BOLAND MOUNTAIN COMPLEX

PART OF THE
CAPE FLORAL REGION PROTECTED AREAS
WORLD HERITAGE SITE
Western Cape, South Africa

Protected Area Management Plan
2019 – 2029

DATE APPROVED: [Date]
MOST RECENT UPDATE: 13 November 2018

CapeNature

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CITATION
CapeNature. 2019. Boland Mountain Complex: Protected Area Management Plan 2019-2029. Internal Report, CapeNature. Cape Town..

The Boland Mountain Complex comprises the following:

Provincial Nature Reserves:
Assegaaibosch Provincial Nature Reserve: The reserve was established in terms of section 6 of the Nature Conservation Ordinance, 1974, on 12 April 1994 and proclaimed in the Provincial Gazette of May 1994 by Proclamation No. 37/1994.

Rooisand Provincial Nature Reserve: The reserve was established in terms of Section 6 of the Nature Conservation Ordinance, 1974, on 25 October 2002 and proclaimed in the Provincial Gazette of 20 November 2002 by Proclamation No. 21/2002.

Brodie Link Provincial Nature Reserve: This reserve was established in terms of Section 6 of the Nature Conservation Ordinance, 1974, on 20 February 2002 and proclaimed in the Provincial Gazette of 15 March 2002 by Proclamation No. 5/2002.

Voëlvlei Provincial Nature Reserve: This reserve was established in terms of Section 6 of the Nature Conservation Ordinance 1974 in April 1994 and proclaimed in the Provincial Gazette by Proclamation No. 37/1994.

Forest Act Nature Reserves:
Hottentots-Holland Nature Reserve (including Jonkershoek): This reserve was proclaimed a Forest Nature Reserve in March 1979 in Government Gazette No. 6348. These portions were demarcated as State Forest under the Forest Act, No. 122 of 1984, but have been released from demarcation in terms of government notice 596 of 2006 and need to be proclaimed a protected area in terms of the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEM: PAA).

State President's Proclamation No.97 of 1992, in Government, assigned legal responsibility for these areas to the Administrator of the Cape. Gazette No. 14246 of 21 August 1992.

Ex-State Forests (previously declared State Forest but now released):
Kogelberg State Forest: This reserve was demarcated as State Forest in terms of the Forest Act, (Act No. 122 of 1984) but released in terms of Government Notice No. 1388 dated 17 June 2005.

Hawequas State Forest (Limietberg Nature Reserve): This reserve was demarcated as State Forest in terms of the Forest Act, (Act No. 122 of 1984) but released in terms of Government Notice No. 1388 dated 17 June 2005.

Waterval State Forest: This reserve formed part of the Kluitjieskraal Forest Station that was established in 1874 on the farms Kluitjieskraal and Knolvlei in the Tulbagh Valley and was designated as a State Forest before it was proclaimed a Natural Heritage site in February 1996, site no. 234. It has been released form State Forest demarcation in terms of Government notice No. 596 of 2006.

State President's Proclamation No. 97 of 1992, in Government, assigned legal responsibility for these areas to the Administrator of the Cape in Gazette No. 14246 of 21 August 1992.

These properties need to be proclaimed as protected areas in terms of the NEM: PAA.

Unproclaimed State land:
Farm Hangklip 559 portion 186 in the district of Caledon (Western Cape Nature Conservation Board: Buffelstal) is unproclaimed and zoned agriculture and is included in the World Heritage Site.

Helderberg (farm 721 in the district of Stellenbosch) and Simonsberg (farm 967 in the district of Paarl): These are unproclaimed State-owned properties managed by CapeNature as part of the Hottentots Holland Nature Reserve Complex and are included in the World Heritage Site.

Farm 858 as well as the remainders of farms 851, 852, 859, and 860 in the district of Stellenbosch are not included in the Hottentots Holland Nature Reserve, but managed as part of it. They are included in the World Heritage Site.

The above properties still need to be proclaimed as protected areas in terms of NEM: PAA.

Unproclaimed land owned by World Wildlife Fund and managed by CapeNature in terms of an agreement:
Farm Hangklip 559 portions 115, 161, 165, 160, 163, 164, 168, 159 and 169 (WWF-SA: Hangklip) are unproclaimed and zoned agriculture and need to be proclaimed as protected area terms of NEM: PAA.

State Forest not included in the Boland Mountain Complex:
Riebfor Forest Reserve (Kasteelberg): This State Forest is managed by CapeNature as part of the Waterval Nature Reserve, but is not included in the World Heritage Site. It is however included in this management plan for management purposes.

Section not included in this management plan:
The Northwestern section of the Theewaterskloof dam, which is covered by water when full is included in the World Heritage Site proclamation, but not managed in terms of this management plan. It is managed by the Department of Water and Sanitation in terms of the Theewaterskloof dam Resource Management Plan.

AUTHORISATION

This management plan for the Boland Mountain Complex is recommended by:

Name and Title	Signature	Date
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And approved by:

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Environmental Affairs and Development Planning Mr Anton Bredell PROVINCIAL MINISTER		
Environmental Affairs Mr Derek Hanekom MINISTER (ACTING)		

For managing the Boland Mountain Complex in terms of Sections 39 and 41 of the National Environmental Management: Protected Areas Act (Act 57 of 2003) and Chapter 4 of the World Heritage Convention Act (Act 49 of 1999).

ACKNOWLEDGEMENTS

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The Boland Mountain Complex was prepared by the core reserve management planning team consisting of Antoinette Veldtman, Corlie Hugo and Zimasa Gibisela, with significant inputs from Natalie Hayward, Mark Johns, Monique Ruthenberg, Patrick Shone, Deon Rossouw, Michael Lewis, Peter Viljoen and Dian Dreyer. The planning team was supported with inputs from various internal and external partners for which the authors are grateful for. A special word of thanks to our Scientific Services, People and Conservation and Conservation Services colleagues in particular.

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[Insert person's name] ([Institution] – [Insert person's job title]) for external review

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 (Act 49 of 1999), CapeNature is required to develop management plans for each of its nature reserves. In developing the management plan for the Boland Mountain Complex, CapeNature strives to establish biodiversity conservation as a foundation for a sustainable economy providing ecosystem services, access and opportunities for all.

The Boland Mountain Complex was inscribed as a World Heritage Site 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 World Heritage Site. The latter comprises a serial property of eight protected areas 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. The Boland Mountain Complex is supported and buffered by a wide network of adjacent or surrounding conserved areas ranging from Provincial Nature Reserves to Private Nature Reserves, Stewardship sites and Mountain Catchment Areas. The UNESCO-registered Kogelberg and Cape Winelands Biosphere Reserves, which surround and include the Kogelberg, Limietberg, Waterval and Jonkershoek Nature Reserves form part of the extensive buffer and buffering mechanisms for the southern part of this large complex.

The Boland Mountain Complex Management Plan comprises eight sections. Section one clarifies the rationale for CapeNature developing Protected Area Management Plans and refers to the "*Guidelines for the Development of a Management Plan for a Protected Area in terms of the National Environmental Management: Protected Areas Act".* The management plan is a strategic document that provides the primary overarching tool for the development and operation of the protected area, in keeping with CapeNature's mandate. It directs management at all levels and facilitates the integration of the various components and functions within the organisation and directs the enabling environment towards the achievement of protected area objectives and conservation and restoration of natural, cultural and other values.

Section one of the management plan 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 Stakeholder Engagement.

Section two outlines the Strategic Management Framework of the Boland Mountain Complex. This section states management intent and desired state; and so doing provides the basis for the management, development and operation of the protected area over a timeframe of 10 years. It epitomises the vision, purpose, focal values and

strategies of the Boland Mountain Complex. The priority (or focal) conservation values selected for the Boland Mountain Complex are: Freshwater Ecosystems, the Table Mountain Group Aquifer, Swartland Alluvium Fynbos, and Mountain and Lowland Fynbos. The collective set of heritage features known from the Complex are grouped into two focal values called Artificial Historical Structures and Pre-colonial Heritage. A host of human wellbeing benefits will flow from the Complex's natural and cultural assets including, and of particular importance to the Boland Mountain Complex, water provision, pollination, recreation and nature-based livelihoods and economic opportunities. The main threats to the focal biodiversity values of the Boland Mountain Complex were identified as:

- Inappropriate fire regime due to anthropogenic fires;
- The negative impact of invasive alien vegetation on fire regime, biodiversity and water availability;
- Impacts of over-abstraction on groundwater dependent ecosystems;
- Impact of invasive alien fish on indigenous species; and
- Illegal resource utilisation.

Clear measurable outcome-based goals, strategies and objectives were based upon the information derived from the viability and threats assessment of the focal conservation targets. A desired future condition was established for conservation 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 Boland Mountain Complex are as follows:

1. By 2029 the condition of delineated wetlands is in a near natural* to natural condition**.
   *Unmodified; ** A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.
2. By 2029 the upper to middle reaches of rivers supporting macro invertebrate species composition represent an Average Score Per Taxon of 6-8, rivers supporting Giant redfin are 90% to 100% clear of alien fish species and amphibian species composition is representative of relevant sites*.
   *All species represented, population estimates for all species exceeding 10 individuals.
3. By 2029 river flow of abstracted rivers is maintained at above 80%.
4. By 2029 groundwater-dependant freshwater ecosystems are in good* condition (*see wetland ecosystem health).
5. By 2029 Swartland Alluvium fynbos has an ecologically healthy fire regime*, comprises 90% - 100% indigenous species, containing species of conservation concern** and is connected and intact***.
   *<20% of area has burned twice or more in the last 25 years, not more than 2 of the age classes are below 5% or above 20%, >80% of the area burnt during December-April, mostly medium sized fires; ** Recruiting populations of geometric tortoise and grey rhebok; ***More than 3 000 ha of veld type secured in conservation.
6. By 2029 Swartland Alluvium fynbos supports all three size classes of geometric tortoise and selected grey rhebok populations are stable.

7. By 2029 Mountain and lowland fynbos has an ecologically healthy fire regime* and is comprised of more than 75 % indigenous species and reseeding proteas species are represented as per historic data**. The selected grey rhebok populations are stable.
   *<20% of area has burned twice or more in the last 25 years, not more than 2 of the age classes are below 5% or above 20%, >80% of the area burnt during December-April; **According to the Protea Atlas data.
8. By 2029 all unnatural disturbances to heritage features are limited to maintain current conditions within the Boland Mountain Complex.
9. By 2029 access to environmentally responsible infrastructure* intact ecosystems and abundant wildlife adding economic value to ecotourism products and socio economic development is facilitated and maintained.
   *Aligned with the Zonation Scheme.
10. By 2029 the Boland Mountain Complex provides managed opportunities for accessing nature and nature-based activities in a manner which is not harmful to the natural environment.
11. By 2029 consumptive utilisation capacity informs sustainable harvesting according to policy while monitoring and evaluation enable adaptive management.

The Boland Mountain Complex strategies that were identified to abate critical threats to focal conservation targets are:

Strategy 1: Update and implement the existing long term Alien Invasive Clearing Plan for the Boland Mountain Complex with relevant management authorities to abate the negative impact that invasive alien vegetation has on fire regime, biodiversity and water availability.

Strategy 2: Determine through empirical evidence the impact of groundwater abstraction on groundwater-dependent ecosystems.

Strategy 3: Enhance the implementation efficiency of the Alien Vegetation Management and Fire Programmes in the Boland Mountain Complex to abate the negative effect that invasive alien plants and inappropriate fire regimes have on biodiversity and water availability.

Strategy 4: Enhance the management and protection of the geometric tortoise population at Voëlvlei Nature Reserve to ensure persistence of the species.

Strategy 5: Update the CapeNature Natural Resource Utilisation policy and permit system to provide usage categories and guidelines for Cultural, Medicinal and Spiritual use, and implement.

Strategy 6: Implement the integrated compliance and enforcement plans for the Boland Mountain Complex and identify common obstacles to their effective implementation and develop focal projects that will address common issues that require elevated coordination, capacity, and specialised skills/equipment (*i.e.* working smarter with the right tools).

Strategy 7: Address non-compliance with regards to the Game Translocation and Utilisation Policy, and ensure implementation of policies and bylaws with regards to damage-causing, nuisance, rehabilitated, or confiscated animals in the Boland Mountain Complex and Zone of Influence.

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

Strategy 9: Refine and implement a targeted environmental education and awareness plan through key partnerships to decrease ignition points of anthropogenic fires and to improve the understanding of the impacts of invasive alien vegetation on fire risk, biodiversity and water supply.

Strategy 10: Develop and implement a comprehensive, progressive and adaptive management plan to facilitate sustainable, responsible access and tourism.

Strategy 11: Secure and protect conservation worthy areas surrounding the Boland Mountain Complex.

Section three provides the legal status and designation of the Boland Mountain Complex. It provides the location and extent of the Complex and summarises its history and biological context. Emphasis is placed on the area's conservation significance given the remarkable floral diversity of this area. It may be referred to as the floristic heart of the globally unique Cape Floral Kingdom since it has the highest levels of plant species richness and endemism in the Fynbos biome. These protected areas conserve outstanding ecological, biological and evolutionary processes associated with the beautiful and distinctive Fynbos vegetation, unique to the Cape Floral Region. In addition, the Complex's importance in water provisioning is highlighted.

The remainder of section three gives the socio-economic and organisational context of the Boland Mountain Complex. It states the financial situation and operational staff component, and explains how environmental and infrastructure management is carried out. The section is concluded with a review of the Boland Mountain Complex's key operational infrastructure such as roads, trails, buildings and signage.

Section four details the planning context of the Boland Mountain Complex management plan. It details the viability analysis of the focal conservation targets and the threat assessment, and identifies the activities that could potentially degrade the values or prevent progress to the established desired state. It outlines the zonation of the Complex, which is based on the results of a sensitivity analysis. 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.

Furthermore, the Concept Development Plan for the Boland Mountain Complex is discussed. The main objectives of this plan is to upgrade and maintain existing tourist accommodation facilities, as well as the maintenance of existing tourist hiking,

kloofing, mountain biking and trail running routes. This plan also considers current and potential concessionaires in development of business propositions or prevailing agreements.

Section four deals with expansion of the Boland Mountain Complex 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 Complex is through the acquisition of priority areas through Stewardship and Forestry Exit Areas.

Lastly, the zone of influence of the Boland Mountain Complex is outlined to ensure that the protected areas are integrated into the landscape so that land and water use planning take due consideration of the objectives of the protected area and do not impede the achievement of objectives. The zone of influence is intended to integrate mechanisms in the landscape that enable protected area expansion, the maintenance of existing expansion nodes, and seeks to proactively encourage compatible land and water use in collaboration with relevant stakeholders.

Section five presents the Strategic Implementation Framework of the Boland Mountain Complex. It provides a summary of the focal ecological and service areas, goals and assosiated strategies. The Strategic Implementation Framework guides the implementation of the management plan over a 10-year period in order to ensure that management objectives are met. The Strategic Implementation Framework translates the information described in Sections 3 and 4 above into management activities, which will be used to inform annual plans of operation as well as the resources required to implement them. The measurable outputs will form the basis for monitoring of performance in implementing the plan and are thus measurable.

Section six contains the references, section seven is an appendix of the land parcels constituting the Boland Mountain Complex and Section eight is an appendix containing the maps discussed in the management plan.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX 2: LIST OF MAPS

ABBREVIATIONS

ASPT	Average Score Per Taxon
APO	Annual Plan of Operations
CBA	Critical Biodiversity Area
CEO	Chief Executive Officer
CFE	Cape Fold Ecoregion
CFR	Cape Floristic Region
CMP	Catchment Management Plan
CoCT	City of Cape Town
CR	Critically endangered
DEAT	Department of Environmental Affairs and Tourism
DWAF	Department of Water Affairs and Forestry
EN	Endangered
EPWP	Expanded Public Works Programme
FEPA	Freshwater Ecosystems Priority Area
IAP	Invasive Alien Plants
IDP	Integrated Development Plan
IUCN	International Union for Conservation of Nature and Natural Resources
LT	Least Threatened
METT	The Management Effectiveness Tracking Tool
METT-SA	Management Effectiveness Tracking Tool for South Africa
MOU	Memorandum of Understanding
NEM: PAA	National Environmental Management: Protected Areas Act
NFEPA	National Freshwater Ecosystem Priority Areas
NHRA	National Heritage Resource Agency
NPAES	National Protected Area Expansion Strategy
SAM	Strategic Adaptive Management
SANBI	South African National Biodiversity Institute
SANSA	The South African National Survey of Arachnida
SASS	South African Scoring System
SDF	Spatial Development Framework
SMME	Small, Medium and Micro Enterprise
TMG	Table Mountain Group
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VU	Vulnerable
WCP	Western Cape Province
WCPAES	Western Cape Protected Area Expansion Strategy
WMA	Water Management Areas
WWF	World Wildlife Fund
WWF-SA	World Wild Fund for Nature – South Africa
YES	Youth Environmental Service Programme

1 INTRODUCTION

1.1 Purpose of Protected Area Management in the Western Cape

In compliance with the National Environmental Management: Protected Areas Act (Act No. 57 of 2003), CapeNature is required to develop management plans for each of its protected areas. Protected area management planning is guided by the Act, associated Norms and Standards for the management of protected areas in South Africa, regulations in terms of the Act, and relevant requirements as set out in the National Environmental Management: Biodiversity Act, 2003 and the National Environmental Management: Integrated Coastal Management Act, 2008.

The primary reason for the declaration of protected areas is part of the 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 biodiversity and cultural assets concerned in a manner which is consistent with the objectives of the Act, and for the purpose for which the protected area was declared.

Protected areas are also subject to the principles and provisions of relevant international treaties and conventions, national and provincial legislation and policy, and any local contractual agreements. The management planning approach and structure of the management plan is also guided by international best practice, the Convention on Biological Diversity Programme of Work on Protected Areas, and the *Guidelines for the Development of a Management Plan for a Protected Area in terms of the National Environmental Management: Protected Area Act* (Cowan & Mpongoma 2010).

The management plan is a strategic document that provides the primary overarching tool for the development and operation of the protected area, in keeping with CapeNature's mandate. The plan directs management at all levels from staff on-site to the Chief Executive Officer, the Western Cape Nature Conservation Board and the Member of the Executive Council (MEC) of the Province. The management plan facilitates the integration of the various components and functions within the organisation and directs the enabling environment towards the achievement of protected area objectives and conservation and / restoration of natural, cultural and other values.

In practical terms, the management plan strives to ensure that the following requirements for the effective management of protected areas are adequately addressed:

- The necessary mandate, human capacity and financial resources to implement and achieve the activities and objectives described in the management plan;
- The delivery of socio-economic benefits to local communities where possible.
- Flexibility of service delivery that encourages innovation and a wide range of government, community and non-government sector involvement.
- Performance indicators and accountability measures that provides for regular review of outcomes.

In working towards CapeNature's Vision of conserving nature for a sustainable future, CapeNature Protected Area Management 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;
- Manage protected areas effectively and efficiently;
- Ensure that protected area planning and management is integrated and participatory; and
- Provide for sustainable use and equitable sharing.

1.2 Guiding principles

The following guiding principles underpin the Management Plan for the Boland Mountain Complex:

- 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 rather than at the end of implementation.
- Invest in management response appropriate to the risk.
- Adapt strategies based on lessons learned, understanding that simply measuring effectiveness 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 respectfully, honestly and transparently to facilitate learning, acknowledging that although success is not a given, learning is, through honest appraisal of efforts.

It is important to note that while these principles are intended to guide protected area management in its work, the protected area 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.

1.3 Strategic Adaptive Management and the Planning Framework

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

- testing assumptions,
- learning through monitoring and evaluation, and
- adapting.

SAM systematically evaluates results and uses this information in a community of practice (Conservation Measures Partnership 2013). SAM thus enables management to 'change direction' when it becomes evident that management is not going in the

right direction, rather than waiting until the end of a project to determine whether an intervention worked (Conservation Coaches Network 2012). SAM bridges management and decision science. Therefore, management intervention design elicits scientifically-measurable results, the analysis of which informs future management decisions.

Protected area management planning requires a broad, holistic or strategic approach due to the many factors that influence the condition of an ecosystem outside of the manager's jurisdiction. The benefit of SAM is its application as a rigorous step-by-step process which follows a logic framework that defines the desired condition (*i.e.* objective) of the protected area, develops management options which are then implemented, and evaluates management options in relation to progress towards that objective or goal (Kingsford & Biggs 2012).

When compiling management plans, CapeNature applies the SAM framework as shown in Figure 1.1, adapted from The Open Standards for the Practice of Conservation (Conservation Measure Partnership 2013).

SAM enables CapeNature to:

- Plan to manage complexity in a changing environment towards pre-determined outcomes;
- Monitor management effectiveness and adapt management actions based on tangible indicators;
- Test and evaluate predictions and outcomes of management actions;
- Learn and adapt based on evidence;
- Define and refine management processes; and
- Consult and engage with stakeholders.

The Planning Framework

The Open Standards for the Practice of Conservation 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. Planning incorporates scientific information through an expert-driven process and peer-reviewed science, expert participation and engagement with local inhabitants.

The Open Standards framework facilitates SAM through the identification of explicit measures of success and the incorporation of lessons learned over time. SAM is based on a foundation where natural and cultural assets / features / values identified by stakeholders as important to conserve, and representing the suite of natural and cultural historic heritage in an area using the best available knowledge, are explicitly defined. Following the methodology of the Open Standards, 'values' are termed 'conservation targets' (Conservation Measure Partnership 2013). In keeping with IUCN best practice, this management plan refers to conservation targets as 'values'.

The foundational process further assesses the health / condition (hereafter referred to as viability) of values, and identifies and ranks threats to values. This forms the basis for establishing long-term goals / desired state for values within a given timeframe. In order to meet the desired state, strategies are selected and short to medium term objectives developed to measure progress towards threat mitigation, improved status

of a value, or maintained status of a value. The maintenance of healthy values delivers a range of ecosystem services crucial for human well-being.

The Open Standards framework follows a systematic approach comprising of five stages (Figure 1.1):

- Conceptualising the protected area (deciding what is important to conserve and what the challenges and opportunities are);
- Planning Actions and Monitoring (drafting the plan);
- Implementing Actions and Monitoring (doing the work and monitoring the work);
- Analysing and using Results to Adapt (deciding if what was planned is working), and
- Capturing Results, Sharing and Learning (learning and sharing what was learnt).

Through this systematic approach, linkages between specific strategies, actions, threats, values and goals are made explicit, enabling management to define and measure success of their actions in the Boland Mountain Complex over time.

Figure 1.1. Strategic Adaptive Management Framework adapted from The Open Standards for the Practice of Conservation (Conservation Measures Partnership 2013).

1.4 Protected Area Management Effectiveness, Monitoring and Evaluation

The IUCN defines management effectiveness evaluation as the assessment of how well a protected area is being managed – primarily the extent to which management is protecting values and achieving goals and objectives (Hockings *et al*. 2015) (See Figure 1.2). The following questions underpin management effectiveness evaluation (Leverington & Hockings 2004):

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

Protected area management effectiveness evaluation is based on the World Commission on Protected Areas framework for protected area management (Hockings *et al*. 2015). The framework provides a consistent, theoretical and practical basis for assessment (Leverington *et al*. 2008). This framework is based on the idea that good protected area management follows a process that has six distinct stages or elements:

- 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** (Dudley *et al*. 2007; Hockings *et al*. 2015).

An assessment of individual elements and the links between these factors build a comprehensive picture of management effectiveness (Leverington *et al*. 2008).

The Management Effectiveness Tracking Tool (METT) adopted by the National Department of Environmental Affairs (DEA) and adapted to South African conditions (METT-SA) (Cowan *et al.* 2010; Carbutt & Goodman 2013), is used to assess management effectiveness at the strategic level.

The Provincial Biodiversity Strategy and Action Plan's Strategic Objective 1: '*Conserve and reduce threats and pressures on biodiversity'* and associated target of sound protected area management is measured by the METT-SA (PBSAP 2015). CapeNature Strategic Goal 1. '*Biodiversity Loss is reduced in the Western Cape'* is underpinned by Strategic Objective 1.2 '*Improve Ecosystem Health'*. Ecosystem health is measured by the percentage protected area coverage (ha's) in the 'Sound Management' category (i.e. a METT-SA result of 67% and above) (CapeNature 2015).

To monitor and evaluate non-financial performance of the Protected Area, management conforms to the following protocols: a strategic 10-year Plan; annual performance plan; quarterly reporting and a 3-year review of the management plan.

Mechanisms for monitoring and evaluation are built into each aspect addressed by the Strategic Implementation Framework (Section 5) through the inclusion of verifiable indicators of progress. The protected area monitoring and evaluation programme monitors site-level implementation of the plan, value status measures and strategy

effectiveness measures. Results contribute to the Western Cape State of Biodiversity report, produced at 5-year intervals.

Furthermore, management report annually on progress 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.

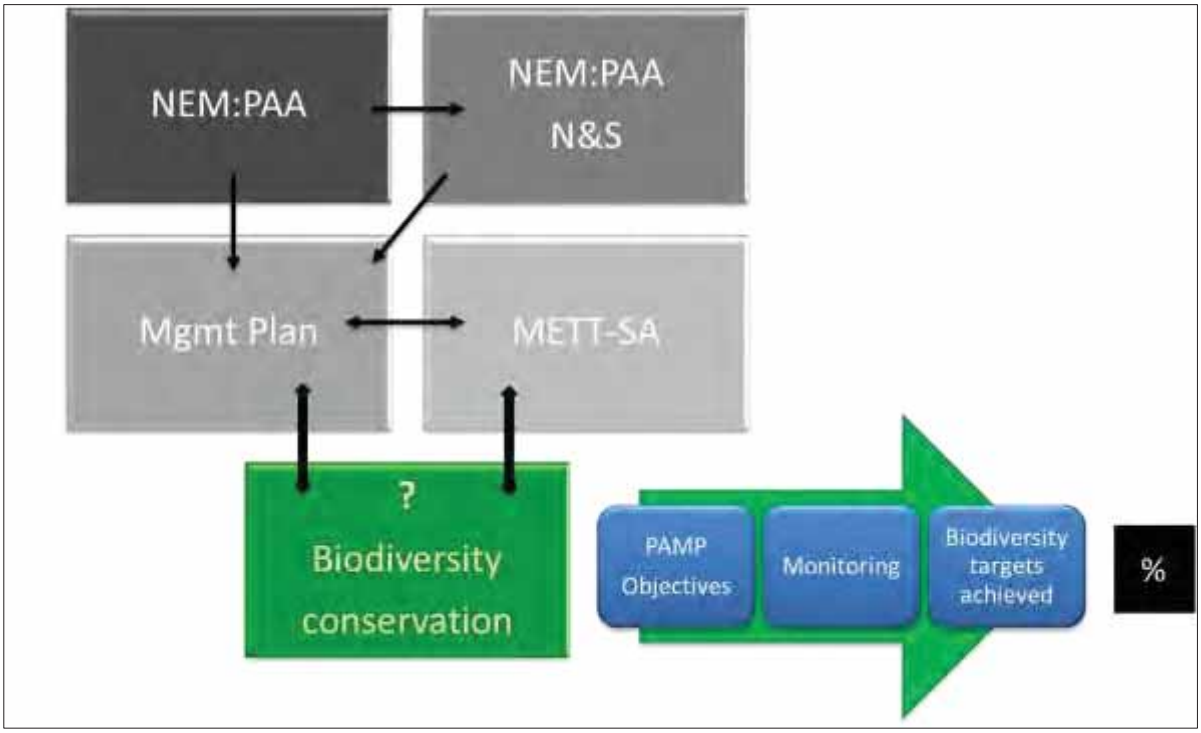

Figure 1.2. Monitoring and evaluation framework.

1.5 Co-ordinated Policy Framework

All CapeNature management plans must be read in conjunction with CapeNature's Co-ordinated Policy Framework.

1.6 Stakeholder Engagement

For protected areas to be relevant they must be integrated into the wider landscape (Ervin *et al*. 2010; Borrini-Feyerabend *et al*. 2013) and management must promote participation. Mainstreaming protected areas as natural solutions to emerging challenges such as climate change, disaster risk reduction, food and water security, providing benefits to human health, livelihoods and well-being requires participatory planning and management (World Congress 2016).

Stakeholder engagement and understanding the context of the Boland Mountain Complex are two key processes that inform the planning process at the onset (Kingsford & Biggs 2012). Stakeholder engagement engages entities in dialogue in an attempt to find out what social and / or environmental issues matter to them, to communicate the purpose of the protected area and promote participatory planning. Stakeholder engagement promotes transparency of planning processes and outcomes, communication, buy-in, and the derivation of new information and / or expertise from various stakeholders to fill or identify knowledge gaps. External experts

can expand the knowledge base of information to include aspects that are relevant to the Protected Area but not necessarily areas of expertise for staff.

Stakeholder engagement is essential for sustainability, provides opportunities for learning for both the planning team and stakeholders themselves; and builds capacity and enhances responsibility.

1.6.1 Participatory Planning and Management

Stakeholder engagement essentially takes place throughout the adaptive management cycle, however, at the onset of planning, a stakeholder analysis was conducted in order to identify relevant internal and external stakeholders and to define the scope and purpose of engagement.

Several approaches to engaging internally and externally with stakeholders were applied throughout the planning process *i.e.* structured workshops, meetings, site visits, circulation of draft documents for comment, *etc.* Different stakeholders were engaged in different ways during the various stages of the planning process, from gathering and sharing information, to consultation, dialogue, working together, and partnership. The degree of engagement was guided by careful consideration of the stakeholder analysis and in response to the need (*i.e.* transparency of process / expert opinion / buy-in and support, *etc.*).

The Desired State, facilitated by the Regional Ecologist, Planning Team and guided by the reserve management committee, was set in a series of workshops and planning team meetings with relevant internal and external stakeholders identified during stakeholder analysis.

Structures such as Protected Area Advisory Committees / Community Liaison Structures are aimed to facilitate support to the Boland Mountain Complex by neighbours, relevant organs of state, non-government organisations and the public, to provide a platform that enables regular interaction and a mechanism to evaluate stakeholder feedback, and promote good neighbour relations.

The following structures are established to facilitate stakeholder engagements within the Boland Mountain Complex:

There are three communication structures that are functioning within the Boland Mountain Complex. The Protected Areas Advisory Committee is intended as a partnership between the communities that live adjacent to the protected areas and the reserve management staff. Meetings take place on a quarterly basis. The biggest challenge to this communication tool is that not all members attend the meetings, mostly due to a lack of transport. Another channel of communication is through normal community meetings that are requested from community leaders and other stakeholders that have a vested interest within the communities. Lastly, Natural Resource User Group meetings serve as a communication structure with Rastafarians, Traditional Healers, Sangomas, and church groups (Zionists Church). These meetings focus on access to the reserve for cultural, traditional, religious and youth development, with the aim of providing benefits to the respective resource user groups.

