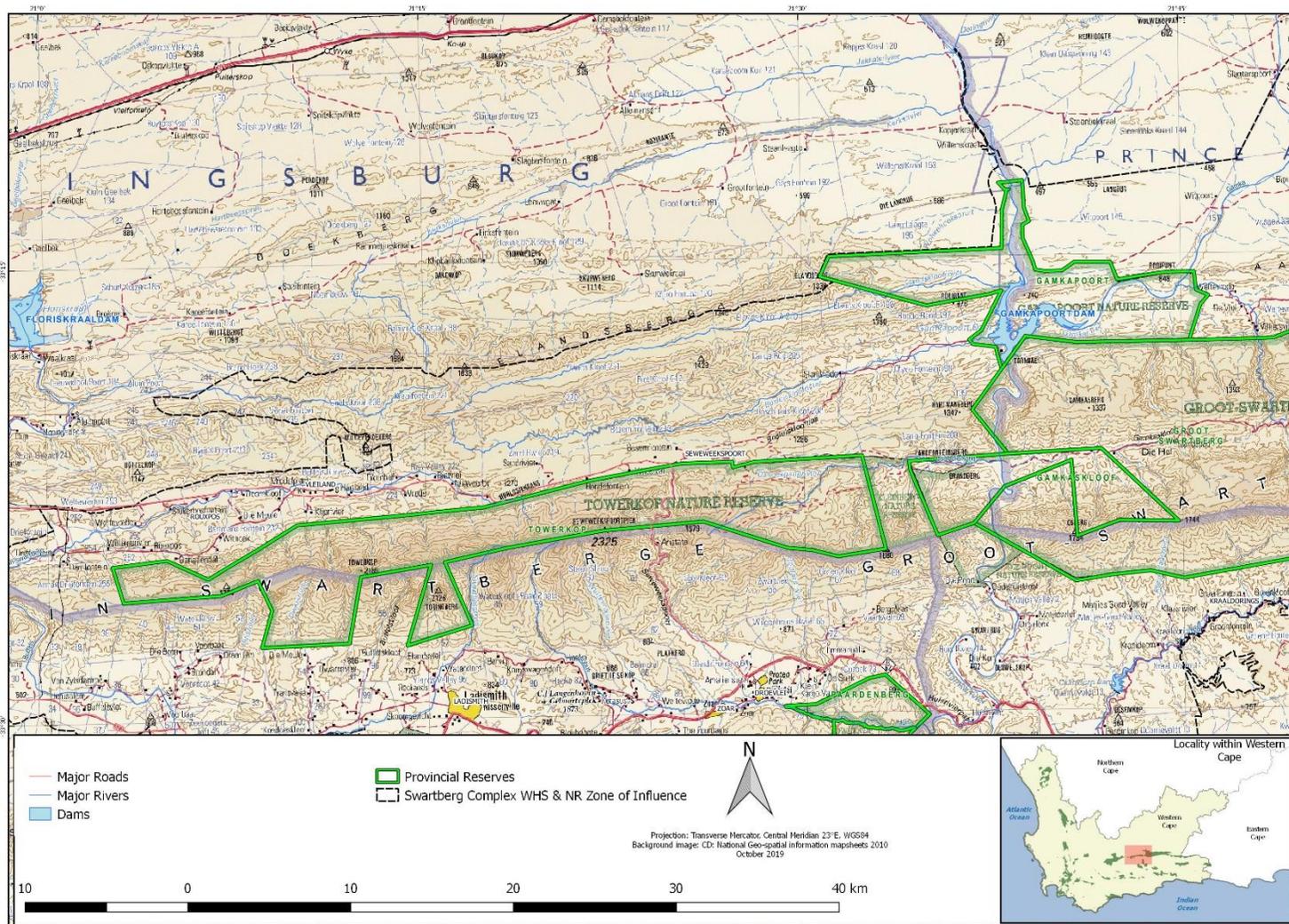
Map 2b: Distribution of rainfall stations and the average monthly rainfall graphs in a north-south transect along the Swartberg pass (Groot Swartberg).



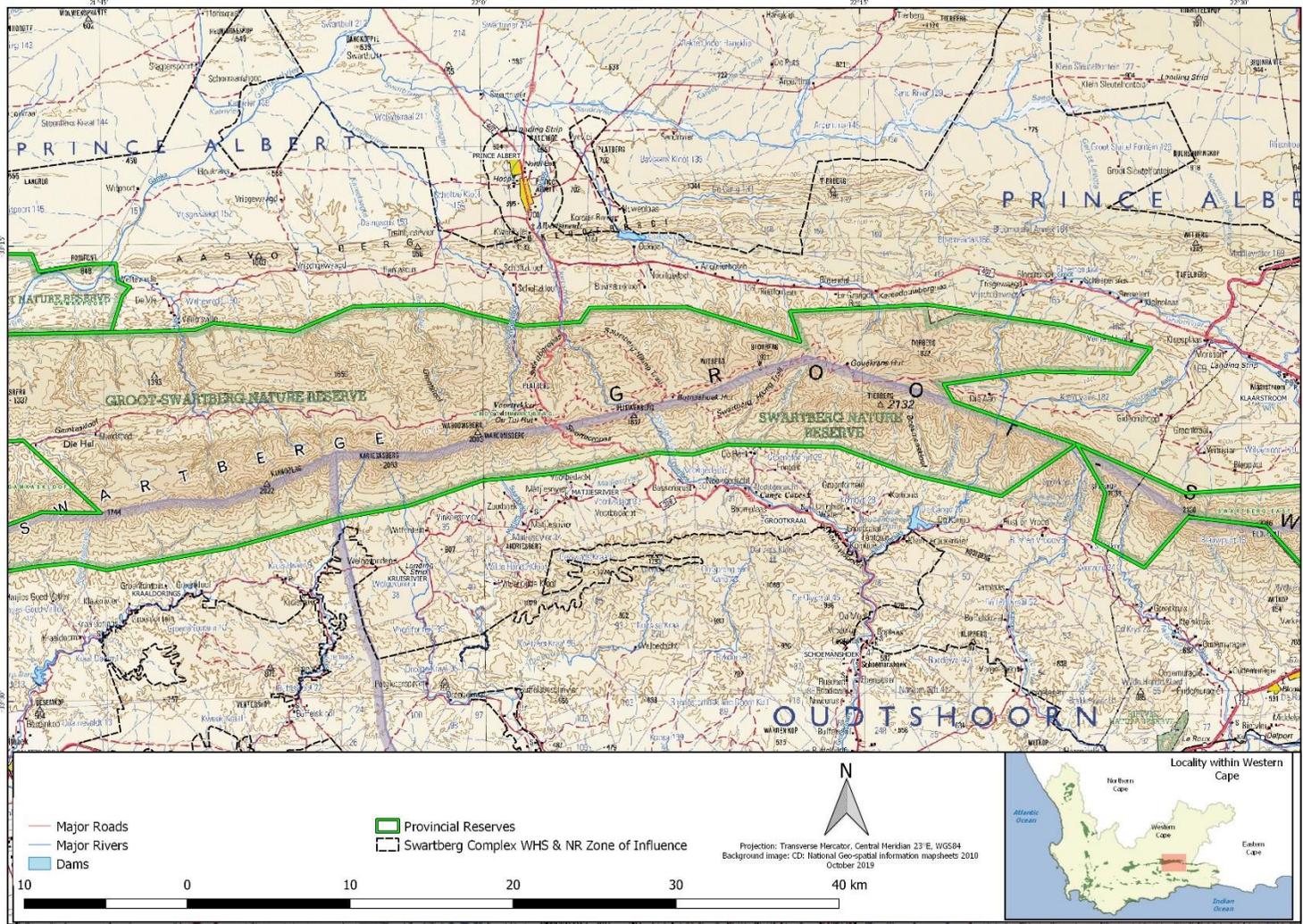
Map 2c: Distribution of rainfall stations and the average monthly rainfall graphs for Blesberg (Swartberg East) and the Kammanassie.



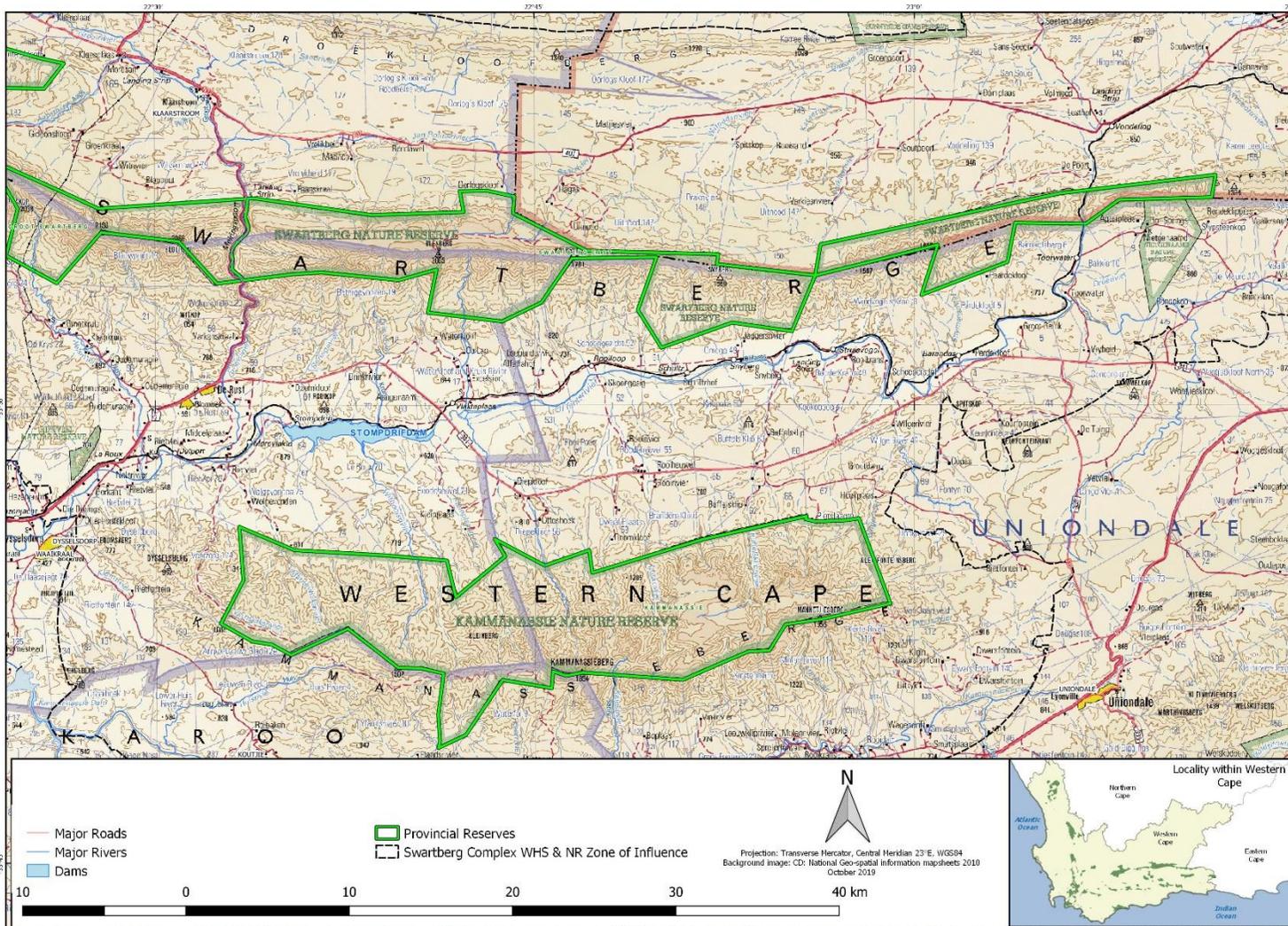
Map 2d: Distribution of rainfall stations and the average monthly rainfall graphs for the Gamkaberg Cluster.



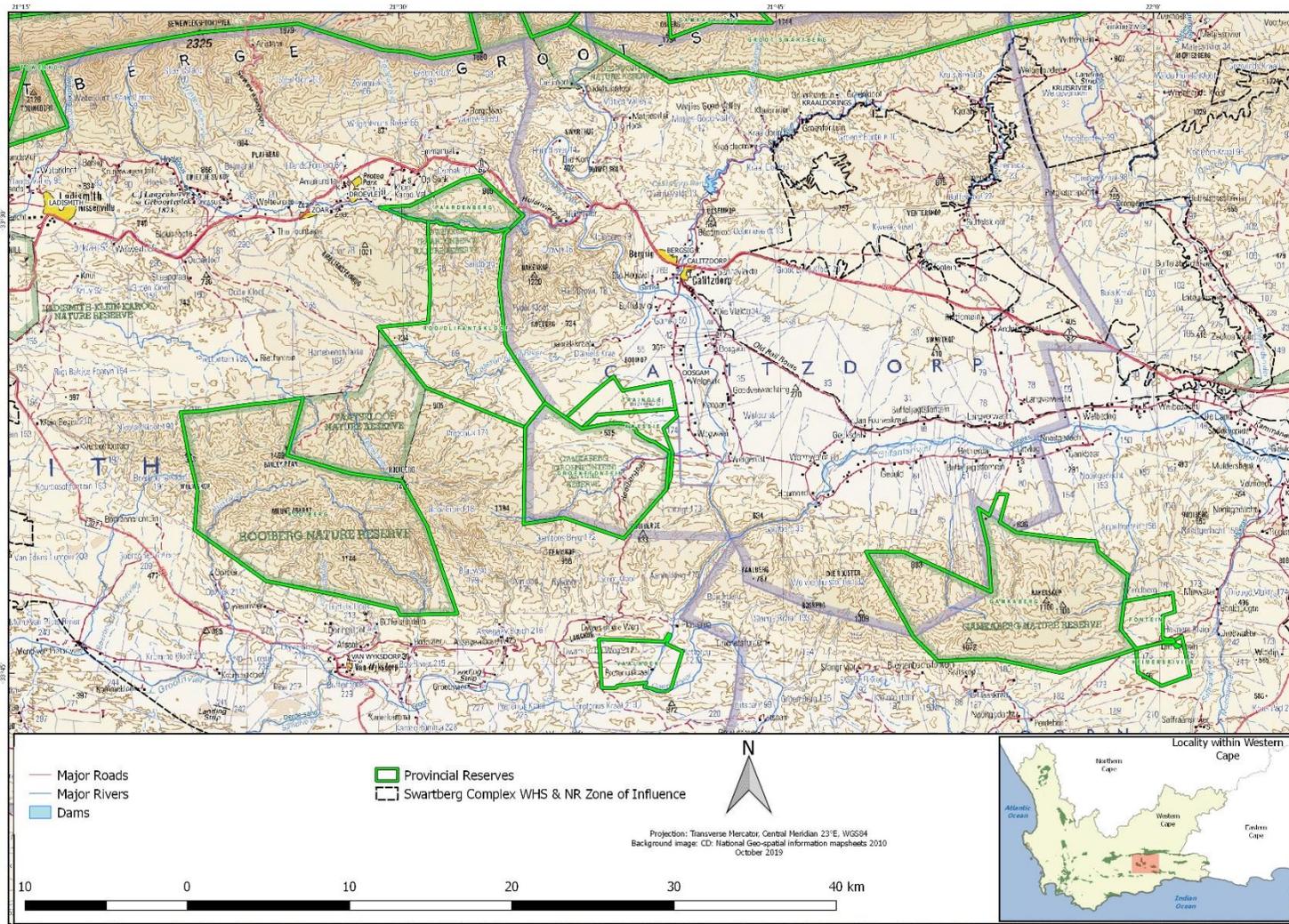
Map 3a: Topography of Towerkop, Gamkapoort and the western section of Groot Swartberg.



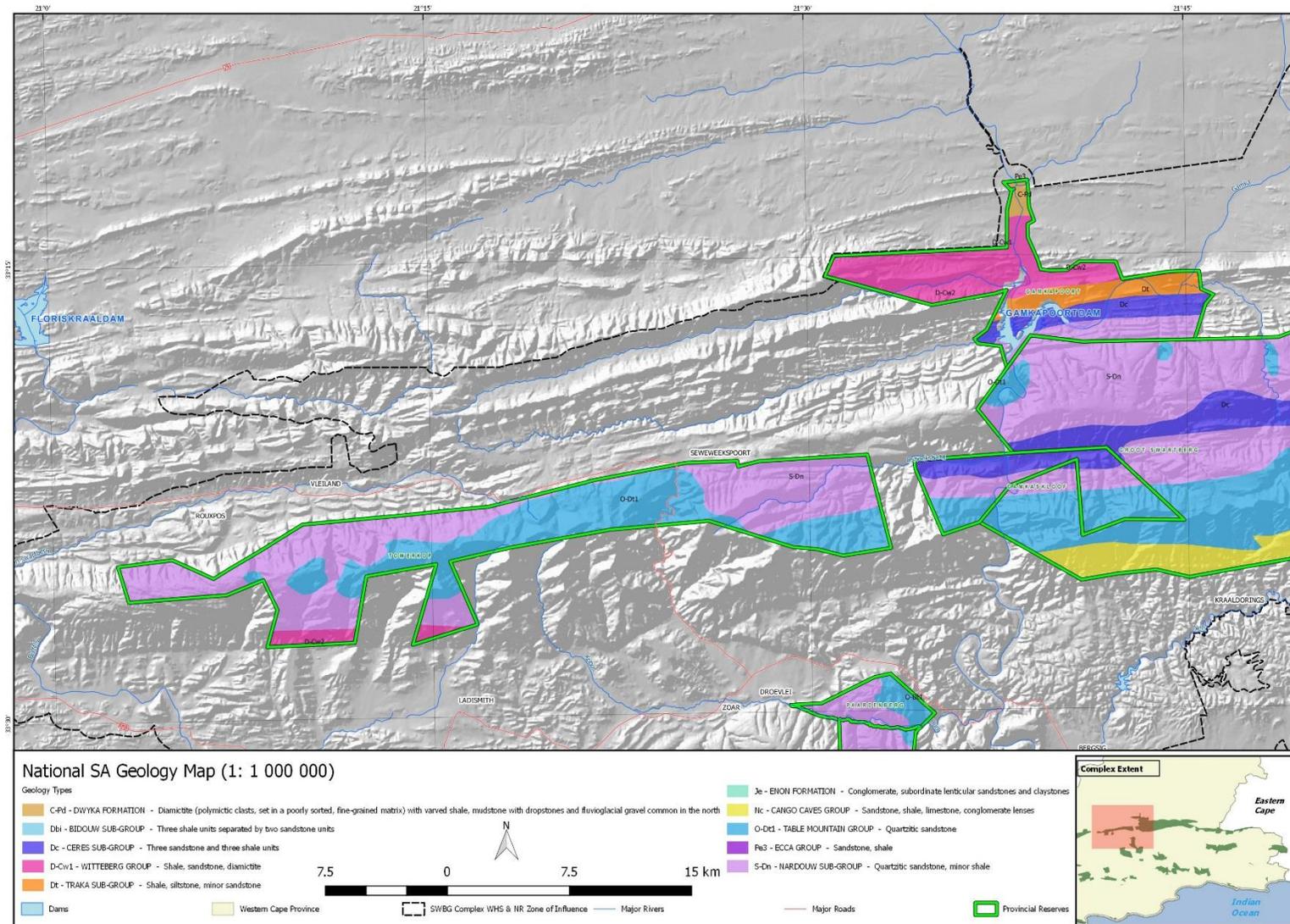
Map 3b: Topography of the central part of Groot Swartberg.



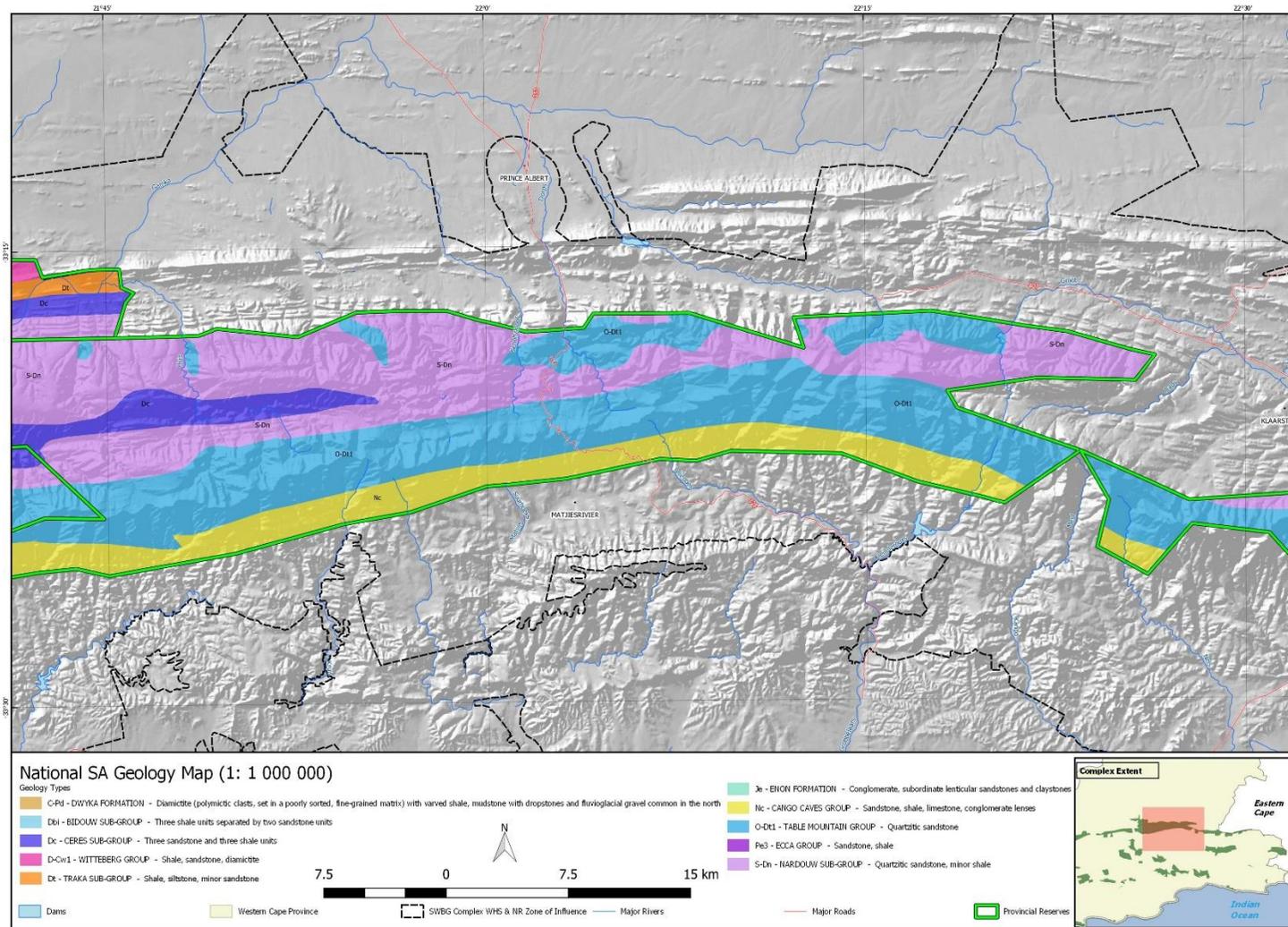
Map 3c: Topography of Swartberg East and Kammanassie.



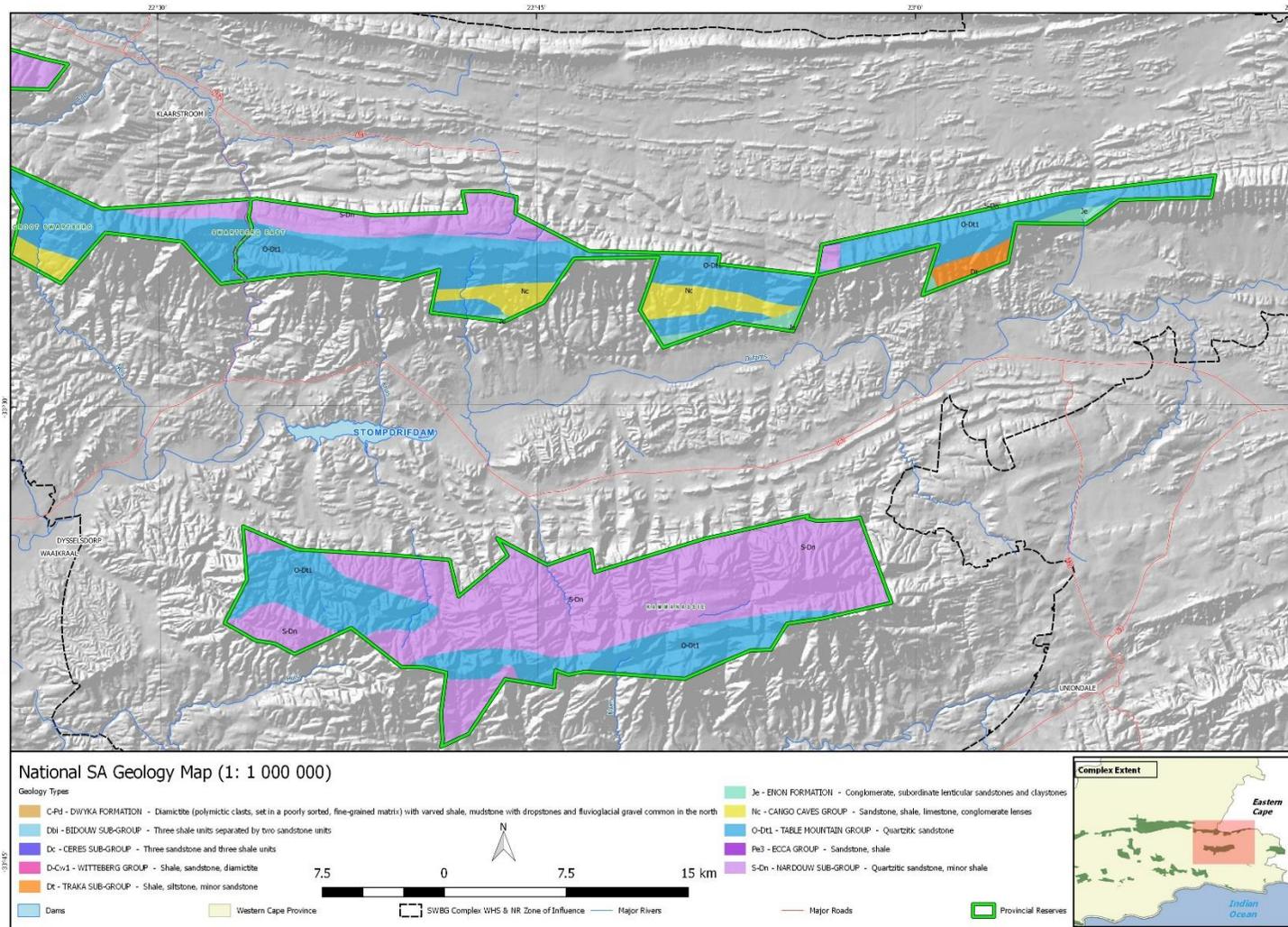
Map 3d: Topography of the Gamkaberg Cluster.