The Protected Area Advisory Committees are currently used to engage with all the relevant stakeholders. The functions of the committees are as follows:

- Act as a forum for discussing reserve issues from the reserve and community perspective;
- Play a role in educating the surrounding communities and various interest groups about the importance of preservation, protection and management of natural resources and the objectives of the reserve management plans that are intended to pursue these goals;
- Monitor the effectiveness of reserve management and community conservation programmes such as Community-Based Natural Resource management, reserve policies and guidelines. This will provide CapeNature an opportunity to measure the performance of these programmes/projects and policies;
- Make recommendations on how CapeNature can improve the programmes and policies;
- Promote local decision-making around the management of natural and heritage resources within and beyond Protected Areas;
- Promote the integration of conservation activities within Protected Areas with those of surrounding areas;
- Provide input into relevant CapeNature policies, management plans and conservation planning frameworks;
- Monitor the implementation of management plans with respect to Protected Areas; and
- Identify major opportunities and constraints pertaining to neighbouring Protected Areas and provide a plan of action.

In other reserves where there is no functional Protected Areas Advisory Committee, community meetings with community leaders are being conducted quarterly and also on request from community leaders.

1.6.2 Public Participation Process

NEM: PAA Section 39(3) states that all persons who may be interested in, or affected by the management plan, are to be given the opportunity to comment on the management plan. Section 41(2)(e) requires that the management plan contains procedures for stakeholder participation including participation by the owner (where a contractual agreement exists between the owner and CapeNature), and/or any local community or interested party.

A process to initiate extensive public participation of the draft management plan was initiated by invitation to the public via the media, e-mail, post, telephone and personal invitation, to register their interest. A stakeholder register, maintained by the reserve management committee, lists registered interested and affected parties. The draft management plan was also placed at relevant libraries and on the CapeNature website, inviting written comment on the draft management plan for a period of 30 days.

Registered interested and affected parties were invited to a public meeting and provided the opportunity to raise concerns and provide comment. Based on a summary report of the outcomes of the public meeting, as well as written comments and responses received, the management plan was amended where relevant, and feedback provided to registered interested and affected parties.

2 THE STRATEGIC MANAGEMENT FRAMEWORK FOR THE BOLAND MOUNTAIN COMPLEX

1.8 Management Intent and Desired State

This section provides the basis for the management, development and operation of the protected area over a timeframe of 10 years. It epitomises the vision, purpose, values and objectives of the Boland Mountain Complex and summarises its challenges and threats.

Establishing the Desired State is a step-wise process which takes the planning team from understanding the purpose of the protected area; understanding values, threats and system drivers, to describing the ultimate condition that protected area management is working to achieve in line with the purpose for which it was declared. It is a process to facilitate understanding what aspects of the biodiversity need to be defined to appropriately manage the site and mitigate threats at the appropriate scope and scale. The process uses knowledge of the biodiversity, its driving processes and ecosystem function, and tests assumptions of responses to anthropogenic stressors, and socio-economic and governance drivers.

Appreciating that protected areas establish biodiversity conservation as a foundation of a sustainable economy creating access, benefits and opportunities for all, the planning approach is aimed at assessing the current condition of selected values / targets necessary to measure condition or trend over time. In the case of international conventions such as Natural World Heritage and Ramsar, management focus would be aimed at the maintenance of outstanding universal value and / or water-related ecosystems. Furthermore, an effectively- and equitably-managed natural resource base is the foundation towards the Convention on Biodiversity's Aichi Target 11 and Sustainable Development Goals, with specific reference to Goals 6, 14 and 15.

The future desired state thus defines the ultimate scope of management and management direction within and beyond protected area boundaries. This serves as a foundation for relevant ongoing monitoring and evaluation to assess effectiveness throughout implementation of the management plan.

Stakeholder workshops identified natural and cultural historic values, explicitly defined and selected for their ability to represent the full suite of biodiversity / natural and cultural historic heritage within the geographic scope of the complex. The methodology used the rationale that effective conservation of carefully-selected values will ensure the conservation of all indigenous biodiversity and cultural historic heritage within a functional landscape. This effort also relied on the Western Cape Biodiversity Spatial Plan and landscape ecology to guide conservation efforts beyond the boundaries of the complex to address threats and inadequacies in protected area design.

An assessment of the viability of values and critical threats served as an evidence base to establish what values require to persist / survive over the long term. The outcomes of these assessments guided the formulation of the future desired state, *i.e.* Goals, and the formulation of conservation strategies with associated objectives, indicators and action plans. The effectiveness of proposed strategies was tested by rating strategies according to their potential impact and feasibility (Conservation Measures Partnership 2013).

2.2 Scope and Vision

The scope and vision indicate the direction of management aspiration, describe the unit, reflect the uniqueness of the unit and justify the existence of the Boland Mountain Complex.

2.2.1 Scope

The planning scope of the Boland Mountain Complex is defined both conceptually and is spatially guided by existing land use plans, spatial development plans and the Western Cape Biodiversity Spatial Plan.

The geographic scope for the Protected Area complex is defined as the area that supports the natural and cultural historic heritage of interest within the boundaries of the Protected Area complex. The planning scope acknowledges the requirement to facilitate climate change resilience and contribute towards the strategic objectives of the Boland Mountain Complex. Thus, conservation efforts extend beyond the borders of the protected areas within the complex within a delineated 'Zone of Influence' (See Section 4.9).

2.2.2 Vision

The Boland Mountain Complex is an ecologically resilient landscape that sustains ecosystem services and infrastructure and promotes indigenous biodiversity necessary for human well-being.

2.3 Purpose

The purpose is the foundation on which all future actions are based and is in line with the Vision, Mission and Strategic Objectives of CapeNature, and objectives of The Act.

According to S17 of NEM: PAA, the purpose of declaring an area as a protected area is: to protect ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes in a system of protected areas;

(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 Boland Mountain Complex was declared specifically for reasons (a), (b), (c), (d), (e), (g), (h), (j), and (k).

In addition, The Cape Floral Region (CFR) was proclaimed as a World Heritage Site based on the outstanding universal value of its natural processes and biodiversity (Criteria (ix) and (x), DEAT 2003. See section 3.3). Its exceptional plant richness and endemism are related to the biophysical diversity of the CFR. Carefully selected protected areas, representative of all eight phytogeographic centres of endemism, were selected as the sites representative of this unique globally-significant region (DEAT 2003). The Boland Mountain Complex constitutes one of these, namely the South-western Phytogeographic Centre of endemism (Goldblatt & Manning 2000).

Moreover, seven of the eight inscribed protected area complexes conserve close to half the number of plant species and selected vertebrate taxa of the region (Lombard 2000). This figure is even higher for endemic plants (69%) and for Proteaceae elements (59%). Preliminary results from Bradshaw and Holness (2013) show that 27 vegetation types that are not conserved anywhere else in the CFR are conserved by the inscribed CFR Protected Area components. A further 48 of the total 119 vegetation types currently recognised in the CFR (SANBI 2006) that are not protected elsewhere are protected by the extended CFR Protected Areas bringing the total to 75 of 119 CFR vegetation types, which are protected nowhere else.

The Cederberg and Groot Winterhoek Wilderness Areas, along with the Boland Mountain Complex, together with their surrounding reserves, form a valuable conservation band along the north-trending axis of the Cape Fold Belt. This imparts a high degree of protection to the levels of biodiversity that occur in this region of the southwestern Cape. In particular, the Boland Mountain Complex, situated at the junction of the Cape Fold Mountains axes, includes the very heart of the fynbos - the hotspot for plant diversity (Anon 1999). This protected area, not only includes some of the most diverse and endemic-rich flora in the world, but it is also an area of great beauty. Incorporating the Palmiet River, it stretches from the coast in the south, extending northwards along rugged mountains with high peaks and deep valleys.

2.4 Focal Values

Protected area design and planning is aimed towards the long-term maintenance of site values. A limited set of values were selected to represent and encompass the broader set of values found in, and associated with, the Boland Mountain Complex. These “focal values” form the basis for setting goals, carrying out conservation actions, and measuring effectiveness.

In selecting focal values, both tangible natural and cultural values were considered, as well as the intangible or non-material human wellbeing values derived from tangible values:

- Natural values can be species, habitats or ecological systems, which collectively represent and encompass the biodiversity of the protected area. They can include the physical, natural features from which ecosystem services flow, benefitting humans in a variety of ways.
- Cultural values are described in terms of the tangible features which collectively represent and encompass the cultural historic heritage of the protected area. They can also include the physical, cultural and/or historic features from which human wellbeing values (see below) 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. Examples include: potable water, nature-based livelihoods, and spiritual and physical health; Table 2.1 below provides further examples.

The priority, or focal, natural values selected for the Boland Mountain Complex are: Freshwater Ecosystems, TMG Aquifer, Swartland Alluvium Fynbos and Mountain and Lowland Fynbos. The collective set of heritage features known to the Complex are grouped into two focal values called Artificial Historical Structures and Pre-colonial Heritage.

A host of human well-being benefits will flow from the Complex's natural and cultural assets including, and of particular importance to the Boland Mountain Complex, water provision, pollination, recreation and nature-based livelihoods and economic opportunities.

All focal values are listed below and briefly described in Table 2.1. Those values considered to be 'nested' within, or will be catered for by the conservation of the focal value, are noted. Some of the key human wellbeing values derived from the tangible natural and cultural focal values are also noted. Importantly, through a process of assessing the 'health' or viability of each focal value, its current status was determined. Because human well-being values are those components of well-being 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. Focal value selection and the assessment of their current status form the basis for setting goals, carrying out conservation actions, and measuring effectiveness.

Section 4 provides more detail on focal value selection, viability assessment, and human wellbeing.

Table 2.1. Summary of the Boland Mountain Complex values and viability as determined in 2018.

Focal Value	Description, nested values & associated human wellbeing values	Current Status
Freshwater Ecosystems	**Description:** Comprising of all natural seasonal rivers, streams, seeps and wetlands. **Nested values of note:** Freshwater invertebrates, fish communities, riparian zone, lowland and high altitude wetlands and seeps, rivers. **Associated human well-being value(s):** Water security and environmental resilience, spiritual and physical health.	Good
TMG Aquifer	**Description:** Comprising of the groundwater systems associated with the Boland Mountain Complex that fall within the Table Mountain Group (TMG) aquifers, which extend from near Niewoudtville in the northwest, down to Cape Agulhas and eastwards toward Port Elizabeth. **Nested values of note:** Groundwater-dependent ecosystems, water provisioning.	Good

Focal Value	Description, nested values & associated human wellbeing values	Current Status
	Associated humanwell-being value(s): Water security and environmental resilience.	
Swartland Alluvium Fynbos	**Description:** Comprises the vegetation type and associated flora and fauna species assemblages. **Nested values of note:** Geometric tortoise population, presence of key species (*e.g.* grey rhebok), patch size and connectivity. **Associated humanwell-being value(s):** Personal agency, tourism and nature based economic opportunities, stewardship.	Fair to Very Good
Mountain and Lowland Fynbos	**Description:** The Mountain and Lowland Fynbos constitutes 21 distinct vegetation types of which five are Critically Endangered and two are Endangered. **Nested values of note:** Serotenous Proteaceae, associated fauna and flora communities. **Associated human well-being value(s):** Knowledge economy contribution, personal agency, tourism and nature-based economic opportunities, responsible utilisation of natural resources, spiritual and physical health and cultural identity.	Poor
Pre-Colonial Heritage	**Description:** Comprising of tangible heritage features such a rock art and artefacts. **Nested values of note:** intangible heritage such as historic, traditional and religious activities, and knowledge. **Associated human well-being value(s):** Spiritual health and cultural identity.	Good
Artificial Historical Structures	**Description:** Comprising of tangible heritage features such as built infrastructure and burial sites older than 70 years. **Nested values of note:** intangible heritage such as historic, traditional and religious activities, and knowledge. **Associated human well-being value(s):** Spiritual health and cultural identity.	Poor to Fair

CapeNature is acknowledged as having a suite of Core Service Areas that must be delivered as an organ of the state in service of the public. Through the Boland Mountain Complex planning process, the following Service Areas have been identified as Focal Service Areas for the Boland Mountain Complex, in that they are essential to the effective execution of this Protected Area Management Plan and achievement of Goals for the Complex.

Table 2.2. Summary of the Boland Mountain Complex Focal Service Areas.

Focal Service Area	Description & associated benefits	Current Status
Personal agency, tourism & nature based economic opportunities	Cooperative governance; advocacy, environmental awareness and education; citizen science; volunteers; local economic development through job creation, skills development.	Good
Responsible utilisation of natural resources	Derived from healthy focal natural and cultural historic values; mechanisms to facilitate evidence based responsible sustainable utilisation equitably and legitimately though cooperative governance.	Poor

2.5 Threats

Protected area management strives to remove values from processes that threaten its existence. Threats are factors or processes that threaten, erode or inhibit values and their key attributes, within or outside the protected area. Threats can also be factors within the organisation or outside, that undermine its values and inhibit the pursuit of the desired state.

Threats to major site values and the relevant contributing factors or drivers of those threats need to be described in sufficient detail in order to support effective planning and management. An assessment of threats influences the direction and effectiveness of management options. Ranking threats according to scope, severity and irreversibility facilitates the allocation of limited resources, simplifies complex scenarios and provides a systematic decision support method to focus efforts. Table 2.3 provides a summary of values at greatest risk.

Table 2.3. A summary of threat ranking results highlighting the natural and cultural historic values at greatest risk.

Values	Threat Ranking
Freshwater Ecosystems	High
TMG Aquifer	Medium
Swartland Alluvium Fynbos	Very High
Fynbos (Mountain and Lowland)	Very High
Pre-Colonial Heritage	Low
Artificial Historical Structures	Low

The results of the threats ranking highlighted the key threats to the values of the Boland Mountain Complex given in Table 2.4. The threats to conservation and other targets are discussed in Section 4.3.

Table 2.4. A summary of threat ranking results highlighting the five biggest threats to the values of the Boland Mountain Complex.

Threat	Description	Current Status
Inappropriate fire regime due to anthropogenic fires	Short fire return intervals cause the structure and composition of fynbos to change and subsequently the loss of species. **Linked Values:** Freshwater ecosystems, Mountain and Lowland Fynbos, Swartland Alluvium Fynbos	Very High
The negative impact of invasive alien vegetation on fire regime,	The major invasive alien plants are pines, Australian *Acacia* species and hakea, which have a major negative impact on our limited water resources, and cause large-scale ecosystem degradation.	High

Threat	Description	Current Status
biodiversity and water availability	**Linked Values:** Freshwater ecosystems, Mountain and Lowland Fynbos, Swartland Alluvium Fynbos	
Impacts of over-abstraction on groundwater dependent ecosystems	Over-abstraction of groundwater will have ecological impacts for groundwater-dependent freshwater (rivers and wetlands) and terrestrial ecosystems in the catchment, but the long-term effects are uncertain. **Linked Values:** TMG Aquifer, Freshwater Ecosystems.	High
Impact of invasive alien fish on indigenous species	Invasive alien fish prey on and outcompete indigenous fish species and alter ecosystem functioning of the rivers. **Linked Values:** Freshwater Ecosystems.	Medium (High to Freshwater ecosystems)
Illegal resource utilisation	Illegal resource use includes direct and indirect impacts on biodiversity due to poaching of fauna, loss of biodiversity due to poaching of flora for subsistence and commercial use and loss of biodiversity due to grazing by livestock. **Linked Values:** Mountain and Lowland Fynbos, Swartland Alluvium Fynbos.	Medium

2.6 Goals, strategies and objectives

Clear 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 upon the information derived from the viability and threats assessment, a desired future condition was established for 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.

Boland Mountain Complex goals:

1. By 2029 the condition of delineated wetlands is in a natural* to near-natural condition**.
   *Unmodified; ** A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.
2. By 2029 the upper to middle reaches of rivers supporting macro-invertebrate species composition represent an Average Score Per Taxon (ASPT) of 6-8, rivers supporting Giant redfin are 90% to 100% clear of alien fish species and amphibian species composition is representative of relevant sites*.
   *All species represented, population estimates for all species exceeding 10 individuals.
3. By 2029 river flow of abstracted rivers is maintained at above 80%.
4. By 2029 groundwater-dependant freshwater ecosystems are in good* condition (*see wetland ecosystem health).
5. By 2029 Swartland Alluvium fynbos has an ecologically healthy fire regime*, comprises 90% - 100% indigenous species, containing species of conservation concern** and is connected and intact***.

*<20% of area has burned twice or more in the last 25 years, not more than 2 of the age classes are below 5% or above 20%, >80% of the area burnt during December-April, mostly medium sized fires; ** Recruiting populations of Geometric tortoise and grey rhebok; ***More than 3 000 ha of veld type secured in conservation.

6. By 2029 Swartland Alluvium fynbos supports all three size classes of geometric tortoise and selected grey rhebok populations are stable.
7. By 2029 Mountain and lowland fynbos has an ecologically healthy fire regime* and comprises more than 75% indigenous species and reseeding protea species are represented as per historic data**. The selected grey rhebok populations are stable.
   *<20% of area has burned twice or more in the last 25 years, not more than 2 of the age classes are below 5% or above 20%, >80% of the area burnt during December-April; **According to the Protea Atlas data.
8. By 2029 all unnatural disturbances to heritage features are limited to maintain current conditions within the Boland Mountain Complex.
9. By 2029 access to environmentally responsible infrastructure*, intact ecosystems and abundant wildlife adding economic value to ecotourism products and socio-economic development is facilitated and maintained.
   *Aligned with the Zonation Scheme.
10. By 2029 the Boland Mountain Complex provides managed opportunities for accessing nature and nature-based activities in a manner which is not harmful to the natural environment.
11. By 2029 consumptive utilisation capacity informs sustainable harvesting according to policy while monitoring and evaluation enable adaptive management.

The social and economic context of the protected area complex, including the positive and negative socio-economic impacts of management, should be based on sound understanding to be adequately reflected in goals and objectives. Thus, the development of effective conservation strategies requires a thorough understanding of the situation, *i.e.* how critical threats and contributing factors affect values and their integrity.

The Boland Mountain Complex Strategies are given in Table 2.5.

Table 2.5. An abbreviated list of all recommended strategies for the Boland Mountain Complex. The Strategic Implementation Framework (Section 5) provides detail for implementation.

Threat(s) abated	Strategy Type	Strategy	Objectives
The negative impact of Invasive alien vegetation on fire regime, biodiversity and water availability.	Target Restoration / Threat Reduction Actions	**Strategy 1:** Update and implement the existing long term Alien Invasive Clearing Plan for the Boland Mountain Complex with relevant management authorities to abate the negative impact that invasive alien vegetation has on fire regime, biodiversity and water availability.	**Objective 1.1:** By 2020 the Central Region Invasive Alien Plant Management Resource Strategy has been revised and updated using current data and implemented in the Boland Mountain Complex.
			Objective 1.2: By 2021 and beyond the Central Region Invasive Alien Plant Management Resource Strategy is implemented.
			Objective 1.3: By 2020 and beyond river flow of NFEPA rivers is being monitored in line with CapeNature protocol.
Impacts of over abstraction on groundwater dependent ecosystems.	Behavioural Change / Threat Reduction Actions	**Strategy 2:** Determine through empirical evidence the impact of groundwater abstraction on groundwater dependent ecosystems.	**Objective 2.1:** By 2019 partnerships with relevant monitoring agencies such as the South African Environmental Observation Network are established and maintained to obtain relevant data on groundwater dependant ecosystems.
			Objective 2.2: By 2020 groundwater dependant ecosystems (wetlands and seeps) within the Boland Mountain Complex have been identified and monitoring of these are initiated to determine baseline before abstraction of groundwater commences.
			Objective 2.3: By 2019, and beyond amphibian species communities are monitored to determine species presence and population estimations in the Boland Mountain Complex.

Threat(s) abated	Strategy Type	Strategy	Objectives
			Objective 2.4: By 2019 and beyond, water abstraction quantity and water quality of CapeNature boreholes on Waterval and Jonkershoek Nature Reserves are being monitored.
The negative impact of Invasive alien vegetation on fire regime, biodiversity and water availability. Inappropriate fire regime due to anthropogenic fires.	Enabling condition actions; Threat Reduction Actions; Stress Reduction Actions; Target Restoration	**Strategy 3:** Enhance the implementation efficiency of the Alien Vegetation Management and Fire Programmes in the Boland Mountain Complex to abate the negative effect that invasive alien plants and inappropriate fire regimes have on biodiversity and water availability.	**Objective 3.1:** By 2019 the internal efficiency of Alien Vegetation Management and Fire Programmes is critically evaluated and shortcomings have been reported.
			Objective 3.2: By 2021 the identified shortcomings have been addressed.
			Objective 3.3: By 2019 and beyond, the fire regime in the Boland Mountain Complex is determined to support management decisions with regards to fire and invasive alien vegetation management.
The negative impact of Invasive alien vegetation on fire regime, biodiversity and water availability. Inappropriate fire regime due to anthropogenic fires. Predation by feral pigs on geometric tortoise population at Voëlvlei Nature Reserve.	Enabling condition actions; Threat Reduction Actions; Stress Reduction Actions; Target Restoration	**Strategy 4:** Enhance the management and protection of the geometric tortoise population at Voëlvlei Nature Reserve to ensure persistence of the species.	**Objective 4.1:** By 2019 an approved standardised monitoring protocol for monitoring of the geometric tortoise population exists.
			Objective 4.2: By 2020 and beyond the approved standardised monitoring protocol for monitoring of the geometric tortoise population is implemented.
			Objective 4.3: By 2019, and beyond feral pigs are controlled and eradicated in partnership with the implementing entity in accordance with the Swartland Feral Pig Project.

Threat(s) abated	Strategy Type	Strategy	Objectives
			Objective 4.4: By 2019 and beyond, the fire regime in the Swartland Alluvium Fynbos is managed to support management decisions with regards to geometric tortoise conservation.
Direct and indirect impacts on biodiversity due to poaching of fauna. Loss of biodiversity due to poaching of flora for subsistence and commercial use. Impacts on biodiversity due to unsustainable regulated harvesting.	Behavioural Change / Threat Reduction Actions; Stress Reduction Actions; Target Restoration	**Strategy 5:** Update the CapeNature Natural Resource Utilisation policy and Permit System to provide usage categories and guidelines for Cultural, Medicinal and Spiritual use, and implement.	**Objective 5.1:** By 2023 the CapeNature Sustainable Resource Utilisation Policy has been updated and implemented.
Direct and indirect impacts on biodiversity due to poaching of fauna. Loss of biodiversity due to poaching of flora for subsistence and commercial use.	Behavioural Change / Threat Reduction Actions; Stress Reduction Actions; Target Restoration	**Strategy 6:** Implement the integrated compliance and enforcement plans for the Boland Mountain Complex and identify common obstacles to their effective implementation and develop focal projects that will address common issues that require elevated coordination, capacity, and specialised skills/equipment (*i.e.* working smarter with the right tools).	**Objective 6.1:** By 2024 increase successful compliance interventions* from 2019 baseline. *Prevention, apprehension and prosecution.
Loss of biodiversity due to grazing by livestock.	Behavioural Change / Threat Reduction Actions; Stress Reduction	**Strategy 7:** Address non-compliance with regards to the Game Translocation and Utilisation Policy, and ensure implementation of policies and bylaws with regards to damage causing, nuisance,	**Objective 7.1:** By 2020 CapeNature have ensured that all game farmers within the Zone of Influence of the Boland Mountain Complex are compliant with the Game Translocation and Utilisation Policy.

Threat(s) abated	Strategy Type	Strategy	Objectives
Direct and indirect impacts on biodiversity due to poaching of fauna. The loss of biodiversity due to invasive and feral fauna.	Actions; Target Restoration	rehabilitated, or confiscated animals in the Boland Mountain Complex and Zone of Influence.	**Objective 7.2:** By 2019 damage causing animals are managed in the Boland Mountain Complex in accordance with the CapeNature damage causing animal protocols.
			Objective 7.3: By 2019 no unconditional releases of nuisance, rehabilitated, or confiscated animals are taking place in the Boland Mountain Complex.
Impact of invasive alien fish on indigenous species.	Behavioural Change / Threat Reduction Actions; Stress Reduction Actions; Target Restoration	**Strategy 8:** Through existing partnerships implement alien invasive fish control and/or removal, guided by legislation and policy in priority rivers in Boland Mountain Complex.	**Objective 8.1:** By 2029 CN has implemented eradication plans that are aligned to legislation, informed by risk assessments and surveys, and trout levels in priority rivers have decreased and new introductions are being prevented.
			Objective 8.2: By 2020, CapeNature is implementing and enforcing its new guidelines regarding the presence, control and removal of trout in protected areas.
The negative impact of Invasive alien vegetation on fire regime, biodiversity and water availability. Inappropriate fire regime due to anthropogenic causes.	Behavioural Change / Threat Reduction Actions; Enabling Conditions	**Strategy 9:** Refine and implement a targeted environmental education and awareness plan through key partnerships to decrease ignition points of anthropogenic fires and to improve the understanding of the impacts of invasive alien vegetation on fire risk, biodiversity and water supply.	**Objective 9.1:** By 2022 there is a decrease in ignition points within the targeted hotspot areas from the 2019 baseline, and the understanding of the impacts of invasive alien vegetation on fire risk, biodiversity and water supply is improved.
Loss of biodiversity due to inappropriate placement of tourism and recreation infrastructure.	Behavioural Change / Threat Reduction	**Strategy 10:** Develop and implement a comprehensive, progressive and adaptive management plan to facilitate sustainable, responsible access and tourism.	**Objective 10.1:** By 2019 initial reserve specific carrying capacity (type, number and frequency) for all non-consumptive utilisation are set in line with sensitivity analysis and detailed zonation scheme (science based).

Threat(s) abated	Strategy Type	Strategy	Objectives
Impacts on biodiversity due to inappropriate location, frequency and size of events. Vandalism to artificial historical structures. Impacts on the environment due to irresponsible environmental management.	Actions; Enabling Conditions		**Objective 10.2:** By 2020 sustainable access* for a diversity of spiritual and cultural uses is determined, agreed upon, communicated and implemented. *Where, what, how much, frequency and compliant.
			Objective 10.3: By 2025, if needed, update reserve specific carrying capacity (type, number and frequency) for all non-consumptive utilisation are set in line with sensitivity analysis and detailed zonation scheme.
			Objective 10.4: By 2028, a Conservation Development Framework that aligns future development (commercial and non-commercial) with zonation of the Boland Mountain Complex has been drafted and implemented.
The negative impact of Invasive alien vegetation on fire regime, biodiversity and water availability. Inappropriate Fire Regime due to anthropogenic causes. Direct and indirect impacts on biodiversity due to poaching of fauna. Loss of biodiversity due to poaching of flora for subsistence and commercial use.	Threat Reduction Actions; Enabling Conditions	**Strategy 11:** Secure and protect conservation worthy areas surrounding the Boland Mountain Complex.	**Objective 11.1:** By 2029, all forestry exit areas identified as a priority for CapeNature are secured and NEM: PAA compliant.

3 PROTECTED AREA COMPLEX OVERVIEW AND BACKGROUND

3.1 Legal Status and Designation

The Boland Mountain Complex was inscribed as World Heritage Site by the World Heritage Convention, UNESCO (United Nations Educational, Scientific and Cultural Organisation) in 2004 and extended in 2015. This World Heritage Site is made up of four protected area complexes and several unprotected state-owned land portions covering in total 131 266.66 ha and forms part of the Cape Floral Region Protected Areas World Heritage Site, a serial site in the Western Cape Province, South African (Bonn 2015).

The Cape Floral Region Protected Areas World Heritage Site as inscribed in 2004 was proclaimed in terms of the World Heritage Convention Act, 1999 in Government Gazette no. 31832, proclamation 72 of 30 January 2009. The extension still needs to be proclaimed in terms of the above act.

The Boland Mountain Complex comprises the following (Land parcels indicated with an asterisk was inscribed as part of the World Heritage Site in 2004):

Provincial Nature Reserves:
Assegaaibosch Provincial Nature Reserve: The reserve was established in terms of section 6(1) of the Nature Conservation Ordinance, 1974, on 12 April 1994 and proclaimed in the Provincial Gazette of May 1994 by Proclamation No. 37/1994.

Rooisand Provincial Nature Reserve*: The reserve was established in terms of Section 6 of the Nature Conservation Ordinance, 1974, on 25 October 2002 and proclaimed in the Provincial Gazette of 20 November 2002 by Proclamation No. 21/2002.

Brodie Link Provincial Nature Reserve*: This reserve was established in terms of Section 6 of the Nature Conservation Ordinance, 1974, on 20 February 2002 and proclaimed in the Provincial Gazette of 15 March 2002 by Proclamation No. 5/2002.

Voëlvlei Provincial Nature Reserve*: This reserve was established in terms of Section 6 of the Nature Conservation Ordinance 1974 in April 1994 and proclaimed in the Provincial Gazette by Proclamation No. 37/1994.

Forest Act Nature Reserves:
Hottentots Holland Nature Reserve (including Jonkershoek)*: This reserve was proclaimed a Forest Nature Reserve in March 1979 in Government Gazette No. 6348. These portions were demarcated as State Forest under the Forest Act, No. 122 of 1984, but have been released from demarcation in terms of government notice 596 of 2006 and need to be proclaimed a protected area in terms of the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEM: PAA).

State President's Proclamation No. 97 of 1992, in Government, assigned legal responsibility for these areas to the Administrator of the Cape. Gazette No. 14246 of 21 August 1992.

Ex-State Forests (previously declared State Forest but now released):
The Kogelberg State Forest*: This reserve was demarcated as State Forest in terms of the Forest Act, (Act No. 122 of 1984) but released in terms of Government Notice No. 1388 dated 17 June 2005

Hawequas State Forest (Limietberg Nature Reserve)*: This reserve was demarcated as State Forest in terms of the Forest Act, (Act No. 122 of 1984) but released in terms of Government Notice No. 1388 dated 17 June 2005

Waterval State Forest*: This reserve formed part of the Kluitjieskraal Forest Station that was established in 1874 on the farms Kluitjieskraal and Knolvlei in the Tulbagh Valley and was designated as a State Forest before it was proclaimed a Natural Heritage site in February 1996, site no. 234. It has been released form State Forest demarcation in terms of Government notice No. 596 of 2006.

State President's Proclamation No. 97 of 1992, in Government, assigned legal responsibility for these areas to the Administrator of the Cape in Gazette No. 14246 of 21 August 1992.

These properties need to be proclaimed as protected areas in terms of the NEM: PAA.

Unproclaimed State land:
Farm Hangklip 559 portion 186 in the district of Caledon (Western Cape Nature Conservation Board: Buffelstal)* is unproclaimed and zoned agriculture and is included in the World Heritage Site.

Helderberg* (farm 721 in the district of Stellenbosch) and Simonsberg (farm 967 in the district of Paarl): These are unproclaimed State owned properties managed by CapeNature as part of the Hottentots Holland Nature Reserve Complex and are included in the World Heritage Site.

Farm 858* as well as the remainders of farms 851*, 852*, 859*, and 860* in the district of Stellenbosch are not included in the Hottentots Holland Nature Reserve, but managed as part of it. They are included in the World Heritage Site.

The above properties still need to be proclaimed as protected areas in terms of NEM: PAA.

Unproclaimed land owned by World Wildlife Fund and managed by CapeNature in terms of an agreement:
Farm Hangklip 559 portions 115, 161, 165, 160, 163, 164, 168, 159 and 169 (WWF-SA: Hangklip) are unproclaimed and zoned agriculture and need to be proclaimed as protected area terms of NEM: PAA.

State Forest not included in the Boland Mountain Complex:
Riebfor Forest Reserve (Kasteelberg): This State Forest is managed by CapeNature as part of the Waterval Nature Reserve, but is not included in the World Heritage Site. It is, however, included in this management plan for management purposes.

Section not included in this management plan:
The Northwestern section of the Theewaterskloof dam, which is covered by water when full is included in the World Heritage Site proclamation, but not managed in terms of this management plan. It is managed by the Department of Water and Sanitation in terms of the Theewaterskloof dam Resource Management Plan.

3.1.1 World Heritage Site

The World Heritage Convention Act, 1999 (Act 49 of 1999) provides for the enforcement and implementation of the convention and for the registration of World Heritage sites in South Africa. The primary mission of the World Heritage Convention is to define and conserve the world's heritage, by drawing up a list of sites whose outstanding universal values should be for all humanity and to ensure their protection through a closer co-operation among nations.

The Boland Mountain Complex was inscribed as a World Heritage Site by the World Heritage Convention, UNESCO in 2004 and extended in 2015 as part of the Cape Floral Region Protected Areas World Heritage Site. The latter comprises a serial property of eight protected areas covering a total area of approximately 557 584 ha, and included 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 (DEAT 2015).

The Boland Mountain Complex is supported and buffered by a wide network of adjacent or surrounding conserved areas ranging from Provincial Nature Reserves to Private Nature Reserves, Stewardship sites and Mountain Catchment Areas. The UNESCO-registered Kogelberg and Cape Winelands Biosphere Reserves, which surrounds and includes the Kogelberg, Limietberg, Waterval and Jonkershoek Nature Reserves form part of the extensive buffer and buffering mechanisms for the southern part of this large complex.

Moreover, the CFR World Heritage Site satisfies two criteria for the inscription into a World Heritage Site. First, the CFR is considered to be of outstanding universal value in that it represents outstanding examples of significant ongoing ecological and biological processes in the evolution of terrestrial ecosystems and plant communities (Criterion (ix), refer to DEAT 2003). The CFR World Heritage Site forms a centre of active speciation where interesting patterns of endemism and adaptive radiation are found in the flora. In addition, the southwestern Cape represents a distinct zoogeographic zone, characterised by the phylogenetic antiquity of much of its invertebrate fauna. In addition to the natural processes of primary production, nutrient recycling, climatic extremes, predation and herbivory, competition, and major natural episodic events such as severe floods and droughts, the Cape flora is dependent on natural fire regimes and specialised pollination guilds (refer to DEAT 2003: Appendix 1 for a synthesis of these aspects). With the exception of nutrient cycling by termites (which is largely restricted to Renosterveld), the ecological and biological processes in evolution (described in DEAT 2003: Appendix 1), are relevant and applicable throughout the entire CFR. That is, they are equally important in all of the individual natural properties that make up the CFR inscribed and Extension Nomination sites.

Although physically small, the CFR World Heritage Site contains the most important and significant natural habitats for *in situ* conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science and conservation (Criterion (x), DEAT 2003). The CFR is one of the richest areas for plants when compared to any similar-sized area in the world. It represents less than 0.5% of the area of Africa but is home to nearly 20% of the continent's flora. The outstanding diversity, density and endemism of the flora are among the highest worldwide. Some 69% of the estimated 9 000 plant species in the region are endemic, with 1 736 plant species identified as threatened and with 3 087

species of conservation concern. The Cape Floral Region has been identified as one of the world's 35 biodiversity hotspots.

3.2 Location, Extent and Highest Point

The Boland Mountain Complex is situated in the Western Cape, South Africa, between latitudes 18º 45′ S and 19º 30' S and longitudes 33º 30' E and 34º 30' E. The Complex is approximately 131 255.66 ha in extent. The Complex lies approximately 120 km northeast of Cape Town and stretches from Sir Lowry's Pass and Bot River to Nuwekloof Pass (South – North). The main access route to the Boland Mountain Complex is through the N2 and R44 on the Southern part of the complex and through the R44 on the Northern part of the complex.

The Boland Mountain Complex forms part of the Theewaterskloof Dam, Berg River, Brandvier Dam and Voëlvlei Dam mountain catchment areas and provide water to the Overberg, Cape Winelands, City of Cape Town, West Coast, and most of the towns and settlements of the surrounding local municipalities.

The altitude in the Boland Mountain Complex ranges between 368 m (lowest peak) and 1994.7m (highest peak – Du Toits Piek)

The Boland Mountain Complex location is shown in Map 1 and the land parcels of which the complex consists of are listed in Appendix 1.

3.3 Administrative Context

In terms of the Municipal Systems Act (Act 32 of 2000) local municipalities in South Africa are required use integrated development planning to plot future development in their area. An Integrated Development Plan (IDP) is a 5-year strategic plan in which the municipal strategic and budget priorities are set.

An IDP is intended to be the principal strategic instrument to inform planning and development within a municipality. It should co-ordinate the work of local and other spheres of government and must take into account the existing conditions, constraints and resources available. Among other things, the IDP should address how the environment will be managed and protected. Among the key components of an IDP are disaster management plans and a Spatial Development Framework (SDF). SDFs are essentially the spatial reflection of a municipality's IDP.

A SDF is updated every five years and must indicate the desired patterns of land-use for the municipality and provide strategic guidance regarding the location and form of development, as well as conservation, within the municipality. A SDF must include basic guidelines for a land-use management system for the municipality and should be used to guide changes in land-use rights and public investment in infrastructure.

The local municipalities are responsible for producing and co-coordinating IDPs and SDFs, but they must consult other stakeholders in the area who can impact on and/or be impacted on by development and other changes in the area. All government departments working in the area should refer to the IDP to ensure their work is aligned.

In essence SDFs and IDPs are tools for integrating social, economic and environmental issues and development within a municipality. As biodiversity is a fundamental component of sustainable development, SDFs and IDPs offer an opportunity to ensure that biodiversity priorities are incorporated into planning

processes. In turn, the identification of biodiversity-related projects for the IDP can support local economic development and poverty alleviation.

The Boland Mountain Complex falls within four district municipalities: the Cape Winelands District Municipality (Jonkershoek and Limietberg Nature Reserves), the Overberg District Municipality (Kogelberg and Hottentots-Holland Nature reserves), the West Coast District Municipality (Kasteelberg Nature Reserve) and the City of Cape Town District Municipality.

Cape Winelands District Municipality
The Cape Winelands District Municipality includes Witenzenberg, Drankenstein, and Stellenbosch Local Municipality. The IDP and SDF for the Cape Winelands District Municipality run on a five year delivery cycle (4th generation IDP 2017/18-2021/22).

West Coast District Municipality
Kasteelberg, which also forms part of the Waterval Nature Reserve, falls in the West Coast District Municipality (Swartland Local Municipality) and they run on a five year cycle, and their current cycle of Integrated Development Plan is for 2017 – 2021 (Draft V;1 March 2017).

Overberg District Municipality
Overberg District Municipality includes Kleinmond and Grabouw municipalities (4th Generation IDP 2017-2022).

City of Cape Town
This district municipality includes the Helderberg basin (Somerset West, Strand and Sir Lowry's Pass Village) (Five Year Integrated Development Plan 2017-2022).

3.4 Internal Rules

In terms of the National Environmental Management: Protected Areas Act (NEM: PAA) (Act No. 57 of 2003), as Amended in Act No. 31 of 2004, Section 52, the management authority of a nature reserve or world heritage site may, in accordance with prescribed norms and standards, make rules for the proper administration of the area.

Rules made must be (1) consistent with the Act and the Management Plan for the area; (2) bind all persons in the area, including visitors and (3) may, as a condition for entry, provide for the imposition of fines for breaches of rules.

The internal rules are drafted in terms of Section 52 of the NEM: PAA (Act No. 57 of 2003) and Regulations for the Proper Administration of Special Nature Reserves, National Parks and World Heritage Sites (Government Notice No. 1061, Gazette No. 28181) for the proper administration of the Boland Mountain Complex.

In addition to the NEM: PAA (Act No. 57 of 2003), the Nature Conservation Ordinance (No. 19 of 1974) and Provincial Notice (No. 955 of 1975) as well as Regulations 1111 (Government Notice No. 1829, Gazette No. 25844) of the Marine Living Resources Act (No. 18 of 1998) have been consulted to set the internal rules for the Boland Mountain Complex.

Definitions and expressions used in this section of the Protected Areas Management Plan, carry the same meaning as expressed in the Act and Ordinance.

Reference to the Protected Area or Reserve or Complex includes the Proclaimed Nature Reserve, Protected Area or World Heritage Site as applicable to this Protected Area Management Plan.

3.5 History of the Boland Mountain Complex

The Boland Mountain Complex has a well-documented history due to its close location to Cape Town, which was the hub of growth and economy since 1652. The area has been inhabited by humans for at least 10 000 years and all the sections of the Boland Mountain Complex have names steeped in human history.

Kogelberg in the south, with its magnificent coastline and towering peaks so close to the sea was named after Koeëlberg, one of the mountain peaks. Early explorers ventured into these mountains and reported on its unusual beauty, biological diversity and wildlife. No towns or villages were established, as the landscape was considered far too wild and inaccessible for farming. The Kogelberg region remained almost pristine for 200 years until, in the early 19th century, the whole area was designated "Crown Land" by the government of the Cape Colony. Over a hundred years later, in 1935, the rugged area finally became accessible when a road was built. This brought about rapid change as the Department of Forestry took over the region in 1937 and declared its intention of using the area for state timber plantations.

The Hottentots Holland Mountains were named after the Khoisan people who were already living here when the Europeans arrived. The mountains were originally called the “Mountains of Africa” but when it was discovered that the Khoisan were living in the area, the name was changed to Hottentots Holland (Hottentots being a generic name for the non-Europeans living in the Cape at the time, and Holland for the country of origin of the new arrivals in the Cape).

The name Jonkershoek is said to come from the 17th-century owner of one of the freeholds that Simon van der Stel issued in the valley, Jan Andriessen. He had been a bachelor midshipman and was also known as Jan de Jonkheer. He named his grant of land “Vallei Jonkershoek”.

Limietberg, named after the Limietberg Mountains with its central town being Paarl, was considered the limit of exploration as even the most advanced trek wagons could not make it over the mountains into the interior.

The northern-most section of the Boland Mountain Complex is Waterval Nature Reserve, named after the natural waterfall at the reserve offices. The area was one of the few areas where access to the interior was relatively easy though the Nuwekloof pass.

All sections of the Boland Mountain Complex have two things in common. They were all established to support the forestry industry and to provide water to the City of Cape Town and surrounds. After World War II, most people were unemployed due to the financial burden of fighting the war and the South African government decided to demarcate “Crown land” for forestry to create employment for those returning from the war and those suffering under the lack of financial resources. Vast tracts of land were planted with pine trees and these plantations proved to be the saving grace of an entire group of people who survived for the next 80 years off the industry. However, these plantations have turned into a significant environmental problem as they diminish water yield in these catchments.

A “sustained yield of fresh water” was the motto behind the establishment of a vast dam and pipeline network that criss-crosses the Boland Mountains transporting water from one catchment to another and ultimately to reservoirs that feed the city of Cape Town and surrounding areas as far north as Saldanha and Langebaan. There are five major dams that feed Cape Town and they all fall within the Boland Mountain Complex. The Steenbras Water Scheme, built from 1918 – 1921, was the first dam to be established to supply Cape Town. CapeNature is therefore responsible for conserving an entire world biome and keeping the taps running for over 4.1 million people in the Cape Metropole and surrounding municipalities.

3.6 Cultural Historic Heritage

Before the settlement of the Cape of Good Hope (Cape Town) was established, nomadic groups of people called the Khoi Khoi and San sparsely populated the Boland Mountains. Depending on where they were living, they fed off the land and the sea further south. Stone implements found in the area suggest that these indigenous people inhabited the Boland Mountains for more than 10 000 years. They had their own names for the mountains, such as Hawequa, Obiqua and Sonqua. These mountains were named after the different tribes that inhabited the areas at the time. The Cochoqua people lived in the Paarl/Stellenbosch area and were cattle-herders people. They were among the richest of the Khoi tribes. Shell middens and burial areas can still be found on the coast between Rooiels and Hermanus showing that these hunter-gathers were very active in the area.

Rock art has been found in numerous sites within the Boland Mountain Complex with many more likely still undiscovered. According to anthropologists and archaeologists the paintings within the caves showed their emotional despair experienced during the time that they watched the European settlers moving into their areas and establishing towns and settlements.

Around 2 000 BP pastoral people, the Khoikhoi herders, moved into the area with sheep and cattle, and burnt the vegetation on a regular basis to provide pastures (Barnard 1992). Historical records show that these burns were carried out in late summer (*e.g.* Mossop 1927). These herders may have pushed the San into habitats that are more marginal so that they permanently occupied the mountains and in turn changed the fire regime through regular patch burning (Sugden and Meadows 1990)

People have influenced the incidence of fire in fynbos (Deacon 1986). Archaeological evidence suggests that Khoisan hunter-gatherers (Parkington 1977) who populated the fynbos biome since 10 000 BP, used fire stick farming to encourage natural fields of geophytes (Deacon 1992), and to attract herbivores to palatable fresh plant growth (Parkington 1977). The practise of fire stick farming in the fynbos at least since the Late Pleistocene is thought to have resulted in a significant increase in the incidence of fires over that of the natural fire regime.

3.7 Biophysical context

This section reflects the ecological conditions of Boland Mountain Complex. The Cape Floral Region, including the Boland Cluster World Heritage Site has been recognised as one of the most special places for plants in the world in terms of diversity, density and number of endemic species. The region is a highly distinctive phytogeographic unit which is regarded as one of the six Floral Kingdoms of the world and is by far the smallest and relatively, the most diverse. It has been acknowledged as one of the

world’s ‘hottest hotspots' for its diversity of endemic and threatened plants, and contains outstanding examples of significant ongoing ecological, biological and evolutionary processes.

The region's exceptional species diversity (Fig. 3.1) is a result of its wealth of different habitats, each with its own topography, soils and climatic conditions - from the high mountains stretching from the north to the coastal plain in the south, unique wetland and river systems and forest remnants, and as a result providing good connectivity and landscape integration.

The extraordinary assemblage of plant life and its associated fauna as represented by the Boland Mountain Complex covers an area of more than 200 000 ha. These protected areas also conserve the outstanding ecological, biological and evolutionary processes associated with the beautiful and distinctive Fynbos vegetation, unique to the Cape Floral Region. Of particular scientific interest are the adaptations of the plants to fire and other natural disturbances; seed dispersal by ants and termites; the very high level of plant pollination by insects, mainly beetles and flies, birds and mammals; and high levels of adaptive radiation and speciation. The pollination biology and nutrient cycling are other distinctive ecological processes to be found.

Figure 3.1. The exceptional biodiversity of the Boland Mountain Complex.

Invasive alien species and fire are the greatest management challenges facing the protected area network at present. Longer-term threats include climate change and development pressures caused by growing human populations in the region. Knowledge management systems must be expanded to advise improved planning and management decision-making, thus facilitating the efficient use of limited resources.

3.7.1 Climate and weather

Occasional snowfalls occur on the high peaks in Boland Mountain Complex during winter (Fig. 3.2). Low-pressure systems during the winter months precede a northwest wind, which bring cold wet weather. High-pressure systems during the summer months cause the dominant southeast winds which may get to gale force. These southeast winds are dry and influence the fire risk considerably by desiccating the vegetation. In the coastal regions the southeasterly can provide some relief from this intense heat, in the form of moisture-laden air, pushed up from the ocean by the southeasterly gales, providing misty conditions that cool and humidify the higher mountain slopes and plateaus and help maintain wetlands and streams (and all their associated biota) throughout the dry, hot summers.

The Boland Mountain Complex winter weather is dominated by the arrival of successive frontal systems that bring lower temperatures and pressures and often leading to rain. High-pressure systems (anti-cyclone winds) dominate the summer months with warm, dry and windy conditions. The average maximum temperature ranges from the low thirties in February to the high teens in July. The average minimum temperature ranges from low teens in February to just above 0 ^{o}C in July (See Figure 3.3a).

The rainfall in the area averages between 500 mm in the northern parts and as much as 1500 mm per annum in the southern sections. The northern sections can experience thunderstorms in the summer months which can result in lightning strikes that start fires (See Figure 3.3b). The top of Dwarsberg at the back of the Jonkershoek valley holds the distinction of recording the highest annual rainfall in South African namely 3 620 mm.

Figure 3.2. Occasional snowfalls on the high lying mountain peaks in the Boland Mountain Complex. Photos by Cape Canopy Tours.

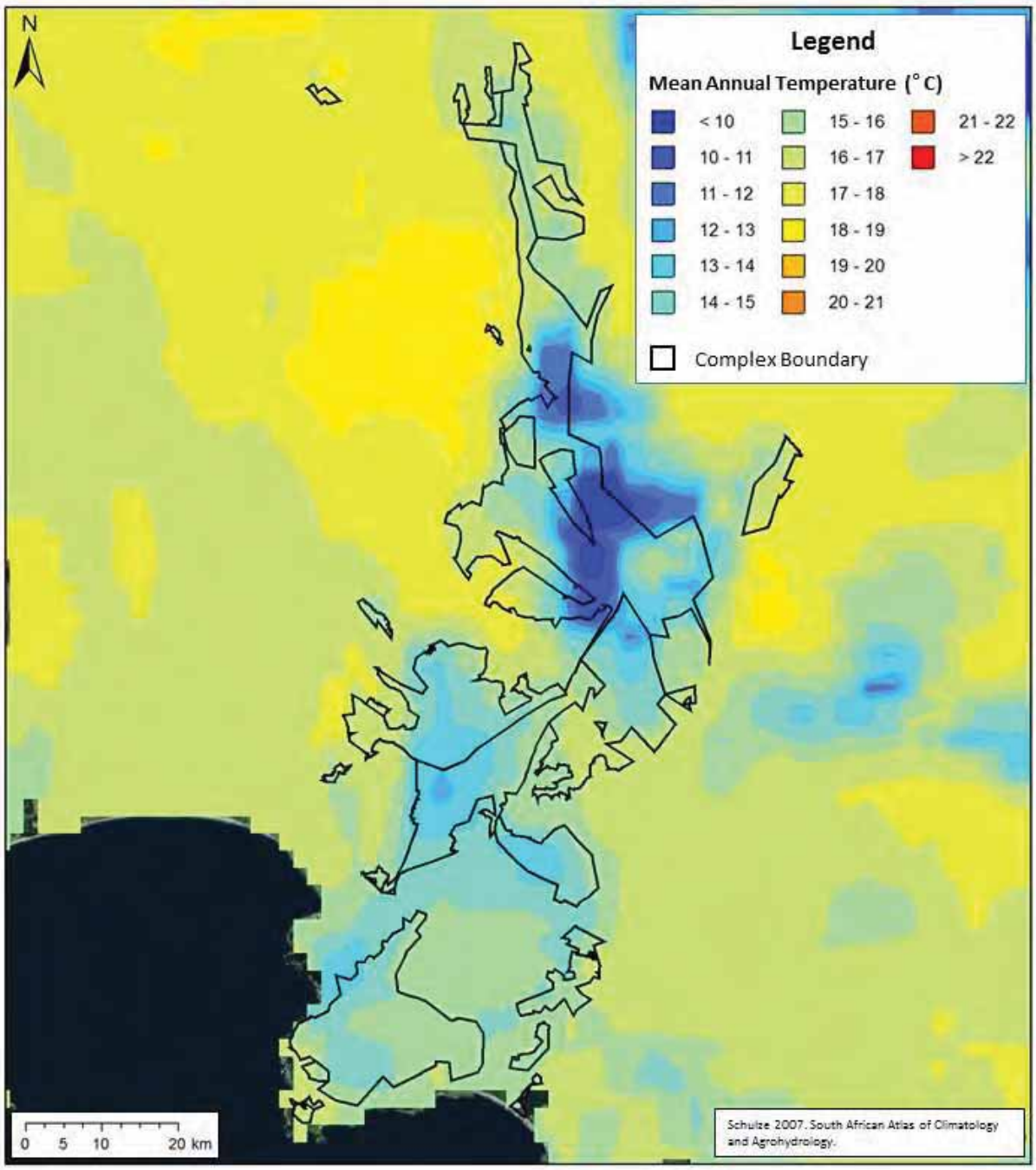

Figure 3.3a. Mean annual temperature of the Boland Mountain Complex.

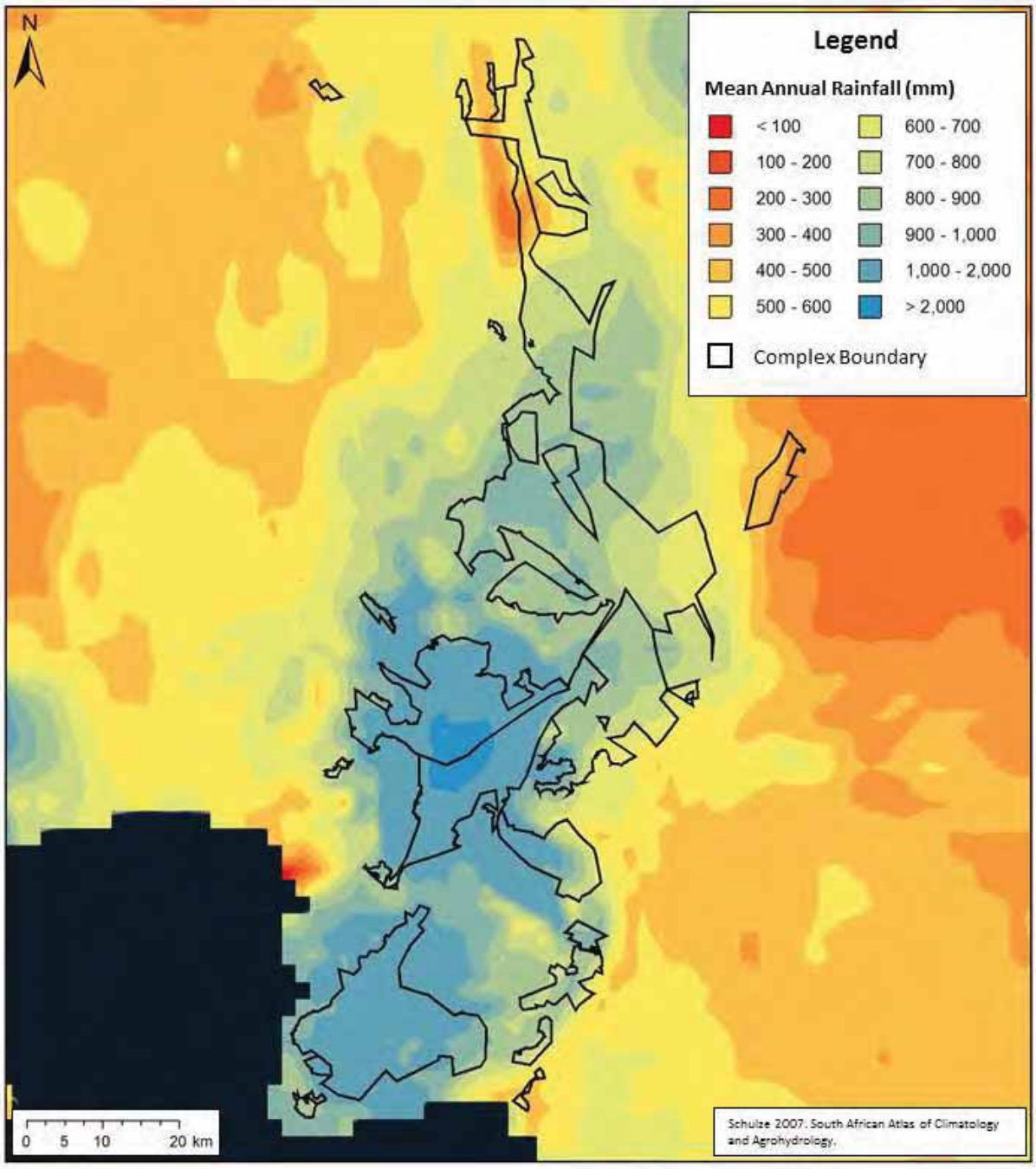

Figure 3.3b. Mean annual rainfall of the Boland Mountain Complex.

3.7.2 Edaphic factors

3.7.2.1 Topography

High peaks and rugged mountainous terrain dominate the landscape of the Boland Mountain Complex (Fig. 3.4). Some of the high points are Kogelberg Peak (1 269 m), Five Beacon Ridge (1 080 m), Sanctuary Peak (1 051 m), Buffelstalberg (844 m), Voorberg (862 m) and Platberg (909 m). These features surround the Palmiet, Dwars and Louws rivers, which are open kloofs without lateral krantzes or high waterfalls.

This creates an unusual central valley system effectively isolated from the surrounding developed environment.

Figure 3.4. The rugged mountainous terrain dominating the landscape of the Boland Mountain Complex. Photo by Corlie Hugo.

3.7.2.2 Geology

In the Hottentots Holland mountain range the most striking of the shale landforms are the dome summits of Victoria peak (1 589 m), Somerset-Sneeukop (1 590 m), and the Triplets (1 515 m). These peaks, together with the contrasting angular summits of the Twins (Die Pieke) (1 500 m) and the Rifberg (1 525 m), are the highest in the area. Map 2 depicts the topography of the Boland Mountain Complex.

The highest peak in the Boland Mountain Complex is Du Toits Piek at 1 994.7 m in the Limietberg Nature Reserve Complex.

The landforms of the Boland Mountain Range were formed by warping and folding of a landscape that was previously largely layers of sedimentary deposits. These processes ended at the end of the Cretaceous period. To the north and east, the mountains overlay Cape granite which is exposed in several places. This results in a convoluted and undulating appearance in the landscape and aids the development of yellowish and reddish soils. This type of soil is heavier and more nutrient rich than that in other areas where most soil is derived from sandstones. The sedimentary layers of the Table Mountain Group formation overlay the above-mentioned formations and dominate the landscape (Kruger 1983). The oldest of these is the Peninsula Formation, which is up to 1500 m thick hard, grey sandstone and quartz, which form

the prominent cliffs throughout the range from the Franschhoek peaks to the escarpments in the Banghoek area and the Hottentotts Holland Complex Mountains to Somerset West (Kruger 1983). This is followed by the Pakhuis Formation, a small band of tillite, which was formed by material deposited by glacial action 400 million years ago. The tillite contains large amounts of water-washed quartz stones. Soft shales of the Cedarberg Formation overlay the tillite. These shales are susceptible to weathering and allow exposure of the underlying layers in a landscape that is relatively resistant to erosion (Kruger 1983).

Most of the mountains are primarily composed of sandstone. These rock formations are poor in nutrients and result in very acidic, leached soil which drains freely. Associated features of this substrate are the formation of swamps and the noticeable brown or tea-coloured discolouration of the water. This colour discrepancy differs from the clear water of westward- and southward-flowing rivers (Kruger 1983). The southerly flowing streams have brown coloured water whereas the northerly flowing streams carry clear (so-called white) waters. This discolouration is from organic leachates (*e.g.* tannins).

Table 3.1 shows the lithostratigraphy of the Boland Mountain Complex.

Table 3.1. Lithostratigraphy of the Boland Mountain Complex (with courtacy from the Council of Geoscience).

Supergroup / age	Group/age	Subgroup	Formation	Description	Map code
Cenozoic				Light-grey to red sandy soil	Q30
				Brackish, calcerous soil	Q31
				Loam and sandy loam	Q46
	Quaternary			Alluvium	Q-a
				Alluvium, gravelly	Q35
				Scree/ Talus/ Alluvium grading into Piedmont gravel	Q39
				Gritty sand	Q43
				Gravelly clay	Q45
	Sandveld		Witzand	Generally unconsolidated, calcareous dune sand	Qwi
	Bredasdorp		Strandveld	Unconsolidated dune sand	Qst
				Ferricrete	Q-f
				Silcrete	Si
	Tertiary			River terrace gravel	T1
			Grahamstown	Silcrete	Tg
Cape	Witteberg	Lake Mentz	Floriskraal	Micaceous, grey or red-weathering shale and up to four quartzitic sandstones	Cf
			Kweekvlei	Dark shale	Ckw
			Waaipoort	Dark grey, silty mudrock, subordinate "dirty", fine-grained, feldspathic sandstone	Cw
			Witpoort	Quartzitic sandstone, subordinate mudrock	Dwi
			Swartruggens	Shale, siltstone, quartzitic sandstone	Dsw
		Weltevrede	Blinkberg	Quartzitic sandstone, siltstone	Dbb
			Wagens Drift Member	Shale, siltstone, quartzitic sandstone	Dwa

	Bokkeveld	Bidouw	Klipbokkop	Mudrock, siltstone, sandstone	Dkl
			Wuppertal	Micaceous sandstone, siltstone	Dwu
			Waboomberg	Dark grey mudrock, siltstone, quartz wacke	Dwb
		Ceres	Boplaas	Sandstone, minor siltstone and mudstone	Dbo
			Tra-Tra	Mudstone, siltstone, subordinate sandstone	Dtr
			Hex River	Feldspathic arenite, wacke, mudrock	Dh
			Voorstehoek	Grey shale, siltstone and fine-grained sandstone	Dv
			Gamka	Fine-grained, feldspathic sandstone, subordinate mudrock	Dga
			Gydo	Mudrock, siltstone	Dga
	Table Mountain	Nardouw	Rietvlei	White, siliceous, feldspathic sandstone, subordinate mudrock in places	Dr
			Skurweberg	Thick-bedded, medium- to coarse-grained, cross-bedded, white-weathering, quartzitic sandstone	Ss
			Goudini	Brownish-weathering, quartzitic sandstone, subordinate shale and siltstone	Sg
			Cedarberg	Shale, siltstone, subordinate sandstone	Oc
			Pakhuis	Mudstone (diamictite) or sandstone containing scattered pebbles, cobbles and boulders	Opa
			Peninsula	Quartzitic sandstone, minor conglomerate and shale	Op
Cambrian				Metadolerite	Mdo
				Dolerite / diabase	do

	Cape Granite Suite			Quartz porphyry, sheared in places;pink veldspar	N-C3
			Kuils River Pluton	Granite	N-Ck
			Paarl Pluton	Granite	N-P
			Wellington Pluton	Granite	N-W
			Stellenbosch Pluton	Granite	N-Cs
	Klipheuwel		Magrug	Conglomerate, sandstone, minor shale	Cm
	Malmesbury		Franschhoek	Quartzite, conglomerate, slate	Nfr
			Tygerberg	Shale, greywacke, quartzite, minor volcanic rocks	Nt
		Swartland	Moorreessburg	Greywacke, phyllite, schist, limestone	Nmo

Map 3 depicts the geology and soils of the Boland Mountain Complex.

3.8 Biodiversity Context: Ecosystems

3.8.1 Freshwater Ecosystems

As a result of its mountainous terrain and relatively high rainfall and resulting high water yield (Nel *et al*. 2011a), the Boland Mountain Complex is classified as a strategic water source area (WWF 2013 a & b) (Map 4). It provides good quality water for the Cape Metropolitan Area as well as for extensive areas on richer soils in the upper catchments. These areas of richer soils are under deciduous fruit orchards (some 25% of the catchment) grown for export and domestic use.