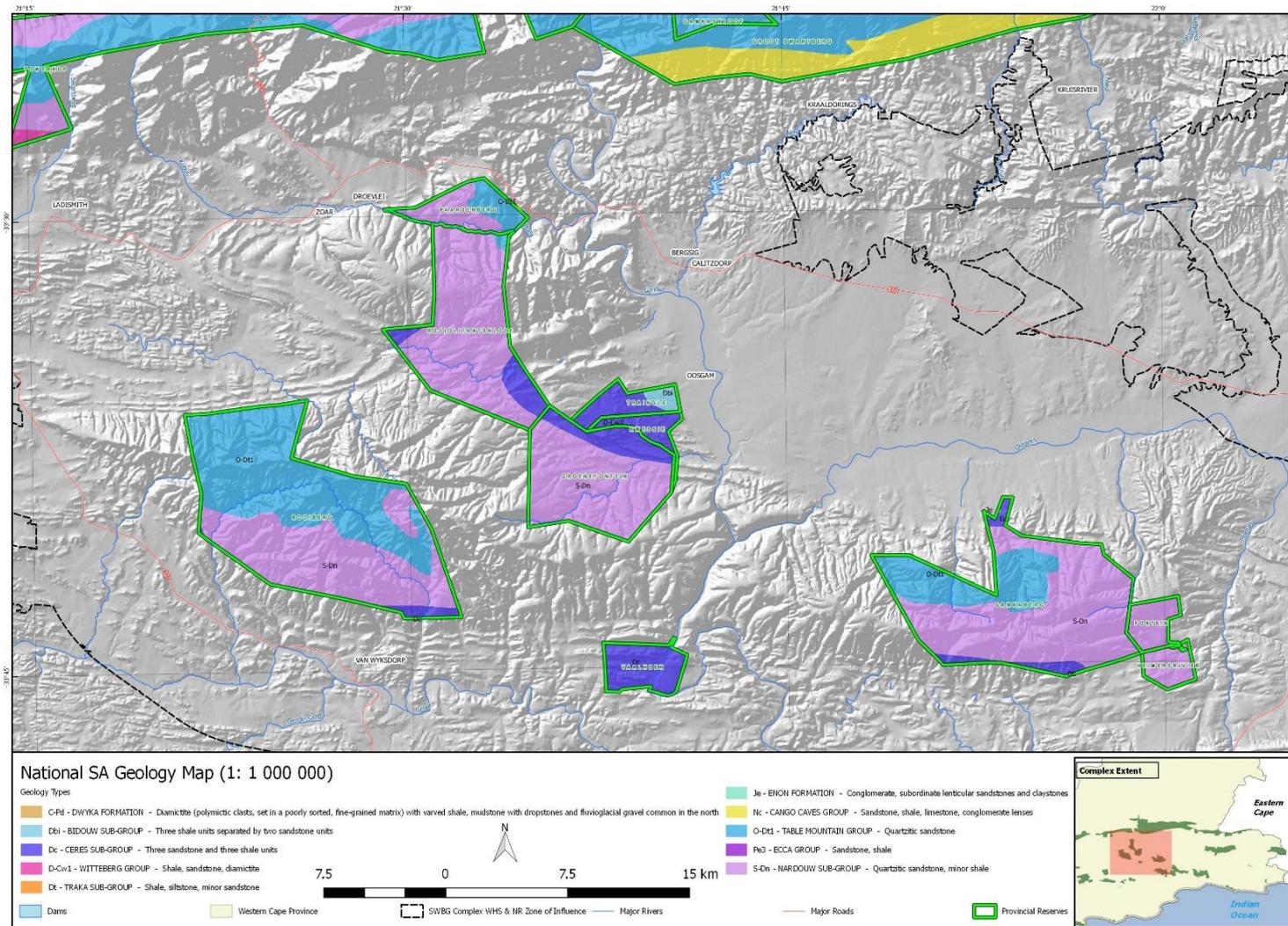
Map 4a: Geology of Towerkop, Gampapoort, Gampaskloof and the western section of Groot Swartberg.



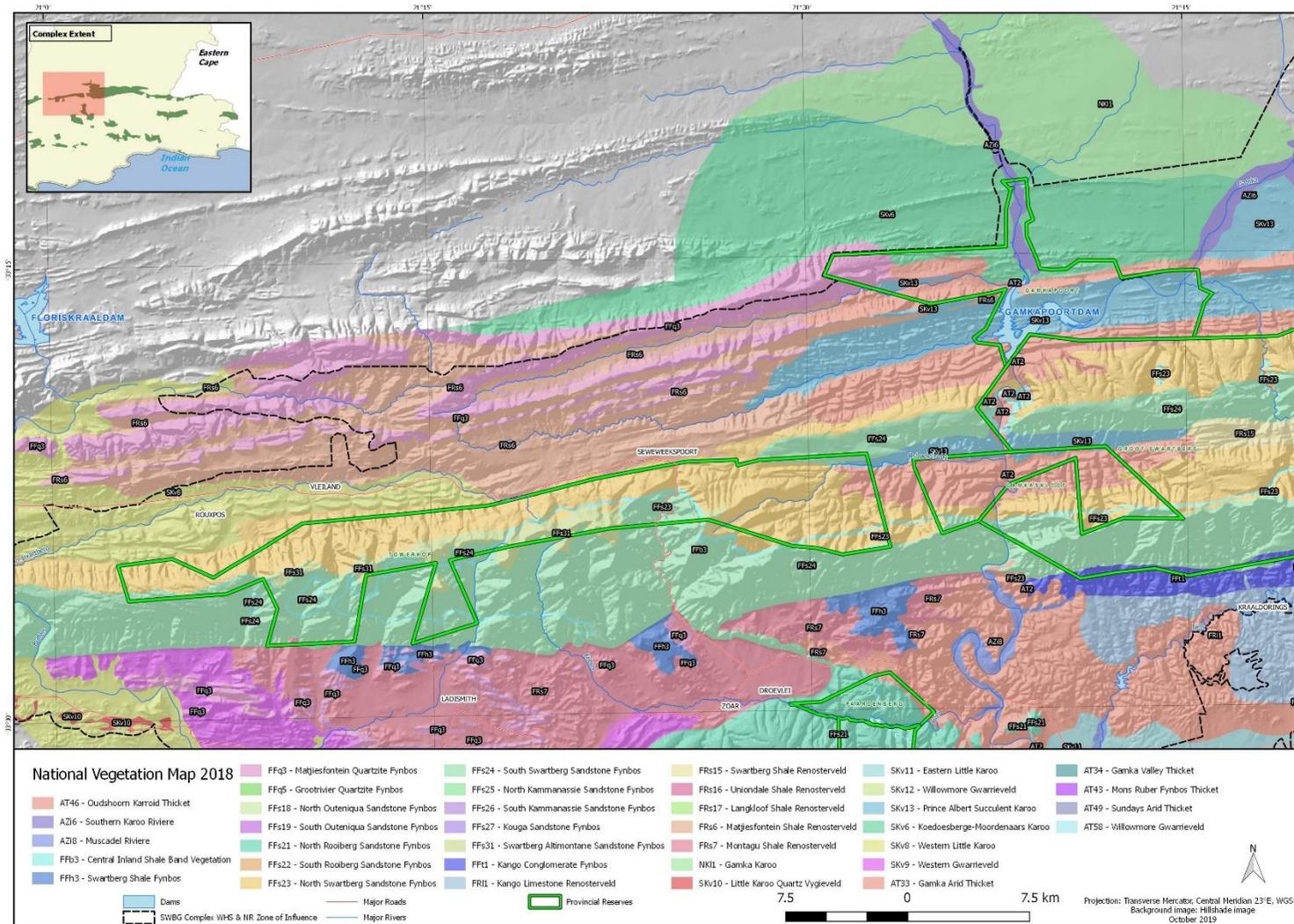
Map 4b: Geology of the central part of Groot Swartberg.



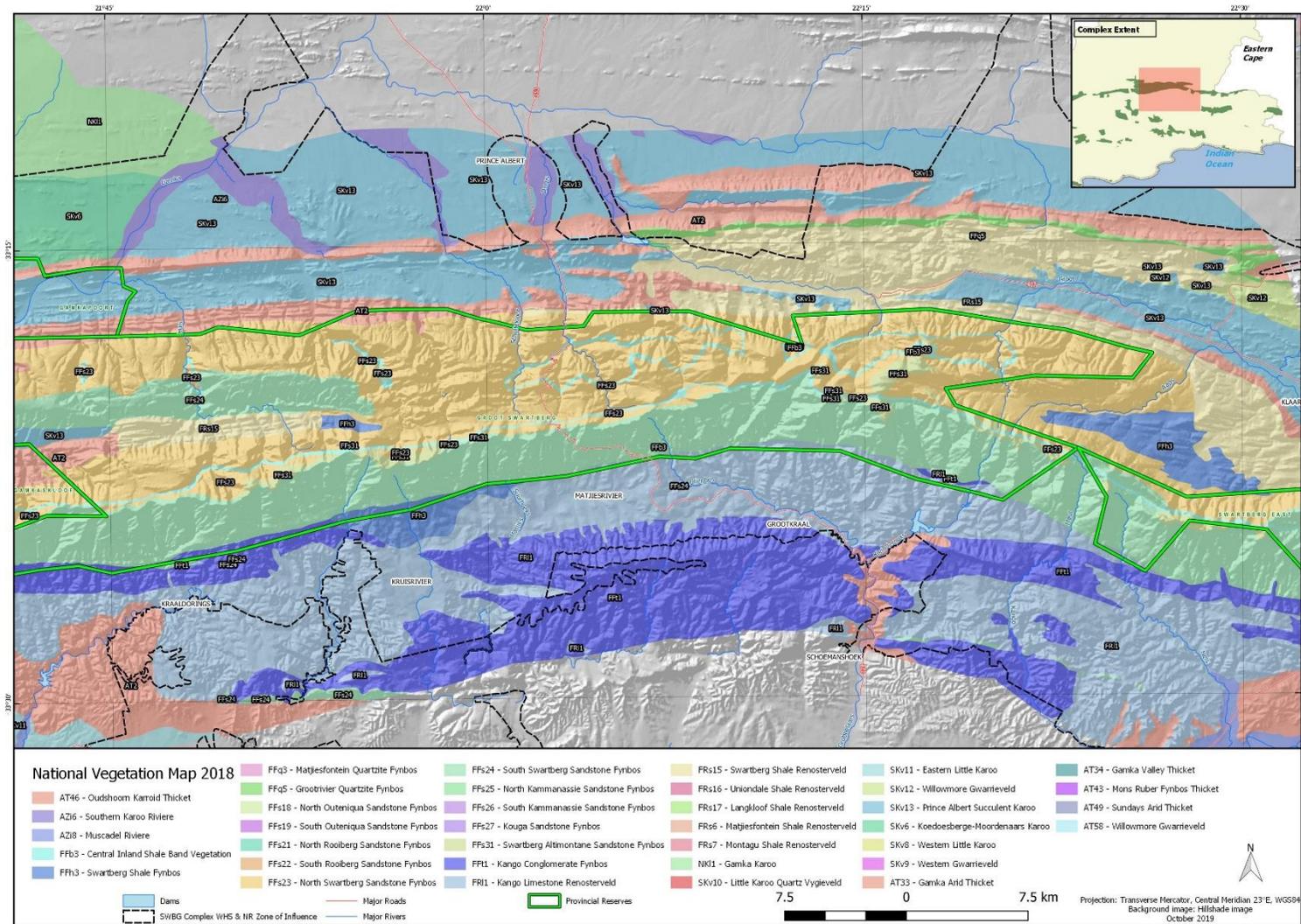
Map 4c: Geology of Swartberg East and Kammanassie.



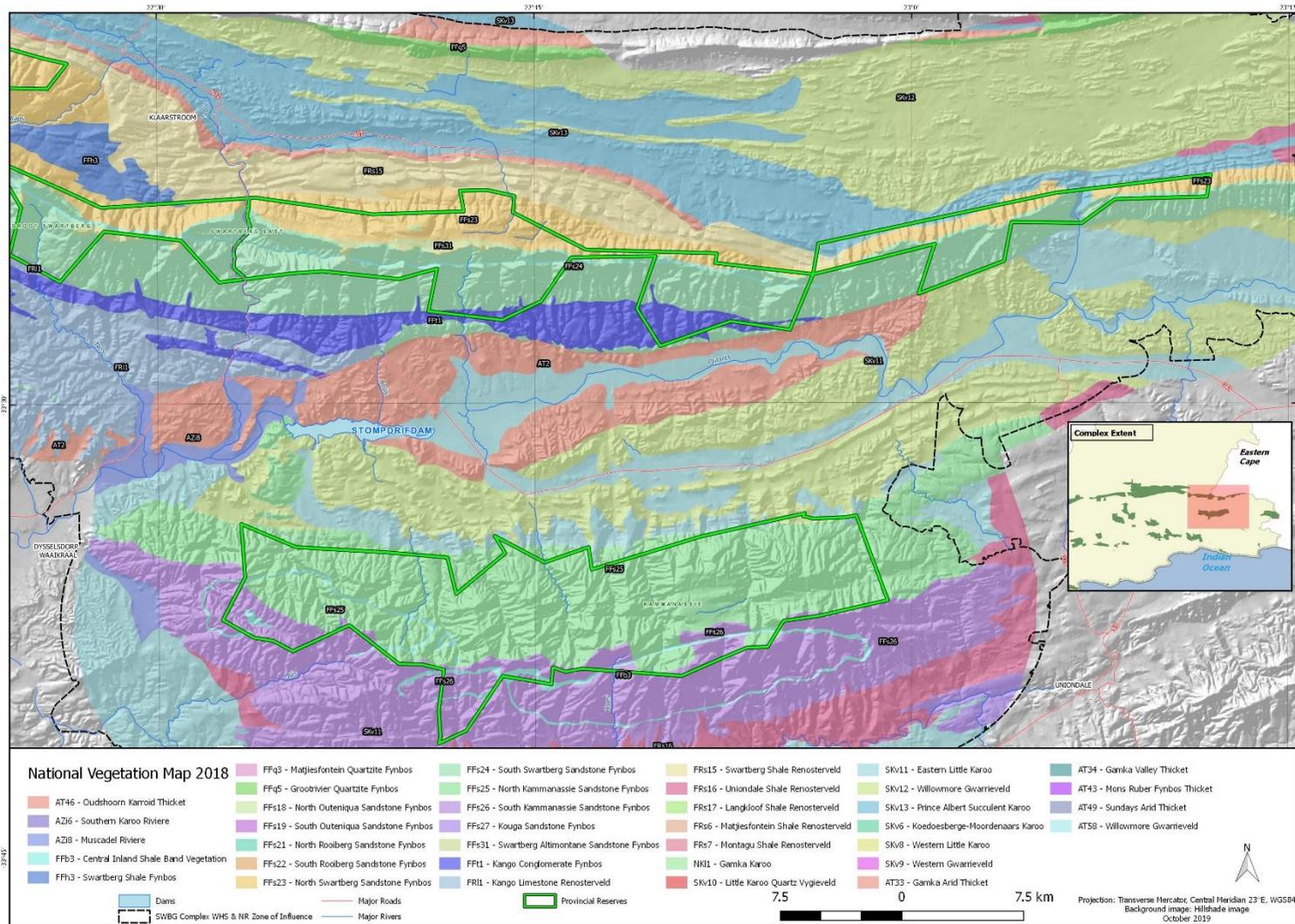
Map 4d: Geology of the Gamkaberg Cluster.



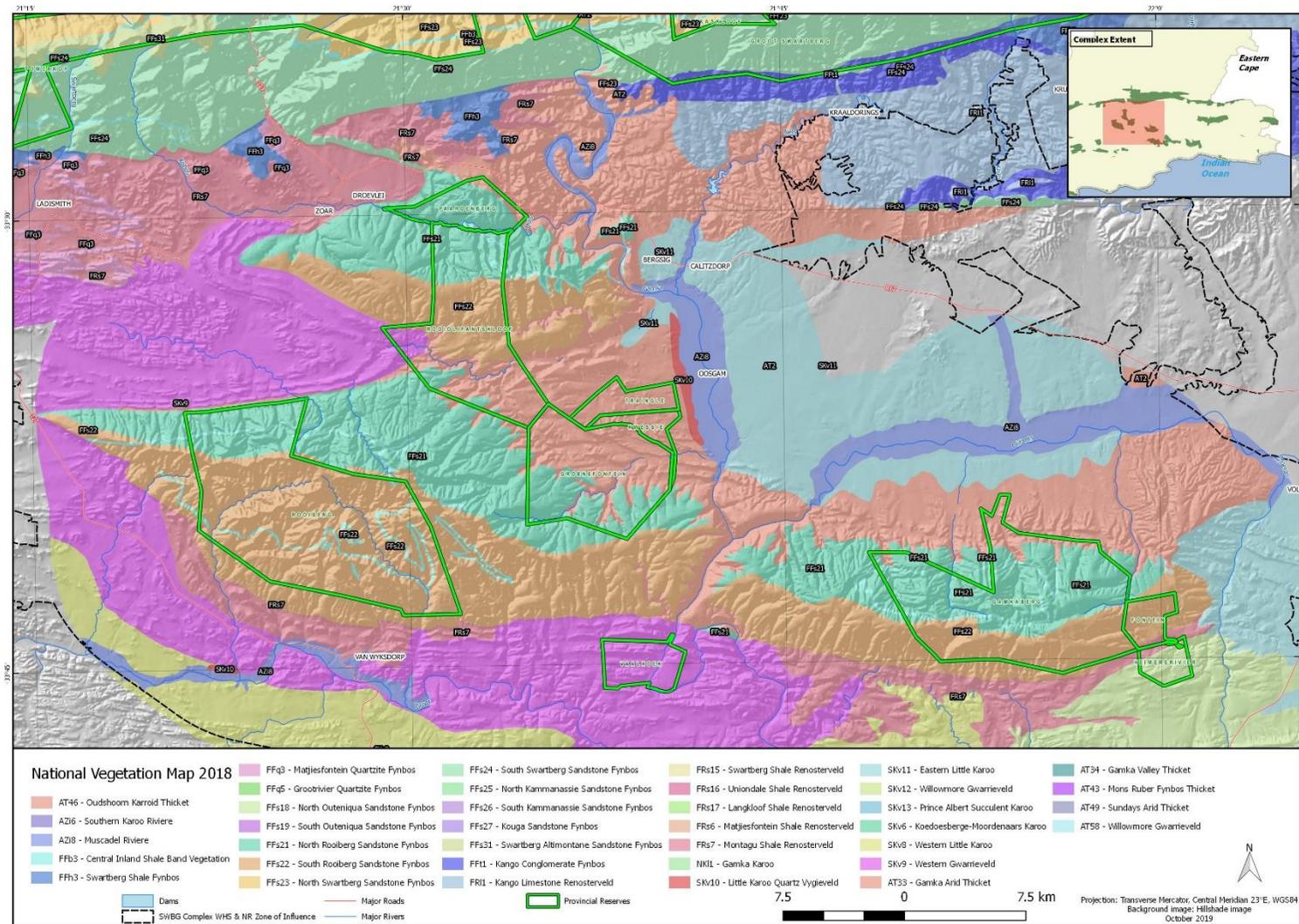
Map 5a: Vegetation of Towerkop, Gankaport and the western section of Groot Swartberg based on the National Vegetation Map (2018).



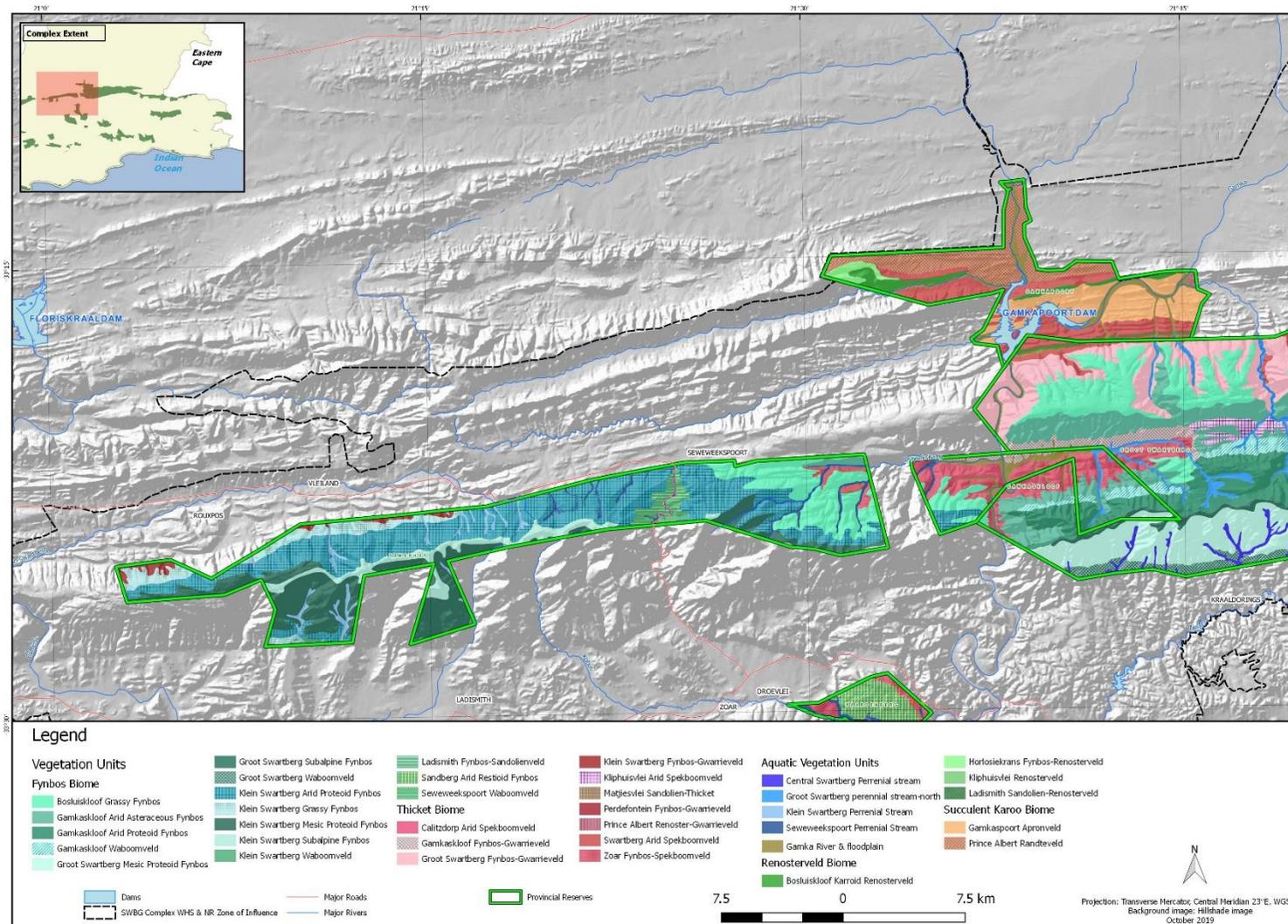
Map 5b: Vegetation of the central part of Groot Swartberg based on the National Vegetation Map (2018).



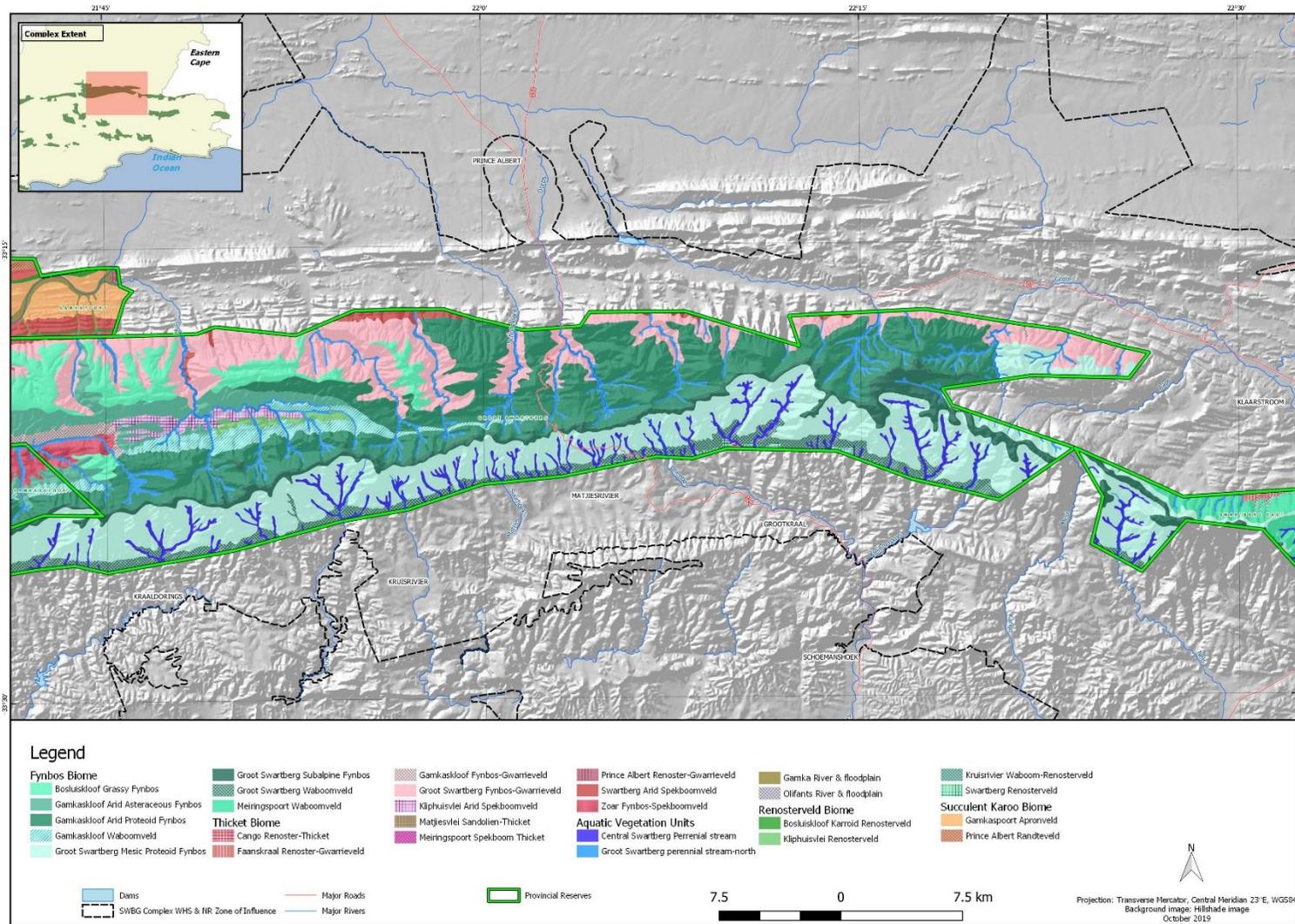
Map 5c: Vegetation of Swartberg East and Kammanassie based on the National Vegetation Map (2018).



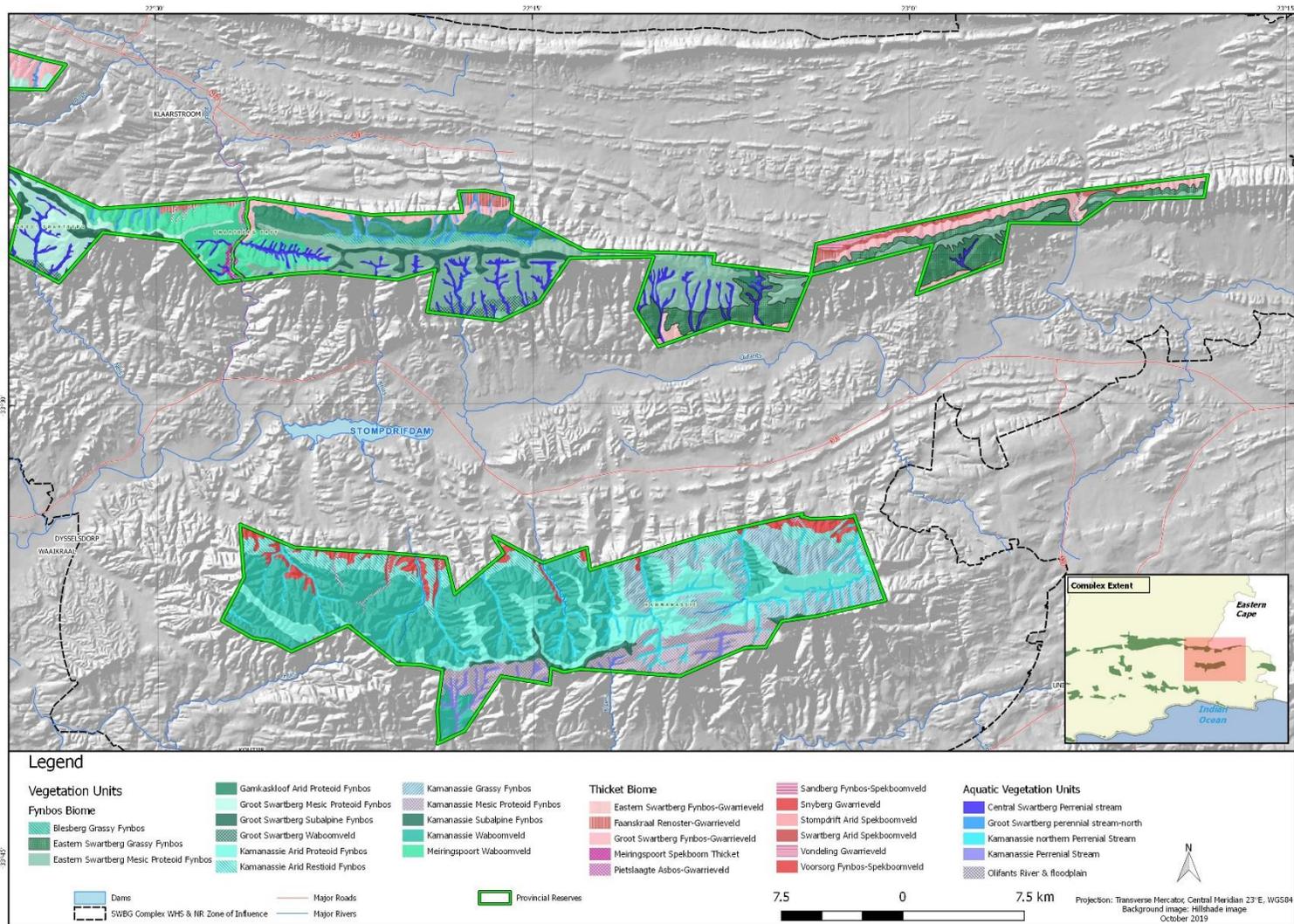
Map 5d: Vegetation of the Gamkaberg Cluster based on the National Vegetation Map (2018).



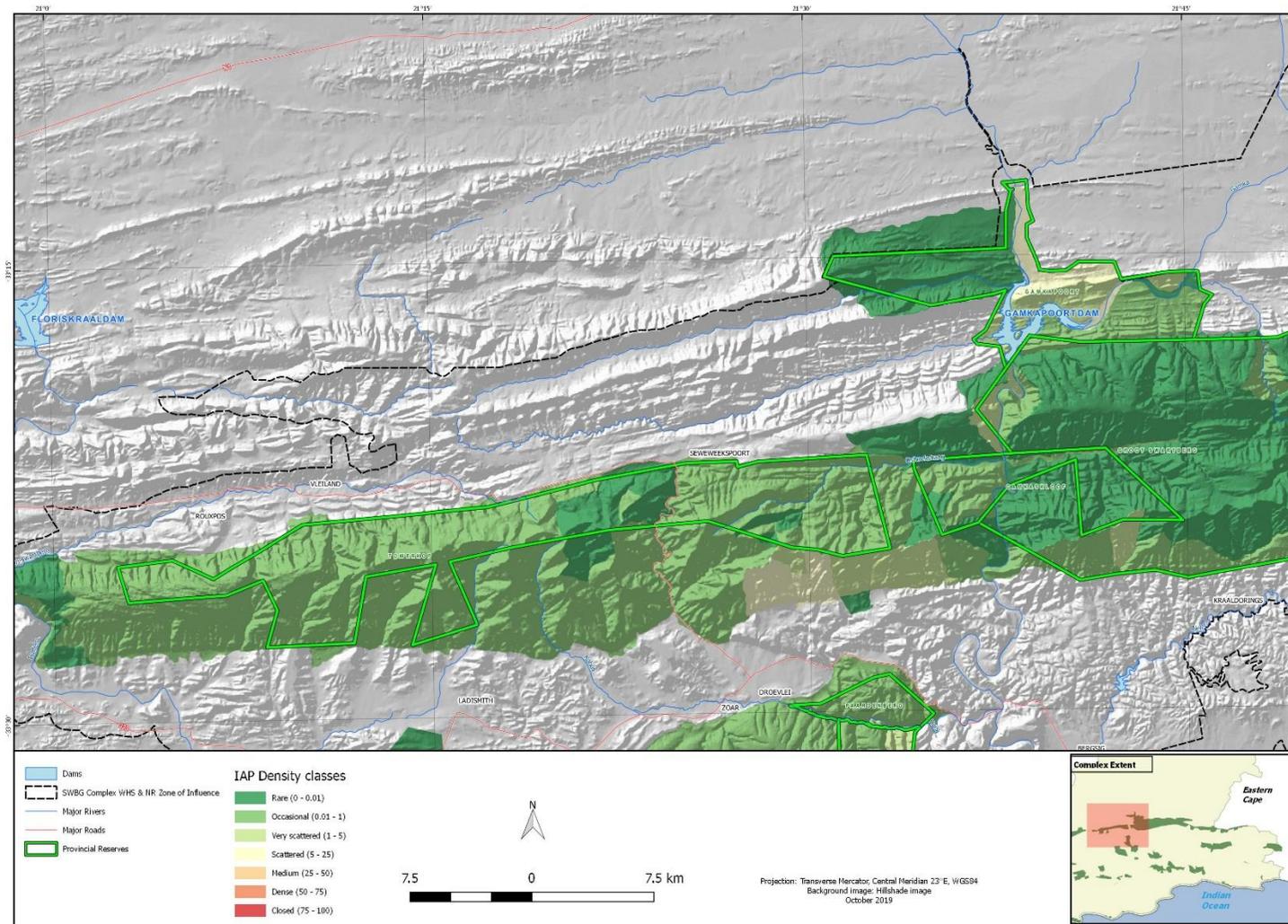
Map 6a: Fine-scale vegetation map of Towerkop, Gamkapoort and the western section of Groot Swartberg based on Vlok *et al.* (2005).



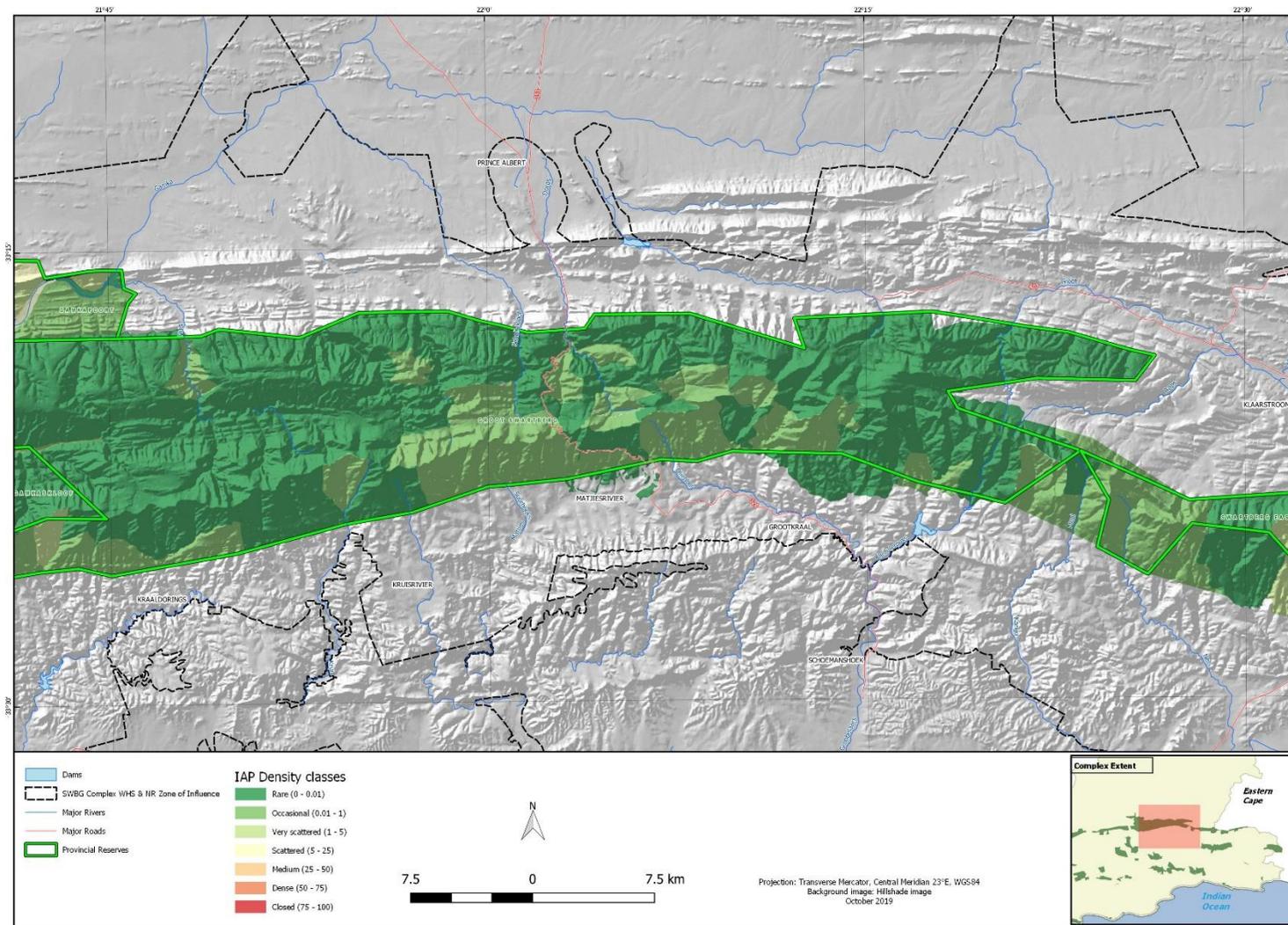
Map 6b: Fine-scale vegetation map of the central part of Groot Swartberg based on Vlok *et al.* (2005).



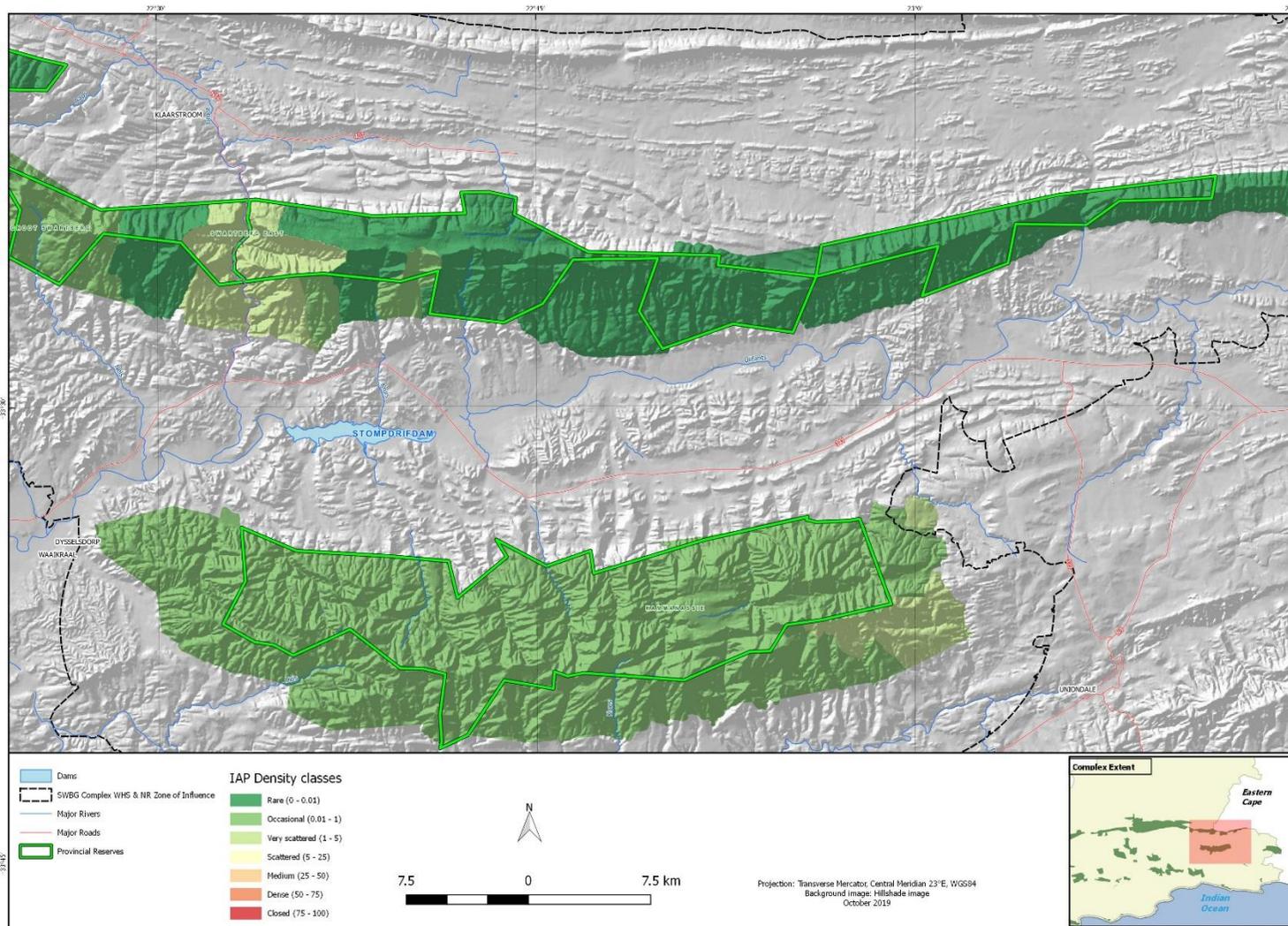
Map 6c: Fine-scale vegetation map of Swartberg East and Kammanassie based on Vlok *et al.* (2005).



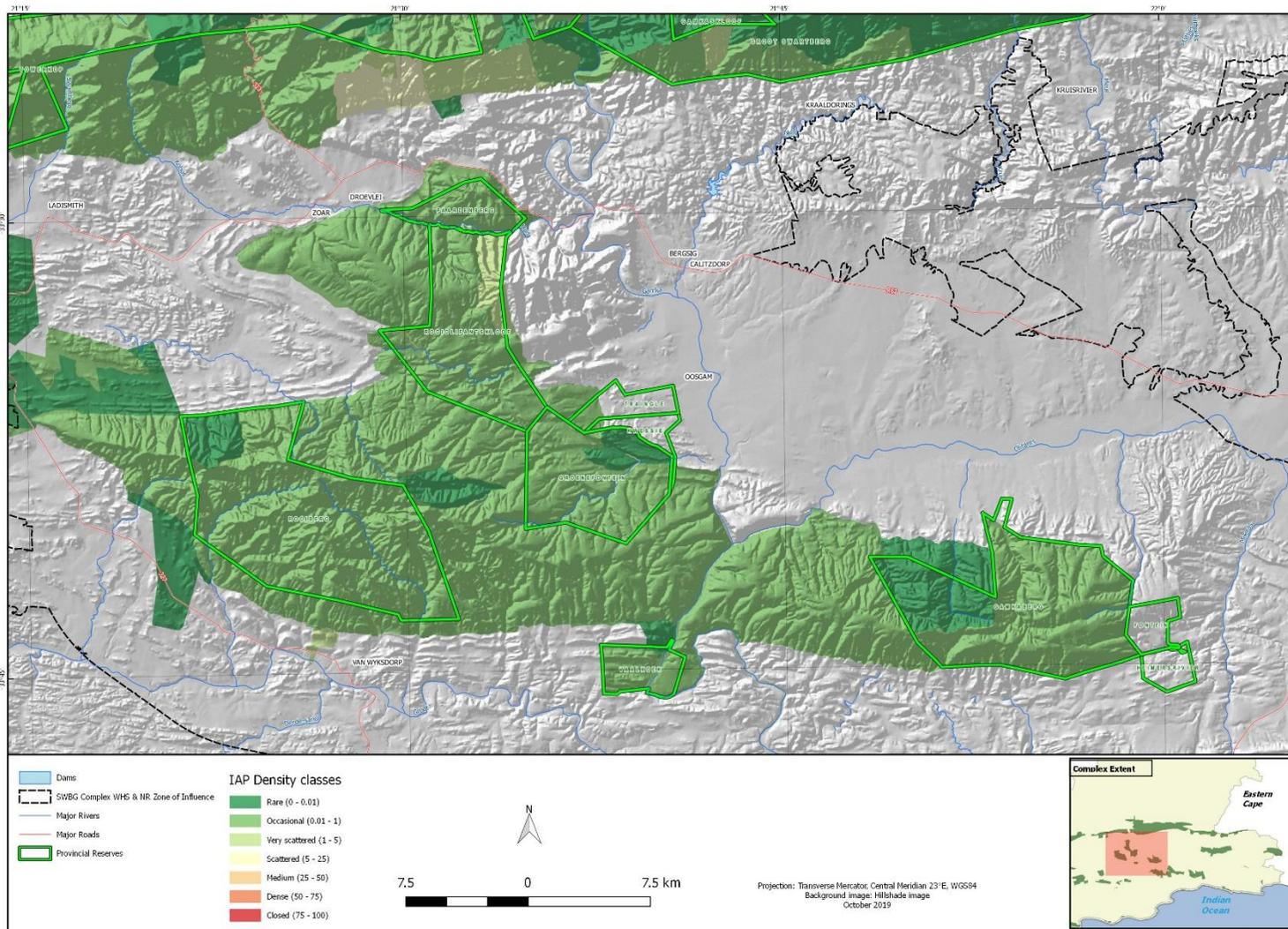
Map 7a: Current (2019) extent and density classes of invasive alien vegetation on Towerkop, Gamkapoort and the western section of Groot Swartberg.



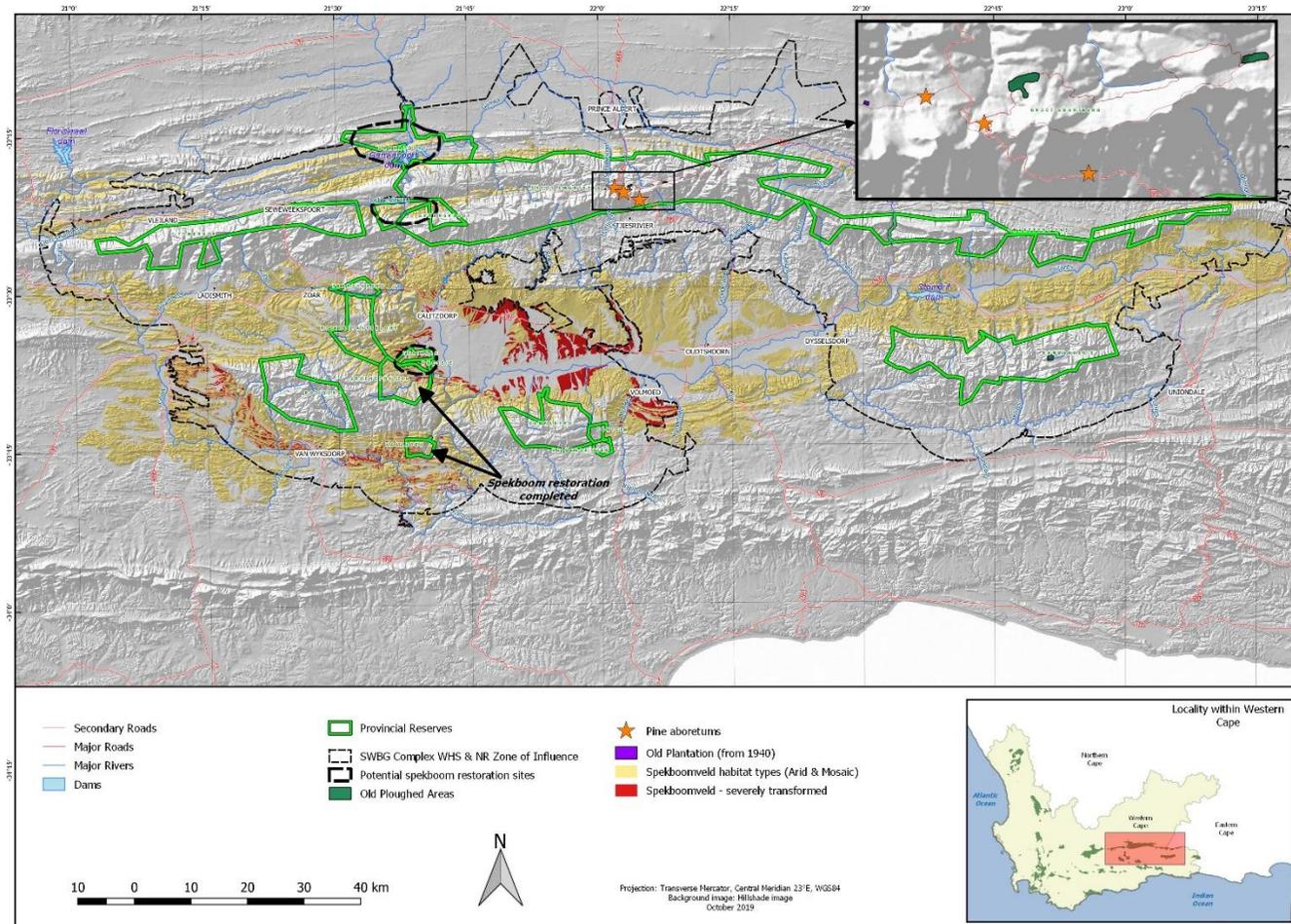
Map 7b: Current (2019) extent and density classes of invasive alien vegetation on the central part of Groot Swartberg.