The headwaters for both the Berg and the Breede Water Management Areas (WMAs) are located in the Boland Mountain Complex, as well as the headwaters of the Eerste, Lourens, Steenbras and Palmiet rivers, and the tributaries of the Klein-Berg River. The protected area complex also forms part of the catchment for some of the Western Cape's major dams. These include the Voëlvlei Dam (Waterval and Limietberg Nature Reserves), the Brandvlei and Stettynskloof dams (Limietberg Nature Reserve); the Wemmershoek Dam, the Berg River Dam, the Steenbras Dam the Theewaterskloof Dam (Hottentots Holland Nature reserve). Some of the main-stem rivers that feed these dams include the upper catchment of the Riviersonderend River (or the Sonderend River), the upper Berg River and the Steenbras River. The Palmiet River system, which originates in the Hottentots Holland Nature Reserve, feeds a total of six regional dams, including Nuweberg and Eikenhof dams, before it enters the Kogelberg Nature Reserve. In addition, this lower section of this river is considered to be one of the highest quality lower foothill rivers in sub-Saharan Africa.

A mosaic of wetland types, including for example the sensitive hillslope seeps and valley-bottom wetlands, form part of the freshwater ecosystems found within the protected area complex. Some 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 within the Boland Mountain Complex, with a degree of intrusion by alien invasive plant species.

The freshwater ecosystems and their buffer zones, contained within the protected areas also provide important refuge areas for the species that utilise these ecosystems.

Pressures on the hydrological functioning of the aquatic systems in these catchments include the ever-increasing water demands for the City of Cape Town (CoCT) and other local municipalities. The Department of Water and Sanitation together with the CoCT Municipality have investigated both surface water and groundwater options for the augmentation of water provision for the city (Frame & Killick 2004). 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. See section 3.7.3.1 below on groundwater for further detail.

An integrated and consultative Catchment Management Plan (CMP) for the Palmiet River has been developed. The CMP provides a framework for integrating objectives for the larger Palmiet River catchment with those of the Kogelberg Nature Reserve Complex. The CMP further requires the setting of objectives, indicators and ongoing monitoring to ensure management towards the desired (ecologically sustainable) future state of the river and its catchment. Previous management of the catchment and especially the middle reaches of the Palmiet system has had a negative impact on the ecology of the river systems in the Kogelberg area.

Generally, the rivers and wetlands located within the Boland Mountain Complex boundaries are found to be in a near-natural or natural condition. These systems provide clear, good quality water, together with intact habitats for the numerous indigenous floral and faunal species that depend on these systems. They serve as corridors for movement and it is here were care should be taken with any development near these ecosystems within the boundaries of the Boland Mountain Complex.

For most of these freshwater ecosystems, important factors regarding catchment management include the clearing of invasive alien plants within the Boland Mountain Complex boundaries, specifically within riparian zones and wetlands. Clearing of the invasive alien plants is also important in any mountain catchments adjacent to the protected area sites. The conservation of the recharge potential of these catchments to not only the surface water ecosystems, but very importantly also the aquifers underlying and extending from these mountain catchments is becoming more important, mainly due to an increase in water demand outside of the Boland Mountain Complex and protected areas boundaries. Beyond the boundaries of the Boland Mountain Complex, there are several more factors that have an impact on the freshwater ecosystems. In some cases, rivers are blocked to some degree by the presence of diversion weirs just outside of the protected area boundary. These weirs

tend to block off all the natural flow during the dry summer months and divert it to for instance farm dams. The lowland sites are also under increased threat from over-abstraction of water and land-use activities within the rivers and wetlands and their buffer zones.

Another general and significant threat to freshwater ecosystems and water provision are the impacts associated with climate change. Mitigation for the effects of climate change is difficult and here adaptive management that is informed by thorough monitoring, including the collection of rainfall and ambient temperature data, is of the utmost importance. Rainfall data in particular are important, as this data can 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).

3.8.1.1 Groundwater/Aquifer

The groundwater systems associated with the Boland Mountain Complex generally fall within the Table Mountain Group (TMG) aquifers, which extend from near Niewoudtville in the northwest, southwards to Cape Agulhas and eastwards toward Port Elizabeth (Frame & Killick 2004) (see Maps 4a and 4b). The TMG aquifer system is considered to have a fractured nature, with compact areneous 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. Within the TMG, four of the eight formations form the fractured aquifers, including the Peninsula and Skurweberg, as well as the Piekenierskloof and Rietvlei Formations (Colvin *et al*. 2009). Of these, the Peninsula Formation has the highest potential for recharge due to where it is situated topographically in the high mountain ranges and summits in the general area, where precipitation levels are higher (Colvin *et al*. 2009). The Skurweberg Formation "sub-aquifer" on the other hand receives less precipitation due to its location in the lower hillslopes and lower-ranges. 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 (near the contact with the Winterhoek aquitard) and are 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. Contributions to river base flow from this sub-aquifer is generally thought to be through direct inflow into an overlying river channel (Colvin *et al*. 2009).

When considering water supply, the TMG aquifers found to underlay the land parcels of the Boland Mountain Complex are considered to be major aquifer types, meaning that they are high-yielding systems of good quality water. In most cases the yields of these systems range between <0.5 - >5 l/s across the landscape. However, there are areas where the aquifer type is a mix between fractured and intergranular parts (sections of Assegaaibosch, Jonkershoek and Theewaterskloof which have some Cape Granite suite and Bokkeveld Group intrusion) where aquifer yield ranges between 0.1 – 0.5 l/s. This is reflected in the Department of Water Affairs Aquifer Vulnerability Map, where these aquifer systems are shown to be a major (high yielding

system of good quality water) groundwater source that is highly susceptible to contamination by anthropogenic activities in especially the lower lying areas within the catchment (DWAF 2000). Moreover, some areas are underlain by minor aquifers, which are moderately yielding systems of a more variable water quality. These systems are often moderately vulnerable to some pollutants, but only when it is continuously discharged or leached.

While most of the Boland Mountain Complex is underlain by TMG rock structures and associated aquifers and sub-aquifers, a section of the Theewaters Nature Reserve is underlain by the Bokkeveld Group, which itself overlays the TMG. This group mainly consists of fine sandstone and mudstones, unlike the hard, erosion resistant quartzite sandstones of the TMG. The aquifers of this group generally contain lower quality water, due to the higher saline properties of the shale-based mudstones. There is also some variance in the western sections of the Voëlvlei, Waterval and Wittebrug Nature Reserves, which are underlain to some degree by shales of Malmesbury Group sedimentary unit. The rock types contained in this group are fractured and weathered sedimentary rock and the water-bearing fractures are mostly restricted to the shallow zone, below the groundwater level.

Although there is some variance in the aquifer types contained within the Boland Mountain Complex, the TMG aquifers are prevalent. Additionally, the high rainfall in the mountain catchments of most of the Boland Mountain Complex leads to a high groundwater recharge in these areas and has been identified as such through the National Freshwater Ecosystem Priority Areas (NFEPA) project (see Nel *et al*. 2011a). Due to these characteristics, *i.e.* high yield of good quality water, the CoCT Municipality has investigated the feasibility of using water from the TMG aquifers (Kogelberg, Hawequa, Jonkershoek, Hottentots Holland and Theewaterskloof Nature Reserves) to augment the water supply for the city. Threats related to this are discussed in section 4.3.

3.8.1.2 Rivers

The Limietberg Nature Reserve lies on a catchment divide and thus include rivers from both the Breede and the Berg Water Management Areas (WMAs). There are three main rivers forming part of the Breede WMA on the Protected Area namely the Holsloot (Stettynskloof), the Smalblaar/Molenaars (Du Toitskloof) and the Witte (Bainskloof). The upper reaches of several rivers forming part of the Berg WMA also fall within the protected area. The upper reaches of the Koopmans, Kompagnies and Hugos Rivers lie towards Paarl/Wellington area, while upper reaches of the Drakenstein and Olifants rivers, as well as three tributaries of the Wemmershoek River, and fall within reserve boundaries upstream from the Wemmershoek Dam. The catchment areas for the Molenaars and the Witte River in the Breede WMA have been identified as National Freshwater Ecosystem Priority Areas (NFEPA's) (Nel *et al.* 2011a, b). The Witte River as well as the Krom River (one of the upper tributaries of the Molenaars River) provides sanctuary for threatened indigenous fish species, while the Molenaars/Smalblaar system is of high importance for good quality water and water yield. The sub quaternary catchment of the Holsloot River has also been identified as a phase 2 Freshwater Ecosystem Priority Areas (FEPA), meaning that it is important for future rehabilitation. The upper reaches of the Holsloot River, while not being formally identified as a fish sanctuary, is home to several indigenous fish species and is of importance for the conservation of these species.

In the Berg River WMA, the rivers of concern for indigenous fish conservation are the Drakenstein, Olifants and Hugos rivers, as well as the upper tributaries of the Wemmershoek River. The catchment areas of all these rivers have been identified as fish sanctuaries according to the NFEPA project (Nel *et al.* 2011a, b).

There are three major rivers flowing through the eastern portions (Berg WMA) of the Hottentots Holland Nature Reserve namely, the Berg River, Banhoek River and Eerste River (called the Jonkershoek River in the upper reaches) (Map 4a). Two other rivers originate in these sub-catchments, namely the Blouklip and Lourens Rivers. The Banhoek River flows into the Dwars River, which then joins with the Berg River. The Berg River discharges at Velddrift, along the West Coast. The Eerste River discharges at Macassar, on the False Bay Coast. On the Hottentots Holland and Theewaters Nature Reserves side of the catchment, two major river systems originate in the mountains. These are the Palmiet and the Riviersonderend Rivers, each of which has several associated tributaries (Map 4a). Table 3.2 shows the NFEPA and condition status of these mainstem rivers and their tributaries. A section of the Du Toits River that originates in the mountain catchment area just outside the boundary of the Hawequa Nature Reserve at Franschoek, also runs through the Hottentots Holland Nature Reserve in Franschoek pass. Other rivers that also originate in the Hottentots Holland Nature Reserve include the Steenbras River and Sir Lowry's River (Map 4b), and the Waterkloof and Bot rivers which flow from the Groenlandberg Nature Reserve (Table 3.2). The Jakkals River also originates from the Groenlandberg Nature Reserve, and flows through the kloof at Houwhoek pass. It joins the Bot River downstream of the Houwhoek kloof (Map 4b). The Bot River discharges into the ocean through an estuary, where the Rooisand Nature Reserve is located (Map 4b). The Bot River estuary has also recently been designated as a Ramsar site (17 January 2017; https://www.ramsar.org/wetlands/south-africa).

The Palmiet River (Fig. 3.5) enters the Kogelberg Nature Reserve a few kilometres downstream of the Transpalmiet Dam, the lowest of at least five instream and off-stream dams. All these dams and the land-use practices and urban impacts upstream of the protected area have had negative impacts on the ecological health and water quality of the Palmiet River. These conditions have been improved over the years due to the development of an integrated and consultative CMP for the river. The CMP provides a framework for integrating objectives for the larger Palmiet River catchment with those of the Kogelberg Nature Reserve. Once the river enters the Kogelberg Nature Reserve, there are very limited further anthropogenic impacts and it is joined by two pristine rivers with very good quality water, *i.e.* the Dwars and the Louws Rivers (Map 4b). As a result, the Palmiet River undergoes a rejuvenation of sorts within the protected area boundary. The Palmiet River discharges into the ocean through an estuary at Kleinmond. Furthermore, both the Rooiels and Buffels rivers originate in the Kogelberg Nature Reserve, with the former being one of the few free-flowing rivers (*i.e.* no dams along its entire reach) in the Western Cape Province (Nel *et al.* 2011a, b). The Rooiels River discharges into the ocean at the town of Rooiels. The Buffels River runs into the Buffelsrivier Dam at the Sonchem link to Kogelberg Nature Reserve from where it drains down and into the ocean at Betty's Bay.

Figure 3.5. The Palmiet River.

The rivers of the Waterval Nature Reserve mainly fall into the Breede River catchment, with some tributaries also running into the Klein-Berg River and the middle reaches of the Berg River. To the west of this complex, the upper parts of the Vis River drain into the middle Berg River from the Kasteelberg parcel. The northern tributary of the Koopmans River originates on the Waterval Nature Reserve, which also drains into the Berg River. The Watervals River drains the eastern slopes of the Waterval Nature Reserve and joins the Klein-Berg River, a major tributary of the Berg River.

Table 3.2. The NFEPA status and estimated health condition of the rivers of the Boland Mountain Complex, from north to south. Health scores are defined as follows; natural (A), good-natural (AB), good (B), fair (C), degraded (D).

Nature Reserve	River	Condition*	FEPA status	*River reach/type
Kogelberg	Palmiet	B	Fish sanctuary	Middle – lower
	Louws	A	Fish sanctuary catchment	Mountain stream – foothills
	Dwars	A	Fish sanctuary catchment	Mountain stream – foothills
	Rooi-els	AB	FEPA sub-catchment	Mountain stream
	Buffels	AB	Fish sanctuary	Mountain stream - foothills
Jonkershoek	Jonkershoek	A	FEPA sub-catchment	Mountain stream - foothills
	Swarboschkloof	AB	Upstream area	Mountain stream
	Lang	AB	Upstream area	Mountain stream
	Tierkloof	AB	Upstream area	Mountain stream

Nature Reserve	River	Condition*	FEPA status	*River reach/type
	Unnamed	AB	FEPA sub-catchment	Mountain stream
	Lambrechtsbos	AB	Upstream area	Mountain stream
	Bosboukloof	AB	FEPA sub-catchment	Mountain stream
	Blouklip/Blaauw klippen	A**	No FEPA status	Mountain stream
Assegaaibosch	Assegaaibosch	A***	Unknown	Mountain stream
	Lourens	AB	FEPA fish sanctuary	Mountain stream
	Dwars	C	FEPA fish rehab	Foothills
	Berg	AB	FEPA fish sanctuary	Foothills
	Banhoek	Unknown	Unknown	
	Wolwekloof	AB	FEPA fish sanctuary	Mountain stream
	Franschoek**	D	FEPA fish support	
Simonsberg	Klippies**	D		
Hottentots-Holland	Du Toits	AB	FEPA fish sanctuary	Mid-section
Theewaterskloof	Du Toits	AB	FEPA fish sanctuary	Mountain stream - foothills
	Elands	D		Foothills
	Riviersonderend	AB	FEPA fish sanctuary	Upper Sonderend
	Riviersonderend	C	FEPA fish sanctuary	Foothills
	Sir Lowry's Pass**	AB	FEPA fish support	Mountain stream
	Steenbras	B	FEPA fish sanctuary	Mountain stream - foothills
	Palmiet**	B	FEPA rehab	Mountain stream - foothills
Groenlandberg	Waterkloof	AB	FEPA fish sanctuary	Mountain stream
Limietberg	Holsloot	C	FEPA fish rehab	Mountain stream - foothills
	Tierstel	AB	Upstream area	Mountain stream
	Smalblaar/ Molenaars	AB	FEPA sub-catchment	Foothills
	Krom	AB	FEPA sub-catchment	Mountain stream - foothills
	Elands	AB	FEPA sub-catchment	Mountain stream - foothills
	Witte	A	Fish sanctuary	Mountain stream - foothills
	Koopmans southern tributary	AB	No FEPA status	Mountain stream
	Kompanjies	C (AB)	No FEPA status	Mountain stream
	Hugos	D (AB)	Fish support area	Mountain stream
	Olifants	D (AB)	FEPA fish rehab	Mountain stream
	Drakenstein	AB	Fish sanctuary	Mountain stream - foothills
	Kasteelskloof	A	Fish sanctuary	Mountain stream
	Bakkerskloof	AB	Fish sanctuary	Mountain stream
	Zachariashoek	AB	FEPA sub-catchment	Mountain stream
Waterval	Watervals	AB	FEPA sub-catchment	Middle reach
	Northern trib Koopmans	C	No FEPA status	Mountain stream - foothills

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

***The lower sections of these rivers where generally found to be in a fair (C) or degraded (D) condition (also see River Health Programme 2003-2011).*
****Confirmed presence of Cape ghost frog Heleophryne purcelli.*

3.8.1.3 Other freshwater aquatic systems (wetlands, springs, pans)

Not many wetlands have been mapped to occur within the Waterval Nature Reserve (Nel *et al.* 2011a, b). However, within those that have been mapped, several are considered to be FEPA wetlands. This includes higher and lower altitude seeps and bench flats located on the Waterval Nature Reserve. The wetland vegetation types are Southwest Sandstone and Southwest Alluvium Fynbos. The threat statuses of the mapped wetlands vary from least threatened and well-protected to critically endangered and poorly-protected (see Table 3.3).

There are a large number of seeps and other wetland types on the Limietberg Nature Reserve, including High Altitude wetlands. In these upland areas, several of the wetland ecosystems have been identified as wetland FEPAs (Nel *et al.* 2011a, b). Many of these wetlands contribute to important wetland clusters, allowing for connectivity between wetlands. Some of the other wetland types found within the Limietberg Nature Reserve complex include bench flats and channelled valley-bottom wetlands, some of which are considered critically endangered and poorly-protected (see Table 3.3). The wetland vegetation types vary between Southwest Sandstone Fynbos in the higher lying areas and Southwest Alluvium Fynbos in the lower lying areas.

Several priority wetlands (those found in Critical Biodiversity Areas (CBAs) and those found in National Freshwater Priority Areas (NFEPAs) (Nel *et al.* 2011a, b)) also occur in the Hottentots Holland Nature Reserve. These include single wetlands and wetland clusters. The wetlands found in the Theewaters Nature Reserve property have generally been mapped as floodplain wetlands and flats associated with the Palmiet and Riviersonderend Rivers (Nel *et al*. 2011a; see Ollis *et al*. 2013 for wetland type descriptions). Flats in general are endangered and poorly protected. In the mountainous parts of the Hottentots Holland Nature Reserve, Southwest Sandstone Fynbos hillslope seeps are prevalent. These regional wetland types are considered least threatened and are thought to be moderately protected (Table 3.3; Gouws *et al*. 2012; Nel & Driver 2012). Similarly, the wetlands mapped in the Groenlandberg Nature Reserve are mostly hillslope seeps. These features play an important role in supplying a steady supply of sediment-free water to the rivers. Due to a discrepancy in the NFEPA wetland layer regarding the wetland vegetation type for this area, the threat and protection status cannot be assessed yet (see Table 3.3).

Several priority wetlands (those found in CBAs and those found in NFEPAs (Nel *et al.* 2011a, b)) also occur in the Kogelberg Nature Reserve. Additionally, most of the Palmiet River catchment has also been identified as river and floodplain wetland FEPA. Most of the wetland types that were mapped here are bench flats, hillslope seeps and channelled valley-bottom wetlands. However, there are bound to be a higher number of wetlands in the entire World Heritage Site area, especially high altitude seepage areas in the mountain catchments of the nature reserve complexes, which have not been mapped in the past.

Table 3.3. The threat status, estimated health and protection level of the different wetland types of the Boland Mountain Complex, from north to south. Threat status is defined at follows; least threatened (LT), vulnerable (VU), endangered (EN) and critically endangered (CR).

Nature Reserve	Wetland type	*Threat status	*Protection level
Waterval	Southwest Sandstone Fynbos seeps	LT	Moderately protected
	Southwest Sandstone Fynbos flats	LT	Well protected
	Southwest Sandstone Fynbos channelled valley bottom	CR	Moderately protected
	Southwest Alluvium Fynbos seeps	EN	Well protected
	Southwest Alluvium Fynbos channelled valley bottom	EN	Moderately protected
	Southwest Shale Fynbos channelled valley bottom	CR	Poorly protected
	Southwest Shale Fynbos seep	LT	Well protected
	Northwest Sandstone Fynbos seep	LT	Moderately protected
	Northwest Sandstone Fynbos flat	LT	Moderately protected
	Northwest Sandstone Fynbos channelled valley bottom	LT	Moderately protected
	Northwest Sandstone Fynbos unchannelled valley bottom	EN	Poorly protected
	Western Fynbos-Renosterveld Shale Renosterveld channelled valley bottom	CR	Moderately protected
	Western Fynbos-Renosterveld Shale Renosterveld channelled flat	CR	Not protected
Limietberg	Southwest Sandstone Fynbos seeps	LT	Moderately protected
	Southwest Sandstone Fynbos flats	LT	Well protected
	Southwest Sandstone Fynbos channelled valley bottom	CR	Moderately protected
	Southwest Sandstone Fynbos depression	LT	Well protected
	Southwest Alluvium Fynbos channelled valley bottom	EN	Moderately protected
	Southwest Alluvium Fynbos unchannelled valley bottom	CR	Poorly protected
Hottentots Holland	East Coast Shale Renosterveld wetland types**		Unknown
	Southwest Sandstone Fynbos flats	LT	Well protected
	Southwest Sandstone Fynbos channelled valley bottom	CR	Moderately protected
	Southwest Sandstone Fynbos seeps	LT	Moderately protected
	Southwest Shale Fynbos channelled valley bottom	CR	Poorly protected
Kogelberg	Southwest Sandstone Fynbos flats	LT	Well protected

Nature Reserve	Wetland type	*Threat status	*Protection level
	Southwest Sandstone Fynbos channelled valley bottom	CR	Moderately protected
	Southwest Sandstone Fynbos seeps	LT	Moderately protected
	Southwest Shale Fynbos channelled valley bottom	CR	Poorly protected
	Southwest Shale Fynbos seep	LT	Well protected

**Threat status and protection levels could potentially change somewhat with the updated National Biodiversity Assessment NBA of 2018.*
***The East Coast Shale Renosterveld wetland vegetation type associated with the Theewaterskloof wetlands is likely to be a discrepancy within the NFEPA wetlands spatial layers.*

Wetlands in general are one of the most highly threatened freshwater ecosystems globally, especially those located in the lowland areas (Gouws *et al.* 2012; Gouws & Gordon 2017). Despite these levels of threat, they are still the least-studied and-monitored freshwater ecosystem in the country. It is with this in mind that a greater understanding of the health of wetlands and other freshwater ecosystems located within the boundaries of the Boland Mountain Complex is needed. This is important, especially when managing a protected area within a strategic water source area (WWF 2013a, b) with the whole catchment (*i.e.* the "catchment to coast" concept) in mind.

3.8.2 Vegetation

The Boland Mountain Complex falls within the Cape Floristic Region, which is the smallest of the world's six floral kingdoms. It is internationally renowned for its especially rich flora containing an estimated 9 000 species of vascular plants of which almost 69% are endemic (restricted to the region). This makes it one of the richest regions in the world in terms of botanical diversity, apart from some Neotropical areas. It is characterised by five endemic families and by the conspicuous presence of, amongst others, species belonging to the families Aizoaceae, Ericaceae, Fabaceae, Iridaceae, Orchidaceae, Proteaceae, Restionaceae, Rutaceae and Scrophulariaceae (Goldblatt & Manning 2000a). Furthermore, the Boland Mountain Complex is notable for its phenomenal range of ecosystems ranging from coastal foredunes through strandveld, lowland and mountain fynbos.

The Boland Mountain Complex may be regarded as the floristic heart of the globally unique Cape Floral Region since it has the highest levels of plant species richness and endemism in the fynbos biome. More than 1 850 plant species are estimated to occur in the Boland Mountain Complex of which *ca*. 150 taxa are estimated to be locally endemic. The remarkable floral diversity of this area is also evident from the distribution patterns of a sample of 1 936 plant taxa from plant families and genera which are characteristic of the Cape Flora such as Proteaceae, Ericaceae, Restionaceae and Bruniaceae. The highest percentage occurrence of these taxa per quarter degree square (20 - 26%) is found in the Boland Mountain Complex (Oliver *et al.* 1983). This is twice the species density for these taxa in the northern parts of the Cape Floral Region (Cederberg) and more than three times the species density in the mountains of the southern and eastern parts of the region (Oliver *et al*. 1983). In a single 14 400 ha core Protected Area an estimated 17% of the Cape Flora (about 1 400 plant taxa out of a total of 8 500 taxa) is protected (Rebelo & Siegfried 1990). The great diversity of plants is attributed to the change in complement of species along environmental gradients and the variation in species in the same habitat type from one geographical location to another (Cowling & Richardson 1995).

Winter rains along with mist-precipitation from the southeaster clouds in the summer provide the habitat for a number of rare *Protea* and *Mimetes* species. The Boland Mountain Complex has the highest concentration of *Mimetes* species in the Western Cape, most notably the rare *M. hottentoticus* and *M. capitulatus*. Another member of this family is the beautiful, but endangered marsh rose, *Orothamnus zeyheri* (Figure. 3.6), once on the brink of extinction, but now conserved on a few relatively inaccessible peaks.

Protea stokoei (pink sugarbush) classified as endangered is a habitat-specific plant that is restricted to the moist, peaty soils and high altitudes of the Kogelberg, Hottentots Holland and Groenland Mountains. *Serruria florida* (blushing bride) is another endangered species that only grows in the Assegaaiboskloof area. The species flower for the first time when the plant is five years old and starts dying when it is 20 years old.

Figure 3.6. *Serruria florida*, the blushing bride (left, photo by Vicki Hudson) and the Marsh rose, *Orothamnus zeyheri* (right).

Vegetation Types found in the Boland Mountain Complex, their Western Cape Biodiversity Spatial Plan status and their contribution to Provincial targets are as follows (see Map 5):

Western Altimontane Sandstone Fynbos Least Threatened

High-altitude summit peaks, generally fragmented and localised, but relatively extensive in the Hex River Mountains. Vegetation in these high-altitude positions is low, open to medium dense restioid fynbos, with ericaceous and asteraceous fynbos occurring locally. Proteoid fynbos generally absent (SANBI 2006).

This, along with Kogelberg Sandstone Fynbos, has the highest Mean Annual Precipitation of all the Fynbos types (>1300 mm) (SANBI 2006-). In the Boland Mountain Complex, this unit has relatively few Species of Conservation Concern and 5% of the Provincial conservation target is met.

This is a slow-growing vegetation type, due to its position above 1700 m, and short interval fires will have a negative impact. Due to the inaccessibility of this vegetation, there is currently negligible transformation due to anthropogenic activities.

Western Coastal Shale Band Vegetation Least Threatened

A narrow 80–200 m linear feature (up to 1 km wide in a few places and also forming rings on some 'Sneeukop' peaks), smooth and flat in profile compared to surrounding areas. The band supports diverse renosterveld and fynbos shrublands of all structural types including waboomveld at lower altitudes (SANBI 2006).

Being less porous than the various Sandstone fynbos types it is generally sandwiched between, this vegetation type plays an important role in water movement and springs and wetlands are associated with these "contact zones". The edaphic interface also serves as a unique habitat and some endemics are associated with this space. For this vegetation type 108% of the Provincial conservation target is met in the Boland Mountain Complex.

Hawequas Sandstone Fynbos Vulnerable (D1)

The vegetation type occurs on mountains with slopes of various steepness, flanks of intermontane valleys and upland plateaus. A band of Cedarberg Shale Formation forms a prominent step at high altitude. Vegetation constitutes a low closed shrubland dotted with emergent tall shrubs, mainly proteoid, restioid and asteraceous fynbos with much waboomveld at lower altitudes, ericaceous fynbos at higher altitudes and abundant Cape thickets (especially in the north of the unit) on cliffs and very steep rocky (scree) slopes (SANBI 2006).

Similar to Kogelberg Sandstone Fynbos, this vegetation type has high endemism and has two genera (*Spetaea* and *Hydroidea*) endemic to this unit. Some 177% of the Provincial conservation target is met in the Boland Mountain Complex.

Kogelberg Sandstone Fynbos Critically Endangered (D1)

High mountains with steep to gentle slopes, and undulating plains and hills of varied aspect. General appearance of vegetation is low, closed shrubland with scattered emergent tall shrubs. Proteoid, ericaceous and restioid fynbos dominate, while asteraceous fynbos is rare. Patches of Cape thicket are common in the northern areas; in the south similar habitats are occupied by scrub fynbos. Numerous seeps and seasonally saturated mountain-plateau wetlands (locally called 'suurvlakte') are very common and support restioid and ericaceous (dominated by Bruniaceae) fynbos (SANBI 2006). A total of 187% of the Provincial conservation target is met in the Boland Mountain Complex.

Winterhoek Sandstone Fynbos Least Threatened

Moderately undulating high plain in the west, with rugged high peaks in the south and southeast, and two linear parallel north-south high mountains in the east, dissected by the Olifants River Valley. The eastern blocks are relatively flat, south- and north-sloping, dissected tablelands. Vegetation is mainly closed restioland in deeper moister sands, with low, sparse shrubs that become denser and restios less dominant in the

drier habitats. Proteoid and ericaceous fynbos are found on higher slopes while asteraceous fynbos is more common on lower slopes. Cape thicket is prominent on the lowest slopes (SANBI 2006). The Southern boundary of Winterhoek Sandstone Fynbos falls largely outside of the Boland Mountain Complex and thus only 0.14% of the Provincial conservation target is met in the area.

Breede Sand Fynbos Vulnerable

Very fragmented, occurring as dune plumes and dune seas in the valley bottoms primarily south of the Breede River, and extending up the sides of adjacent hills. Vegetation is an open proteoid tall shrubland combined with an open to medium dense restioid herbland in undergrowth. Proteoid and restioid fynbos are dominant, with some asteraceous fynbos also found (SANBI 2006). Only 2.4% of the Provincial conservation target is met in the Boland Mountain Complex.

Elgin Shale Fynbos Critically Endangered

Undulating hills and moderately undulating plains and steep slopes of adjacent mountains. An open to medium dense tall proteoid shrubland over a matrix of moderately tall and dense evergreen shrubs, dominated by proteoid, asteraceous and closed-scrub fynbos, and ericaceous fynbos in the wetter faces (SANBI 2006). The Boland Mountain Complex meets 10.8% of the Provincial conservation target is for this vegetation type.

Boland Granite Fynbos Vulnerable

Moderately undulating plains and hills, varying from extensive deep soils, to localised deep soils between large granite domes and sheets. A fairly dense, 1–2 m tall closed shrubland with occasional low, gnarled trees dotted through the landscape. A diverse type, dominated by scrub, asteraceous and proteoid fynbos (with *Protea repens, P. burchelli, P. laurifolia* with *Leucadendron rubrum* and *L. daphnoides* as dominants on drier slopes, *Leucospermum grandiflorum* or *L. gueinzii* dominant in seepage areas, and *P. neriifolia* and *Leucadendron sessile* on moist slopes), but with patches of restioid and ericaceous fynbos in wetter areas. Waboomveld is very typical and very extensive within this unit (SANBI 2006) and 30.4% of the Provincial target is met in the Boland Mountain Complex.

Cape Winelands Shale Fynbos Vulnerable

Moderately undulating plains and steep slopes against the mountains. Vegetation is a moderately tall and dense shrubland dominated by proteoid and closed-scrub fynbos in structural terms (SANBI 2006). A total of 23.1% of the Provincial target is met in the Boland Mountain Complex.

Breede Shale Fynbos Least Threatened

Steep upper slopes below mountains grading to slightly undulating plains, well dissected by rivers. Vegetation is a moderately tall and dense shrubland—mostly restioid, proteoid and asteraceous (mesotrophic) fynbos. A remarkably tall and dense post-fire component dominates early seral communities on wetter slopes (SANBI 2006). Zero percent of the Provincial conservation target for this vegetation type is met in the Boland Mountain Complex.

Breede Shale Renosterveld Least Threatened

Low hills, slightly undulating to undulating plains and lower mountain slopes. In the western regions low, cupressoid-leaved shrubland (with scattered emergent small trees) is dominated by renosterbos. Elements of shale fynbos are present. In the

eastern regions open, tall shrublands (possibly closely affiliated to FRs 12 Central Rûens Shale Renosterveld) are found, with microphyllous shrubs forming the dominant layer. Heuweltjies are very prominent, with either bush clumps in moister areas or succulent shrubs in drier habitats (SANBI 2006-). Only 0.015% of the Provincial conservation target is met in the Boland Mountain Complex.

Elim Ferricrete Fynbos Critically Endangered

Undulating hills and plains covered with open to closed dwarf shrubland with occasional scattered tall shrubs. It is a diverse unit, with all structural fynbos types present, but with extensive areas of asteraceous fynbos dominated by low proteoid elements. To differentiate mesotrophic asteraceous from mesotrophic proteoid fynbos the following proteoid types are recognised: *Leucadendron elimense, L. laxum, L. modestum, L. stelligerum* and *L. teretifolium.* When degraded, this vegetation type becomes dominated by *Elytropappus rhinocerotis*. On transitions to deep sandy soils, *Protea repens* may be dominant, and these transitional communities are often much richer in species than associated FFs 12 Overberg Sandstone Fynbos (SANBI 2006). Only 0.07% of the Provincial conservation target for this vegetation tye is met in the Boland Mountain Complex.

Swartland Alluvium Fynbos Critically Endangered

Moderately undulating plains, adjacent mountains and in river basins. The vegetation is a matrix of low, evergreen shrubland with emergent sparse, moderately tall shrubs and a conspicuous graminoid layer. Proteoid, restioid and asteraceous fynbos types are dominant, with closed-scrub fynbos common along the river courses. Ericaceous and restioid fynbos are found in seeps (SANBI 2006). Only 4.9% of the Provincial conservation target for this vegetation type is met in the Boland Mountain Complex.

Swartland Shale Renosterveld Critically Endangered

Moderately undulating plains and valleys supporting low to moderately tall leptophyllous shrubland of varying canopy cover as well as low, open shrubland dominated by renosterbos. Heuweltjies are a very prominent local feature of the environment, forming ‘hummockveld’ near Piketberg and giving the Tygerberg Hills their name. Stunted trees and thicket are often associated with the heuweltjies. Disturbed areas are dominated by *Athanasia trifurcata* and *Otholobium hirtum*. Patches of *Cynodon dactylon* ‘grazing lawns’ also occur in abundance (SANBI 2006). Only 0.48% of the Provincial conservation target is met in Boland Mountain Complex.

Hangklip Sand Fynbos Endangered

Sand dunes and sandy bottomlands supporting moderately tall, dense ericoid shrubland. Emergent, tall shrubs in places. Proteoid, ericaceous and restioid fynbos are dominant, with some asteraceous fynbos also present. On the coastal fringe this unit borders on strandveld. The deep soils of the coastal plains are replaced by shallow soils on mountain slopes on the northern edge. Hangklip Sand Fynbos occurs mainly on old dunes, but the high rainfall and leaching allows many typical sandstone fynbos species to occur on older deposits as well, so that this unit is not as floristically distinct as other sandstone fynbos units. (SANBI 2006). The Boland Mountain Complex meets 6.8 % of the Provincial conservation target.

Southern Afrotemperate Forest (Includes National Forest Inventory types: Western Cape Afrotemperate and Southern Cape Afrotemperate Forest) Least Threatened

Tall, multi-layered afrotemperate forests are dominated by yellowwoods (*Afrocarpus falcatus* and *Podocarpus latifolius*), *Ocotea bullata, Olea capensis* subsp. *macrocarpa, Pterocelastrus tricuspidatus, Platylophus trifoliatus etc.* In scree and deep-gorge habitats *Cunonia capensis, Heeria argentea, Metrosideros angustifolia, Podocarpus elongatus* and *Rapanea melanophloeos* predominate. The shrub understorey and herb layers are well-developed, especially in mesic and wet habitats (SANBI 2006).

The forests are a minor element in a landscape dominated by Mountain Fynbos. Patches of evergreen, broad-leafed forests, are confined to narrow kloofs, and other sheltered localities where favourable moisture conditions coupled with shelter against weather and fire permit their development. Common trees found in the valleys include red alder (*Cunonia capensis*), Cape holly (*Ilex mitis*), wild olive (*Olea europaea* subsp. *africana*), Cape beech (*Rapanea melanophloeos*) and wild peach (*Kiggelaria africana*) (Kruger 1983).

This vegetation type naturally occurs as small pockets in the Boland Mountain Complex and therefore only 0.9% of the Provincial conservation target is met in the region. The forest types would also be an interesting unit to look at historical extent and potentially do some restoration in areas that have lost footprint.

Overberg Dune Strandveld Least Threatened

Flat or slightly undulating dune fields of Die Plaat near Stanford and those of De Hoop, supporting up to 4 m tall, closed, evergreen, hard-leaved shrublands in moist dune slacks and wind-protected valleys and up to 1 m tall, coastal thicket in many places wind-shorn along exposed littoral situations (SANBI 2006). A mere 0.15% of the Provincial conservation target is met in the Boland Mountain Complex.

Cape Lowland Freshwater Wetlands Least Threatened

Flats and landscape depressions with extensive tall reeds of *Phragmites australis* and *Typha capensis*, temporarily or permanently flooded restiolands, sedgelands and rush-beds, as well as macrophytic vegetation embedded in permanent water bodies. Substrate of fine sand, silty and clayey soils over young Quartenary sediments from weathering shales, Cape granites and Table Mountain Sandstone, they fill depressions and accompany broad alluvia of lowland rivers. Major source of water is either temporary or permanent. In places, especially associated with Malmesbury shales, wetlands can acquire a brackish character (SANBI 2006). The Boland Mountain Complex meets 0.91% of the Provincial conservation target of this vegetation type.

Cape Seashore Vegetation Least Threatened

Beaches, coastal dunes, dune slacks and coastal cliffs of open grassy, herbaceous and to some extent also dwarf shrubby (sometimes succulent) vegetation often dominated by a single pioneer species. Various plant communities reflect the age of the substrate and natural disturbance regime (moving dunes), distance from the upper tidal marl and the exposure of dune slopes (leeward *vs* seaward) (SANBI 2006). A total of 10.4 % of the Provincial conservation target for this vegetation type is met in the Boland Mountain Complex.

Table 3.4 gives a summary of the vegetation types represented in the Boland Mountain Complex and their protection status (Jacobs *et al.* 2017). Table 3.5 presents the number of plant species of conservation concern found in the Boland Mountain Complex. The data were obtained from the latest South African Biodiversity Institute's (SANBI), Threatened Species Programme.

Table 3.4. Vegetation types occurring in the Boland Mountain Complex indicating the conservation status of each.

NAME	WC Provincial Protection Target ha	% of WC target under management	Ha Under Management	Ecosystem Status 2012	CapeNature Endangered Ecosystem Threat Status
Boland Granite Fynbos	15627.93	30.43	4755.50	VU	VU
Breede Alluvium Fynbos	15046.73	0.17	26.11	EN	EN
Breede Sand Fynbos	2929.64	2.41	70.62	VU	VU
Breede Shale Fynbos	9541.77	0.00	0.00	LT	LT
Breede Shale Renosterveld	28334.21	0.02	4.29	LT	LT
Cape Coastal Lagoons	673.37	5.01	33.74	LT	LT
Cape Lowland Freshwater Wetlands	7878.98	0.92	72.12	LT	LT
Cape Seashore Vegetation	192.03	10.47	20.11	LT	LT
Cape Winelands Shale Fynbos	2549.36	23.14	589.91	VU	VU
Elgin Shale Fynbos	8384.13	10.83	908.33	CR	CR
Elim Ferricrete Fynbos	19958.53	0.08	15.66	CR	CR
Hangklip Sand Fynbos	2606.74	6.85	178.59	EN	EN
Hawequas Sandstone Fynbos	31515.85	177.44	55923.08	VU (D1)	VU (D1)
Kogelberg Sandstone Fynbos	27427.78	187.70	51481.55	CR (D1)	CR (D1)
Winterhoek Sandstone Fynbos	32905.47	0.15	48.36	LT	LT
Western Coastal Shale Band Vegetation	4034.54	108.06	4359.79	LT	LT
Western Altimontane Sandstone Fynbos	1087.80	5.32	57.88	LT	LT

NAME	WC Provincial Protection Target ha	% of WC target under management	Ha Under Management	Ecosystem Status 2012	CapeNature Endangered Ecosystem Threat Status
Swartland Shale Renosterveld	128758.11	0.48	611.75	CR	CR (A1 & D1)
Swartland Alluvium Fynbos	13962.29	4.93	688.41	CR	CR
Southern Afrotemperate Forest	143808.20	0.94	2.13	LT	LT
Overberg Dune Strandveld	12982.93	0.15	18.86	LT	LT

Table 3.5. The number of plant species of conservation concern occurring in the Boland Mountain Complex.

SA Redlist Status	Kogelberg NR	Hottentots Holland NR	Jonkershoek NR	Limietberg NR	Waterval NR
Critically Endangered	6	0	2	3	5
Endangered	26	15	9	6	8
Vulnerable	37	18	9	16	10
Near Threatened	32	15	14	13	12
Rare	28	7	1	6	0
Data Deficient Insufficient Information (DDD)	1	0	0	0	1
Data Deficient Taxonomically Problematic	11	1	1	0	0
Total Species of Conservation Concern	141	56	36	44	36
Total species recorded	1151	386	404	562	285

3.9 Biodiversity Context: Taxa

3.9.1 Amphibians

Amphibians are generally regarded as good indicators of environmental change and are likely to be sensitive to the threats of climate change, pollution, increasing UV light levels and poor environmental management. Existing frog monitoring in CapeNature shows them to be sensitive to fire and so they may also be good indicators of appropriate fire-return intervals. Amphibians may also be sensitive to novel diseases and any mass die-offs of frogs should be urgently reported to Scientific Services.

Fourteen frog species have been recorded from the Kogelberg Nature Reserve. Three Threatened species that have been recorded for the adjacent area and are listed in Table 3.6. The western leopard toad (*Sclerophrys pantherina)* and Kogelberg moss frogs (*Arthroleptella kogelbergensis*) populations at Betty's Bay seem to have become

locally extinct. The highly threatened micro frog (*Microbatrachella capensis*) and Cape platanna (*Xenopus gilli*) are not known to occur on CapeNature land in the Kogelberg Nature Reserve but do occur nearby. Thus surveillance for the presence of all these species is required both on and where possible adjacent to the reserve.

At least one species of mountain toadlet (genus *Capensibufo*) occurs within the Kogelberg Nature Reserve. This is possibly *C. deceptus* (see Channing *et al*. 2017), which has not yet been formally assessed for threat status according to IUCN criteria (IUCN 2001). This species' identity still needs to be established and active searching for any species of *Capensibufo* in the Kogelberg Nature Reserve is required as it may represent a threatened taxon and may be at threat even within the Protected Area.

In addition, the montane marsh frog (*Poyntonia paludicola*), which is listed as Near Threatened (IUCN Red List) and the newly described Kogelberg moss frog (*Arthroleptella kogelbergensis*), which has also not yet been formally assessed for threat status according to IUCN Criteria (IUCN 2001), occur within the Kogelberg Nature Reserve with the Kogelberg moss frog is virtually endemic to the Kogelberg Nature Reserve.

Eight of the 12 frog species known to occur within the Hottentots Holland Nature Reserve are endemic to the Western Cape Province. The Landdros moss frog (*Arthroleptella landdrosia*) is endemic to the Hottentots-Holland Mountains (including the Jonkershoek Nature Reserve), and the recently described Landdroskop mountain toad (*Capensibufo magistratus*) (Fig. 3.7) is largely dependent on the Hottentots Holland Nature Reserve. This species still requires formal IUCN threat assessment.

There are also several very important high-altitude seeps that provide undisturbed breeding habitat for frogs which are dependent on such habitats. There is also considerable variation in the advertisement calls and genetics of the Landdros moss frog which will require further investigation to assess fine-scale gene-flow.

Thirteen frog species have been recorded in Limietberg Nature Reserve. Of these none are currently listed as threatened (IUCN Red List) but two recently-described species of mountain toadlets (genus *Capensibufo*) are yet to have their threat status formally assessed *viz*. the Deception Peak mountain toadlet (*Capensibufo deceptus*) and the Landdros mountain toadlet (*Capensibufo magistratus*). Furthermore, the Near Threatened Cape rain frog (*Breviceps gibbosus*) may well occur within the Limietberg Nature Reserve, and it would be informative to establish whether this species is afforded any protection by the Protected Area.

Figure 3.7. The recently described Landdroskop mountain toad, *Capensibufo magistratus.* Photo by Atherton de Villiers.

Only six frog species have been recorded for Waterval and Voëlvlei Nature Reserves combined. The Near Threatened Cape caco (*Cacosternum capense*) has been recorded historically in the Voëlvlei Nature Reserve. Renewed surveillance monitoring for the continued presence of this species will be valuable as it does not occur in many Protected Areas.

Threatened amphibian species that have been recorded for the Boland Mountain Complex are listed in Table 3.6.

Table 3.6. Amphibian species of conservation concern that occur in the Boland Mountain Complex.

Species	Common Name	Global IUCN Threat Category 2016
Arthroleptella landdrosia	Landdros moss frog	Near Threatened
Poyntonia paludicola	montane marsh frog	Near Threatened
Cacosternum capense	Cape caco	Near Threatened
Capensibufo magistratus	Landdros mountain toadlet	Still to be assessed
Microbatrachella capensis	Micro frog	Critically Endangered (B2ab)
Sclerophrys pantherina	western leopard toad	Endangered (B1ab+2ab)
Xenopus gilli	Cape platanna	Endangered (B1ab+2ab)
Capensibufo deceptus	Deception Peak mountain toadlet	Still to be assessed
Capensibufo magistratus	Landdros mountain toadlet	Still to be assessed

3.9.2 Reptiles

Fynbos reptiles generally occur in low numbers although species numbers may be quite high for a temperate region.

A total of 27 reptile species have been recorded for the Kogelberg Nature Reserve, 42 species for the Hottentots Holland Nature Reserve, 29 reptile species for Limietberg Nature Reserve and 13 reptile species for Waterval and Voëlvlei Nature Reserves combined. One species, the dwarf crag lizard (*Hemicordylus nebulosus*) is restricted to the Hottentots Holland Nature Reserve. This species is also one of the threatened species listed for the Boland Mountain Complex (see Table 3.7). The Hawequa flat gecko (*Afroedura hawequensis*) is a near-endemic to the Limietberg Nature Reserve.

The reptile list is largely complete (except Waterval and Voëlvlei which could do with an updated survey) but there are species anecdotally recorded such as the yellow-bellied house snake (*Lamprophis fuscus),* Burchell's sand lizard *(Pedioplanis burchelli)* and the Hawequa flat gecko (*Afroedura hawequensis*), which should have their presence confirmed through the diligent recording of incidental observations.

One Threatened reptile species occurs in the Voëlvlei Nature Reserve, namely the geometric tortoise (*Psammobates geometricus*) (Fig. 3.8), which is a Critically Endangered IUCN Red List species (Table 3.7). This species is restricted to the Alluvium Fynbos and Shale Renosterveld vegetation types in the Voëlvlei Nature Reserve. These habitat types are themselves listed as Threatened. In addition to the paucity of remaining suitable habitat for the geometric tortoise, there is the additional threat of feral pigs in the Voëlvlei Nature Reserve (see section 4.3). The already low population numbers of geometric tortoise makes them susceptible to demographic and stochastic environmental effects and too frequent fires pose a serious threat.

Figure 3.8. The geometric tortoise, *Psammobates geometricus.* Photo by Atherton de Villiers.

The threatened reptile species that occur in the Boland Mountain Complex are listed in Table 3.6.

Table 3.7. Reptile species of conservation concern that occur on the Boland Mountain Complex.

Scientific Name	Common Name	Global IUCN Category (Bates *et al.* 2014)
Bitis armata	Southern adder	Vulnerable (B1ab+2ab)
Bradypodion pumilum	Cape dwarf chameleon	Vulnerable (B1ab)
Afroedura hawequensis	Hawequa flat gecko	Near Threatened
Cordylus oelofseni	Oelofsen's girdled lizard	Near Threatened
Psammobates geometricus	Geometric tortoise	Critically Endangered (A2acde)
Hemicordylus nebulosus	dwarf crag lizard	Vulnerable (D1+2)

3.9.3 Fish

The Cape Fold Ecoregion (CFE) is located mainly within the Western and Eastern Cape Provinces and is one of the six aquatic ecoregions of Southern Africa (Abell *et al*. 2008). The region is characterised by a temperate freshwater fish fauna which is relatively species-poor compared to the tropical or Zambezian fish fauna which extend from the Orange system northwards into Southern Africa (Skelton *et al*. 1995). In contrast to the tropical fauna, the southern temperate fauna is entirely endemic to South Africa and within this group several species and families are endemic to the CFE. The Boland Nature Reserve Complex spans nine discrete river systems within the region. These are the Berg, Breede, Palmiet, Eerste, Bot, Hangklip, Lourens, Sir Lowry's Pass and Steenbras systems. Of these, the Lourens, Sir Lowry's Pass and Steenbras are of limited importance in terms of freshwater fish for this complex as only the upper reaches of the catchment intersect with the reserves and are thus unlikely to include viable fish populations. These are high altitude mountainous areas and often the distribution ranges of indigenous fish species only start downstream of the reserve boundaries. Within the remaining systems, a number of unique indigenous freshwater fish species exist, many of which are extremely range-restricted and are thus important conservation targets.

The indigenous freshwater fish community of the reserve complex consists of three families of fish. These are the Cyprinidae with three described species, Breede River redfin (*Pseudobarbus burchelli*), giant redfin (*P. skeltoni*) (Fig. 3.9) and Berg River redfin (*P. burgi*). The Berg Breede River whitefish (*Cheilobarbus capensis*) is also endemic to the Berg and Breede River systems but no longer occurs within the boundaries of the reserve complex due to alien fish invasion. In addition, there are the Galaxidae and Anabantidae families with one described species each: Cape galaxias (*Galaxias zebratus)* and Cape kurper (*Sandelia capensis*), respectively. The longfin eel (*Anguilla mossambica*) also occurs in the Palmiet system (River Health Program 2003). Catadromous species such as eels migrate from the ocean to the estuaries where they metamorphose into glass eels before becoming elvers when migrating into freshwater. The young eels mature in freshwater where they can remain for many years before migrating back to the ocean for spawning (Skelton 2001).

Figure 3.9. The Giant redfin, *Pseudobarbus skeltoni*. Photo by Dean Impson.

When considering the freshwater fish of the region, current taxonomy vastly underestimates the species richness of the indigenous fish fauna of the entire CFE (Linder *et al.* 2010, Chakona *et al.* 2013) and thus by definition also for the reserve complex. Significant taxonomic revisions are underway within all three families (Ellender *et al.* 2017). The Breede River redfin (*P. burchell* Smith 1841) consists of four unique lineages of which only the recently-described giant redfin (*P. skeltoni*) and the relatively widespread *Pseudobarbus sp. "burchelli* Breede" lineage are of relevance to the reserve complex. *Galaxias zebratus* and *S. capensis* each represent a species complex with a number of genetically distinct lineages present within the reserve (Table 3.8). It must be noted that the taxonomic revision of these two genera is still underway and therefore it is not possible to consistently present accurate information on the distribution of the different lineages within the reserve complex at present.

The Breede River redfin (*Pseudobarbus* sp. "*burchelli* Breede") is currently listed as Near Threatened (Tweddle *et al.* 2009) with the potential to be up-listed to Vulnerable (Jordaan & Chakona, in review). At least five populations exist within the reserve complex, all of which are at present viable and secure against threats (Table 3.8). The giant redfin (*P. skeltoni*) is highly threatened and listed as Endangered (Chakona *et al*. 2017). It is only known from three localities in the CFE of which only the upper Riviersonderend population in the Hottentots Holland Nature Reserve is considered viable in the long term. Historical records for this species exist for the Witte River downstream of the Haweqwa Nature Reserve but recent surveys have not detected them in this river, providing evidence for their extirpation by invasive black bass (Kadye *et al*. 2016). The giant redfin population in the Krom tributary, despite occurring on a provincial nature reserve, is small and at high risk of extinction under the current management strategy of the reserve (Weyl *et al.* 2015). The redfin population in the upper Riviersonderend River is located upstream of Theewaterskloof Dam. The dam

is dominated by invasive non-indigenous fishes, which could potentially invade the upper Riviersonderend River if an invasion barrier is not in place.

The Berg River redfin (*P. burgi*) is listed as Endangered and also occurs within the reserve complex and in river reaches immediately downstream. The most important Berg River redfin populations relevant to the reserve complex are located in headwaters of the Berg River within the Jonkershoek Nature Reserve and in the Olifants and Drakenstein tributaries on the Haweqwa Mountain catchment area immediately downstream of the Haweqwa Nature Reserve (Jordaan *et al*. 2017). The CoCT manages the catchment area of the Wemmershoek Dam into which these streams flow and is aware of the conservation importance of the streams. Redfins currently co-occur with invasive rainbow trout in these areas where their survival is likely a result of trout density and thermal dynamics of the system, two factors that have been shown to influence trout impacts on indigenous fish (Shelton *et al.* 2014a, b, Shelton *et al*. 2018).

Cape galaxias and Cape kurper co-occur with redfins in many of the rivers in the Boland Mountain Complex. Based on the work of Chakona *et al*. (2013) and Ellender *et al*. (2017), potentially three Galaxias lineages occur within the reserve complex. These are *Galaxias* sp. "*zebratus* Riviersonderend", *Galaxias* sp. "*zebratus* Rectognathus" and *Galaxias* sp. "*zebratus nebula*" (Table 3.8). Based on current distribution knowledge, the former two lineages are range-restricted while the latter is widespread across the CFE (Table 3.8). In terms of conservation status, *Galaxias* sp. "*zebratus* Riviersonderend" is listed as Vulnerable and occurs within the reserve complex boundary in the upper Palmiet, upper Riviersonderend, Amandel, and Du Toit's Rivers (Chakona 2017). While its biology and ecology remain unstudied, this lineage appears to prefer pool habitat with moderate to slow-flowing water and was detected in vegetated marginal areas of Theewaterskloof Dam. It was not sampled from riffle habitat during any surveys (Chakona 2017). Its preference for pool habitat makes this taxon more susceptible to predation by non-indigenous fishes. *Galaxias* sp. "*zebratus* Rectognathus" and *Galaxias* sp. "*zebratus nebula*" have not been evaluated using IUCN criteria and are thus listed as Not Assessed (Ellender *et al*. 2017). The former lineage likely co-occurs with the "Riviersonderend" lineage in the Hottentots Holland Nature Reserve while the exact distribution of the "*nebula*" lineage is still under investigation. A number of additional *Galaxias* records exist on the reserve where the taxonomic status remains uncertain at present and these were included as *Galaxias zebratus* in Table 3.8.

Cape Kurper *(Sandelia capensis)* occurs in a number of rivers within the Boland Mountain Complex and is subject to major taxonomic revision. Chakona *et al.* (2013) reported that within the CFE, two deeply divergent lineages exist along with seven minor lineages within the currently described *S. capensis*. Relevant to the Boland Mountain Complex is the *Sandelia* sp. "Riviersonderend" lineage, which is restricted to the Riviersonderend and Palmiet Rivers. A number of additional *Sandelia* taxa exist in the reserve complex and these were listed as *Sandelia capensis* (Table 3.8) as the lineage to which they belong is presently unresolved.

Table 3.8. Indigenous freshwater fish species diversity within the Boland Mountain Complex. Note that in the absence of accurate distribution information on new lineages of *Galaxias* and *Sandelia*, all records not known to be part of a new lineage were assigned to the currently described *Galaxias zebratus* and *Sandelia capensis.*

Species	Common name	Distribution range	Known on-reserve distribution	
			Reserve	Rivers
*Pseudobarbus sp. "*burchelli Breede*"*	Breede River redfin	Breede River system excluding the Tradouw catchment and the Agulhas Plain (Chakona *et al*. 2013)	Hottentots Holland NR Theewaters Haweqwa NR	Upper Riviersonderend, upper Du Toits Amandel Witte, Wolwekloof
Pseudobarbus skeltoni	Giant redfin	Upper Riviersonderend within Breede River system (Chakona *et al*. 2013)	Hottentots Holland NR Haweqwa NR	Upper Riviersonderend Krom
Pseudobarbus burgi	Berg River redfin	Berg River system (Skelton 2001)	Jonkershoek NR Haweqwa NR	Headwaters of Berg Olifants, Drakenstein and upper Wemmers
Galaxias zebratus	Cape galaxias	Widespread in the Cape Fold Ecoregion (Skelton 2001). Now recognised as a species complex.	Kogelberg NR Jonkershoek NR Haweqwa NR	Louws, Buffels, Dawidskraal (unconfirmed records) Headwaters of Berg, upper Eerste Holsloot, Olifants, Drakenstein
Galaxias zebratus 'Riviersonderend'		Tributaries of the Riviersonderend River & Palmiet River (Ellender *et al*. 2017)	Hottentots Holland NR Theewaters NR	Upper Palmiet, upper Riviersonderend, Du Toits Theewaterskloof Dam, Amandel
Galaxias zebratus 'nebula'		Widespread in the Cape Fold Ecoregion (Ellender *et al*. 2017)	Present distribution in BNRC unknown	Present distribution in BNRC unknown
Sandelia capensis	Cape kurper	Widespread in the Cape Fold Ecoregion (Skelton 2001). Now recognised as a species complex.	Kogelberg NR Jonkershoek NR Haweqwa NR Waterval NR	Louws, Buffels, Dawidskraal (unconfirmed records) Headwaters of Berg, Eerste Holsloot, Hugos, Olifants, Drakenstein, Witte Waterval
Sandelia capensis 'Riviersonderend'		Upper Riviersonderend within Breede River system (Chakona *et al*. 2013)	Hottentots Holland NR	Upper Palmiet, upper Riviersonderend, Amandel,

The NFEPA project (Nel *et al.* 2011a, b) further identified both the Palmiet catchment and the Hangklip catchment as indigenous fish sanctuaries due to the presence of the Cape galaxias (*Galaxias zebratus*) in both catchments and the additional presence of the Cape kurper (*Sandelia capensis*) in the Hangklip River. The conservation status

of both these species is presently listed by the IUCN as Data Deficient (Tweddle *et al*. 2009). The reason for this is that the taxonomic status of both species is in the process of being reviewed as recent genetic research has presented evidence for the existence of a number of unique lineages of which the exact distribution ranges have not been confirmed (Chakona *et al.* 2013). These unique lineages are in the process of being described as new species, many of which will likely be listed as Endangered or Critically Endangered due to the presence of invasive alien fish species and a loss of suitable habitat (Chakona *et al.* 2013).

3.9.4 Mammalian fauna

The CapeNature Biodiversity Database indicates 85 terrestrial mammal species including four locally extinct and eight introduced mammal species, for the Boland Mountain Complex based on historical and current accounts (Birss 2017). Of these species, four are IUCN Red Listed as Vulnerable and eight as Near Threatened. Table 3.9 gives the list of Threatened, endemic and Conservation Dependent mammal species for the Boland Mountain Complex.

Table 3.9. Mammal species of conservation concern that occur on the Boland Mountain Complex

Species	Common Name	Regional IUCN Red List Category (Child *et al*. 2016)	Level of Endemism
Damaliscus pygargus pygargus	bontebok	Vulnerable	WCP endemic
Panthera pardus	leopard	Vulnerable	
Dasymys capensis (previously incomtus)	Cape marsh rat	Vulnerable	WCP endemic
Mystromys albicaudatus	white-tailed mouse	Vulnerable	
Pelea capreolus	grey rhebok	Near Threatened	South African endemic
Graphiurus ocularis	spectacled dormouse	Near Threatened	South African endemic
Otomys laminatus	laminate vlei rat	Near Threatened	South African endemic
Amblysomus corriae	Fynbos golden mole	Near Threatened	WCP endemic
Poecilogale albinucha	African striped weasel	Near Threatened	
Aonyx capensis	African clawless otter	Near Threatened	
Parahyaena brunnea	brown hyaena	Near Threatened	
Acomys subspinosus	Cape spiny mouse	Least Concern	
Bathyergus suillus	Cape dune molerat	Least Concern	WCP endemic
Gerbilliscus afra	Cape gerbil	Least Concern	WCP endemic
Equus zebra zebra	Cape mountain zebra	Least Concern; Conservation Dependent	WCP near-endemic
Raphicerus campestris	steenbok	Least Concern	
Raphicerus melanotis	Cape grysbok	Least Concern; Conservation Dependent	WCP near-endemic
Georychus capensis	Cape molerat	Least Concern	WCP near-endemic
Myomyscus verreauxii	Verreaux's mouse	Least Concern	WCP near-endemic
Leptailurus serval serval	serval	Near Threatened	

Species	Common Name	Regional IUCN Red List Category (Child *et al*. 2016)	Level of Endemism
Oreotragus oreotragus	Klipspringer	Least Concern	
Sylvicapra grimmia	Common duiker	Least Concern	

3.9.4.1 Game

Fourteen components of the Boland Mountain Complex have implemented and 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 and persistence of most listed species. Please refer to Table 3.10 for a list of components, indicating presence and total population estimates of domestic and game species.

Small antelope species, such as Cape grysbok, klipspringer, steenbok, common duiker and grey rhebok occurs naturally in the landscape and generally exhibit unimpeded dispersal. They are important indicators of the overall ecological state of the Boland Mountain Complex. Their persistence is indicative of resilience against urban edge effects, however, the impact of poaching is currently being investigated. Presence and persistence of these species is inferred through monitoring and recording spatial distribution data and natality observations.

Grey rhebok, a South African endemic species, have demonstrated an overall national population decline and are now IUCN Red Listed as Near Threatened. The maintenance of population trend data for this species is focussed on seasonal observations towards spatial population density indications in the absence of conducting precision counts. The current estimates inform a baseline against which future data will be compared to establish whether the population is stable, declining or increasing.

Similarly, Cape grysbok, a near endemic to the Cape Floristic Region, is primarily associated with the Fynbos biome and also primarily regarded as a browser (Palmer *et al*. 2016). Cape grysbok are poached for bushmeat and are vulnerable to snaring.

Klipspringer are associated with steep rocky and mountainous habitats and are able to move efficiently over rocky terrain due to its small body size and the structure of their feet. Klipspringer coats provide excellent insulation against extremes in temperature and they are able to live at high and low elevations with a very adaptable diet, consisting primarily of browse in the Boland Mountain Complex. A survey of klipspringer in the Boland Mountain Complex during 2014 has raised concerns related to the long term impacts of previous capture and translocations which appear to be exacerbated by illegal hunting, highlighting the need to monitor population trends (Birss *et al*. 2016).