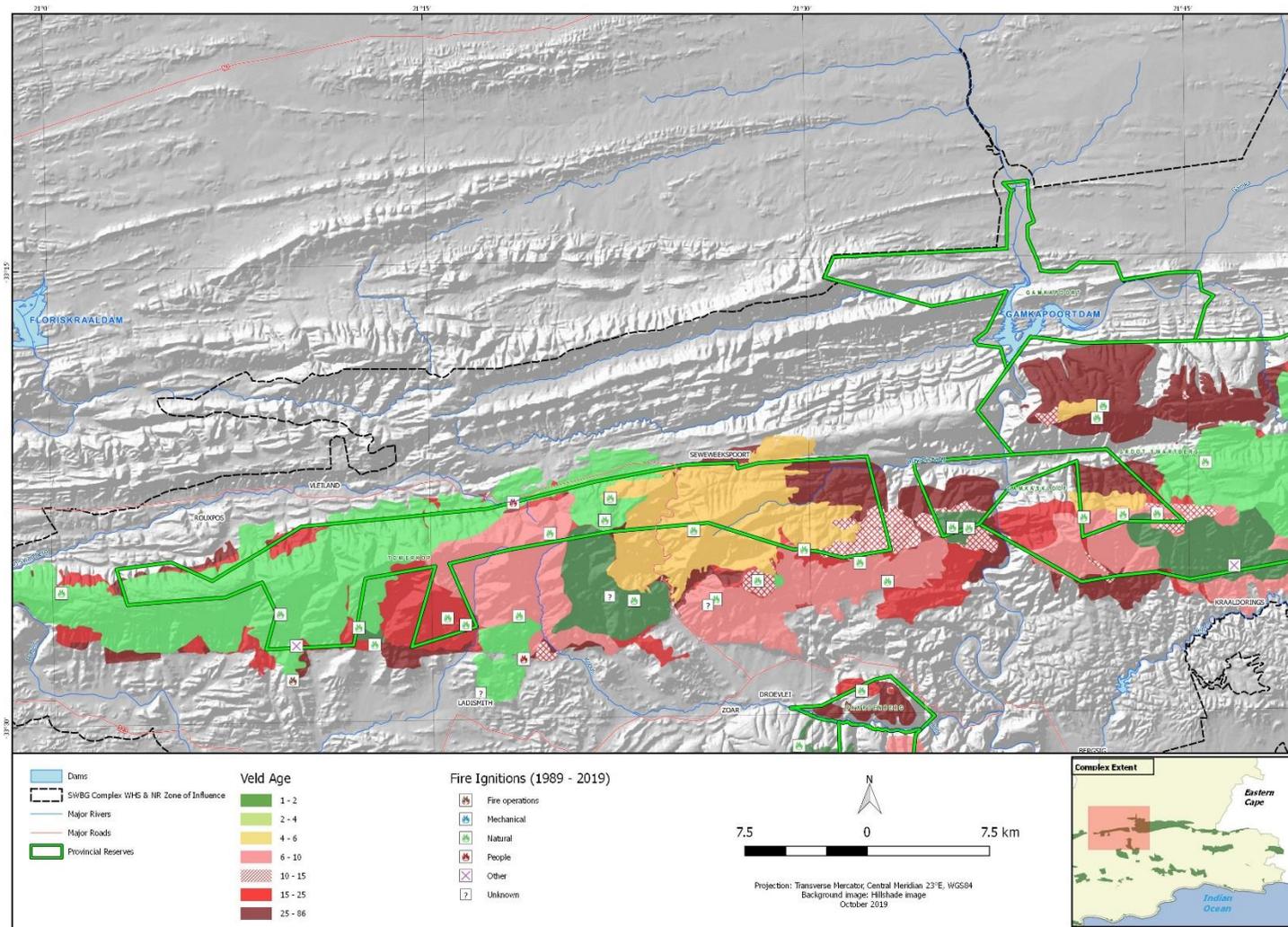
Map 7c: Current (2019) extent and density classes of invasive alien vegetation on Swartberg East and Kammanassie.



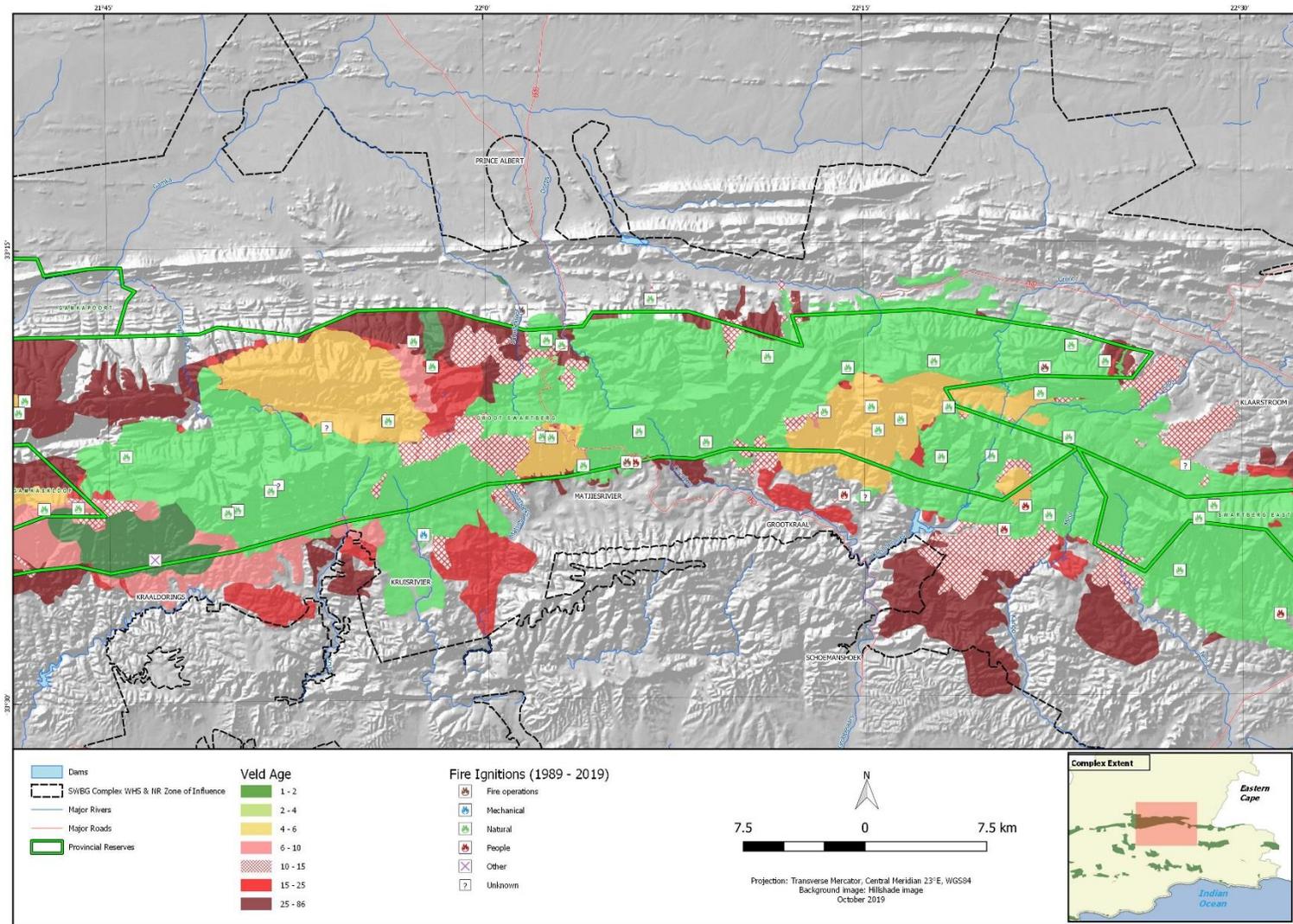
Map 7d: Current (2019) extent and density classes of invasive alien vegetation on the Gamkaberg Cluster.



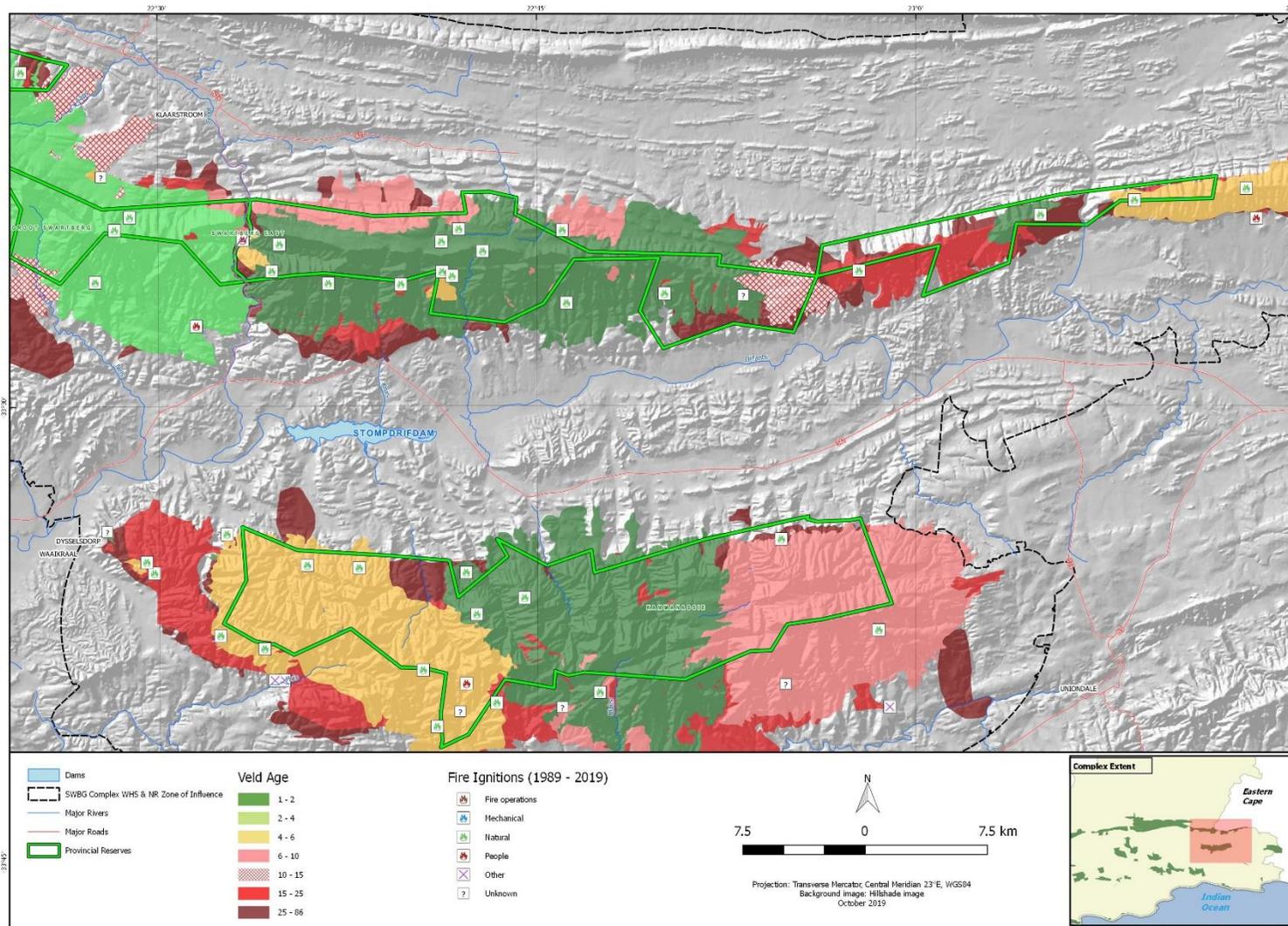
Map 8: Extent of severely transformed spekboomveld in the area around Vanwyksdorp and between Calitzdorp and Oudtshoorn. The sites that have been planted on reserves are indicated with arrows. Future sites to be planted with spekboom, as well as areas that have potential for restoration are encircled. In the insert box the locations of the old pine arboretums, plantation and the ploughed area on the Groot Swartberg are also shown.



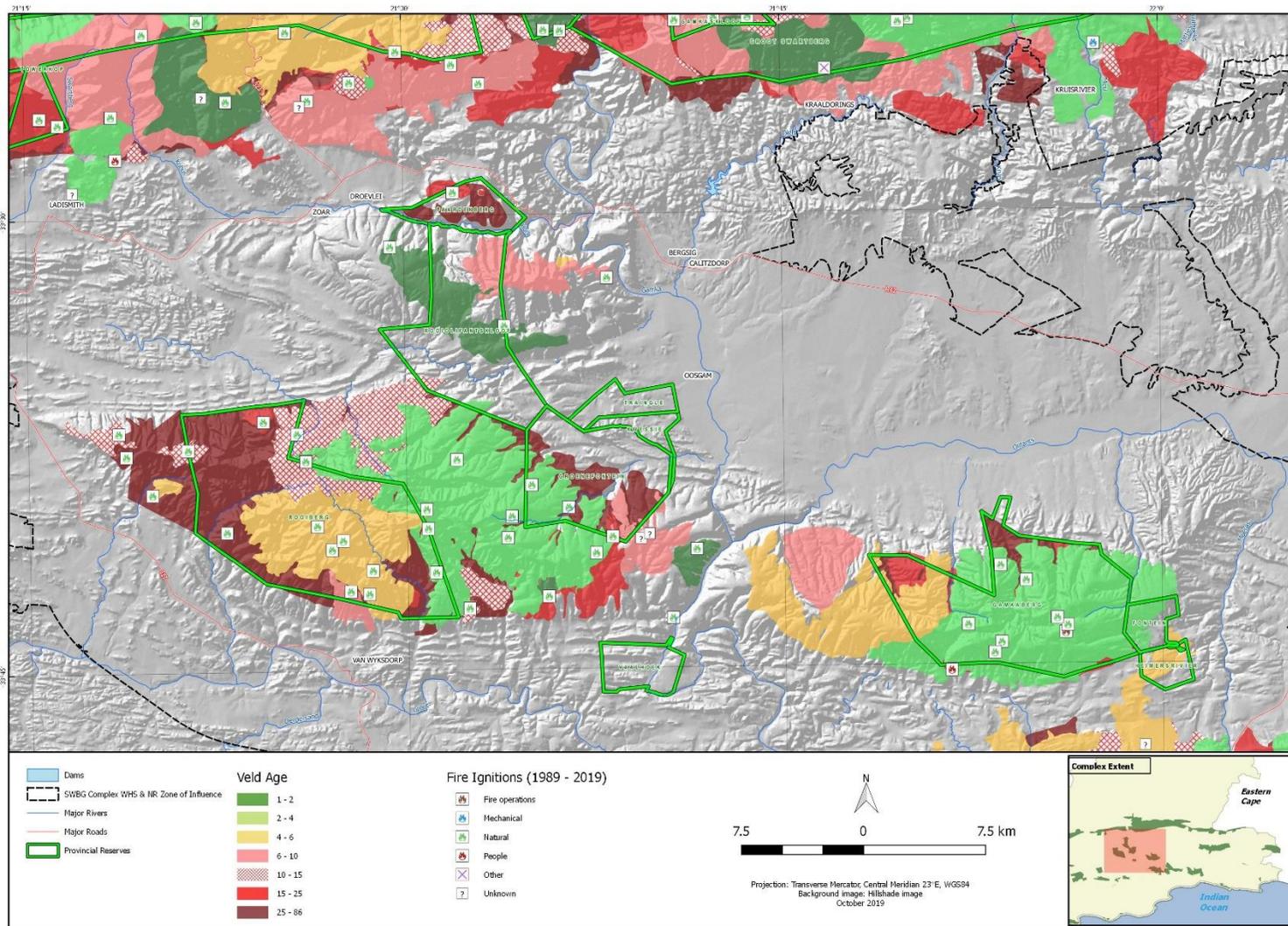
Map 9a: Current (2019) distribution of veld age classes and recorded sources of ignition on Towerkop, Gamkaskloof and the western section of Groot Swartberg.



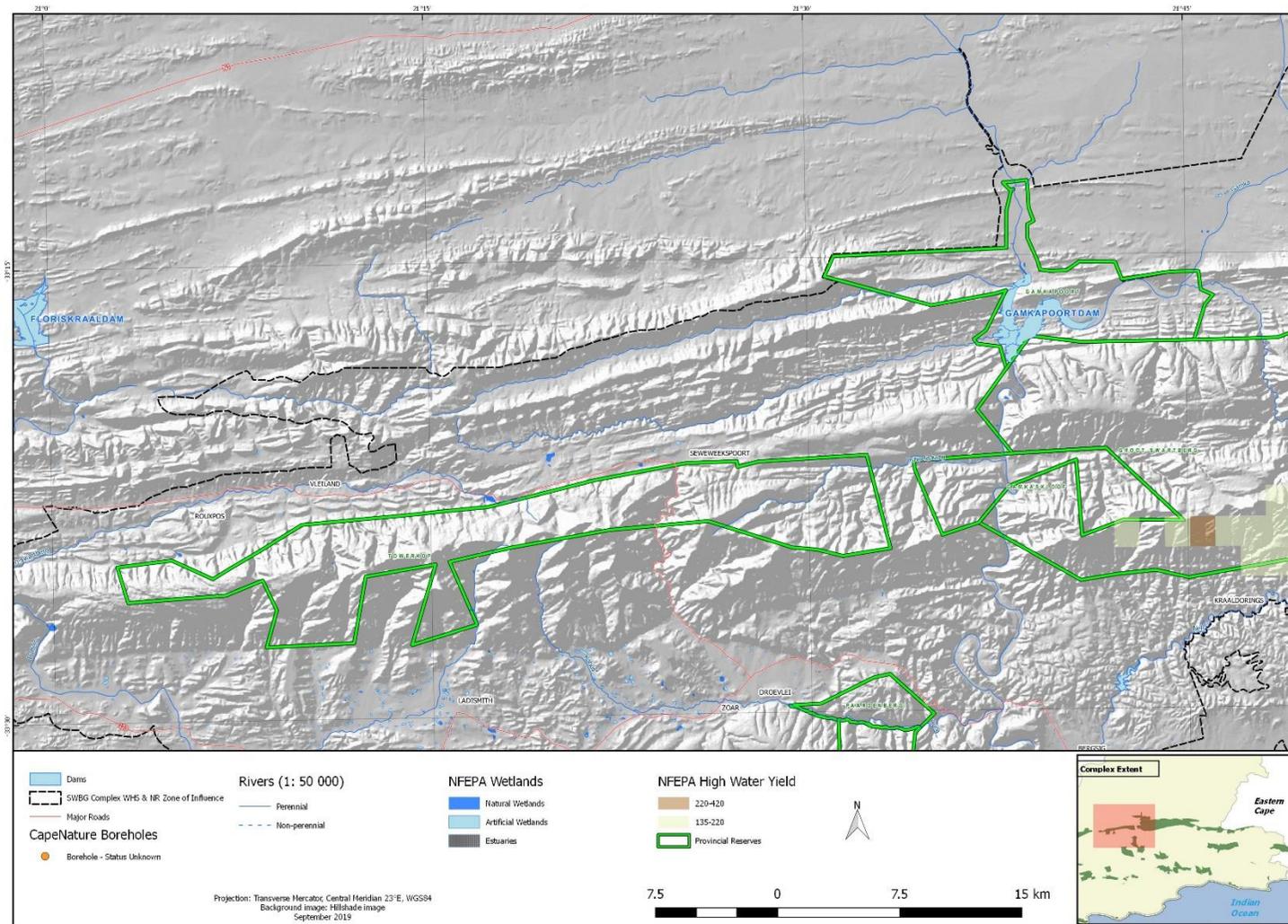
Map 9b: Current (2019) distribution of veld age classes and recorded sources of ignition on the central part of Groot Swartberg.



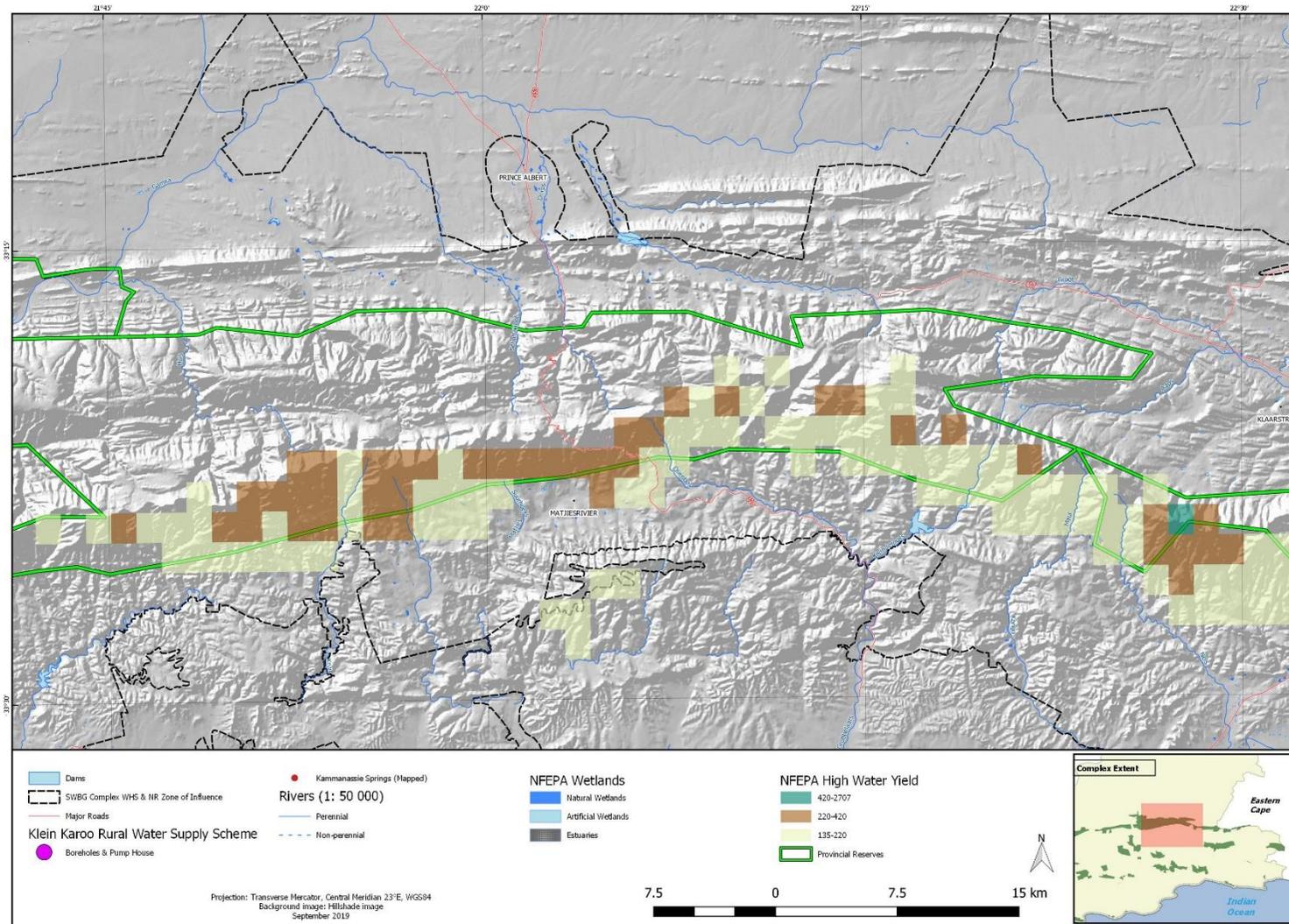
Map 9c: Current (2019) distribution of veld age classes and recorded sources of ignition on Swartberg East and Kammanassie.



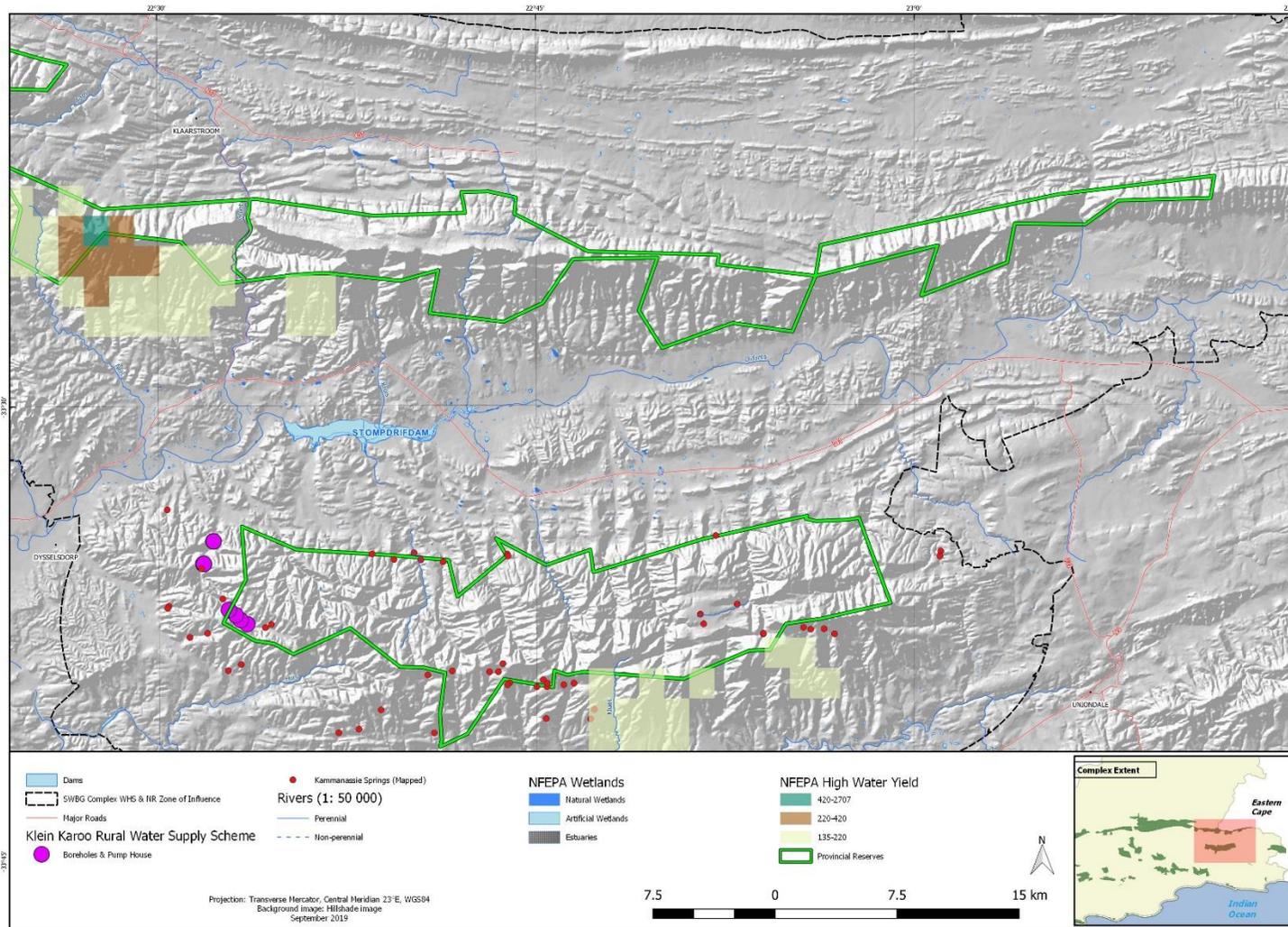
Map 9d: Current (2019) distribution of veld age classes and recorded sources of ignition on the Gamkaberg Cluster.