Table 3.10. Game and domestic species recorded for the components of the Boland Mountain Complex.

Component	Cape mountain zebra	cattle	bontebok	gemsbok	red hartebeest	eland	pig (feral)	sheep	springbok	Cape grysbok	common duiker	grey rhebok	klipspringer	steenbok
Brodie										■	■	■	■	
Brandvlei										■	■	■	■	
Kasteelberg							■			■	■		■	
Voëlvlei		■		■	■	■	■		■	■	■	■	■	■
Groenberg										■	■	■	■	
Hawequa								■		■	■	■	■	
Helderberg										■	■	■	■	
Hottentots Holland	■		■		■	■				■	■	■	■	
Jonkershoek										■	■	■	■	
Houwhoek										■	■	■	■	
Kogelberg										■	■	■	■	
Simonsberg										■	■	■	■	
Waterval							■			■	■	■	■	■
Rooisand										■	■	■	■	
Total Population Estimates	6	25	84	1	23	15	13	1	3	126	80	97	133	3

A small subpopulation (6) of Cape mountain zebra (*Equus zebra zebra*) is present on the Theewaterskloof component of the Boland Mountain Complex. Cape mountain zebra have shown a significant improvement in conservation status due to a steady increase in population size and is now IUCN Red Listed at Least Concern, Conservation Dependent. It was previously listed as Vulnerable (Hrabar *et al*. 2016). The Biodiversity Management Plan for Cape mountain zebra in South Africa, approved for implementation by the Minister of Environmental Affairs on 8 March 2018, promotes the establishment and maintenance of viable subpopulations within their natural distribution range, to contribute to a managed metapopulation (Birss *et al*. 2018). Due to the small size of this subpopulation, long term viability is compromised, and therefore either needs to be augmented or translocated to combine with subpopulations to counter the threats associated with inbreeding and population fragmentation.

The subpopulation of bontebok (*Damaliscus pygargus pygargus*) present on the Theewaterskloof component, outside the natural distribution range for bontebok, is managed to contribute to the metapopulation as identified in the Draft Biodiversity Management Plan for bontebok in South Africa. Bontebok are endemic to the East Coast Renosterveld bioregion, entirely within the Western Cape Province and are IUCN Red Listed as Vulnerable Bontebok are threatened by habitat loss, low genetic diversity and hybridisation with blesbok (*Damaliscus pygargus phillipsii*) (Radloff *et al*. 2016).

Management of both the Cape mountain zebra and bontebok is happening in conjunction with the Theewaterskloof Conservancy as outlined in the memorandum of understanding between CapeNature and the conservancy. All large game in the Boland Mountain Complex will be dealt with according to the following principles:

- All game farms bordering the Boland Mountain Complex that have extra-limital or historic alien animals, must be enclosed to the standards as stipulated in the CapeNature fencing policy. Protected area personnel must do regular inspections on the reserve side of the fence and escapees must be reported 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 are *res nullius* and must be dealt with accordingly. Conservation Managers must stipulate and regulate the actions to remove the animals (*i.e.* flying with a helicopter to recapture or to chase back).
- In cases where *res nullius* game animals enter the Boland Mountain Complex, the Conservation Manager must report it immediately and a decision must be taken to either have the animals removed, culled or that they may remain on the protected area.
- All protected areas with game animals who wish to remove surplus animals, must follow protocol which includes approval at regional level (*i.e.* ecological meetings) and approval at corporate level through the Wild Animal Advisory Committee.
- Where alien invasive game (*e.g.* fallow deer) are observed in protected areas, Conservation Managers must take immediate action by removing these animals in a humane manner.

3.9.4.2 Damage-Causing Wild Animals

Predators

All reports of predators found on the Boland Mountain Complex and causing stock losses on neighbouring properties must be reported to and investigated by CapeNature Conservation Services 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 Boland Mountain Complex. No hunting or pursuing of predators on any protected area is allowed.

Baboons

All protected areas in the Boland Mountain Complex must deal with problem-causing baboons in terms of the Standard Operating Guidelines. A proper waste management plan must be in place to remove potential sources of food. No feeding of any wild baboons is allowed within any protected area.

Other Wildlife

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

Domestic Animals

Domestic animals (*e.g.* donkeys, goats, cattle, sheep and pigs) that roam onto protected areas 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.

Feral Animals

All feral animals (domestic animals that have become wild and without an owner) found within a protected area must be removed in a humane manner immediately. Feral pigs (*Sus scrofa*) (Fig. 3.10), listed as one of the world's worst invasive species, occur on Kasteelberg, Voëlvlei and Waterval and require the implementation of an Alien Invasive Species Control and Eradication Strategy (see section 4.3).

General

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

Figure 3.10. Feral pig, *Sus scrofa*, at a small dam in Voëlvlei Nature Reserve. Photo by Riaan van der Walt.

3.9.5 Avifauna

The area covered by this management plan is very extensive and includes a number of different bird habitats. Furthermore, additional bird habitats (*e.g.* marine, estuarine and agricultural habitats) occur adjacent to the Boland Mountain Complex and species typical of these habitats have also been recorded within the complex. Bird species recorded for this area reflect this range of habitat diversity and to date 253 bird species have been recorded within the complex.

The vegetation type covering most of the area is fynbos and is therefore important for the seven species of birds endemic to the Fynbos biome. The habitat preference of these endemic species varies indicating the importance of maintaining a mosaic of different vegetation age and types within the Boland Mountain Complex. Cape Sugarbird (*Promerops cafer*) and Orange-breasted Sunbird (*Anthobaphes violacea*) prefer mature mountain Fynbos (Siegfried & Crowe 1983), while Hottentot Buttonquail (*Turnix hottentotus*) generally occur in young fynbos between the veld age of two and five years, 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*) occur in high mountain areas with open rocky habitats (Hockey *et al*. 2005)

Victorin's Scrub-warbler (*Cryptillas victorini*) is found predominantly in mesic mountain fynbos (Fraser 1997b), while the Protea Canary (*Crithagra leucopterus*) prefers open arid Fynbos with tall Protea plants (Milweski 1976).

Reporting rates from the second South African Bird Atlas Project for surveys carried out within the Boland Mountain Complex suggest that the populations of Cape Sugarbird, Orange-breasted Sunbird, Victorin's Warbler and Cape Siskin are still relatively healthy (http://sabap2.adu.org.za/). However, comparative analysis of data between the first and second atlas projects over the entire distribution range indicate that the Cape Sugarbird, the Orange-breasted Sunbird, the Cape Rock-jumper, the Cape Siskin and the Protea Canary have all undergone substantial (>15%) range contractions as well as range fragmentation (Lee & Barnard 2012).

The Hottentot Buttonquail (*Turnix hottentottus*) was only recognised as a separate species in 2015 and was therefore not included in the analysis by Lee and Barnard (2012). The Buttonquail is however currently listed as Endangered both at a regional and global scale, due to its fragmented distribution and low population numbers (Peacock 2015).

Table 3.11 lists threatened species (regional and/or global) that have been recorded within the Boland Mountain Complex. Those species marked with an asterisk are more common in the habitats adjacent to the complex (*e.g.* African Penguin, Blue Crane, Southern Black Korhaan, *etc.*) or the edge of the species distribution range is close to or extends into the reserve complex (*e.g.* Knysna Warbler) or occur at relatively low densities (*e.g.* Martial Eagle). These species only occur sporadically within the boundaries of the complex and any management strategies implemented will not have a significant impact on the species as a whole. Those threatened species that are of importance within the complex and which are not endemic to the Fynbos, are the Striped Flufftail (*Sarothrura affinis*) Verreaux's eagle (*Aquila verreauxii*) and Lanner Falcon (*Falco biarmicus*). In the southwestern Cape the Striped Flufftail occurs in mesic mountain fynbos requiring a structural component of dense vegetation cover with open ground for foraging (Hockey *et al*. 2005). The reporting rates for this species

within the complex is relatively low (http://sabap2.adu.org.za/), partially because the skulking nature of the species makes it difficult to observe and probably because numbers are low within the Fynbos biome. Both the Verreaux's Eagle and the Lanner Falcon are apex predators and are therefore expected to occur in lower numbers. The Lanner Falcon occurs at low densities over most of the Boland Mountain Complex with the high densities restricted to the western edge of the complex (Taylor 2015a). High densities of Verreaux's Eagle occur within most of the mountainous areas within the Western Cape Province (Taylor 2015b). The Boland Mountain Complex is no exception to this rule with an average reporting rate of 7.5% (http://sabap2.adu.org.za/). Within the Western Cape both the Lanner Falcon and the Verreaux's Eagle are subject to threats that not only occur outside the Boland Mountain Complex, but across the entire distribution range and should be dealt with at a national scale (Taylor 2015a, b). In terms of these two species the reserve complex acts as a safe haven from the threats impacting on them. It is apparent that if the threats (predominantly alien invasive species and too frequent fires) as identified during the workshops are addressed, it will benefit the fynbos endemic species and the Striped Flufftail resulting in increased populations.

Table 3.11. Avifaunal species of conservation concern that occur on the Boland Mountain Complex

Species	Common Name	IUCN Category (IUCN 2014)	South African Red Data Book Category (Bates *et al.* 2014)
*Circus ranivorus**	African Marsh-harrier	Least Concern	Endangered
*Spheniscus demersus**	African Penguin	Endangered	Endangered
*Phalacrocorax neglectus**	Bank Cormorant	Endangered	Endangered
*Circus maurus**	Black Harrier	Vulnerable	Endangered
*Phalacrocorax capensis**	Cape Cormorant	Endangered	Endangered
Turnix hottentottus	Hottentot Buttonquail	Endangered	Endangered
*Polemaetus bellicosus**	Martial Eagle	Vulnerable	Endangered
*Sterna caspia**	Caspian Tern	Least Concern	Vulnerable
*Neotis denhami**	Denham's Bustard	Near Threatened	Vulnerable
*Pelecanus onocrotalus**	Great White Pelican	Least Concern	Vulnerable
*Bradypterus sylvaticus**	Knysna Warbler	Vulnerable	Vulnerable
Falco biarmicus	Lanner Falcon	Least Concern	Vulnerable
*Sagittarius serpentarius**	Secretarybird	Vulnerable	Vulnerable
*Afrotis afra**	Southern Black Korhaan	Vulnerable	Vulnerable
Sarothrura affinis	Striped Flufftail	Least Concern	Vulnerable
Aquila verreauxii	Verreaux's Eagle	Least Concern	Vulnerable
*Anthropoides paradiseus**	Blue Crane	Vulnerable	Near Threatened

Species	Common Name	IUCN Category (IUCN 2014)	South African Red Data Book Category (Bates *et al.* 2014)
Chaetops frenatus	Cape Rock-jumper	Least Concern	Near Threatened
*Charadrius pallidus**	Chestnut-banded Plover	Near Threatened	Near Threatened
*Phalacrocorax coronatus**	Crowned Cormorant	Near Threatened	Near Threatened
*Numenius arquata**	Eurasian Curlew	Near Threatened	Near Threatened
*Phoenicopterus ruber**	Greater Flamingo	Least Concern	Near Threatened
*Phoenicopterus minor**	Lesser Flamingo	Near Threatened	Near Threatened
*Oxyura maccoa**	Maccoa Duck	Near Threatened	Near Threatened
*Haematopus moquini**	African Black Oystercatcher	Near Threatened	Least Concern
*Limosa lapponica**	Bar-tailed Godwit	Near Threatened	Least Concern

3.9.6 Invertebrates

3.9.6.1 Terrestrial Invertebrates

Invertebrates are a vital component of terrestrial ecosystems and constitute more than 80% of all animal diversity, yet they are grossly under-represented in studies of African diversity. Site biodiversity estimates that do not consider invertebrates not only omit the greatest components of what they are attempting to measure, but also ignore groups that are very significant contributors to terrestrial ecosystem processes.

The southwestern Cape represents a distinct zoogeographic zone, characterised by the phylogenetic antiquity of much of its invertebrate fauna. In addition to the vital roles invertebrates play in ecosystems (McGeoch 2002, Samways *et al.* 2010, 2012), such as primary production, nutrient recycling, predation, herbivory, competition, the Cape flora is dependent on specialised pollination guilds. For example, *Nivenia stokoei* (Kogelberg blue stars or Stokoe's bush iris) is pollinated by long-proboscis flies of the family Nemestriniidae and by long-tongued bees belonging to the family Anthophorideae (Goldblatt & Manning 2000a, b). Of note is the presence of oil-collecting bees, as opposed to pollen-collecting, on *Tritoniopsis parviflora* along the lower Palmiet River, a first such recording within the genus (J. Manning pers. comm.).

Myrmecochory (seed dispersal by ants) is another important ecological process in the Fynbos biome (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).

Endemism is most pronounced amongst flightless taxa in the Fynbos. Flightless species are locally scarce and difficult to collect and their restricted distributions and inability to disperse make them vulnerable to extinction. For example, each of the 17 species of the wingless stag beetle genus *Colophon* of the family Lucanidae are restricted to a single mountain range in the Western Cape. Fourteen of these species

have been Red Listed. Three of these species are present on high-altitude peaks in the Boland Mountain Complex, namely *Colophon barnardi, C. thunbergi,* and *C. izardi* (see Table 3.12). These species are under threat due to illegal harvesting by collectors and from climate change.

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. Species of conservation concern that are likely to occur in the Boland Mountain Complex are given in Table 3.12. Two of these species occur in vegetation types that are present in the Boland Mountain Complex, but have not been seen on the reserve. The scarce mountain copper (*Trimenia malagrida paarlensis*, Paalse bergsilwerkolkopertjie) occurs in Boland Granite Fynbos, and is only found on Paarl and Paardeberg mountains (Mecenero *et al.* 2013). This species is Critically Endangered and population monitoring, synecological and autoecological studies are needed to ensure persistence of the species. Carolynn's copper (*Aloeides carolynnae carolynnae)* that occurs in Hawequas Sandstone Fynbos and is currently known from only one small site (Mecenero *et al.* 2013). Another Critically Endangered butterfly species is Riley's opal (*Chrysortis rileyi*), which is restricted to the Brandvlei Dam area (Mecenero *et al.* 2013). All three these species are in the family Lycaenidae. The most pronounced threats to the persistence of these species is destruction of their habitat due to anthropogenic activities and the spread of invasive alien plants (Mecenero *et al.* 2013).

Table 3.12. Invertebrate species of conservation concern that occur on the Boland Mountain Complex.

Species	Common Name	IUCN Category (IUCN 2014)	Red List Criteria
Coleoptera			
Colophon barnardi	Colophon beetle	EN	B1+2e
Colophon izardi	Colophon beetle	NT	
Colophon thunbergi	Colophon beetle	EN	B1+2e
Lepidoptera			
Chrysortis rileyi	Riley's opal	CR	B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)
Trimenia malagrida paarlensis	Scarce mountain copper (Paarlse berg-silwerkolkopertjie)	CR	B1ab(ii,iii)
Aloeides carolynnae carolynnae	Carolynn's copper	EN	B1ab(i,iii,iv,v)

Species that are classified as Least Concern may still perform unique functions. One such example is *Aeropetes tulbaghia* (Table Mountain beauty), which is the only known pollinator of several plants with red flowers, including the red Disa orchid *Disa uniflora* (Johnson & Bond 1992). 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 3.13 gives the classification of the five Western Cape species that are likely to occur in the Boland Cluster World Heritage Site that are classified as Least Concern with local rarity.

Table 3.13. Conservation status of butterfly species that are likely to occur in the Boland Mountain Complex that were classified as Least Concern during Red Listing but are locally rare (Mecenero *et al.* 2013).

Species	Common name	Distribution
Rare – Low density (small subpopulations or single individuals scattered over a wide area)		
Hesperiidae		
Tsitana dicksoni	Dickson's sylph	Inland areas from Franschhoek to Baviaanskloof, widespread on the Langeberg and its foothills.
Rare – Habitat specialists (restricted to micro-habitat)		
Lycaenidae		
Chrysoritis irene	Irene's opal	Du Toit's Kloof Pass. Steep, rocky south- to southwest-facing mountain slopes, frequenting exclusively the bases of large cliffs.
Thestor strutti	Strutt's skollie	Rocky areas in fynbos at the foot of mountain peaks, between Franschhoek and Wolseley.
Rare - Habitat specialists and Restricted range (Range less than 500 km²)		
Lycaenidae		
Chrysoritis endymion	Endymion opal	Du Toit's Kloof Pass to Riviersonderend mountains above 1200m.
Rare – Habitat specialists and Low density		
Lycaenidae		
Lepidochrysops bacchus	Wineland blue	Occurs in Fynbos and Albany Thicket localities that receive between 500 mm and 750 mm rainfall per annum.

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. Unfortunately there is not a spider species list available for the Boland Mountain

Complex, but given the information generated by SANSA, it is likely that there might be endemic spider species in the reserve complex.

3.9.6.2 Freshwater Macro-invertebrates

Assessments that have been conducted formally according to the latest IUCN criteria (IUCN 2001) for the Odonata (dragonflies and damselflies) include Samways (2006), Samways and Grant (2006), and Suhling *et al.* (2009). All South African odonate species have now been updated and national as well as global statuses applied (Samways & Simaika 2016). A freshwater health index (the Dragonfly Biotic Index) has also been developed which places great emphasis on these irreplaceable endemics, and is particularly useful for assessing the level of threat to the local dragonfly fauna as well as its recovery when these threats are lifted (Samways & Simaika 2016). By far the biggest threat to Western Cape dragonflies is invasive alien trees. Removal of these trees has resulted in substantial recovery of these irreplaceable dragonfly species, as well as that of other endemic invertebrates, especially in low-elevation mountain rivers.

Recent work on some of the Western Cape dragonflies and damselflies has indicated that they represent ancient lineages. Species in the genus *Syncordulia* (Corduliidae or Emeralds) for example, diverged some 60 million years ago. These species, along with several others, currently survive in small populations and are more resilient than expected, recovering quickly when invasive alien trees are removed. Invasive alien trees shade out the sunny habitat that the dragonflies require for their life activities.

There are three species of dragonfly of conservation concern in the Western Cape (Table 3.14). *Orthetrum rubens* (EN), a highly threatened and restricted species that is only known from the mountains of the Western Cape, was discovered in the early part of the last century on Table Mountain but has not been seen there since, nor in Du Toits Kloof where it was present in the mid-1970s. It has now been rediscovered near Victoria Peak in the Hottentots Holland Mountains, and since 2016 is the only known extant population. Another species, *Spesbona angusta* (EN) (Fig. 3.11) was originally only known from a female specimen collected at Ceres in the 1920s. It was thereafter not observed until 2003 when it was rediscovered in a wetland at the base of Franschhoek Pass (on the Villiersdorp side). It is one of South Africa's rarest damselflies, having only been recorded from two localities at an elevation of approximately 400 m above sea level in the Western Cape (Samways & Simaika 2016). This species displays an unusual (to date globally unique) phenomenon of showing rapid reversible color change in both sexes that is linked to reproductive enhancement, competitive advantage and thermoregulation (Deacon & Samways 2016a). This species is also very unusual in its ecology, aspects of behavior and larval morphology (Deacon & Samways 2016b). Consequently, a conservation plan has been developed with two viable options to ensure the conservation of the species (Deacon & Samways in press). The first option is to improve the current habitat condition by increasing water supply of the pools, physically deepening the pools and increasing the density of the pools. The second option is to translocate a part of the current population to a suitable area in the Cederberg where similar species assemblages exist as at the current site.

Figure 3.11. The colour changing damselfly *Spesbona angusta.* Top: female, bottom: male. Photo by C. Deacon.

The third species of conservation concern is *Proischnura polychromatica* (EN). This species was last seen in the early 1960s at Franschhoek. It was rediscovered in 2003 in the same locality as *S. angusta* and has since also been found near Ceres. Both these last species were only known from sites where invasive alien trees had been removed. *Syncordulia legator* (VU), a rare and localized Western Cape endemic with few scattered records from Clanwilliam, Du Toits Kloof, the Palmiet River,

Jonkershoek and Franschhoek, at an elevation between 350 and 800 m was also recorded at the same site. Therefore, Deacon and Samways (in press) argued that the conservation plan they developed for *S. angusta* will serve as an umbrella plan for *P. polychromatica* and *S. legator*.

Other species in the area which have a global Red List status are *Syncordulia gracilis* (VU), *S. venator* (VU) and *S. serendipator* (VU), all of which are threatened by invasive alien trees, as are most of the Western Cape freshwater biota. *Syncordulia venator* is a Western Cape endemic that is only found at 300 – 1300 m elevation. *Syncordulia serendipator* (VU) only have a few scattered records from the Western Cape, including Riebeeck Kasteel, Bainskloof and Jonkershoek and only occur above 350 m elevation.

Table 3.14. Odonata species and their National Red List categories and criteria (Samways & Simaika 2016).

Scientific Name	Common Name	National Red List Category	National Red List Criteria
Platycnemididae (Featherlegs and Threadtails)			
Spesbona angusta	Spesbona/Ceres Streamjack	EN	A2c; B1ab(i,ii,iii)+2ab(i,ii,iii)
Coenagrionidae (Pond damsels)			
Proischnura polychromatica	Mauve Bluet	EN	B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv)
Corduliidae (Emeralds)			
Syncordulia legator	Gilded Presba	VU	B2ab(i,ii,iii), D2
Syncordulia gracilis	Yellow Presba	VU	B2ab(i,ii,iii), D2
Syncordulia venator	Mahogany Presba	VU	B2ab(i,ii,iii), D2
Syncordulia serendipator	Rustic Presba	VU	B2ab(i,ii,iii), D2
Libellulidae (Skimmers)			
Orthetrum rubens	Elusive Skimmer	EN	B2ab(i,ii,iii), D2

There is no comprehensive invertebrate species list available for the Boland Mountain Complex. Such lists are essential as inventories of what occurs in the Reserve Complex, especially in terms of Red Data and endemic species, and as baseline information for long-term monitoring. Some protection might be provided to certain arthropod groups in protected areas given the fact that there are correlations between insect species richness and biomes in the Western Cape (*e.g.* Procheş & Cowling 2006, 2007; Procheş *et al.* 2009). Therefore, the argument can be made that the attention and protection that the area receives in terms of its floral diversity might provide some protection for its insect diversity (Samways *et al.* 2012).

The invertebrate species list of the Boland Mountain Complex is updated through *ad hoc* baseline data collection. Additional information on the insects of the Cape Floral Region can be obtained from the Iziko Museums of South Africa (www.iziko.org.za).

3.10 Socio-economic context

CapeNature aims to build and sustain support among communities in terms of natural resource management, education and cultural heritage activities through promoting biodiversity management.

A protected area management plan cannot be complete without considering the role of its neighbours namely, the communities or private landowners. The majority of nature reserves are located in rural areas, which are predominantly characterised by the provision of inadequate infrastructure and basic services, at times prevalent low levels of education and high levels of unemployment. By default, CapeNature is viewed by many in these communities as a catalyst for development and it is therefore the expectation of Government and other stakeholders that, as CapeNature discharges its mandate, it takes into account these realities and engages in people-centred, outcomes-oriented and structured programmes contributing towards sustainable development and poverty eradication in these communities.

CapeNature's People and Conservation Programme is responsible for leading engagement with communities with the aim of developing mutualy beneficial activities. It aims to build and sustain constituencies among people to meaningfully partake, support and engage with biodiversity management and the natural and cultural preservation activities and efforts being undertaken by the organisation. This is achieved through means of engagement on social, economic and environmental aspects.

The main purpose of the People and Conservation Programme is to build and sustain constituencies among people to meaningfully partake, support and engage with the biodiversity management and the natural and cultural heritage preservation activities and efforts being undertaken by CapeNature. This is done through targeted, structured facilitations and capacity building interventions within local communities by promoting biodiversity management as a socio-economic development and positive change catalyst.

The 2015 – 2020 People and Conservation Strategic Plan speaks to four focus areas (see Fig. 3.12) that are aligned and linked to other relevant organisational, provincial and National imperatives.

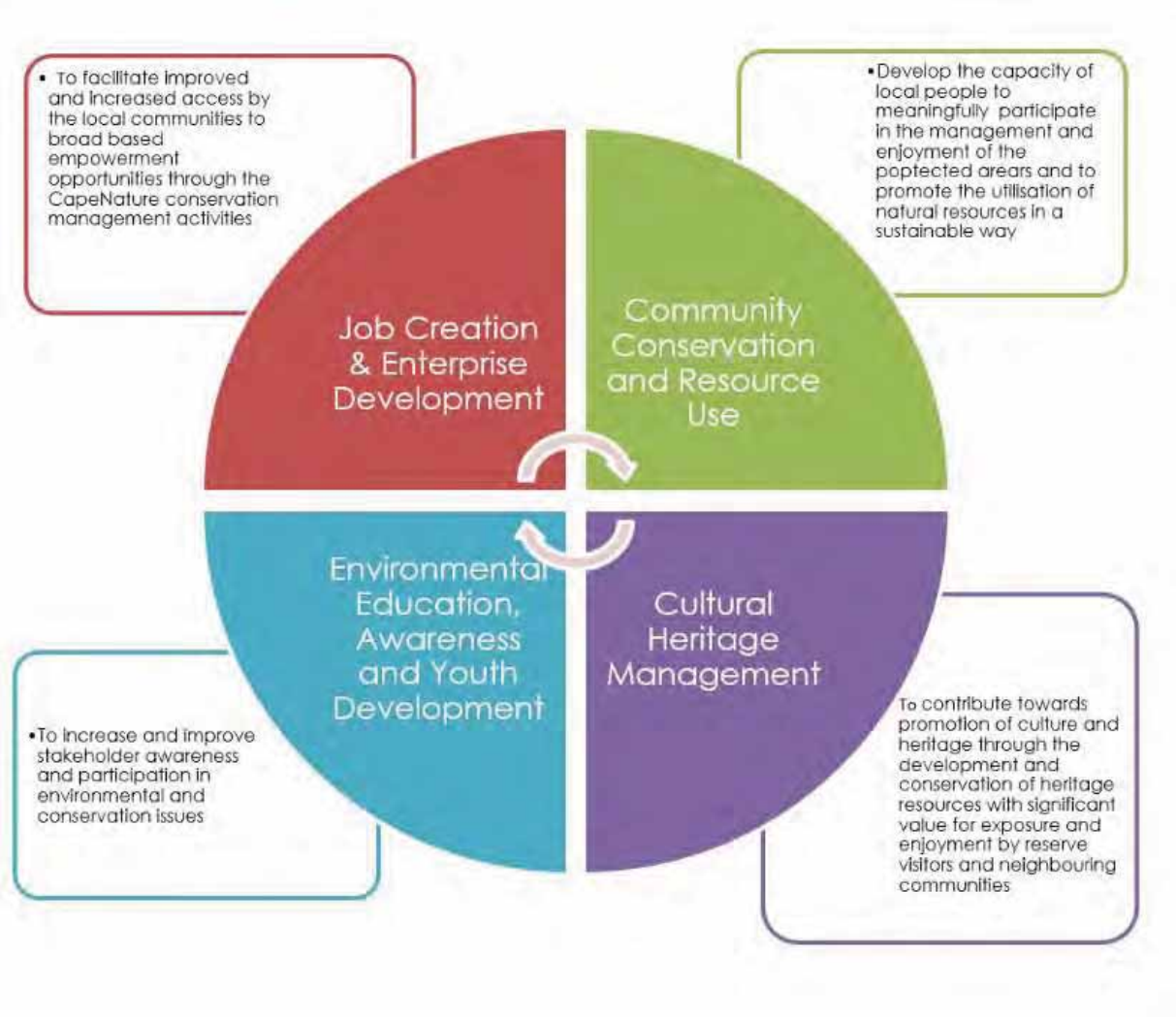

Figure 3.12. The 2015 – 2020 People and Conservation Strategic Plan showing its four focus areas.

3.10.1 Job Creation and Enterprise Development

Over the years CapeNature has, through its People and Conservation Programme spearheaded community beneficial projects through Integrated Management Programmes, implemented Expanded Public Works Programmes and developed Small, Medium and Micro Enterprise (SMME) development programmes to stimulate local economic development. These efforts contributed directly and indirectly towards alleviation of poverty for many communities living adjacent to the protected areas. The implementation of the suite of job creation programmes like Expanded Public Works Programmes (EPWP), Natural Resources Management, working for wetlands and so forth have created a number of jobs and small businesses in these areas and has the potential to continue serving as one of the key economic drivers in these regions going forward.

3.10.1.1 Expanded Public Works Programme

The provincial-wide footprint of CapeNature operations presents an opportunity for improving lives of communities especially in the rural landscape by providing job

opportunities. CapeNature is committed to provide decent job opportunities through its ecotourism operations and conservation management actions.

CapeNature facilitates the job creation footprint and facilitation of social development and functional training interventions across the province through EPWP projects that are implemented on nature reserves with the focus placed on vulnerability groups *i.e.* youth, woman and people with disabilities.

EPWP classifies projects according to the National Department of Public Works Projects List and are recorded in the EPWP Reporting System annually, at the beginning of the financial year. The job opportunities created in those projects are reported in the National Department of Public Works database and reporting system on a monthly basis. Jobs in CapeNature emanate from EPWP and Small Business Opportunities created for local entrepreneurs.

The EPWP is implemented within the relevant region through the Responsible, Accountable, Consulted and Informed Chart and related Standard Operating Guidelines that clarify how the job creation programmes are rolled out. The planning process starts by drafting an Annual Plan of Operation (APO) for the period of one year. This plan indicates what activities are planned for each reserve and which resources will be required which includes the EPWP participants who will be engaging to complete these activities. Accredited training is provided based on the activities that are required to be completed for each reserve. A training needs analysis is completed for all EPWP participants which informs the training plan that will be drafted and implemented.

The EPWP component is reported on in the relevant region on the Biodiversity Management System on a monthly basis. The People and Conservation Programme utilises the Management Information System to check the wage expenditure, as well as that the staff turnover.

3.10.1.2 Enterprise Development - SMMEs

CapeNature provides local communities with business opportunities in line with approved annual operational plans and budgets, aligned to organisational set objectives goals and targets. A focused Enterprise Development Programme and localised support become key in growing small businesses. CapeNature will continue to partner with business support institutions such as the Small Enterprise Development Agency, South African Revenue Service, Department of Labour, banks and relevant provincial and national departments in providing capacity building and incubation opportunities to all identified and appointed small businesses.

In understanding the value of engagement of small businesses in their development agenda, CapeNature has institutionalised Regional Contractor Development Forums for focused business development discussion, networking opportunities, engagement opportunity with business support institutions and success stories sharing.

Local economic development is stimulated through the facilitation of SMME opportunities within both the eco-tourism as well as integrated catchment management services in CapeNature.

3.10.1.3 Capacity building

CapeNature ensures accredited and functional training for different categories of workers and knowledge and skills gained to add value to their employability in the

mainstream economy through projects aimed at Youth Development such as the Youth Environmental Service (YES) programme.

Capacity building initiatives are being implemented within the region and roles are clarified through a Responsible, Accountable, Consulted and Informed Chart. The YES program is aimed at capacitating the youth (Grade 12 up till age of 35 years) to develop skills that will equip them for the job market. Various accredited training courses have been planned. Non-accredited training can consist of in-house training and training that are not unit standard aligned, for example Field Safety and Survival.

YES, and other capacity building initiatives, are reported on through Regional and Corporate Training Plans. Within the YES program there is an appointed YES administrator through which all reporting should be channelled and a monthly report compiled.

As part of social development framework, a Women Empowerment Plan has been implemented across the organisation and includes focused interventions that address societal challenges that are at the centre of women emancipation struggles. This plan provides a wide range of activities aimed at advancing women in the workplace and in the society. Within the Boland Mountain Complex as per EPWP requirements, 55% of the EPWP composition need to be women. Social days within the Boland Complex involves a great focus on women's issues.

3.10.2 Community Conservation and Resource Use

In a democratic state like South Africa it becomes an entrenched practice to involve communities in the management of protected areas, notwithstanding the enabling legislative mechanisms that would be flowing from the lawmakers aligned to the Constitution of the country. This practice provides an opportunity to engage and agree on a "shared conservation action destiny". This also gives the community the assurance of being an equal partner in the engagement process. Transparency and honesty are the fundamental guiding values as the past decades of oppression, inhumane practices and social fabric destruction imposed policies and legislation of the government created a huge platform for confrontation and total distrust. Given the young and delicate democracy of the country, the approach to community participation in protected areas requires a sound foundational architecture complimented by enablers aligned to clear conservation action targets and achievable deliverables. This being a concurrent function, it becomes critical to promote cooperative governance and build sustainable partnerships with all role-players who see an opportunity to contribute to the overall conservation action objectives.

3.10.2.1 PAACs, committees and forums

Participation of stakeholders in protected area management is encouraged through Protected Area Advisory Committees, which are CapeNature institutionalised structures.

In a conflict situation at any platform, the different organisations need to be guided by an agreed-upon conflict and dispute resolution mechanism. This process requires swift activation so that the issues can be addressed, resolved and normalisation of relations to be restored. In CapeNature this process is driven through the Protected Area Advisory Committees and further captured in the People and Conservation Programme and Natural Resource User Groups approved Code of Conduct. The protected area advisory committees' key role is to hold the conservation authority to

account for the effective and sound management of the protected areas in their vicinity for the benefit of the society.

There are two Protected Area Advisory Committees within the Boland Mountain Complex which engage on a quarterly basis. Engagement also takes place at the following forums and meetings: Heuningnes Estuary Forum, the Initiation Forums, Fire Protection Associations and Police Forums. Engagements ensure cooperation and assistance where needed. A Stakeholder Matrix is used to provide adequate details about relevant stakeholders.

Protected Area Advisory Committees and other stakeholder engagements are reported on via the METT report, Regional People and Conservation monthly/quarterly narrative reports and general Regional Management Team meeting reports.

3.10.2.2 Natural Resources User Groups

CapeNature sustains relationships with Natural Resource User Groups (NRUGs) at local and regional levels for meaningful participative discussions and capacity building interventions relating to the Nature Conservation Ordinance, 1974 (Ordinance 19 of 1974) or its replacement, fire awareness, access to certain sites for initiation purposes, sustainable harvesting and other bioprospecting initiatives, wise water use, climate change, waste management and recycling (this list is not exhaustive).

Regional and Corporate People and Conservation Action Plans are used to guide interventions across the Complex. Within the Boland Mountain Complex, there are currently five NRUGs, including Rastafarians in the Jonkershoek, Limietberg and Hottentots Holland Nature Reserves, and Initiation groups, which are located within the Hottentots Holland and Limietberg Nature Reserves.

All activities are informed by regular meetings such as the Quarterly NRUG meetings at Regional level and Provincial People and Parks Steering Committee Meetings. At least eight of these meetings are held each year within the Boland Mountain Complex.

3.10.3 Cultural Heritage Management

Cultural heritage management contributes towards the promotion of culture and heritage through the development and conservation of heritage resources with significant value for exposure and enjoyment by reserve visitors and neighbouring communities.

Access refers to cultural, religious, traditional and harvesting activities that take place within a specific reserve. Regular meetings are held with People and Conservation staff to determine their access needs. Furthermore, environmental education and awareness activities are being conducted within and around the Boland Mountain Complex to inform the public (leaners and community members) regarding environmental concerns and challenges relevant to the area or community.

Culture and heritage management is being reported on through the METT reports as well as through the Biodiversity Management System.

3.10.4 Environmental Education, Awareness and Youth Development

The legislative mandate for Education for Sustainable Development in the Western Cape resides with the Department of Environmental Affairs and Development Planning and CapeNature. They are mandated to be facilitative, thereby providing an enabling platform for collaborative implementation of environmental education programmes,

while strengthening networks and partnerships with other environmental education role players and stakeholders in the Western Cape.

CapeNature provides an enabling environment for environmental education, awareness and youth development that are primarily aligned to the curriculum (where relevant), environmental calendar days and species conservation. The aim of this focus area is to increase and improve stakeholder awareness, expand knowledge and participation in environmental and conservation issues. Main themes for the organisation include fire, species conservation, culture and heritage, healthy living, water and waste which all link to the broader theme of Climate Change.

Both outreach and on-site programmes are conducted as formal programmes aligned to the curriculum during the school day and whenever possible. Other types of education and awareness projects include exhibitions, volunteer-based learning opportunities (such as beach clean-ups), holiday programmes, educational talks and overnight camps. Longer term, more sustainable projects such as the Junior Rangers Programme are also catered for.

Within the Boland Mountain Complex, the critical themes that have been identified include: species conservation (including invasive species and unique fauna and flora), fire (specifically with reference to fire hotspots) and water. Approximately 53 interventions are planned annually to address these themes and other environmental concerns relevant to the area. Activities are reported on through the Biodiversity Management System on a monthly basis.

Detailed plans for each protected area are captured in the regional People and Conservation Work Plans which are also embedded in targets in the CapeNature Annual Performance Plan which feed into the People and Conservation Strategic Action Plan.

3.11 Organisational context

3.11.1 Finance and Asset Management

In line with the legal requirement, the strategies of implementation to achieve the desired state have been costed below.

The protected area will adhere to the guiding principles listed below:

- Responsibly manage the allocation of budget, revenue raising activities and expenditure;
- Ensure solid financial management support the achievement of the objectives of this plan; and
- Compliance to the Public Finance Management Act as well as CapeNature's financial policies and procedures.

Using the 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.*).

3.11.1.1 Income

CapeNature's budget is funded by the Medium Term Expenditure Framework 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 eco-tourism, finance, biodiversity support, conservation services, people and conservation, legal services *etc.* which are not allocated to individual protected area complexes and must also be funded through grant funding or own revenue generated.

This PAMP is a 10-year plan, and thus straddles multiple Medium Term Expenditure Framework periods which impact on actual budget allocation and projection.

Total income projected for 2019/20 is budgeted at R35 850 778, increasing at an estimated annual rate of 10% from previous years. A summary is presented in Table 3.15.

Table 3.15. A summary of the total projected income for the protected area management plan.

	2017/18	**2018/19 (current year)**	**2019/20 (projection)**
Total Income	R 29 165 165	R 28 799 233	R 37 419 168
Medium Term Expenditure Framework Allocation	R 18 940 217	R 20 831 927	R 24 046 595
Own Fund	R -	R 3 475 931	R -
External Funding	R 10 224 948	R 4 491 375	R 13 372 573

3.11.1.2 Expenditure

3.11.1.2.1 Recurring costs

The annual directly allocated cost (includes staff, transport & travel, communication, stores and equipment) is estimated at R37 419 168 for 2019/20. These ongoing costs are split according to strategies as illustrated in Figure 3.13.

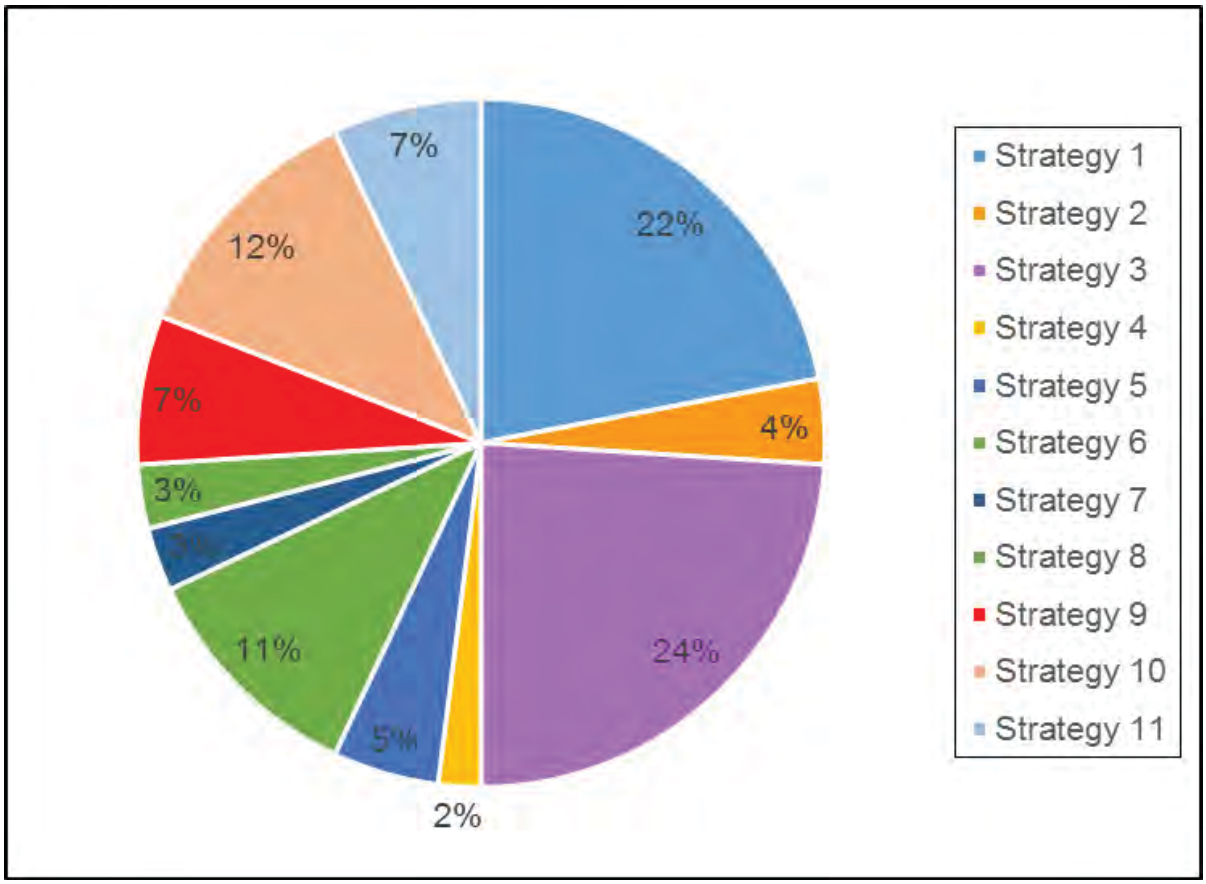

Figure 3.13. The estimated proportion of annual operational costs for the Boland Mountain Complex for 2019/20 aligned with the identified and prioritised strategies.

3.11.1.2.2 Once off costs

In addition to the above there might be once-off replacement costs of assets, *e.g.* tractor and or minor assets aligned with the life span of the relevant asset.

3.11.1.2.3 Maintenance

The Provincial Department of Transport and Public Works is responsible for and carries out maintenance on buildings in CapeNature-managed protected areas as captured in the User Asset Management Plans, governed by the Government Immovable Asset Management Act (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.

3.11.1.3 Summary

It is estimated that the protected area will require an annual operating budget of R37 419 168 for 2019/20, increasing at a projected annual rate of 10%.

3.11.1.4 Implications

Unsuccessful securing of external funding and replacement of crucial captital equipment could lead to potential shortfall and will have a negative impact on strategies throughout.

3.11.2 Operational Staff

The Boland World Heritage Site Complex consists of five Nature Reserve Complexes, namely Waterval, Limietberg, Jonkershoek, Hottentots Holland and Kogelberg. In total there are 64 permanent staff between the five reserve complexes. Waterval has nine, Limietberg 16, Jonkershoek 11, Hottentots Holland 16 and Kogelberg 12 permanent workers (Fig. 3.14).

In addition to the permanent staff each reserve has contract employees, better known as Full Time Equivalent staff, funded by Expanded Public Works Program (EPWP). In total there are 110 Full Time Equivalent staff between the five reserve complexes. Waterval has 21, Limietberg 30, Jonkershoek 20, Hottentots Holland 20 and Kogelberg 19.

The permanent staff component of Waterval Nature Reserve Complex consists of a Conservation Manager that manages the Reserve Complex from the office at Waterval. One Nature Conservator, one Project Manager, one Senior Field Ranger and one Finance and Admin Officer report to the Conservation Manager. Two Quality Controllers report to the Project Manager and two Field Rangers report to the Senior Field Ranger.

The permanent staff component of Limietberg Nature Reserve Complex consists of a Conservation Manager that manages the Reserve Complex from the office in Paarl. One Nature Conservator, one Project Manager, one Finance and Admin Officer and one Field Ranger at Tweede Tol report to the Conservation Manager. One Quality Controller and three Conservation Assistants report to the Project Manager, five Field Rangers report to the Nature Conservator and two Conservation Assistance report to the Field Ranger at Tweede Tol.

The permanent staff component of Jonkershoek Nature Reserve Complex consists of a Conservation Manager that manages the Reserve Complex from the office at Jonkershoek. One Nature Conservator, one Project Manager and one Finance and Admin Officer report to the Conservation Manager. One Quality Controller reports to the Project Manager, and three Field Rangers and two Conservation Assistants report to the Nature Conservator.

The permanent staff component of Hottentots Holland Nature Reserve Complex consists of a Conservation Manager that manages the Reserve Complex form the office at Nuweberg. One Nature Conservator, one Project Manager and one Finance and Admin Officer report to the Conservation Manager. Two Quality Controllers report to the Project Manager and one Senior Field Ranger reports to the Nature Conservator. The Senior Field Ranger co-ordinates four Field Rangers and four Conservation Assistants.

Kogelberg Nature Reserve Complex staff component consists of a Conservation Manager that manages the Reserve Complex from the office at Oudebosch. One Project Manager and one Finance and Admin Officer report to the Conservation Manager. The Conservation Manager also supervise one Tourism Liaison Officer.

The Conservation Managers of the Limietberg, Jonkershoek, Hottentots Holland and Kogelberg report to the Protected Areas Manager of the Central Region, based at Paarl, within the Conservation Management Directorate. The Conservation Manager of Waterval report to the Protected Areas Manager of the West Region, based at Wolwekloof, within the Conservation Management Directorate.

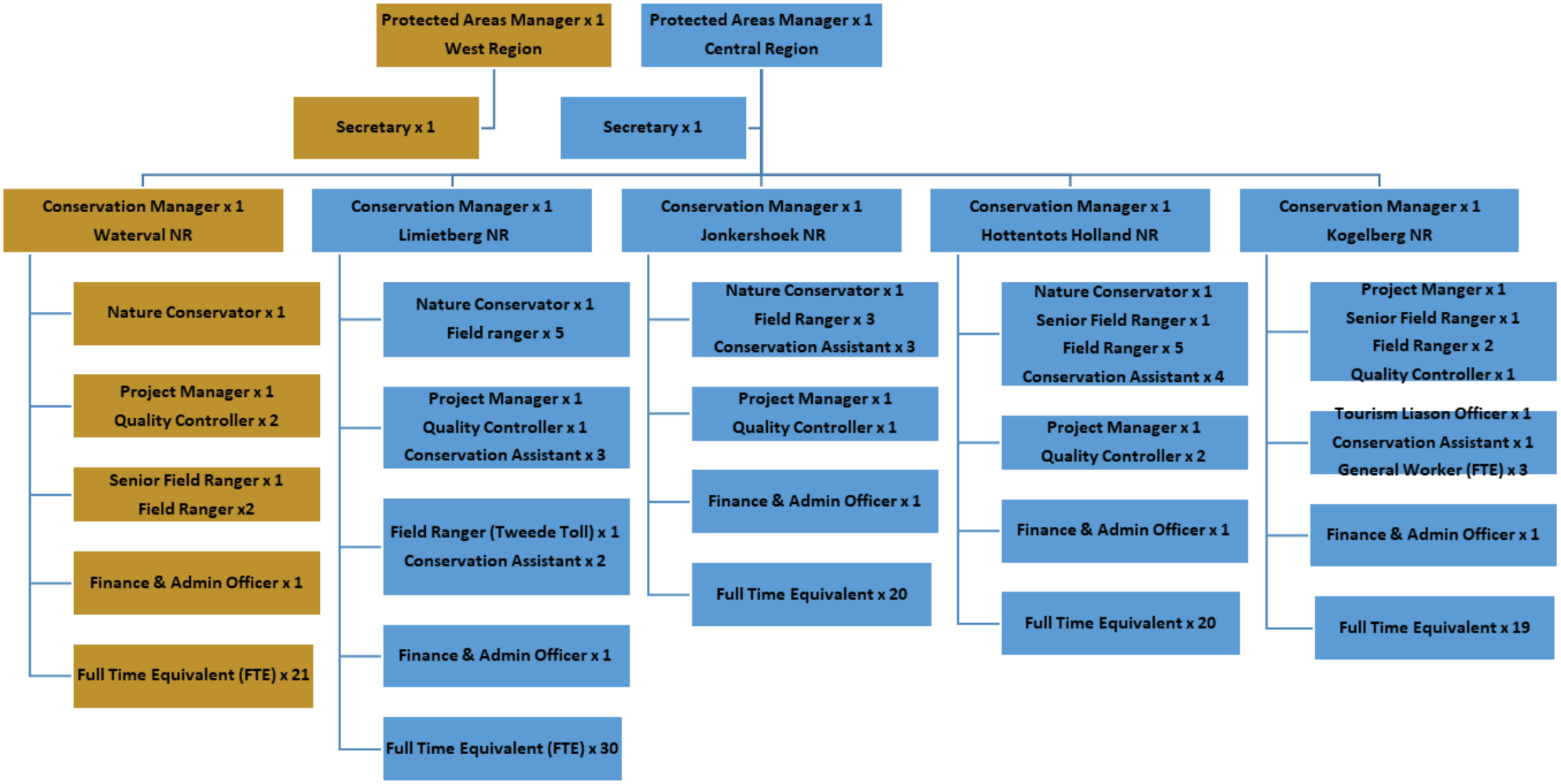

Figure 3.14. The approved organogram of the Boland Mountain World Heritage Site Complex.

3.12 Environmental Management

In terms of NEM: PAA (Act 57 of 2003) Norms and Standards for the Management of Protected Areas in South Africa (Gazette No. 382 of 31 March 2016), Sections 11 g & h:

(g) All development projects that require environmental scoping are assessed through and are authorized at the relevant level. The indicators for this are that (1) there are records of decisions and authorisations in place and that (2) there is a process to monitor and effect compliance with conditions of the records of decisions.

(h) Commercial tourism, where applicable, is compatible with and contributes to, the protected area objectives. Indicators include (1) cooperation between Protected Area Management and Tourism operators to enhance visitor experiences, maintain Protected Area conservation values and resolve conflicts; (2) the commercial tour operators are subject to the Protected Area management authority; (3) Permits, licenses and concessions are granted in terms of management plan objectives; (4) Tourism standards are developed for nature based tourism.

All new developments are subject to the rules and regulations set in terms of the National Environmental Management Act (Act 107 of 1998) as amended in terms of the Environmental Impact Assessment Regulations (2014). All development shall be in line with the ethos, values and conservation principles of the Management Authority and compliment or enhance the biodiversity estate and visitor experience.

The management authority shall investigate strategic business opportunities as well as Reserve specific tourism needs and opportunities, evaluate sustainability options and ensure that tourism facilities and products are ecologically and economically responsible and viable.

The Management Authority shall determine the carrying capacity, both cumulative and for individual activities and events to ensure that natural and cultural values are not negatively impacted.

The Management Authority shall investigate business opportunities with external partners to facilitate responsible Eco-Tourism and Adventure events and activities within the Boland Mountain Complex.

The Management Authority shall suitably capacitate staff or appoint external partners to monitor business ventures, events and activities within the Boland Mountain Complex.

Activities (including Filming, Photography, Events and Functions) are allowed on the authority of a Special Use Permit or are allowed in terms of a Memorandum of Agreement or Understanding (MOU) with the Management Authority. Such activities are only allowed in pre-approved locations within the Boland Mountain Complex and under strict conditions. Environmental Management Plans are required where (1) the activity is considered large scale; (2) crosses sensitive environments; (3) has the potential to impact the environment negatively; (4) has the potential to impact CapeNature or surrounding communities negatively.

Environmental Management plans will also be required for the following:

1) All development activities, whether new construction or upgrade of existing facilities.
2) All tourism or adventure activities permitted on the Reserve *e.g.* Mountain biking, ziplining, kloofing, horse riding, *etc.*
3) Where MOUs are in place and external organisations or companies bring visitors, especially youth groups.

Environmental Management plans must contain as a minimum the following information pertaining to the Activity (including events, films and functions).

- Date, time and duration
- Locations, including maps and routes
- Contact information of relevant stakeholders and responsible persons
- Numbers of participants
- Type of activity
- Logistics (including set-up and departure)
- Potential environmental impact
- Mitigation of potential impact
- Activity specific rules
- Non-compliance penalties
- Media implications and requirements
- Medical contingencies and evacuation plans
- Contact information of Compliance Officials
- OHS management

The use of qualified and experienced Environmental Control Officers is essential to ensure a high level of monitoring and compliance management for all activities (including development, construction, events, filming, photography and functions). The Management Authority shall ensure that an Environmental Control Officer manual with the minimum requirements, standards and protocols is in place.

The issuing of contracts for Alien Clearing, Integrated Catchment Management or other environmental projects may also be subject to Environmental Management Plans. Contractors will be required to undergo induction training, sign the Environmental Management Plans and site conditions.

3.13 Infrastructure Management

The infrastructure of the Boland Mountain Complex is depicted in Maps 6a-f.

3.13.1 Roads

Roads within the Boland Mountain Complex are mostly gravel and are accessible by all vehicles. Tourist access the Boland Mountain Complex uses public roads. Maintenance of these roads fall under the Provincial and District Road Authorities.

Kogelberg Nature Reserve Complex

Access roads within the Kogelberg Nature Reserve Complex are mainly vehicle track roads that are usually only negotiable by means of a 4x4 vehicle, especially during the wet season. Due to the high risk of erosion of soils in the region, the grading of management roads is not allowed. In many instances cement track roads were constructed at key areas and the aim is to extend these to as many frequently-used management roads practically and financially possible.

Hottentots Holland Nature Reserve Complex

Roads within the Hottentots Holland Nature Reserve Complex are mostly gravel, with many of them being jeep tracks and are only accessible by suitable high rise, with differential lock or 4x4 vehicles. The section of road from the main gate to Cape Canopy Tours venue is accessible by standard code 8 vehicles. Some of these roads are public roads that are used by tourists to access the Hottentots Holland Nature Reserve Complex facilities. The maintenance of these roads fall under CapeNature and in some cases the Provincial Authority.

Limietberg Nature Reserve Complex

Access roads within the Limietberg Nature Reserve Complex are mainly vehicle track roads that are usually only negotiable by means of a 4x4 vehicle, especially during the wet season. Due to the high risk of erosion of soils in the region, the grading of management roads is not allowed. In many instances, cement track roads were constructed at key areas and the aim is to extend these to as many frequently used management roads practically and financially possible.

Waterval Nature Reserve Complex

Roads within the Waterval Nature Reserve Complex are mostly gravel and some of these roads are public roads that are used to access the reserve. The maintenance of these public roads fall under the Provincial and District Road Authorities.

3.13.2 Jeep Tracks

Jeep tracks are exclusively used for management purposes and are only accessible by 4x4 vehicles. Due to the high risk of soil erosion the grading of jeep tracks within the Protected Areas is not allowed. Regular assessments and maintenance work is conducted as part of Integrated Catchment Management.

3.13.3 Trails

Boland Mountain Complex has a network of day and overnight hiking trails providing access for hikers to the remote mountainous areas and other popular tourist sites. Trails are vulnerable to erosion due to steep slopes and sandy substrate. Some of the day trails to popular geological features carry high tourist traffic and require regular maintenance. Maintenance is conducted as part of Integrated Catchment Management.

3.13.4 Buildings

Maintenance and repairs of buildings are prioritised and included on the schedule of Department of Public Works. Minor maintenance and repairs to buildings are identified and attended to by management using the reserve budget.

3.13.5 Fences

In the Boland Mountain Complex, all internal fences have been removed. Boundary fences shared with properties where game has been re-introduced are intact and are being maintained by the relevant landowners. The Limietberg is currently unfenced except around the stores at Hawequa and this results in tourism, operational or ecological problems. The maintenance of the eastern boundary fence has been prioritised to prevent nuisance animals from entering the wilderness. Tourism management barriers have been placed at a number of popular tourist sites to restrict unauthorised access.

3.13.6 High Sites

Kogelberg Nature Reserve Complex

The high points are Kogelberg Peak (1 269 m), Five Beacon Ridge (1 080 m), Sanctuary Peak (1 051 m), Buffelstalberg (844 m), Voorberg (862 m) and Platberg (909 m)

The proliferation of high sites for radio towers and masts is discouraged. However, a lease agreement with a cellular company exists at Buffelstal near Pringle Bay. Access is gate-controlled.

Hottentots-Holland Nature Reserve Complex

There are numerous high sites on the Hottentots Holland Nature Reserve Complex due to the mountainous terrain and proximity to urban environments. Currently only Simonsberg, Hansekop and Groenlandberg are registered high sites. These sites are also used as radio repeater sites by CapeNature on Victoria Peak and Square Tower Peak, although these sites are not operational at present.

Limietberg Nature Reserve Complex

One major high site exists in the Limietberg Nature Reserve Complex, namely a Telkom Tower at the top of Du Toitskloof pass. Access is controlled via a locked gate.

Waterval Nature Reserve Complex

Currently only Ontongskop peak is registered as a high site in Waterval Nature Reserve. The site is used as a radio repeater site by CapeNature and is assessed through a jeep track from the office.

3.13.7 Signage

Kogelberg Nature Reserve Complex

Discrete regulatory and safety signage to inform visitors is maintained as per CapeNature standards.

Hottentots-Holland Nature Reserve Complex

Signboards are located at all major vehicle and hiking entrance points to the HHNRC. There is a requirement for additional signage at all access points (vehicle, pedestrian, cycling routes). Signage must conform to the CapeNature brand signage as per the signage manual. It is essential that all signage include a place name, indemnity, do's and don'ts of the area, safety regulations and the emergency contact telephone number.

Limietberg Nature Reserve Complex
Discrete regulatory and safety signage to inform visitors is maintained as per CapeNature standards.

Waterval Nature Reserve Complex
Signboards are located at all entrance points to the reserve and no-entry signs have been placed at a number of access points to restrict unauthorised access to the WNRC where the is no proper fence due to the reserve landscape.

3.13.8 Utilities

Kogelberg Nature Reserve Complex
Water provision is through the Local Municipal supply at Stony Point Nature Reserve, rainwater at Brodie Link Nature Reserve and abstraction from the Oudebosch and Palmiet Rivers at Oudebosch.

The Eskom utility supplies electricity to the Oudebosch settlement and residential buildings on Brodie Link Nature Reserve while prepaid Municipal supply is utilised at Stony Point. In the event of an outage, power is generated at Oudebosch.

Self-removal of waste to Municipal transfer depots happens in the case of the Oudebosch settlement and Brodie Link Nature Reserve. Glass, metals and paper for recycling is sorted at Oudebosch before removal. Municipal services including sewerage are provided for at Stony Point Nature Reserve. All other sewerage is either composted or pumped conservancy tanks.

Hottentots-Holland Nature Reserve Complex
Water is sourced from the river behind the Nuweberg Offices. It is piped (gravity-fed) first into a series of water tanks and then to the buildings / facilities at Nuweberg.

Electricity is supplied through Eskom, with the accounts sent to CapeNature. Additionally, electricity is supplied to the Nuweberg Forestry community through a third party which CapeNature purchases electricity vouchers from. These vouchers are then sold to the community at cost. Discussions in terms of moving over to Eskom Pre-Paid boxes are underway.

Waste management is currently done by CapeNature and household waste is removed to the Local Municipal waste facility on a weekly basis. Discussions are underway with National Department of Public Works and the Theewaterskloof municipality for the transferal of land on which the Nuweberg Forestry Community lives to the Municipality. This will require the Municipality to take over the Provision of Services and Management of Facilities.

Limietberg Nature Reserve Complex
Limietberg Nature reserve gets its water for the Paarl Office from the Drakenstein Municipal water grid. Tweede Tol has a weir and a network of pipes and reservoirs to get the water to the houses, offices, picnicsites and campsites.

Electricity is supplied to the Paarl office by the Drakenstein Municipal electricity grid. Tweede Tol is off the grid and gets its power from a 25 KVa generator and solar power.

All waste from the Paarl Office and Tweede Tol is delivered to the Municipal waste transfer station where it is sorted and sent to the municipal dump. Recycling happens at the waste transfer station.

Waterval Nature Reserve Complex
Water is sourced from the borehole behind the Waterval Offices. It is piped (gravity-fed) first into a series of water tanks and then to the buildings / facilities at Waterval.

Electricity is supplied to the Waterval office by Eskom.

Waste Management is currently done by CapeNature and household waste is removed to the Local Municipal waste facility on a weekly basis.

4 THE PLANNING CONTEXT

4.1 Establishing Natural and Cultural Values

This approach entailed the selection of values that represent the overall biodiversity and cultural historic heritage of the Boland Mountain Complex. Values that are in good condition or healthy, provide the ecosystem services that support human welfare. Human well-being targets, or aspects of human welfare that are within the scope of protected area management, were also selected based on the condition of healthy natural and cultural historic values.

Facilitated stakeholder workshops identified values systematically at the coarse level through the identification of ecological systems, followed by a fine scale review of ecological communities and species. Selected values were then screened for species or features that have special or unique conservation requirements or management. The same approach was followed for cultural historic heritage.

The assemblage of values identified captures all parts of ecosystems and the critical processes that sustain them, as well as cultural and historic heritage, and the attributes that maintains it. The following standard criteria (CMP 2013) guided the final selection of values:

- Co-occurrence in the landscape (*i.e.* are they captured by other values).
- Requiring similar ecological processes.
- Having similar viability.
- Having similar threats.

4.2 Viability analysis

Viability analysis identified the key characteristics that define healthy values, established indicators to measure key characteristics / attributes of values, assess the current status of the value, and establish what protected area management wants to achieve (measurable goals).

Once values were defined, workshop participants conducted viability analyses to establish the current condition of values and future desired states. For each value, the characteristics (hereafter key attributes) defining the healthy value *i.e.* attributes or characteristics that if lost, missing or altered, result in overall degradation of the value and an inability of the value to persist over the long term, were identified.