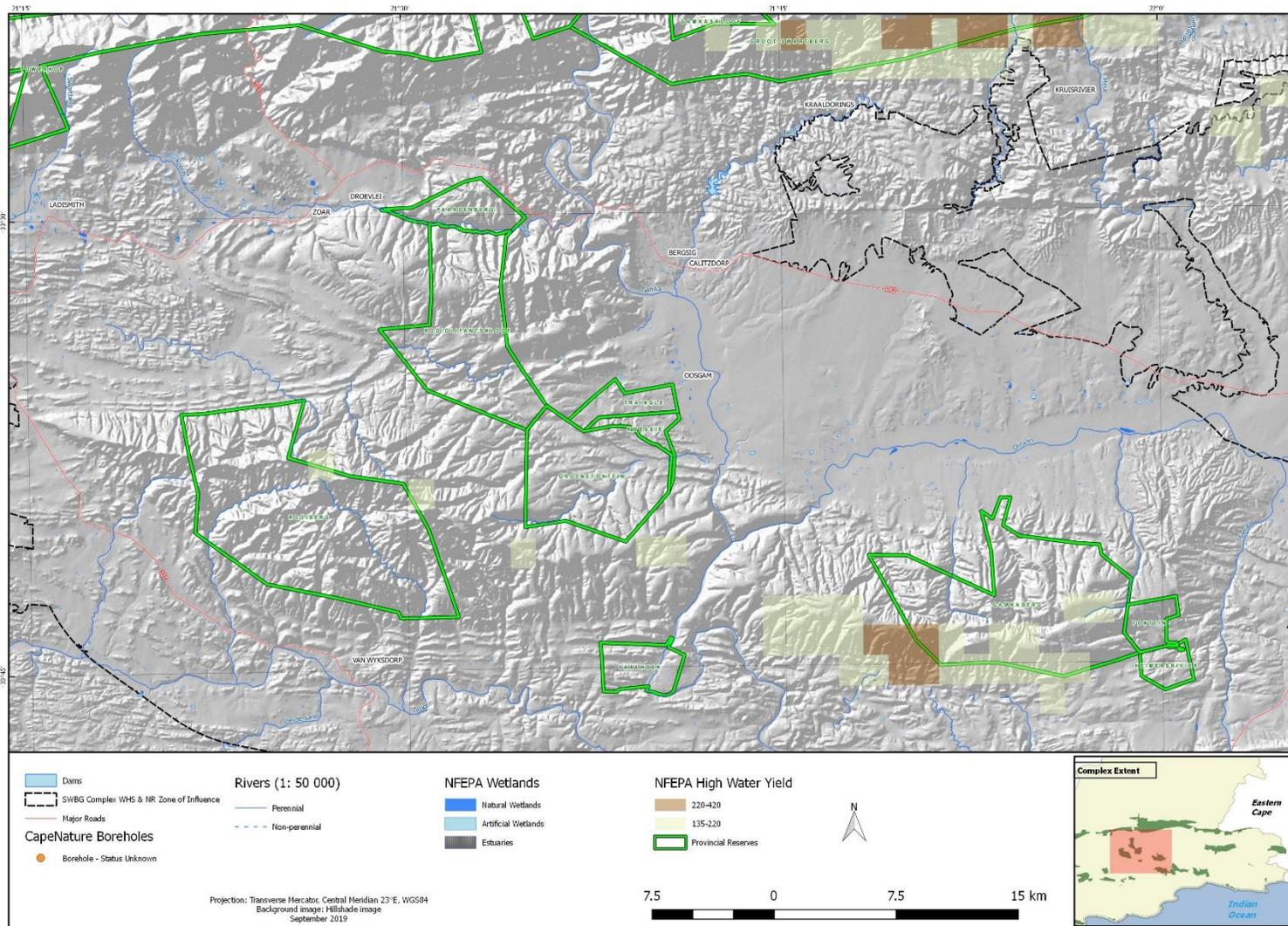
Map 10a: National Freshwater Ecosystem Priority and High Water Yield Areas of Towerkop, Gamkapoort and the western section of Groot Swartberg.



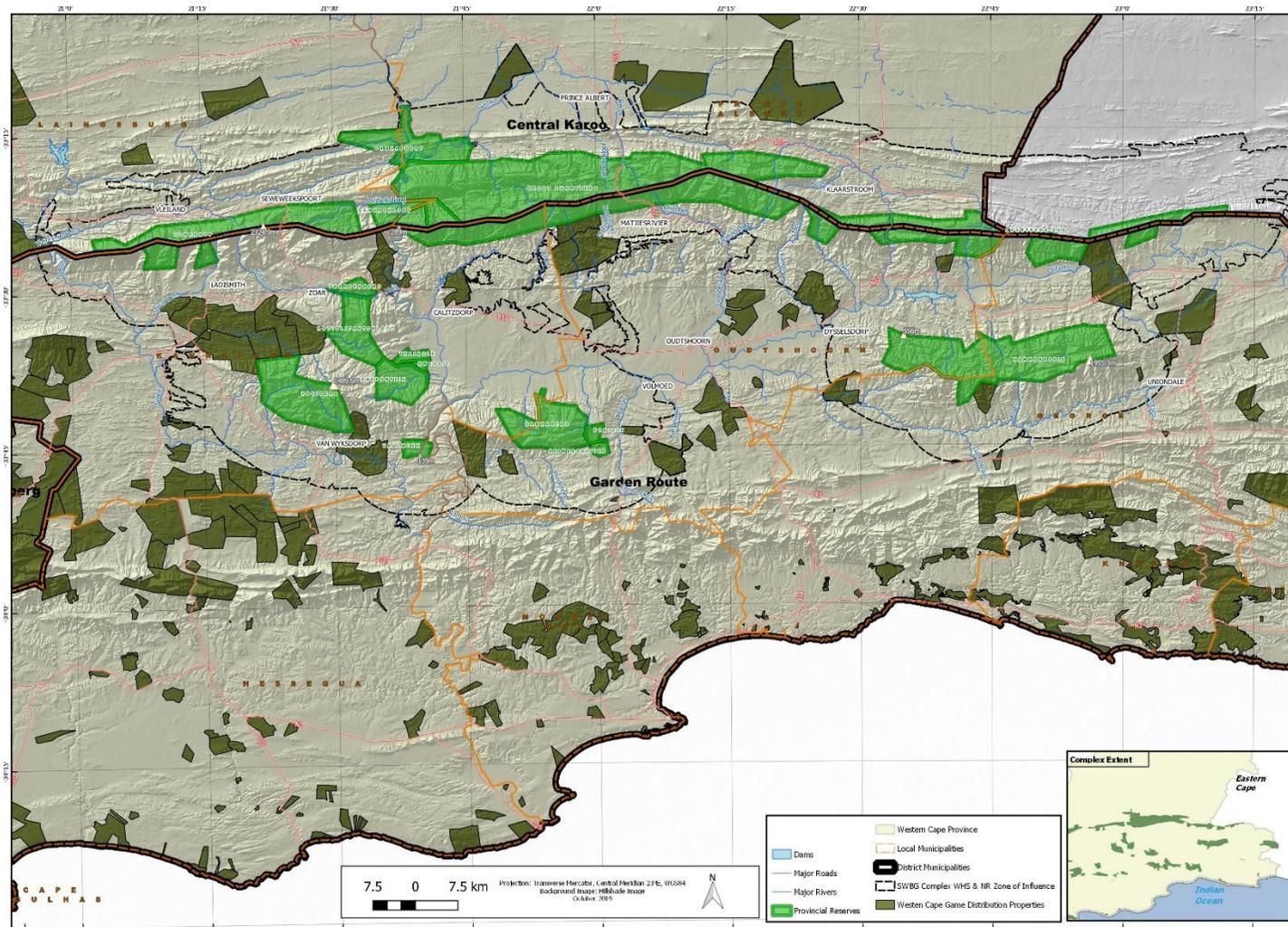
Map 10b: National Freshwater Ecosystem Priority and High Water Yield Areas of the central part of Groot Swartberg.



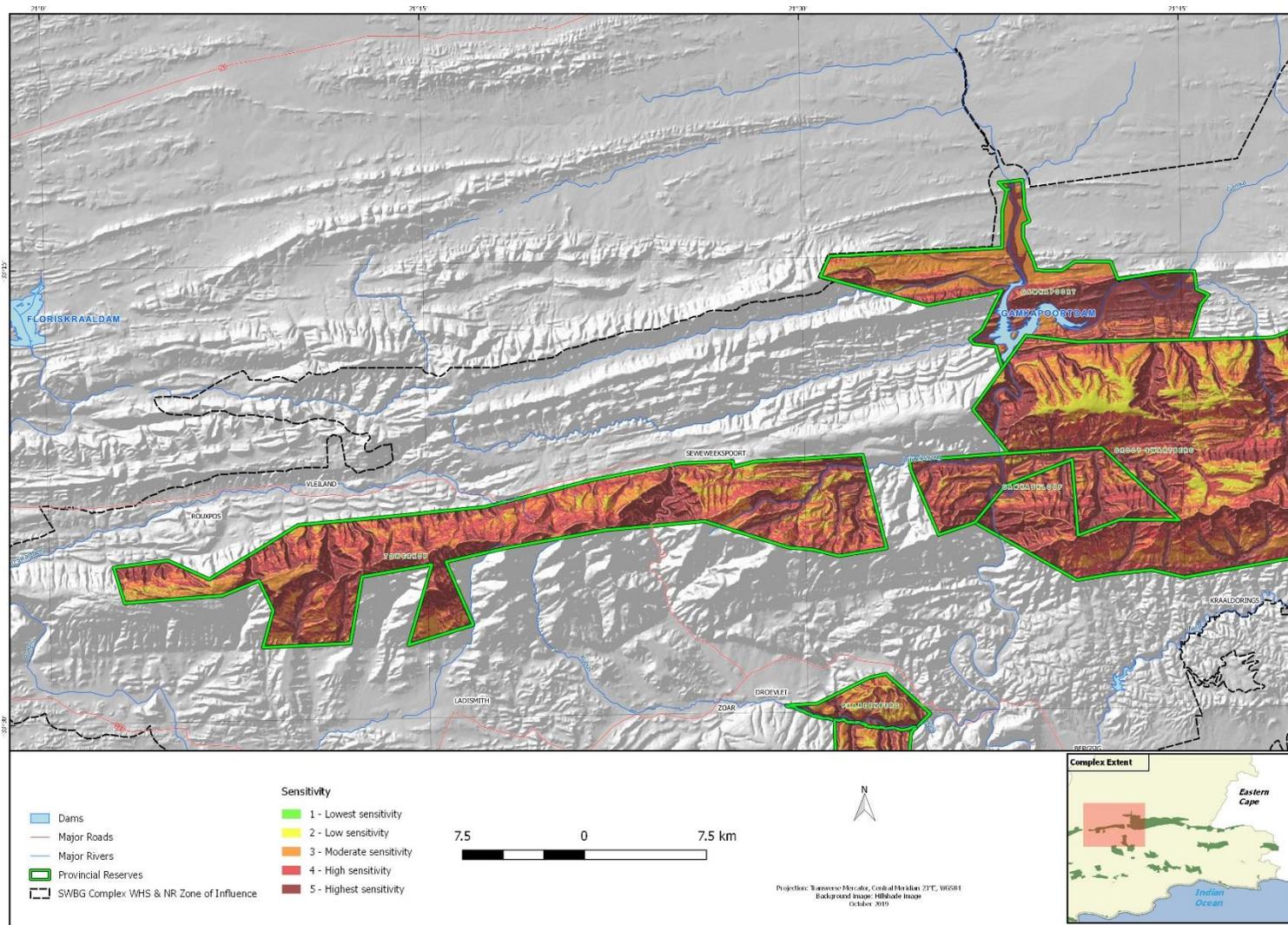
Map 10c: National Freshwater Ecosystem Priority and High Water Yield Areas of the Swartberg East and Kammanassie. Springs that are being monitored in and adjacent to the Kammanassie, as well as the location of boreholes and pumpstations of the KKRWSS are shown.



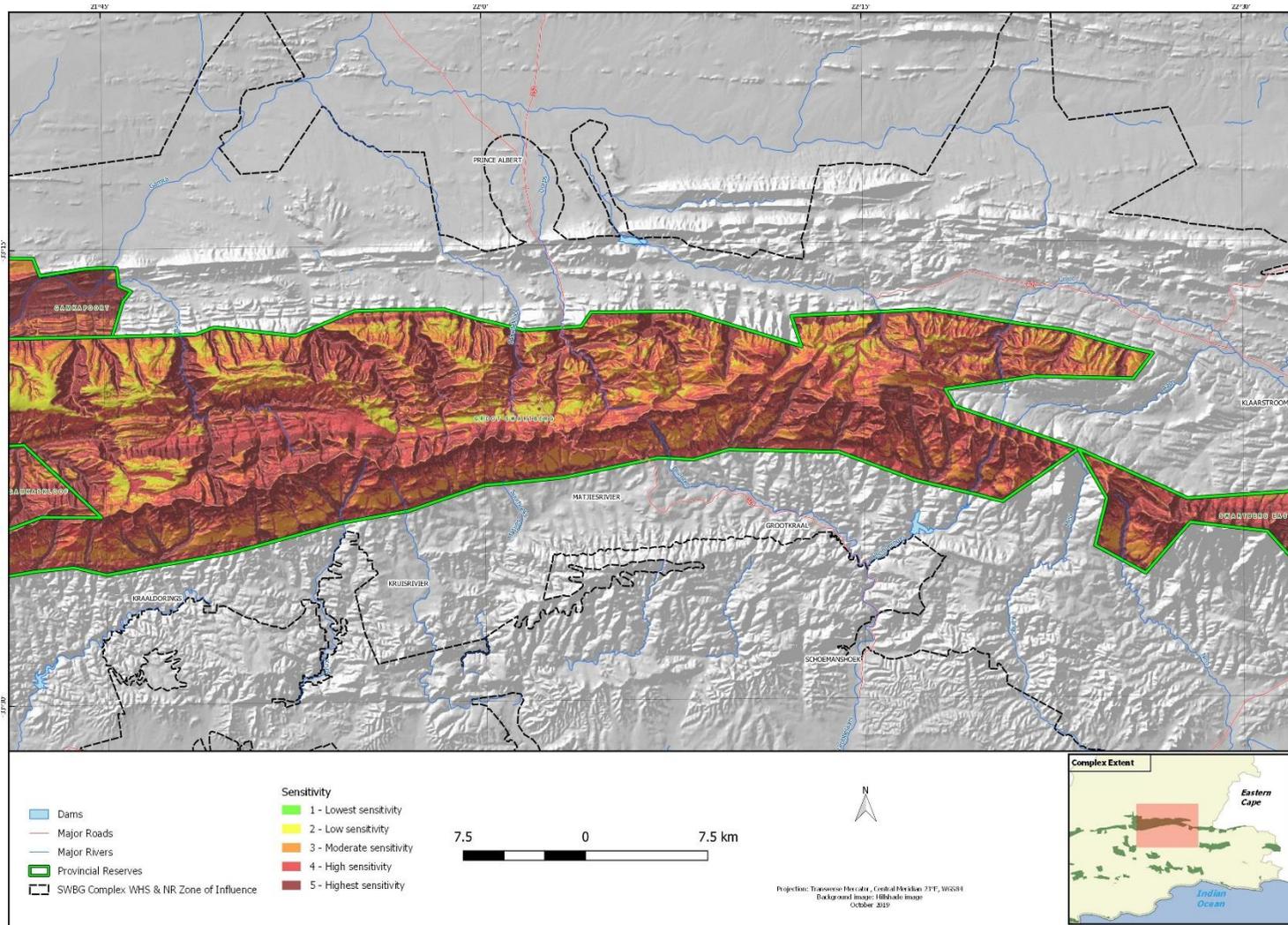
Map 10d: National Freshwater Ecosystem Priority and High Water Yield Areas of the the Gamkaberg Cluster.



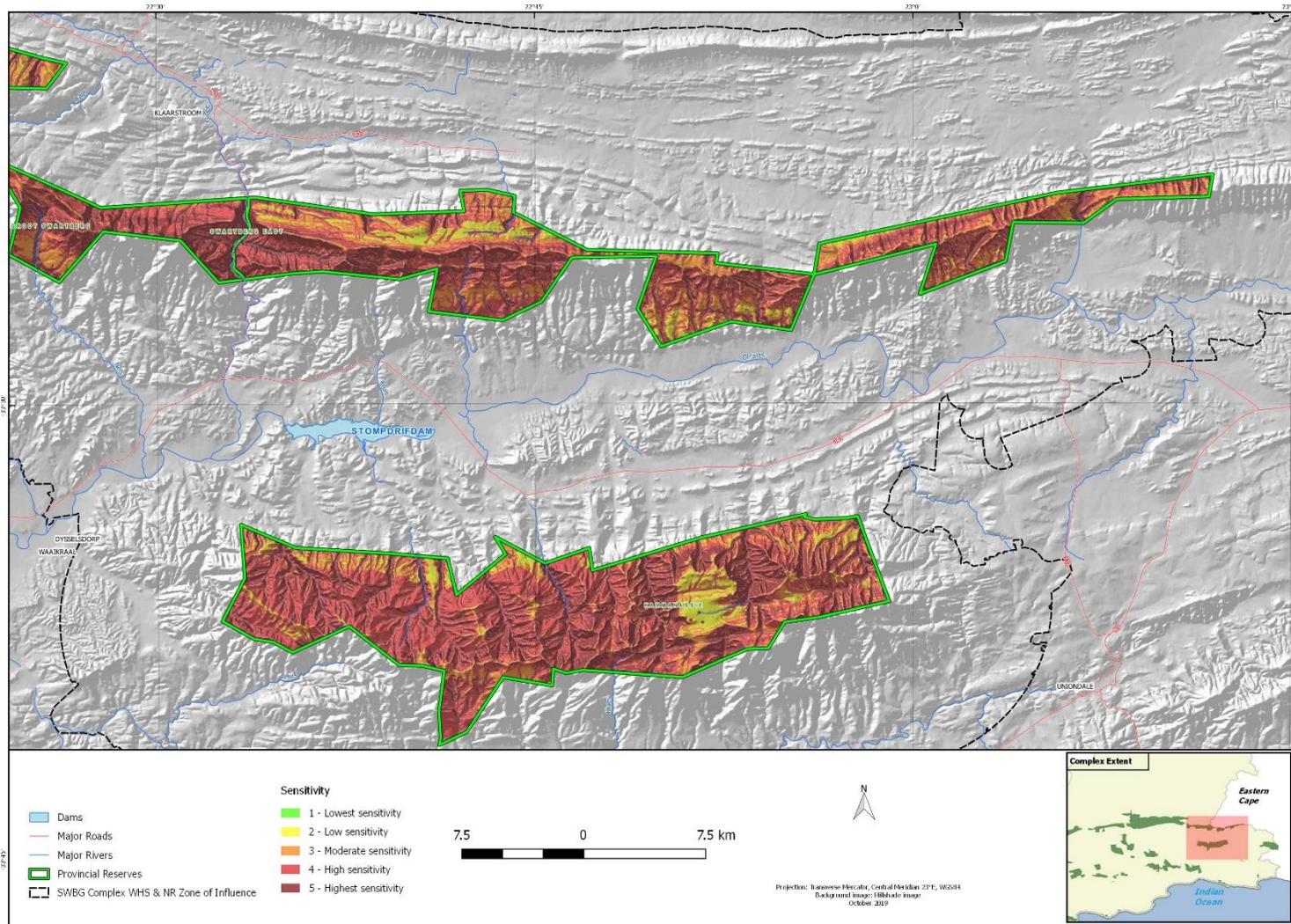
Map 11: Existing game farms adjacent to and within the zone of influence of the Swartberg Complex World Heritage Site and Nature Reserves.



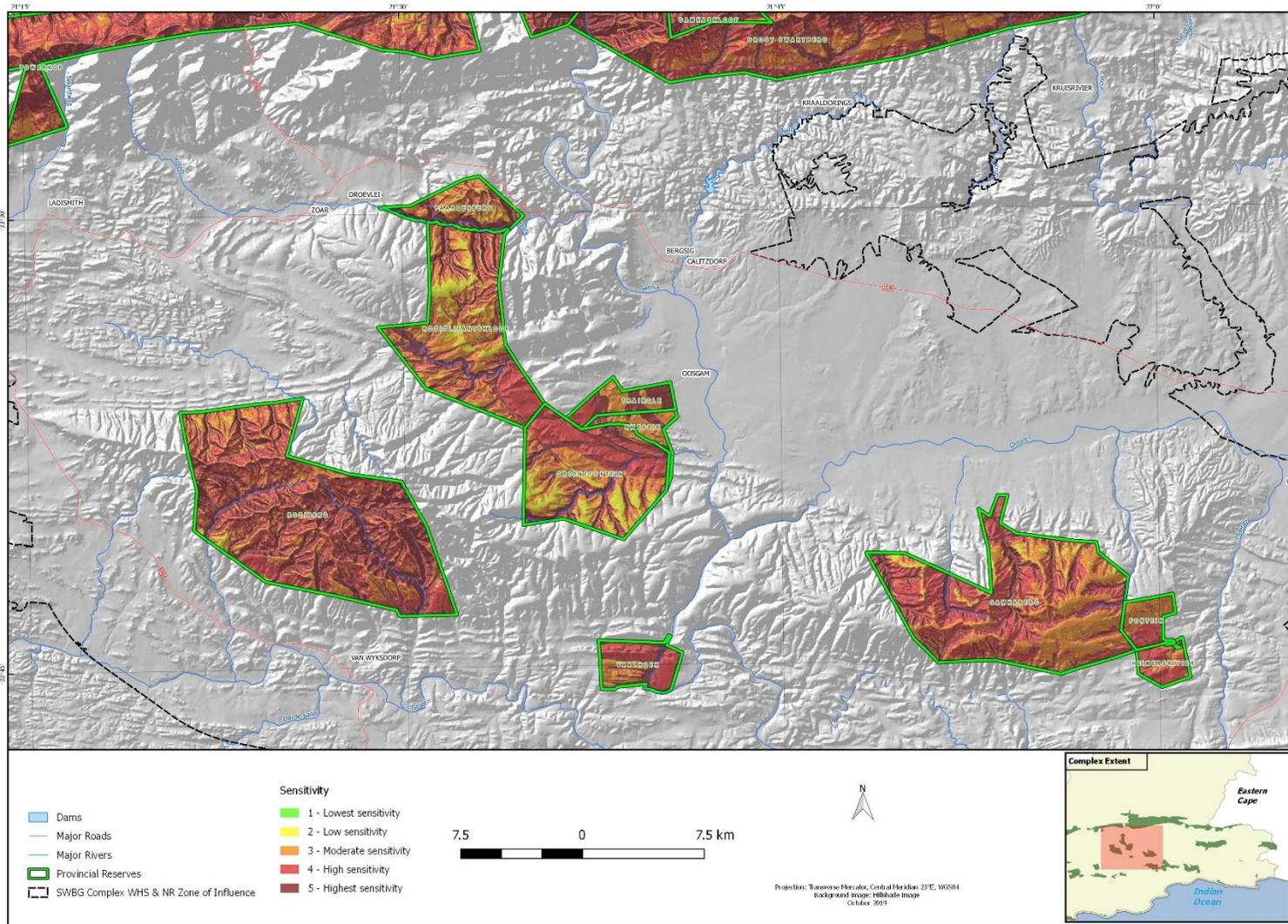
Map 12a: Sensitivity of Towerkop, Gamkapoort and the western section of Groot Swartberg.



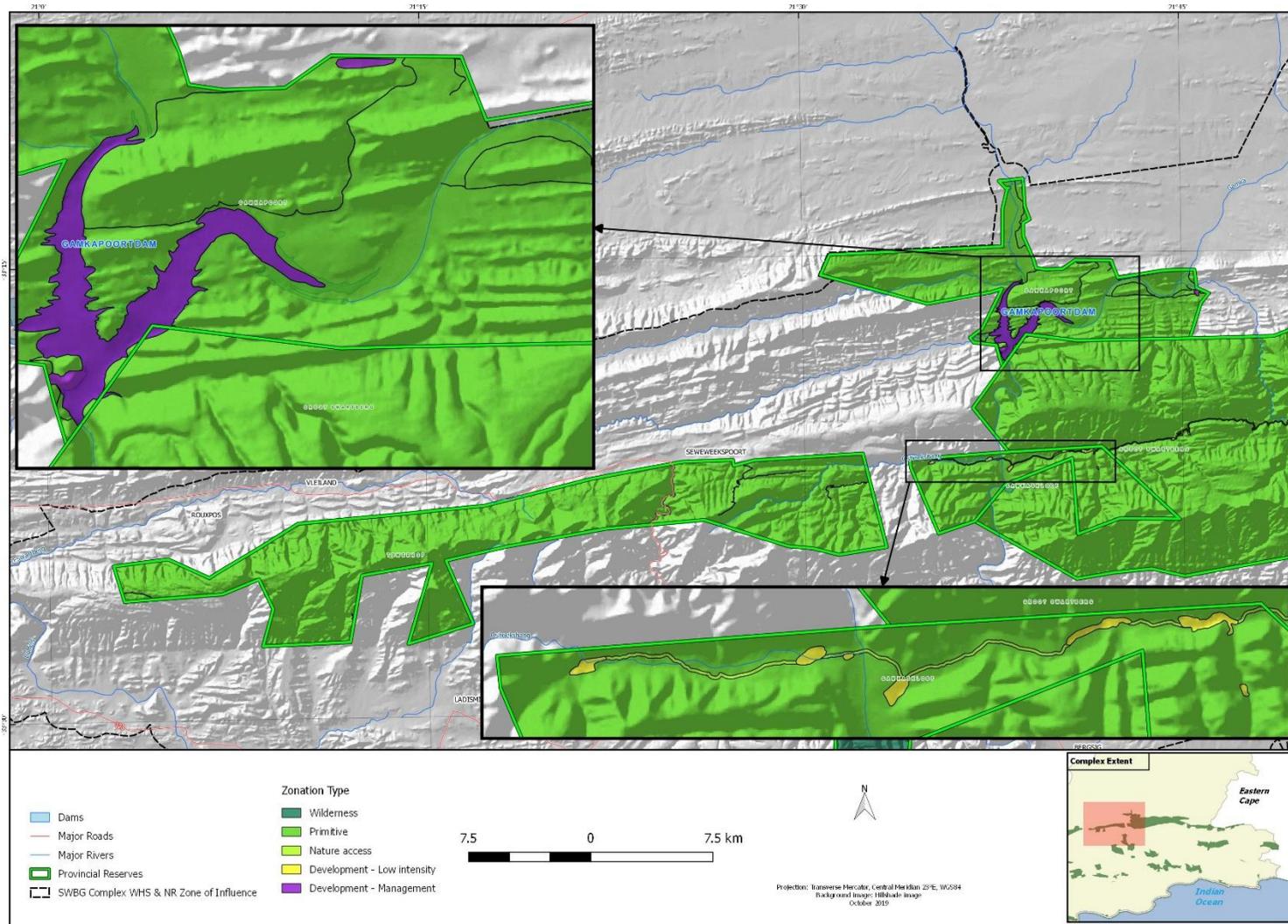
Map 12b: Sensitivity of the central part of Groot Swartberg.



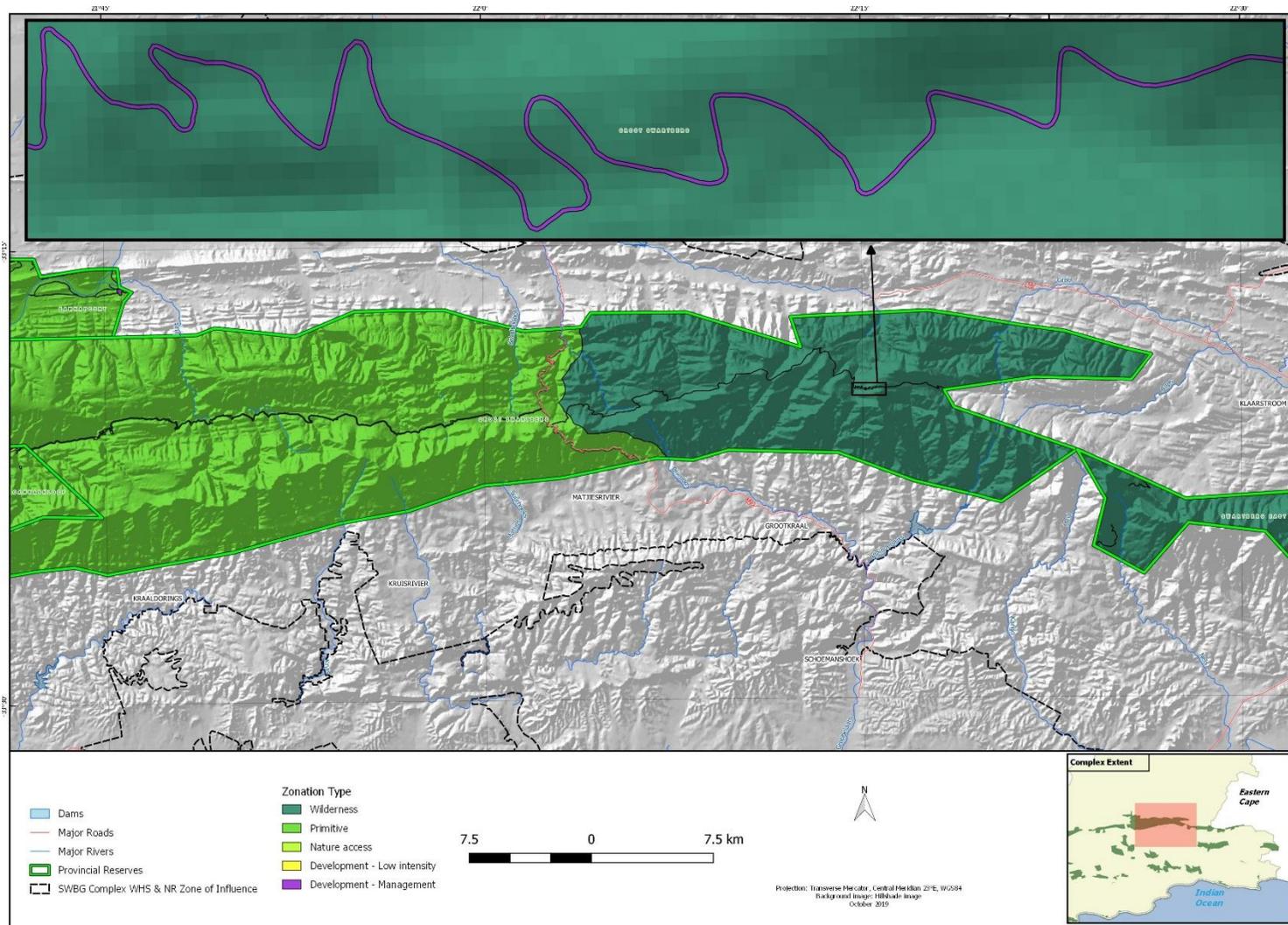
Map 12c: Sensitivity of Swartberg East and Kammanassie.



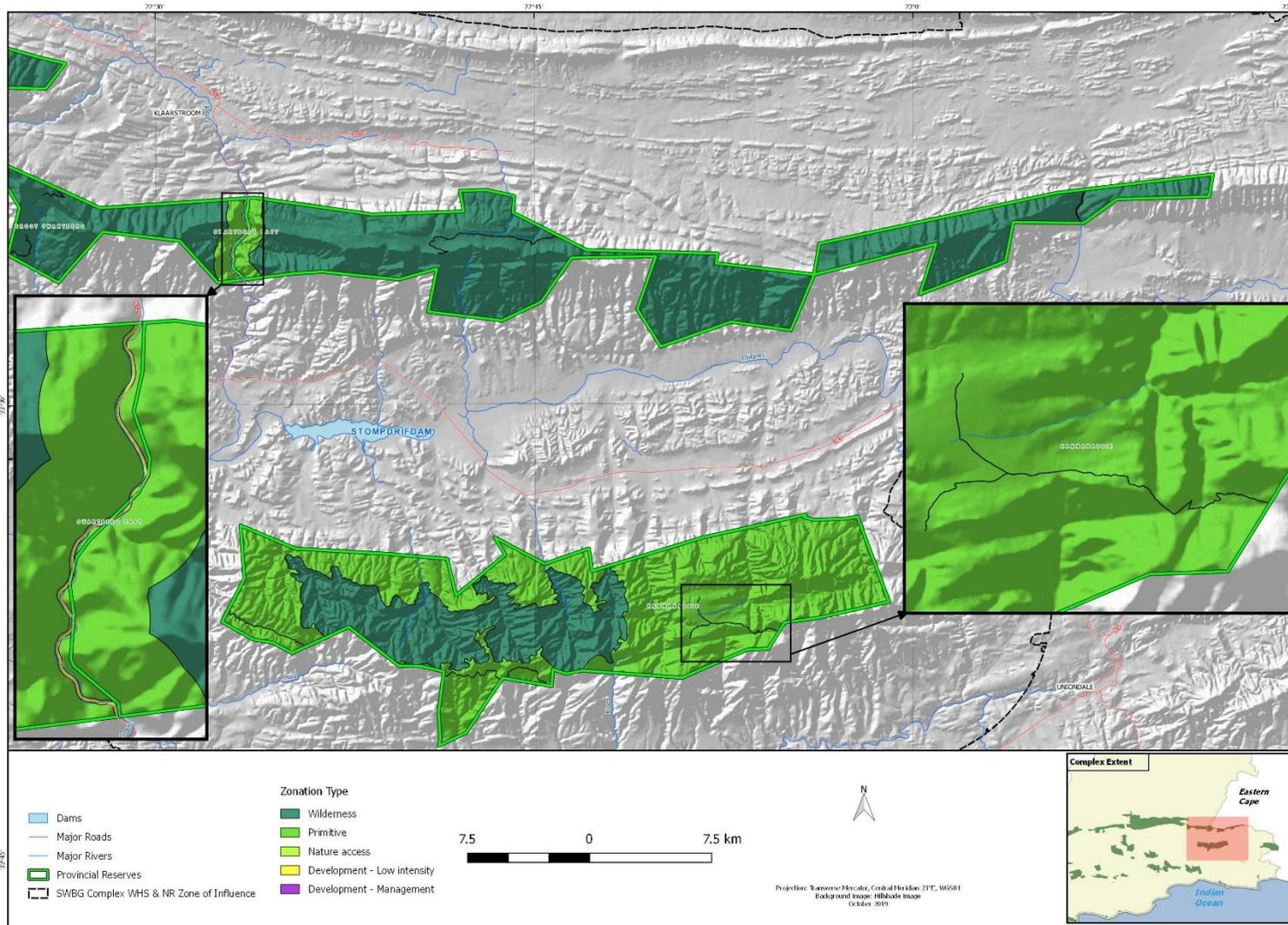
Map 12d: Sensitivity of the Gamkaberg Cluster.



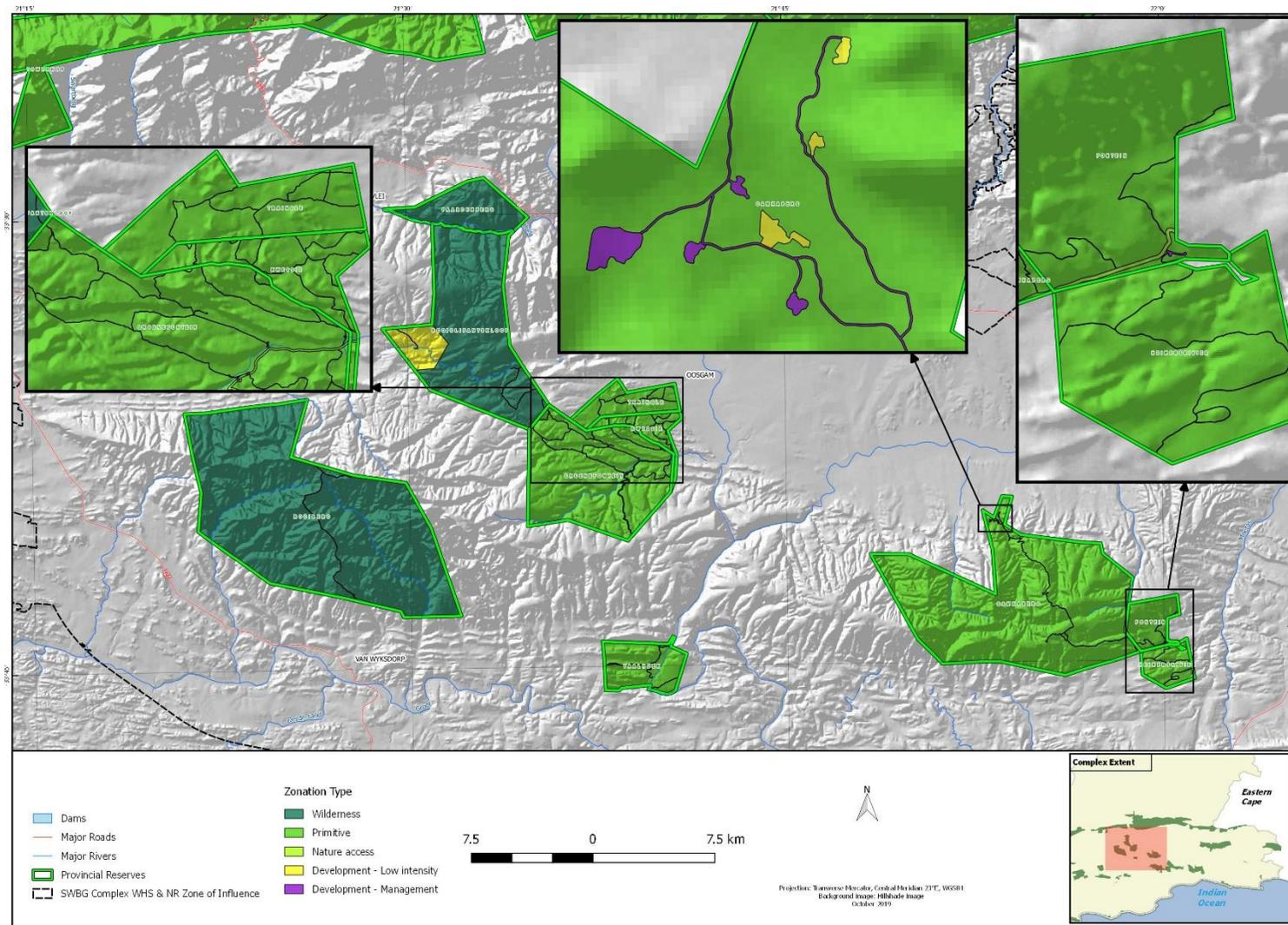
Map 13a: Zonation of Towerkop, Gamkaskloof, Gamkapoort and the western section of Groot Swartberg.



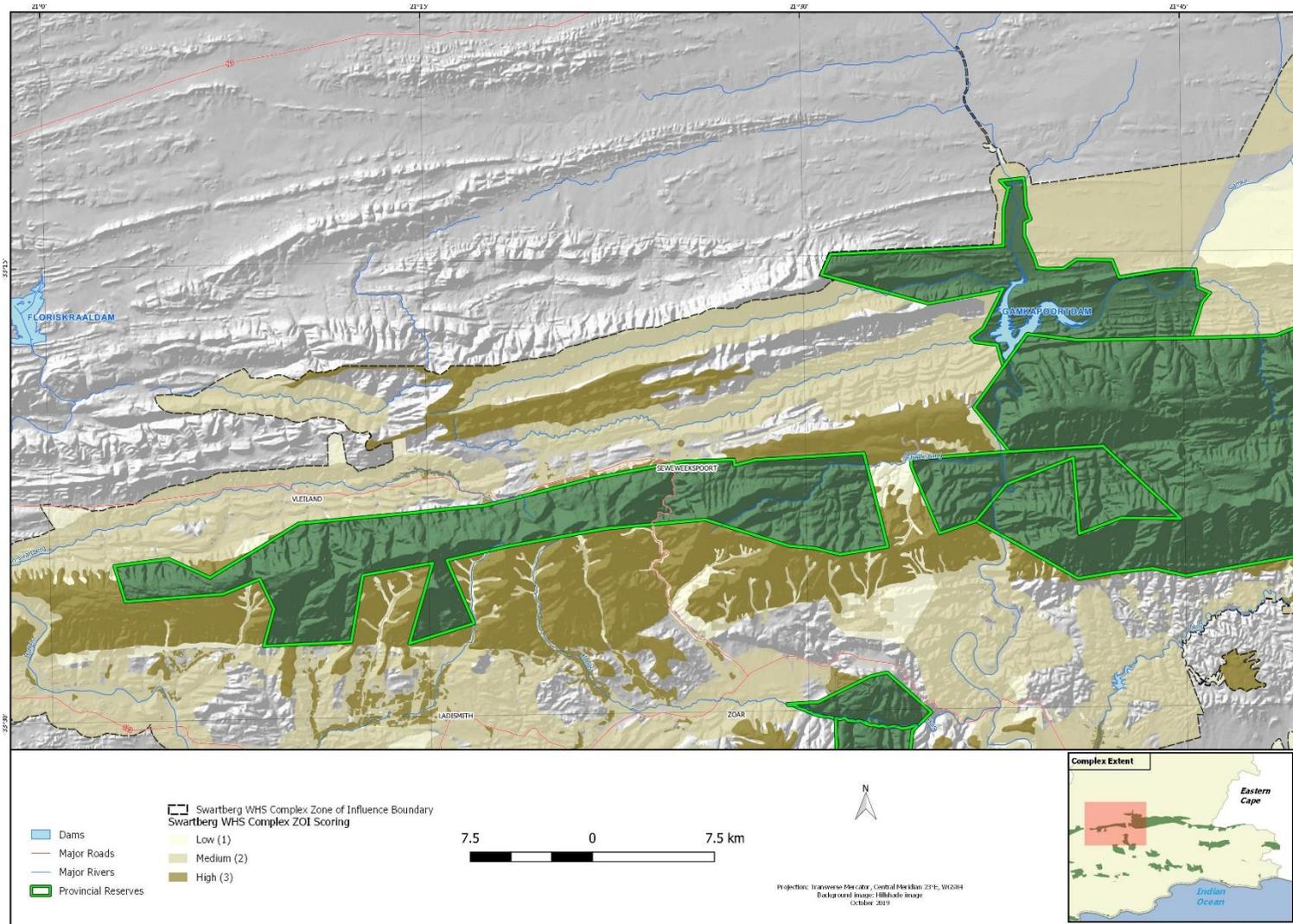
Map 13b: Zonation of the central part of Groot Swartberg.



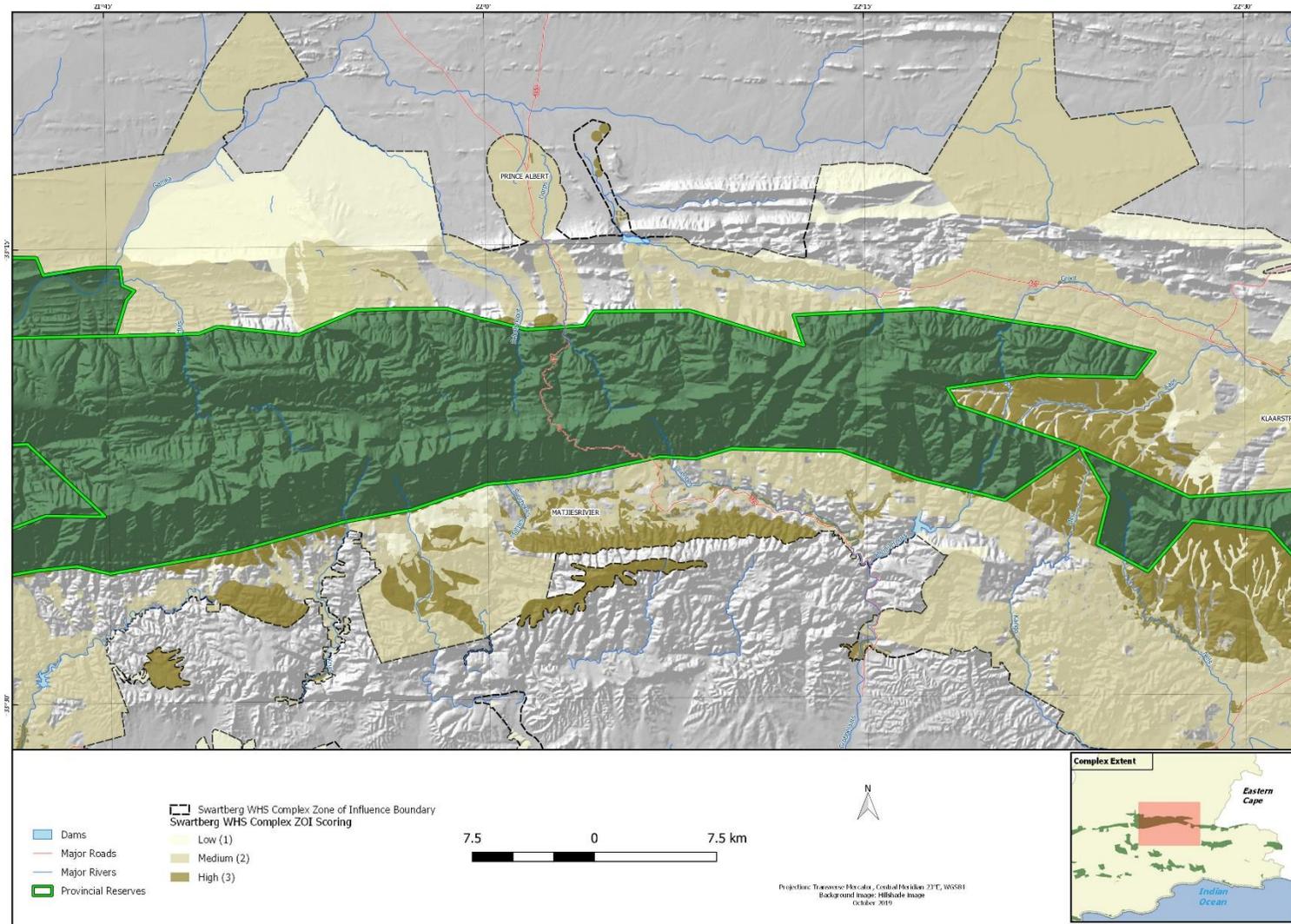
Map 13c: Zonation of Swartberg East and Kammanassie.



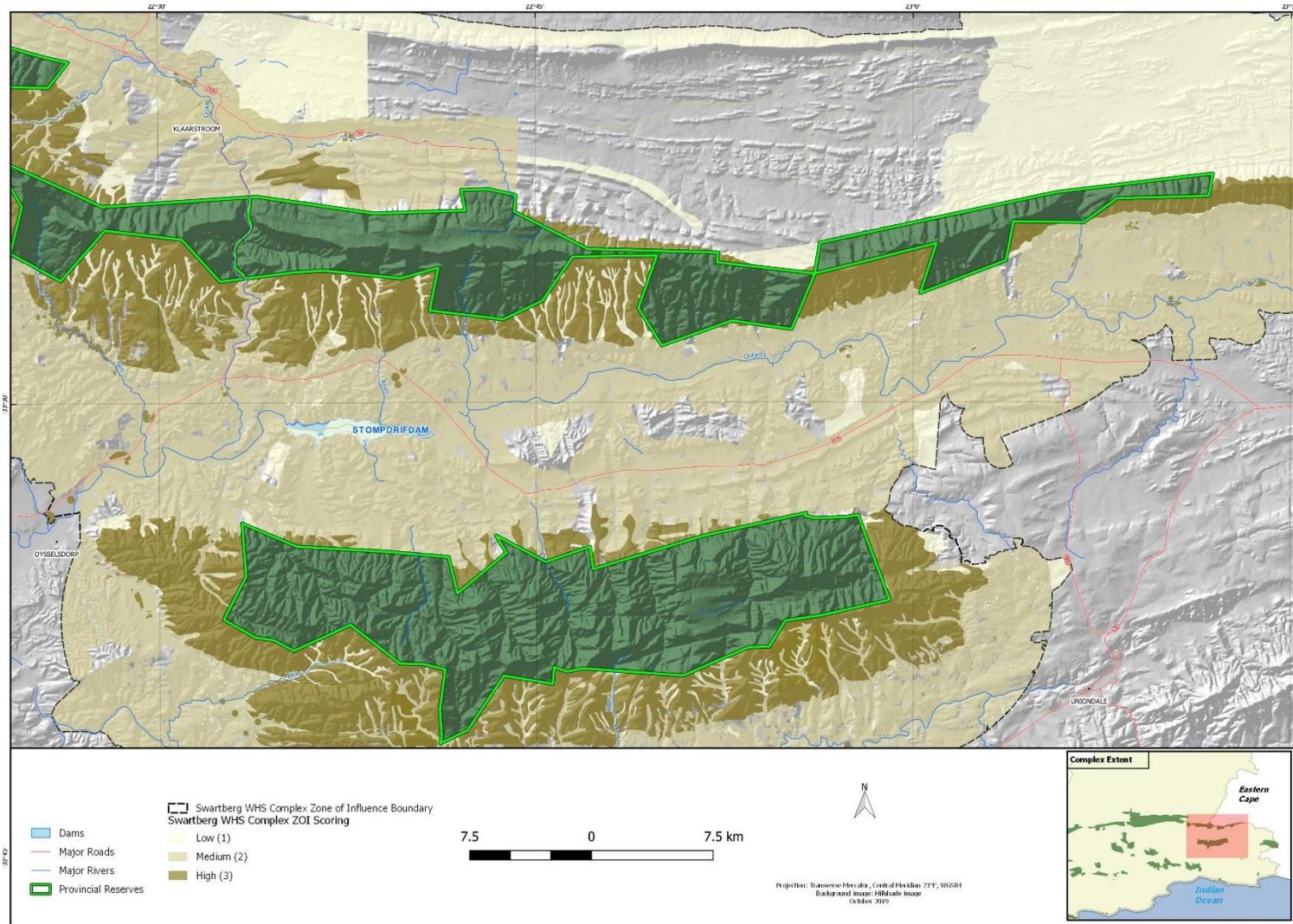
Map 13d: Zonation of the Gamkaberg Cluster.



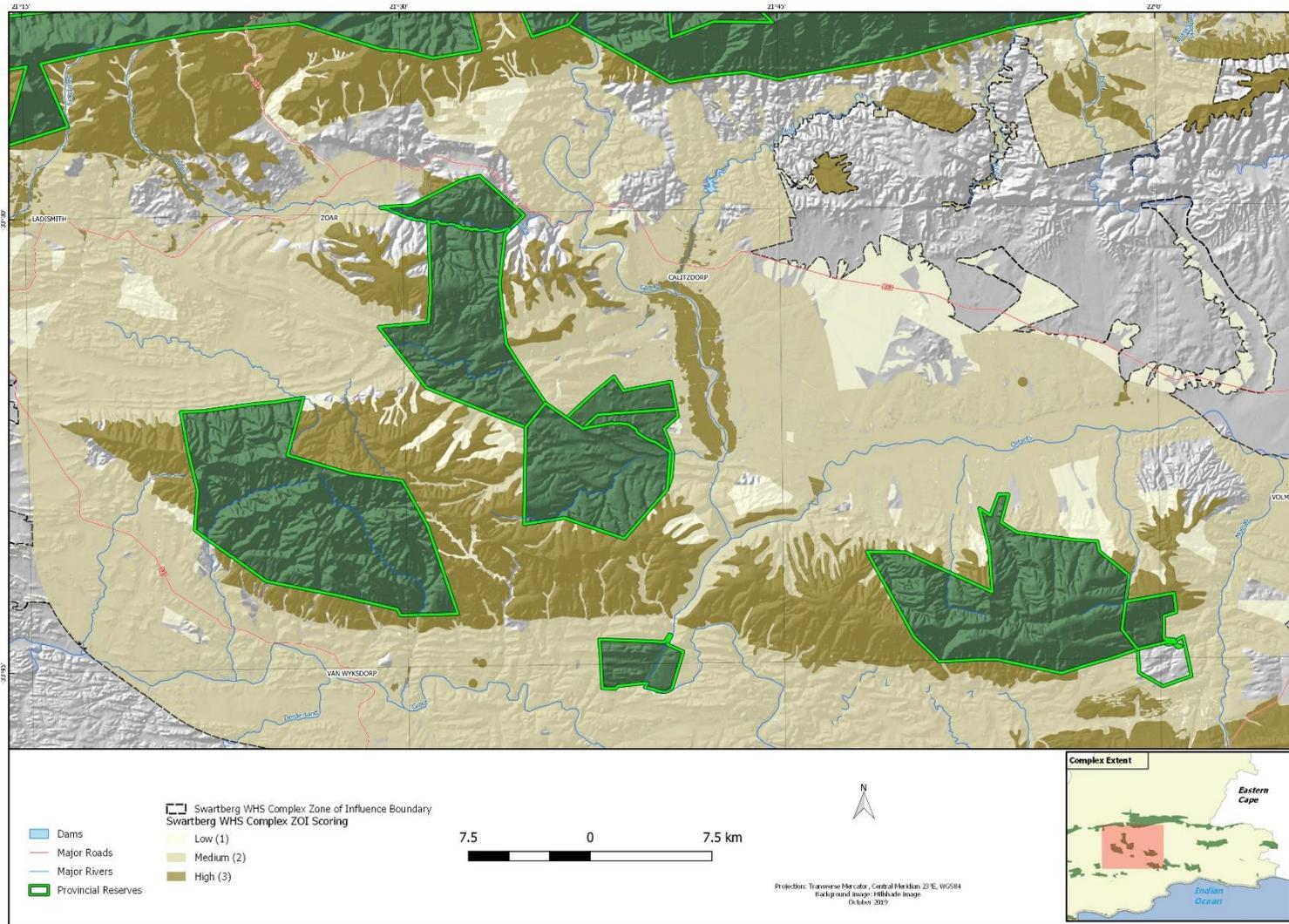
Map 14a: Zone of influence around Towerkop, Gamkapoort and the western section of Groot Swartberg.



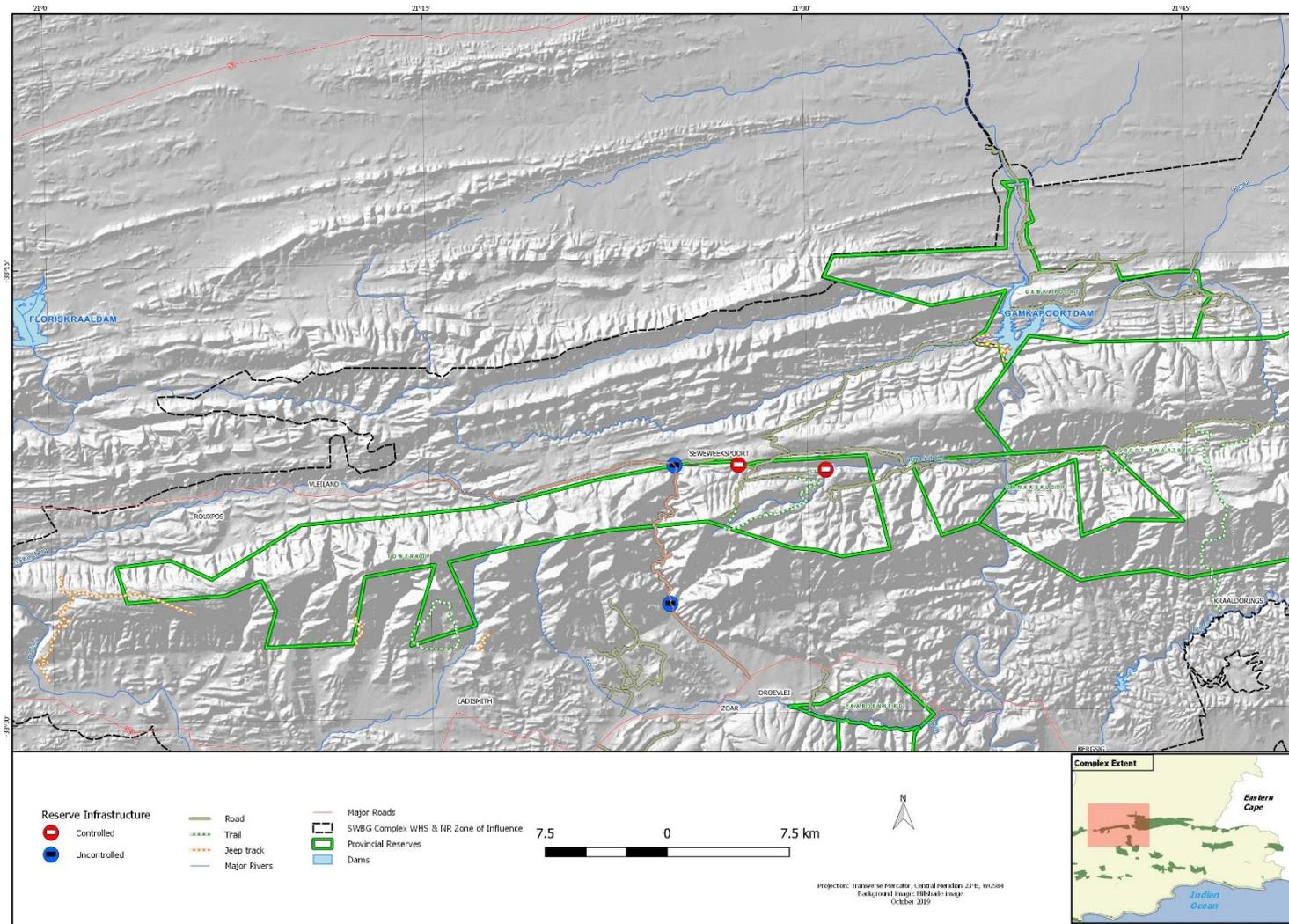
Map 14b: Zone of influence around the central part of Groot Swartberg.



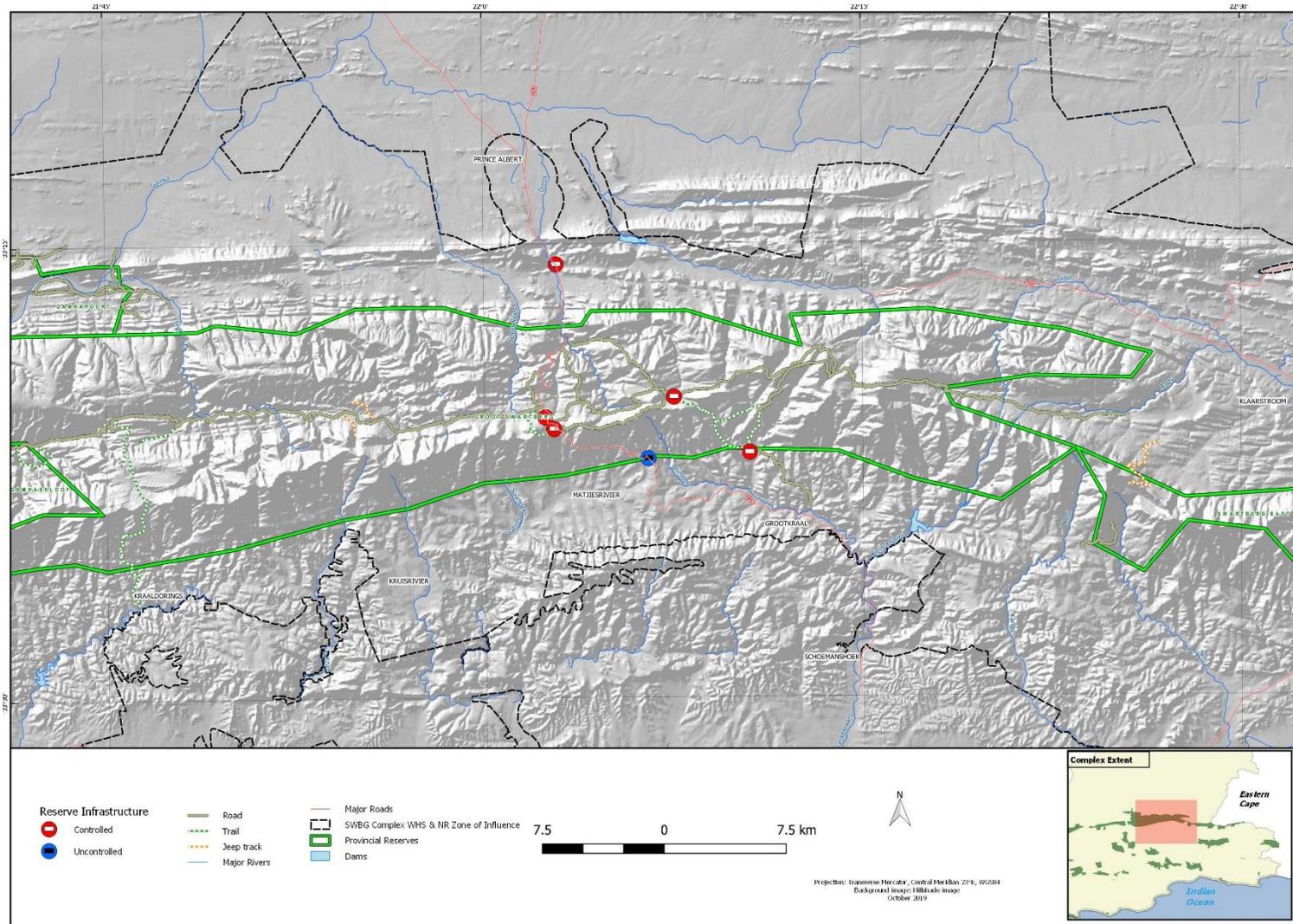
Map 14c: Zone of influence around Swartberg East and Kammanassie.



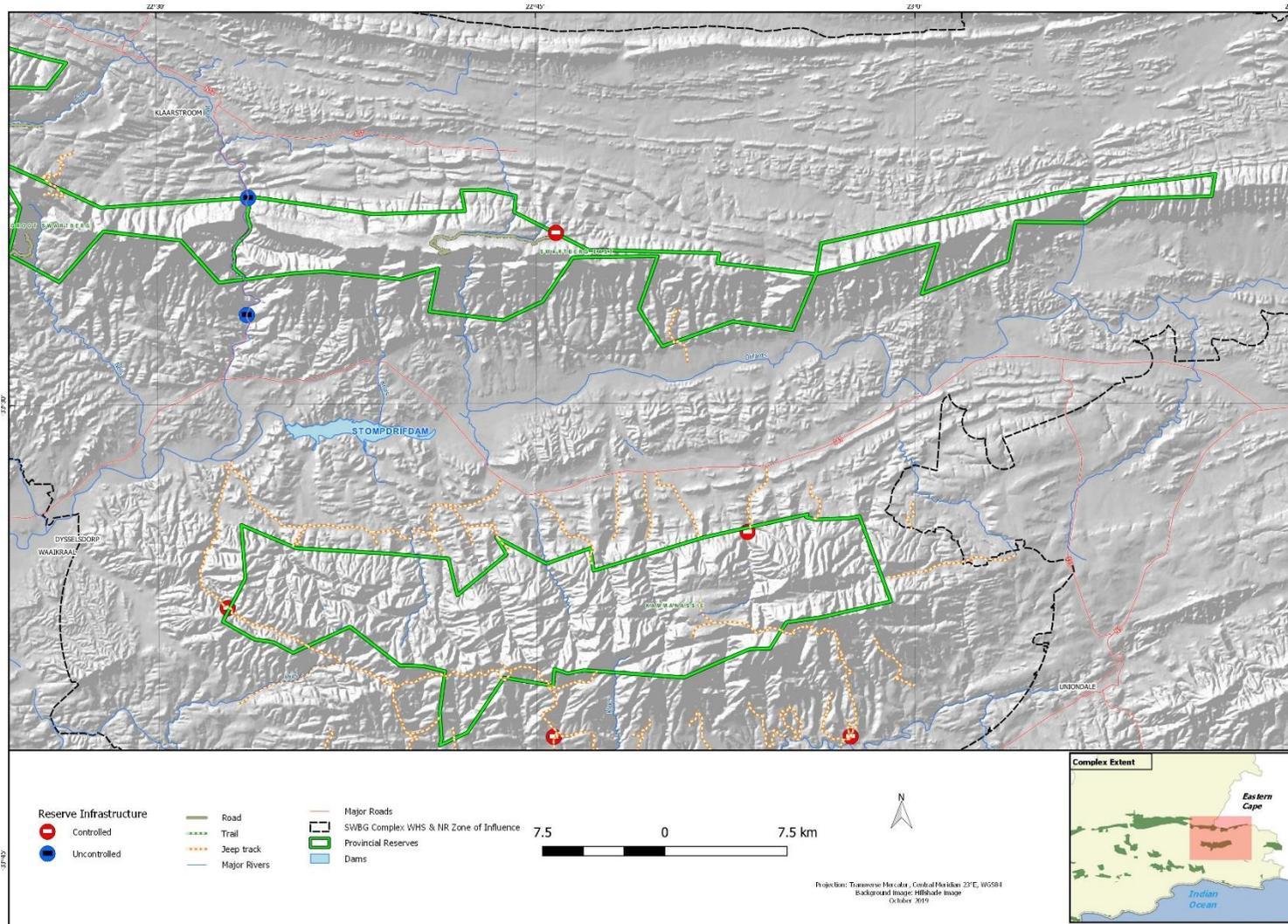
Map 14d: Zone of influence around the Gamkaberg Cluster.



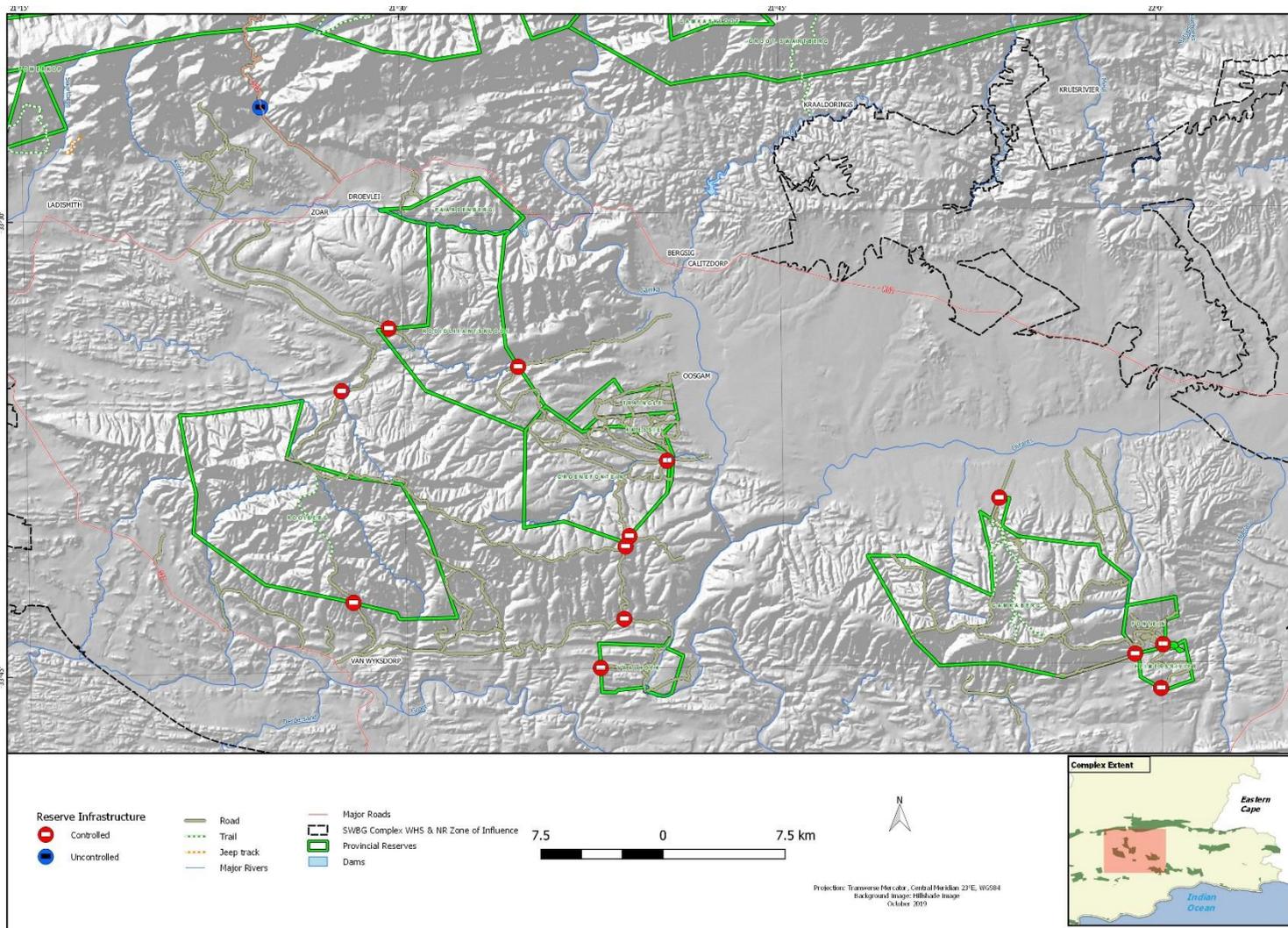
Map 15a: Access points on Towerkop, Gamkapoort and the western section of Groot Swartberg.



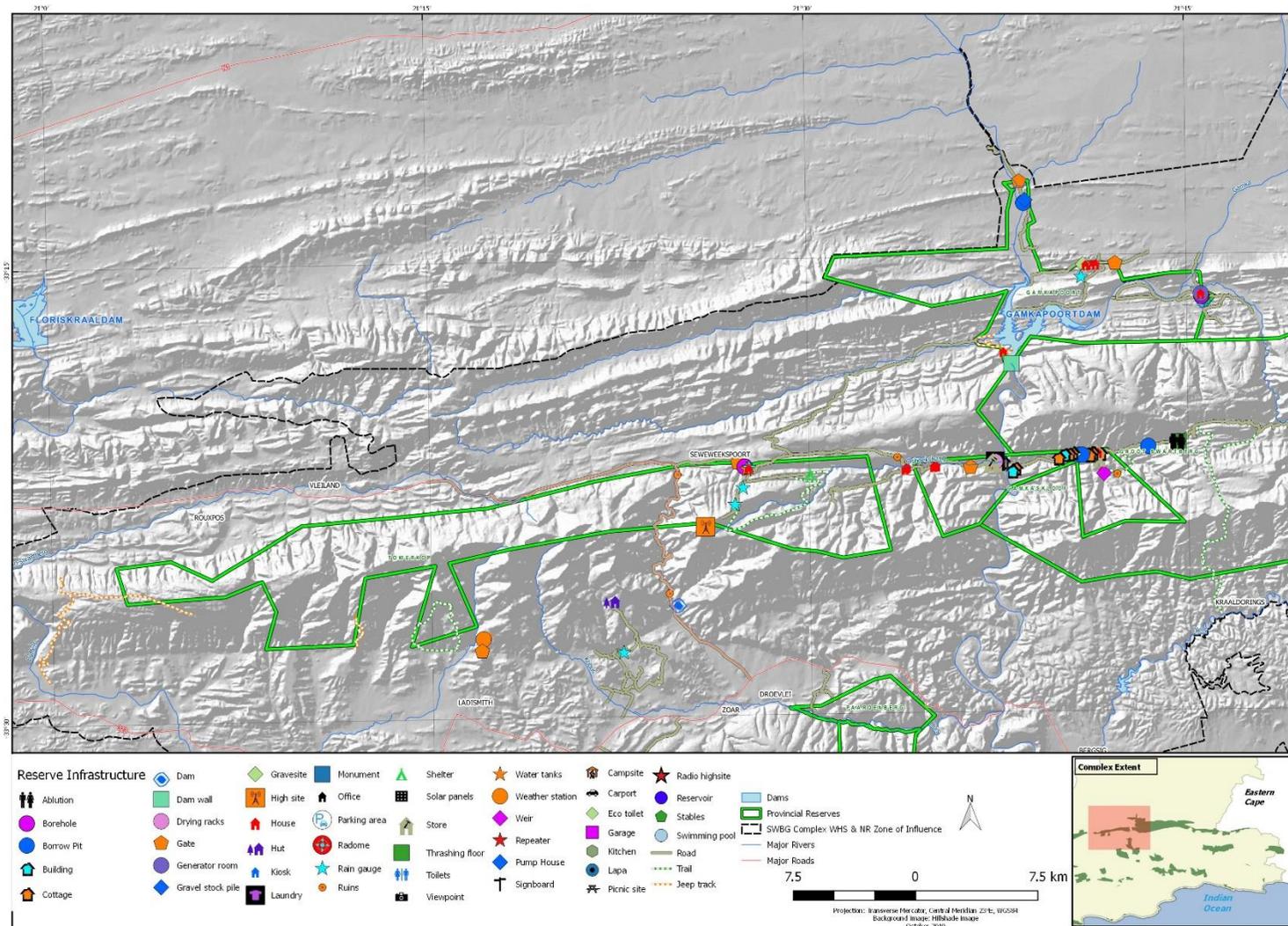
Map 15b: Access points on the central part of Groot Swartberg.



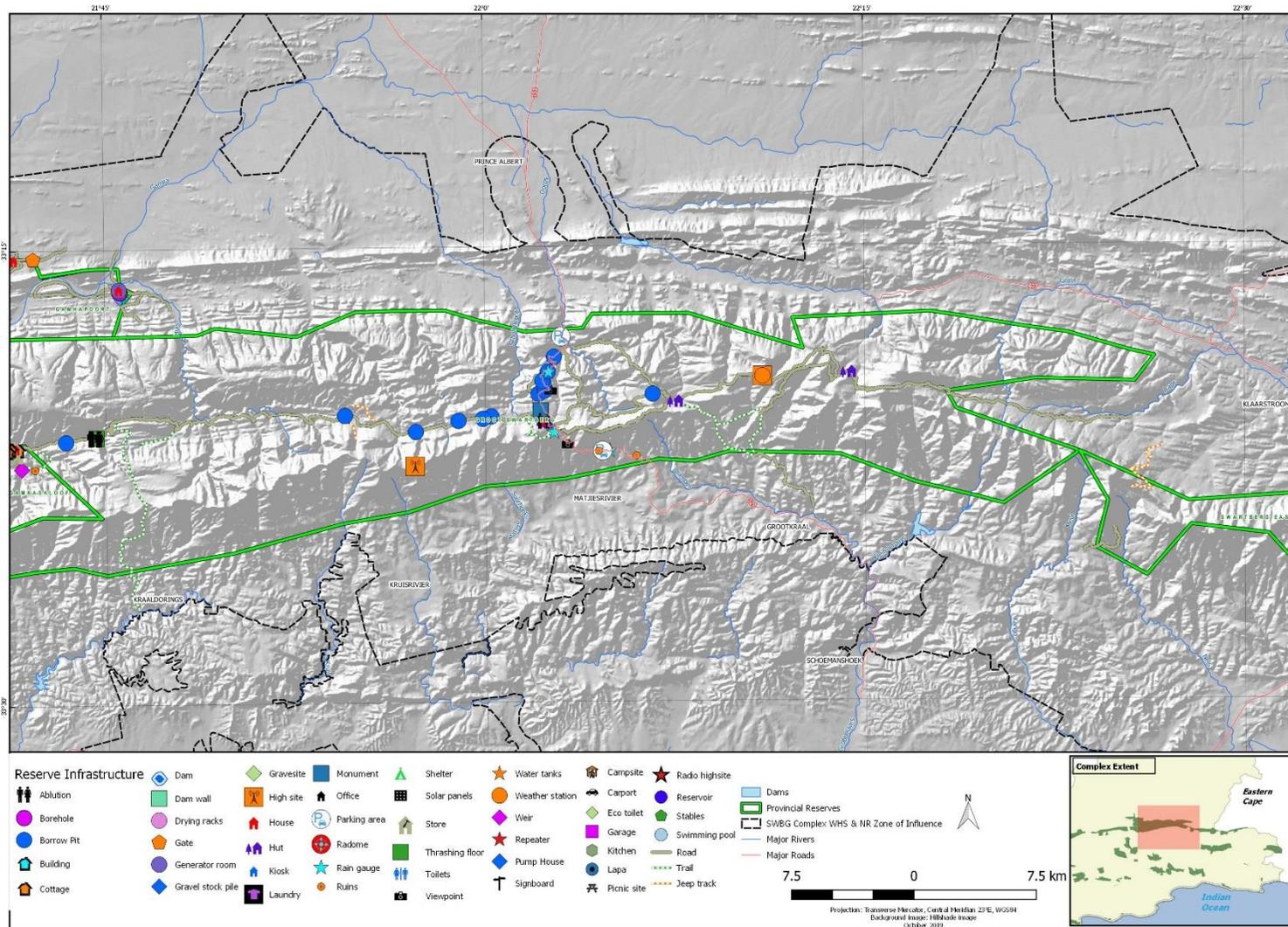
Map 15c: Access points on Swartberg East and Kammanassie.



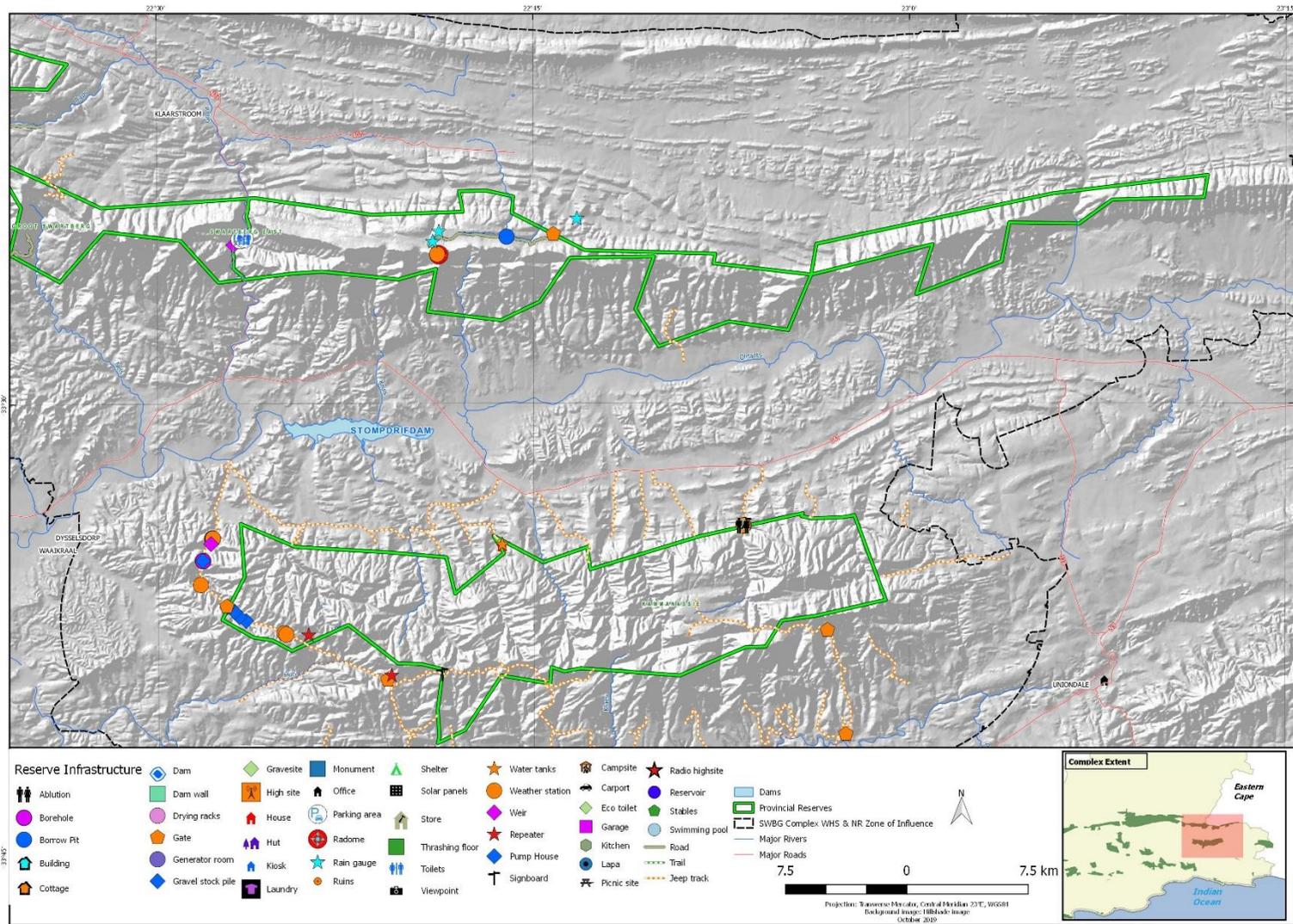
Map 15d: Access points on the Gamkaberg Cluster.



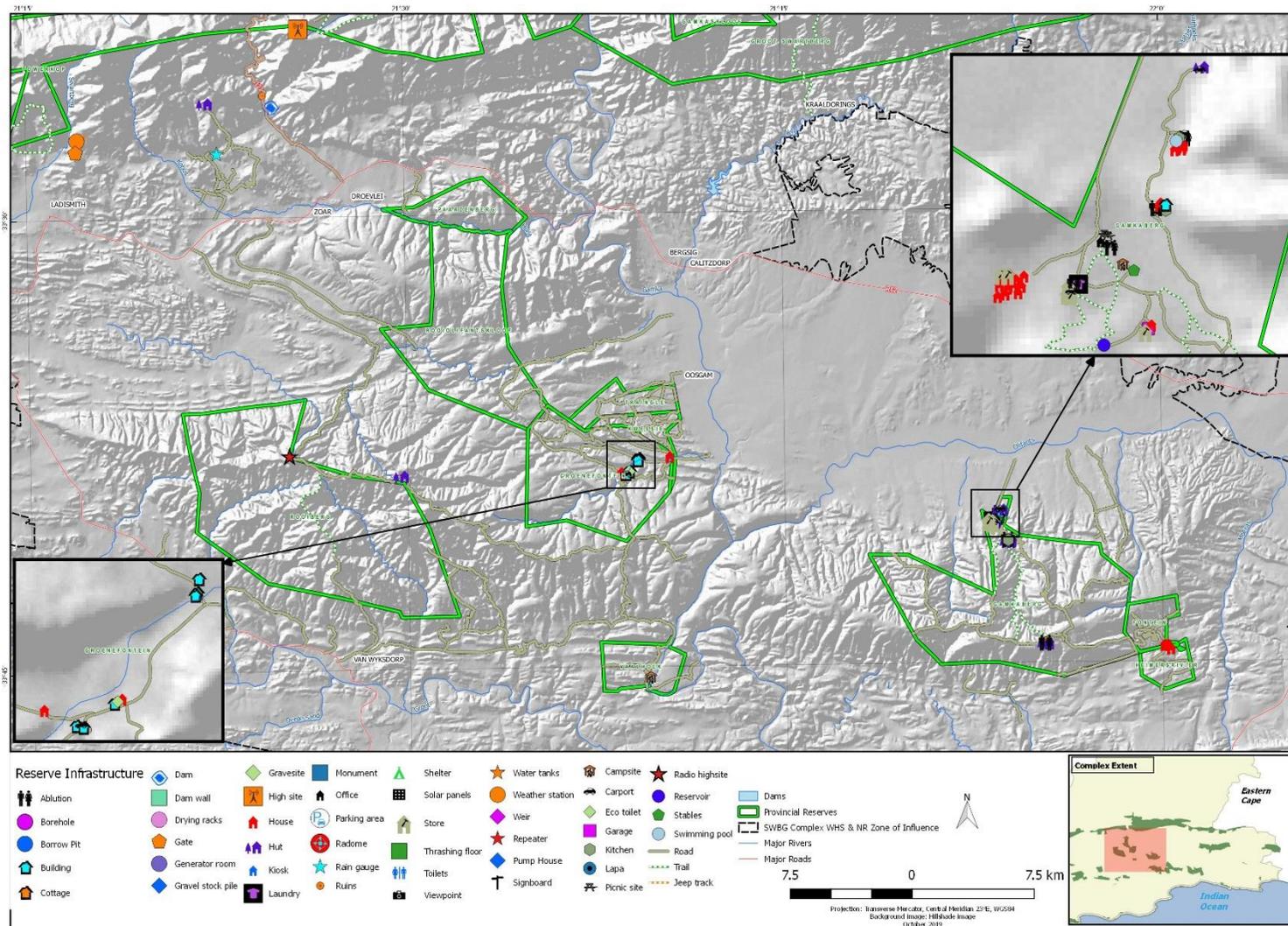
Map 16a: Infrastructure on Towerkop, Gamkaskloof, Gamkapoort and the western section of Groot Swartberg.



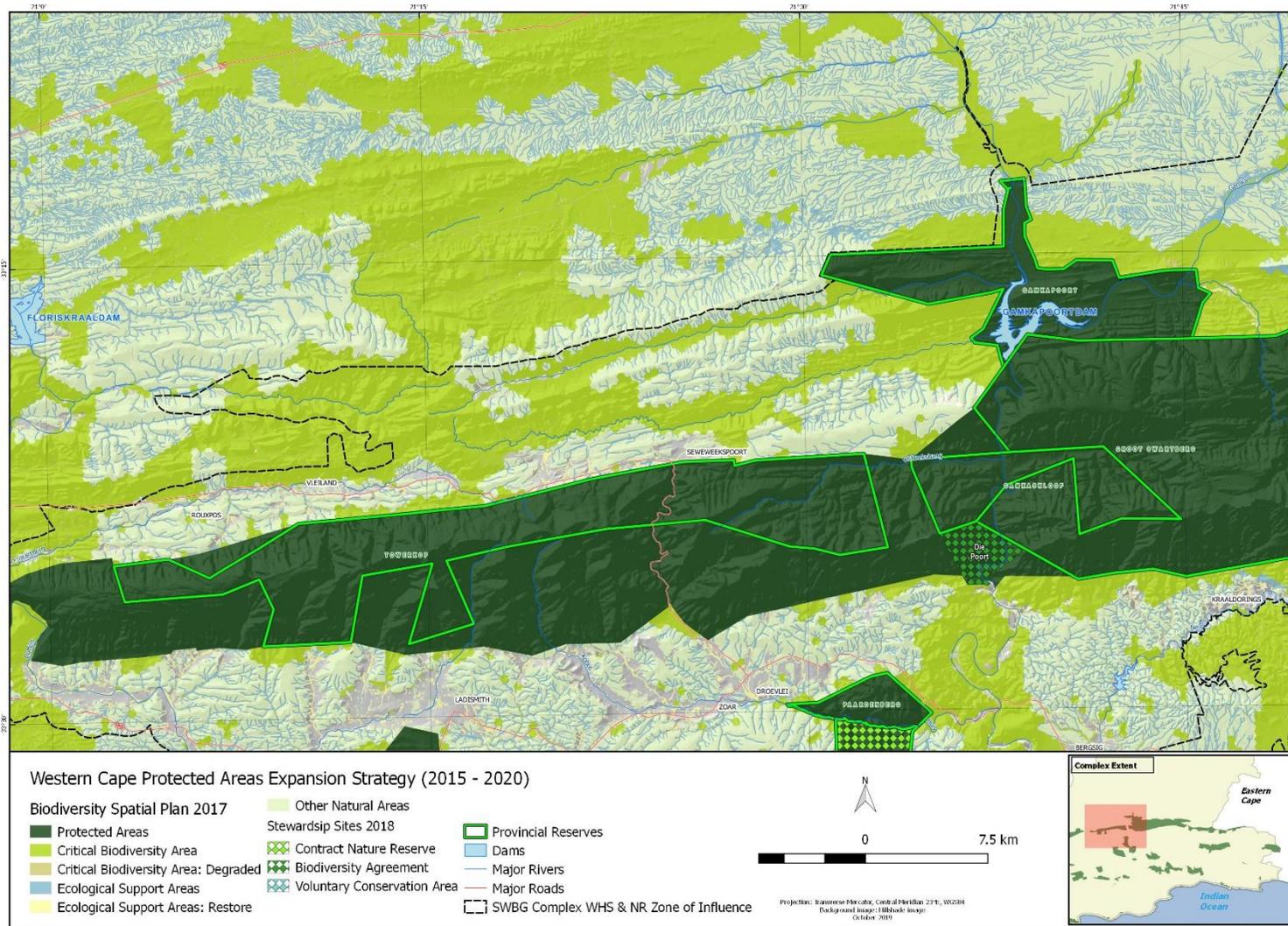
Map 16b: Infrastructure on the central part of Groot Swartberg.



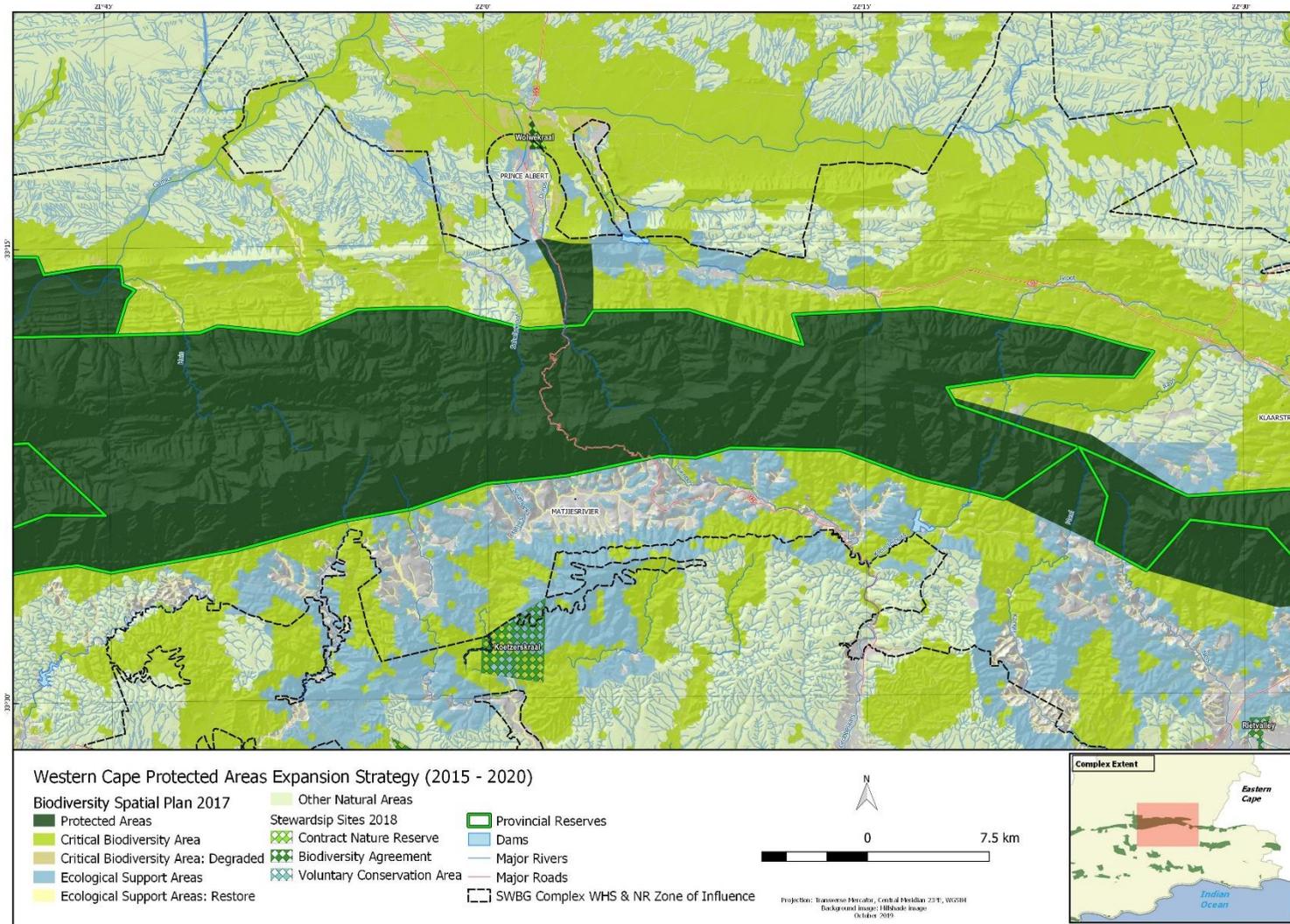
Map 16c: Infrastructure on Swartberg East and Kammanassie.



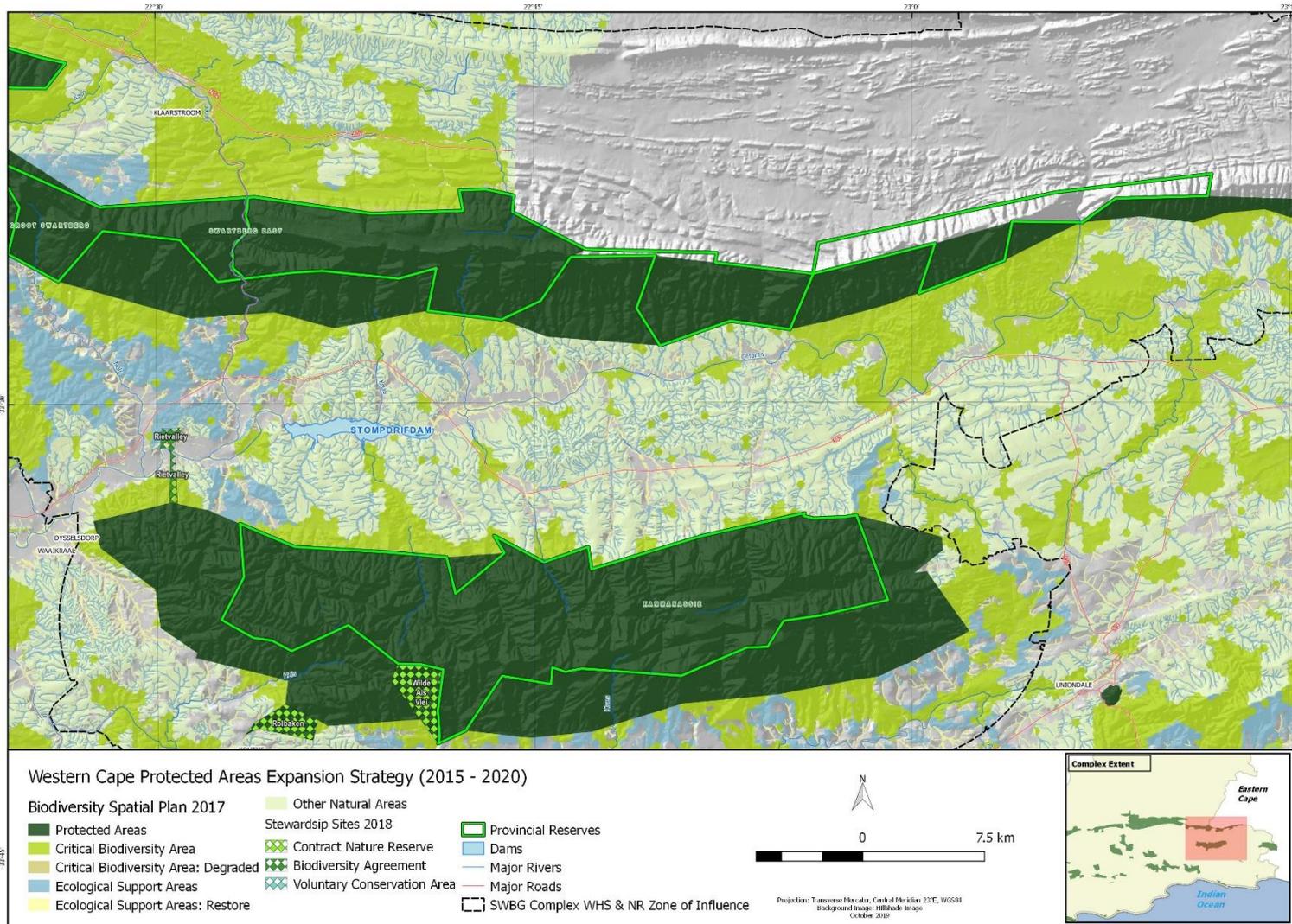
Map 16d: Infrastructure on the Gamkaberg Cluster.



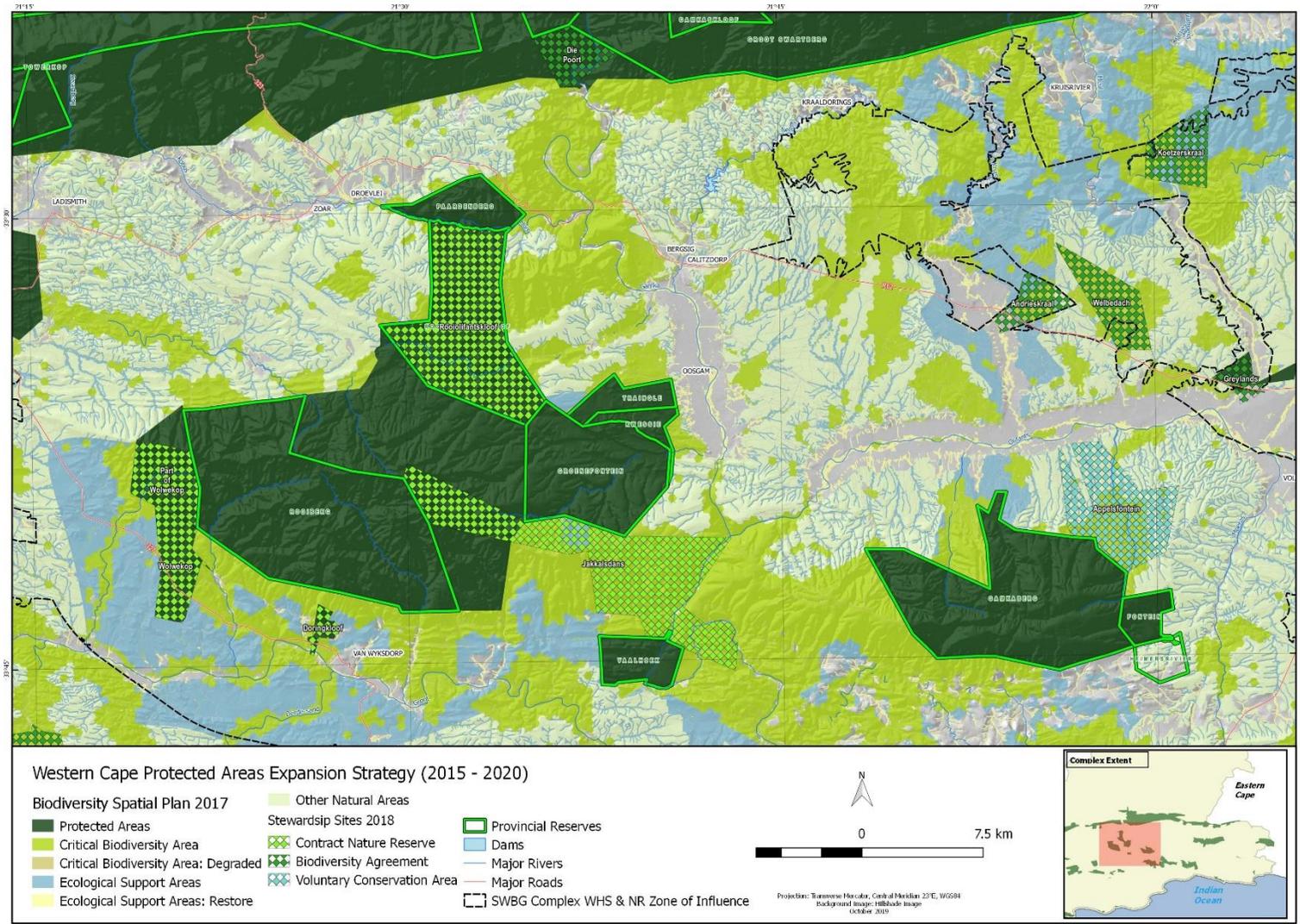
Map 17a: Expansion of Towerkop, Gamkapoort and the western section of Groot Swartberg.



Map 17b: Expansion of the central part of Groot Swartberg.



Map 17c: Expansion of Swartberg East and Kammanassie.



Map 17d: Expansion of the Gamkaberg Cluster.

APPENDIX 3: Stakeholder Engagement Report for the Swartberg Complex World Heritage Site and Nature Reserves.

STAKEHOLDER ENGAGEMENT REPORT SWARTBERG COMPLEX WORLD HERITAGE SITE AND NATURE RESERVES



SWARTBERG COMPLEX WORLD HERITAGE SITE AND NATURE RESERVES

Western Cape, South Africa

STAKEHOLDER ENGAGEMENT PROCESS REPORT

COMPILED BY FOOTPRINT ENVIRONMENTAL SERVICES

DATE: JANUARY 2020