Key ecological attributes of natural values were measured in terms of size (*i.e.* population size / patch size), condition (*i.e.* reproduction or species composition), and landscape context (ecological processes and connectivity) by selecting indicators of attribute health. Attributes and indicators relating to cultural historic values and human well-being were measured in terms of condition (presence and condition of assets, knowledge, mechanisms, access).

Once current condition was articulated, indicators informed setting thresholds for condition to aid determining viability. For each value, indicators provide the basis for ratings of status: POOR, FAIR, GOOD, or VERY GOOD, using the best available information. See Table 4.1 for viability rating definitions.

Table 4.1. Descriptions of viability ratings used in the Open Standards. Indicator ratings are usually quantitative although can be qualitative when relationships between an indicator and the viability of a value are poorly understood or information is lacking. (CMP 2013).

Very Good ***Optimal integrity***	The attribute and/or value is functioning at a desirable status and requires little human intervention.
Good ***Minimum integrity***	The attribute and/or value is functioning within its acceptable range of variation; it may require some human intervention.
Fair ***Vulnerable***	The attribute and/or value lies outside its acceptable range of variation and requires human intervention. If unchecked, the value will be vulnerable to serious degradation.
Poor ***Imminent Loss***	Allowing the attribute and/or value to remain in this condition for an extended period will make restoration or preventing extirpation practically impossible.

Based upon the information derived from the viability assessment, a desired future condition was established for values by setting measurable, time-bound Goals directly linked to values and key attributes.

The following sub-section provides the results of establishing values and viability assessment:

4.2.1 Freshwater Ecosystems

4.2.1.1 Value Description

This value is comprised of natural seasonal and perennial rivers, streams and wetlands that occur in the Boland Mountain Complex. Several of the wetlands and seeps are connected to the TMG Aquifer and are thus groundwater-fed. Most rivers have their source in the Boland Mountains.

4.2.1.2 Key Ecological Attributes

Freshwater fish species composition (includes threatened fish species)

Annual or biennial (every two years) monitoring should be done for all redfin populations to determine population size and structure. This information will inform

reserve management, as well as provide data for future Red List assessments. Redfins were selected as monitoring target as they most often co-occur with *Sandelia* and *Galaxias* so a single monitoring effort should cover all resident species. Intensity of monitoring effort will be resource-dependent but the sites listed in Table 4.2 should be used as a guideline as it is linked to CapeNature's draft fish Critical Biodiversity Area (CBA) monitoring strategy. Given the taxonomic uncertainty within the genera *Sandelia* and *Galaxias*, baseline surveys and collection of genetic and voucher material should be done for all populations within the complex where material has not been collected in the past. Historical *Galaxias* records exist for a number of rivers on the reserve complex but the status of these populations should be verified. This is to enable the identification of range-restricted lineages and populations of high conservation value that require further monitoring or conservation interventions.

Monitoring priorities in the Boland Mountain Complex:

- *P. skeltoni*: (1) Upper Riviersonderend, (2) Krom
- *Pseudobarbus sp.* 'burchelli Breede': (1) Upper Riviersonderend, (2) Witte, (3) Wolwekloof, (4) Du Toits, (5) Amandel
- *P. burgi: (*1) Olifants, (2) Drakenstein (3) Upper Berg (4) Upper Wemmers

In terms of baseline data collection to fill in distribution gaps and to update gaps in distribution data, the following areas are priority:

- Kogelberg Nature Reserve Complex: Louws, Buffels and Dawidskraal Rivers
- Hottentots Holland Nature Reserve Complex: upper Palmiet River and tributaries upstream of Eikenhof and Nuweberg Dams. Also off reserve sections of the upper Riviersonderend upstream of Theewaterskloof Dam to determine extent of *P. skeltoni* presence and possible invasion pathways/barriers downstream.
- Haweqwa Nature Reserve: Tributaries upstream of Stettynskloof Dam

The current condition of the rivers in the Boland Mountain Complex is shown in Table 4.3.

Table 4.2. Sampling sites proposed for monitoring of freshwater fish communities of the Boland Mountain Complex.

Site no	River	CBA	Site code	DDS	DDE	Site description	Expected species	Gear type
BE1	Upper Berg	Yes	G1BERG-BRBM1	33,956	19,0728	upstream of Berg River Dam, upstream of weir	*P. burgi, S. capensis, G. zebratus, O. mykiss*	Snorkel, Electrofishing,Go-Pro
BE2	Olifants	Yes	OLW-1 (G1OLIF-ABRID)	33,83	19,1277	Upstream of Wemmershoek Dam at low flow causeway	*P. burgi, S. capensis, G. zebratus, O. mykiss*	Snorkel, Electrofishing,Go-Pro
BE3	Drakenstein	Yes	G1DRAK-WEMME	33,808	19,0769	Upstream of Wemmershoek Dam	*P. burgi, S. capensis, G. zebratus, O. mykiss*	Snorkel, Electrofishing,Go-Pro
BE4	Franschhoek	Yes	G1FRAN-LAPRO	33,901	19,0889	Upstream of the road bridge to Winefarm "La Provence"	*P burgi, S. capensis, G. zebratus, O mykiss*	Electrofishing
BE5	Wemmers_upper	Yes	CN site	33,831	19,0572	Turn off from road leading to Wemmershoek Dam, follow dirt road to river crossing	*P. burgi, S. capensis, G. zebratus*	Electrofishing
BE6	Hugos_upstream	Yes	HU-1	33,748	19,0651	Upstream of trout farm on old pass road	*P burgi, G. zebratus, O. mykiss*	Snorkel, Electrofishing,Go-Pro
BE7	Hugos_downstream	Yes	CN	33,740	19,0524	below N2 road bridge on farm road	*P. burgi, S. capensis, G. zebratus*	Electrofishing
BE8	Krom_upstream	Yes	KR-1 (G1KROM-BEIBT)	33,620	19,0854	Below IBT on Doolhof farm	*P. burgi, S. capensis, G. zebratus*	Snorkel, Electrofishing,Go-Pro

Site no	River	CBA	Site code	DDS	DDE	Site description	Expected species	Gear type
BR3	Upper Witte	Yes	WTT-2	33,631	19,1067	Upstream of Eerste Tol Hiking hut in Bainskloof Pass	*P. burchelli, S. capensis, G. zebratus, S. trutta*	Snorkel, Fyke, Go-Pro
BR4	Middle Witte	Y	WTT-3	33,572	19,1384	Upstream of Tweede Tol in Bainskloof Pass above alien fish barrier	*P. burchelli, S. capensis, G. zebratus*	Snorkel, Fyke, Go-Pro
BR5	Tweede Tol Tributary	Yes	CN	33,567	19,1355	Tributary of Witte at tweede Tol campsite	*P. burchelli, S. capensis, G. zebratus*	Electrofishing
BR11	Krom	Yes	KRB-1	33,725	19,1124	In Limietberg NR, approximately 30 min hike upstream of parking lot	*P. skeltoni, G. zebratus*	Snorkel, Fyke, Go-Pro
BR12	Tierstel	No	CN	33,694	19,1881	In Limietberg NR, follow jeep track and hike to pool in river.	*P. skeltoni*	Snorkel, Go-Pro
BR16	Upper Riviersonderend upstream site	Yes	CN	34,063	19,0708	Site immediately downstream of suspension bridge on Hottentots Holland NR	*P. burchelli, P. skeltoni, S. capensis, G. zebratus*	Snorkel, Electrofishing, Fyke
BR17	Upper Riviersonderend downstream site	Yes	CN	34,057	19,0995	Road from Grabouw to Villiersdorp, turn left before Vyeboom, pools below bridge crossing	Unknown	Snorkel, Electrofishing, Go-Pro
BR18	Upper du Toits	Yes	AC09D16	33,937	19,168	Hike upstream to bass barrier and sample in indigenous fish zone	*P. burchelli, S. capensis, G zebratus*	Snorkel, Electrofishing, Go-Pro
BR32	Davidskraal	Yes	CN	34,356	18,9225	Sample downstream of Harold Porter Botanical Garden (site located at dirt road rossing river)	Unknown	Electrofishing, Fyke
BR33	Buffels at Pringle Bay	Yes	CN	34,338	18,843	Pool upstream of road crossing on coastal road (R44) between Rooiels and Bettys Bay	*G. zebratus*	Electrofishing, Fyke

Site no	River	CBA	Site code	DDS	DDE	Site description	Expected species	Gear type
BR34	Upper Palmiet	Yes	G4PALM-NUWEB	34,056	19,0411	In Hottentots Holland NR on road to Landdroskop Hut	*G. zebratus*	Electrofishing, Fyke
BR35	Louwsbos	Yes	LO-1	34,322	18,9052	Along road to Louwsbos, hike down to site	*G. zebratus*	Electrofishing, Fyke
BR36	Dwars	Yes	DW-1	34,285	18,9319	Spinnekopnes waterfall at high rock bank downstream of washed away bridge and tributary	*G. zebratus*	Electrofishing, Fyke

Table 4.3. The current viability condition of the rivers that occur in the Boland Mountain Complex.

River	Indigenous species	Non-indigenous species	Current condition
1. Buffels (at Pringle Bay)	*G. zebratus, S. capensis*	unknown	Unknown (presumed good)
2. Palmiet & Louws River tributary	*G. zebratus, S. capensis?*	*L. macrochirus, M. dolomieu, O. mykiss*	Poor
3. Houwhoek (tributary of Bot)	*G. zebratus?*	unknown	unknown
4. Palmiet headwater (upstream of Nieuweberg Dam)	*G. zebratus, S. capensis*	unknown	Good/Very good
5. Upper Riviersonderend	*G. zebratus, S. capensis, P. skeltoni, P. burchelli*	none	Very good
6. Berg River headwaters	*P. burgi, S. capensis, G. zebratus*	*O. mykiss*	Good
7. Upper Eerste	*G. zebratus*, (also *S. capensis, P. burgi?)*	*O. mykiss*	Poor
8. Du Toits	*P. burchelli G. zebratus, S. capensis*	*M. punctulatus*	Very good upstream of barrier, poor downstream
9. Wemmers River headwaters (Olifants, Drakenstein and Wemmers tributaries)	*P. burgi, S. capensis, G. zebratus*	*O. mykiss*	Good
10. Elandspad	No indigenous fish	*O. mykiss, M. dolomieu*	Poor
11. Krom (Du Toitskloof)	P. skeltoni	*O. mykiss*	Fair
12. Holsloot	G. zebratus, S. capensis	*O. mykiss*	Fair
13 Witte (Bainskloof)	*P. burchelli G. zebratus, S. capensis*	*S. trutta* (Outside reserve boundary?), *M. dolomieu, C. gariepinus*	Very good upstream of barrier, poor downstream

River	Indigenous species	Non-indigenous species	Current condition
14. Upper Hugos	*G. zebratus*	*O. mykiss*	Fair
15. Waterval	*S. capensis*	unknown	Good

River Health (invertebrate species composition)

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 animal 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 Cape Floristic region, 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 (Gouws & Gordon 2017; de Moor & Day 2013). 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 are 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 an indicator of river health (see Dickens & Graham 2002).

Subsequently, biomonitoring of headwater streams, such as those found within the boundaries of the Boland Mountain Complex 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 South African Scoring System version 5 (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 (Figure 4.1) and each point falls into an ecological category, ranging from natural to critically modified (see Table 4.4). In the rivers of the Boland Mountain Complex, an ASPT score of eight or more would be considered to indicate a good to natural condition ecosystem. There is likely to be some variation in scores seasonally (*e.g.* Dallas 2004), so allowances should be made for this. For example, 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).

Table 4.4. The biological bands / ecological categories for interpreting SASS 5 data. Adapted from Dallas and Day (2007).

Biological Band/ Ecological Category	Category Name	Description
A	Natural	Unmodified, natural.
B	Good	Largely natural with few modifications.
C	Fair	Moderately modified.
D	Poor	Largely modified.
E	Seriously modified	Seriously modified.
F	Critically modified	Critically or extremely modified

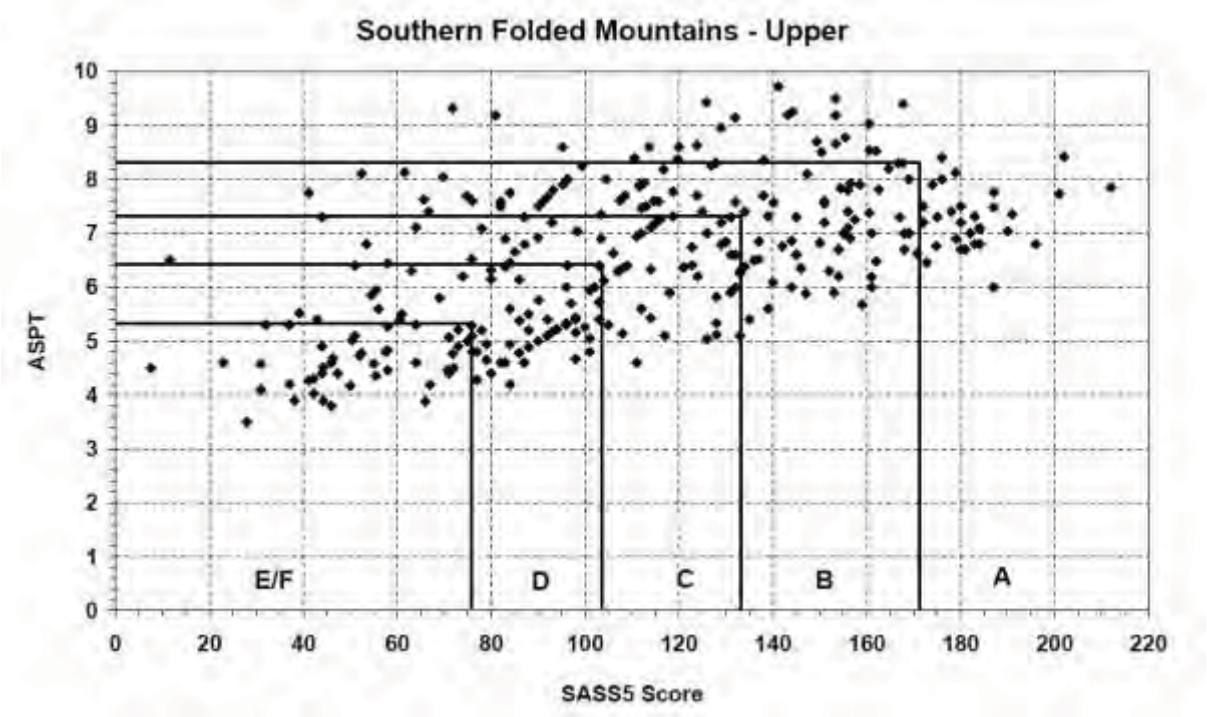

Figure 4.1. An example of the biological bands determined for the upland sites of the Southern Folded Mountains. Copied from Dallas and Day 2007.

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 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.

Size of characteristic amphibian communities

Hottentots-Holland Nature Reserve Complex has been identified as an informative place for long-term monitoring of frog populations and of climate change. This is done at two sites: Landdroskop and Swartboskloof (Jonkershoek). Long-term frog

population monitoring within the Hottentots-Holland Nature Reserve Complex has been carried out since 2002 and should continue in perpetuity.

The results of the long-term frog population monitoring in this reserve complex (since 2002 at Landdroskop and 2003 at Swartboskloof) show that fires can dramatically reduce frog population numbers, particularly of frogs in the genus *Arthroleptella* (moss frogs), but possibly also the montane marsh frog (*Poyntonia paludicola*), Landdros mountain toadlet (*Capensibufo magistratus*), the strawberry rain frog (*Breviceps acutirostris*) and banded stream frog (*Strongylopus bonaespei*). *Arthroleptella* frog populations appear very slow to recover, particularly for *A. landdrosia*, and at high altitudes where populations have not reached recorded maximum levels (which may be less than peak levels) after more than nine years post-fire. This may be a result of the relatively slow recovery of the vegetation on the very nutrient-poor soils of the higher altitudes of this reserve, or due to some other altitude-related factor. On the other side of the fire-return spectrum, we may also be able to use the results from the Landdros mountain toadlet (*Capensibufo magistratus)* populations to assess when fire-intervals ever become too long, as this species (and possibly the montane marsh frog *Poyntonia paludicola*) are associated with sparser vegetation and hence shorter fire-return intervals.

The long-term frog monitoring will continue to inform the recommended fire-return interval (range of thresholds of potential concern), and will be adjusted based on the ongoing findings of this monitoring in a strategic adaptive management framework.

The pertinent management implications of monitoring findings indicate that fire return intervals need to be long (certainly more than 10 years and possibly even longer, as this figure is subject to ongoing revision as the monitoring and research proceeds), and that woody invasive alien plants need to be controlled and eradicated within the sensitive wetlands of the Hottentots Holland Nature Reserve Complex. Development footprints must avoid wetlands. The indicators are both the presence of the suite of representative species (see Table 4.5 below), and that the populations of these species do not fluctuate to the extent that the risk of local population extinction becomes likely; *i.e.* more than a 10-fold fluctuation in number and/or where the total population estimate of calling males drops below 10 individuals.

Table 4.5. Amphibian species representative of long-term frog population monitoring sites in the Hottentots Holland Nature Reserve Complex. This is not an exhaustive list of frog species present but just of those that are representative from a monitoring perspective.

Scientific Names	Common Names	Global IUCN Category 2016
Landdroskop long-term monitoring site		
Amietia fuscigula	Cape river frog	Least Concern
Arthroleptella landdrosia	Landdros moss frog	Near Threatened
Arthroleptella villiersi	De Villiers' moss frog	Least Concern
Breviceps acutirostris	Strawberry rain frog	Least Concern
Breviceps montanus	Cape mountain rain frog	Least Concern

Scientific Names	Common Names	Global IUCN Category 2016
Capensibufo magistratus.	Landdros mountain toadlet	Still to be assessed
Poyntonia paludicola	montane marsh frog	Near Threatened
Strongylopus bonaespei	banded stream frog	Least Concern
Swartboskloof long-term monitoring site		
Amietia fuscigula	Cape river frog	Least Concern
Arthroleptella villiersi	De Villiers' moss frog	Least Concern
Breviceps montanus	Cape mountain rain frog	Least Concern
Poyntonia paludicola	montane marsh frog	Near Threatened (locally extinct at monitoring site)
Strongylopus bonaespei	banded stream frog	Least Concern
Strongylopus grayii	clicking stream frog	Least Concern

Wetland Ecosystem Health

Monitoring the health of groundwater- and/or aquifer water-dependent ecosystems is important. Especially in light of the increased pressures of bulk water supply in the relevant municipal areas surrounding the Boland Mountain Complex. In fact, the highest rated, potential and present threats to these wetland ecosystems are the current and future plans for increased abstraction of groundwater. As a result, there is a need to identify and monitor those wetland and other freshwater ecosystems that might be negatively affected by abstraction due to their dependence on these groundwater and/or aquifer water sources.

In order to conduct initial baseline assessments and biomonitoring of strategically selected wetland ecosystems, the simplified version of the WetHealth assessment method will be used (see CapeNature Wetland Monitoring Protocol). Initial steps would include a desktop wetland census, where all available spatial layers are considered, including NFEPA and CBA layers. This will be followed with field verification and ground-truthing to set a baseline and subsequent identification of sites for long-term monitoring. Long-term monitoring sites should represent a variety of different wetland types and be chosen based on their threat status (*e.g.* vulnerable, endangered or critically endangered), whether they are groundwater- or aquifer dependent ecosystems or where they might be affected by any development within the protected area. If a wetland might be impacted on by threats from outside the boundaries of the protected area, for example groundwater abstraction, these sites should also be considered for long-term monitoring.

Assessments should include aspects concerning the health condition (see Table 4.6 for condition/category explanation) and extent (size) of each chosen wetland ecosystem, taking into account for example the water source, basic soil characteristics and dominant plant community. Where the presence of specific or threatened amphibian species that depend on these ecosystems are known, the presence and population estimates of these species should also be monitored. With the additional threats associated with the presence of invasive alien vegetation and other physical

impacts, the vegetation structure of the buffer areas of the wetland systems should also be maintained as close to natural as possible. At least within the first 32 metres of any wetland to accommodate legal requirements under the Natural Environmental Management Act but ideally within 100 m or more to accommodate ecological needs of wetland-associated species.

Table 4.6. The combined impact scores and Present Ecological State categories used to describe the health/integrity of wetlands. Adapted from McFarlane *et al*. (2008).

Present Ecological State	Impact score	Description
A	0 – 0.9	Unmodified, natural.
B	1 – 1.9	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.
C	2 – 3.9	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.
D	4 – 5.9	Largely modified. A large change in ecosystem processes and loss of natural habitats and biota has occurred.
E	6 – 7.9	The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognisable.
F	8 – 10	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.

According to the NFEPA wetlands map layer data, all of the wetlands mapped in the Boland Mountain Complex are in a good to natural condition. Due to the current protection status of the wetland ecosystems located within the Boland Mountain Complexs, it is expected that the unmapped wetlands should generally be in a good-to-natural condition.

River flow regime

For flow regime monitoring, the deployment of fixed flow monitors for high priority rivers (important for biodiversity (*e.g.* FEPA) and/or water production) should be considered. This will depend on funding/available budget, but is much needed especially with regards to determination of the value of the ecological infrastructure and services provided by the mountain catchments in the Boland Mountain Complex.

As was mentioned before, 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.* FEPA rivers and 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 Boland Mountain Complex, would add a lot to tracking flow patterns linked to for example invasive alien tree clearing in the catchment. This in term will highlight the importance of adaptive and sustainable management of our freshwater ecosystems, especially in relation to the ecological services the Boland Mountain Complex 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.

For example, a relatively good flow regime data set already exists for the Palmiet River. Here, streamflow is measured at the gauging weir on the Palmiet River just below the Kogelberg Nature Reserve, where it averages 173.8 x 106 m^3 per year (Reynecke 1975). There are no other measuring weirs in the Boland Mountain Complex, but the contribution of the catchments within the complex are estimated at approximately 100 x 106 m^3, of which the Louws- and Dwars Rivers contribute about 40 x 106 m^3 (Palmiet River Catchment Management Plan 2000).

4.2.1.3 Viability Assessment

Table 4.7 shows the viability assessment of the Freshwater Ecosystems in the Boland Mountain Complex.

Table 4.7. Freshwater Ecosystems Viability Assessment.

KEAs and Indicators for the Freshwater Ecosystems						
Category	**Key Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**
Condition	Wetland Ecosystem Health	Wetland ecosystem (seeps, tributaries/spring) condition and extent	D-F (Largely to critically modified)	C (Moderate level of modification)	B (Near natural, minor impacts or modifications)	A (Natural condition)
	River Health (invertebrate species composition)	Instream macro-invertebrate composition. Derive condition index using SASS5 Average Score Per Taxon (ASPT)	ASPT <5	ASPT = 6-7	ASPT = 7 – 8	ASPT >8
	Representation of viable population of amphibian communities	Species presence and population estimations	<80 % of full complement of species with population estimates exceeding 10	>=80 % of full complement of species with population estimates exceeding 10	All sp represented, population estimates for all species exceeding 10 individuals	All sp there, population at optimum of or above acceptable size range
	Freshwater fish species composition (includes threatened fish species)	Indigenous fish diversity in relation to the presence of alien invasive fish species (%) – Giant redfin; other	Indigenous fish species absent	Equal to 50% or less of expected indigenous fish species present, only 1 age class present. Some non-indigenous present.	>50% of expected indigenous fish species present, but not 100%, 1-2 age classes present. Some non-indigenous present.	All expected indigenous fish species and age classes present. No non-indigenous present.
	River flow regime	Stream flow and recharge (ecological reserve)	<10%	11-79%	*80-99%*	100%

4.2.2 TMG Aquifer

4.2.2.1 Value Description

The groundwater systems associated with the Boland Mountain Complex generally that fall within the TMG aquifers, which extend from near Niewoudtville in the north-west, down to Cape Agulhas and eastwards toward Port Elizabeth.

4.2.2.2 Key Ecological Attributes

Water quality: Includes water level (depth), Physico-chemical properties (Conductivity, Dissolved oxygen and pH), Heavy metals / pollutants. This aquifer system is a major, potentially high-yielding system of good quality water that is highly susceptible to contamination by anthropogenic activities in especially the lower lying areas within the catchment (DWAF 2000). Currently, there are several test boreholes to determine the feasibility of water abstraction from the aquifer, mostly off reserve. The monitoring is being done by consultants to the City Of Cape Town. The thresholds and condition of the aquifer will be determined using these baseline data.

Monitoring of boreholes that are associated with use within the Boland World Heritage Site should take place. Aspects to be monitored on the Boland World Heritage Site would include primary water level of boreholes, but could also include monitoring of the physico-chemical variables (including water temperature, pH and Ecological Conductivity) if possible. This should be done according to the CapeNature Groundwater Monitoring Protocol. Monitoring data for boreholes where abstraction is taking place should include the measurements of abstraction rates, with implementation of a predetermined threshold low water level from where no further abstraction should take place. This should be done by the municipality that is abstracting the water and updates should be fed back to Conservation Management timeously.

4.2.3 Swartland Alluvium Fynbos

4.2.3.1 Value Description

This vegetation type is Critically Endangered with 4.9% of the Provincial conservation target for this vegetation type is met in the Boland Mountain Complex. Nested values include the Geometric tortoise.

4.2.3.2 Key Ecological Attributes

Geometric tortoise population structure

The Voëlvlei Nature Reserve and Elandsberg Nature Reserve geometric tortoise populations are monitored annually (as far as possible) by CapeNature, and this includes the monitoring of habitat threats. This allows for appropriate recommendations to be made to reserve management for further action. Monitoring surveys are controlled by CapeNature's Geometric Tortoise Working Group and according to CapeNature's monitoring protocol for this species. Monitoring data are sent to Scientific Services for processing and inclusion in the CapeNature Biodiversity Database.

Fire Regime

Alluvium Fynbos falls within the same fire ecoregion as Mountain and Lowland Fynbos (Van Wilgen & Forsyth 2008). The fire regimes of these vegetation types will be discussed under the Mountain and Lowland Fynbos value (see section 4.2.4 below)

Indigenous vegetation species composition

The vegetation at Voëlvlei Nature Reserve is mapped as mostly Swartland Shale Renosterveld. On the ground, however, it is a complex mix of Swartland Alluvium Fynbos and Swartland Shale Renosterveld, depending on soil and moisture levels. A course marker differentiating the two is the presence of *Leucadendron lanigerum* subspecies *lanigerum* (Endangered) and *Leucadendron stellare* (Critically Endangered). The area is largely dominated by asteraceous shrubs, *Elytropappus rhinocerotis* in the drier parts and *Relhania fruticose* in the wetter parts. Voëlvlei is rich in bulb species, many of which are threatened. After a recent fire in dense renosterbos dominated vegetation, *Polhillia ignota* (Critically Endangered) which was thought to be extinct until 2016 emerged.

Grey rhebok population density

Monitoring of Grey rhebok populations is focussed on seasonal observations towards spatial population density indications in the absence of conducting precision counts. The current estimates inform a baseline against which future data will be compared to establish whether the population is stable, declining or increasing. This potentially provides an indicator for monitoring the state of Alluvium Fynbos and Mountain and Lowland Fynbos in the Boland Mountain Complex. Grey rhebok are associated with the rocky hills of mountain fynbos, are predominantly browsers, feeding on ground hugging forbs and independent of the availability of open water sources. Their adaptation to exploiting plants for moisture and ability to feed on steep mountain slopes provides an indication of their ecology and the important role they perform in foraging species in hilly areas which are not accessible to other browsers. Where grey rhebok are successfully breeding and persisting in the landscape it can be inferred that the ecosystem is effective in providing enough resources (mate availability, forage, shelter and territory size), thus an ecosystem is large and sufficiently continuous with an inferred balance in predator-prey interactions, where leopard and mesopredators (*e.g.* caracal and black-backed jackal) are present.

Extent of continuous Swartland Alluvium Fynbos habitat

The size of current conservation areas in Swartland Alluvium Fynbos was used as benchmark to assess the viability of the extent of this vegetation type. The conservation areas used were Briers-Louw Nature Reserve (25 ha), Voëlvlei Nature Reserve (825 ha) and Elandsberg Nature Reserve (>3000 ha). Currently, 688 ha of Swartland Alluvium Fynbos is under the conservation management of the Boland Mountain Complex (Voëlvlei Nature Reserve). However, due to the neighbouring Elandsberg Nature Reserve, which is a CapeNature stewardship siteand Contract Nature Reserve, the conservation area is extended.

4.2.3.3 Viability Assessment

Table 4.8 shows the viability assessment of Swartland Alluvium Fynbos in the Boland Mountain Complex.

Table 4.8. Swartland Alluvium Fynbos Viability Assessment.

KEAs and Indicators for Swartland Alluvium Fynbos						
Category	**Key Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**
Condition	Indigenous vegetation species composition (%)	% Indigenous Swartland Alluvium Fynbos vegetation	0-75%	75-89%	90-99%	100%
Landscape Context	Fire Regime	Fire frequency % (The number of times that fires occur within complex in 25year period)	>20% of area that has burned twice or more in the last 25 year	20% of area that has burned twice or more in the last 25 year	10% of area that has burned twice or more in the last 25 year	5% of area that has burned twice or more in the last 25 year
		Proportion of veld in different age classes (%)	Three or more of the age classes have exceeded >5% and <20% of protected area	Two of the age classes have exceeded >5% and <20% of protected area	One of the age classes have exceeded >5% and <20% of protected area	Zero of the age classes have exceeded >5% and <20% of protected area
		Fire Season (Period of the year during which fires occur in complex over the last 15 years)	<40% burned in winter (May-Nov inclusive) over the last 15 years	<30% burned in winter (May-Nov inclusive) over the last 15 years	<20% burned in winter (May-Nov inclusive) over the last 15 years	<10% burned in winter (May-Nov inclusive) over the last 15 years
		Size (The portion of area burnt in fires)	Small -25%, Medium-25%, Large - 30%, Very Large - 20%	Small -25%, Medium-40%, Large - 25%, Very Large -10%	Small -25%, Medium-45%, Large - 25%, Very Large -5%	Small -25%, Medium-50%, Large - 25%, Very Large -0%
	Extent of contiguous Swartland Alluvium fynbos habitat (extent of connected alluvium fynbos)	Ha's of connected Alluvium fynbos secured	<25 ha	25 ha	825 ha	>3000 ha

KEAs and Indicators for Swartland Alluvium Fynbos						
Category	**Key Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**
Condition	Geometric tortoise population structure	Presence of size classes (0 - 2 cm; >2 cm - <7 cm; > 7 cm)	Only >7 cm observed age classes during a survey	>2 cm and >7 cm age classes observed during a survey	All three age classes observed during a survey	All three age classes observed during a survey, with the total number recorded exceeding 20.
	Grey rhebok population density	Population density (distribution and size of observed groups) of grey rhebok (*i.e.* are they stable and breeding)	No grey rhebok	Decreasing	Stable	Increasing

4.2.4 Mountain and Lowland Fynbos

4.2.4.1 Value description

The Mountain and Lowland Fynbos constitutes 21 distinct vegetation types of which five are Critically Endangered and two are Endangered (see Table 3.4).

Western Shale Band Vegetation (LT), Kogelberg Sandstone Fynbos (CR) and Hawequas Sandstone Fynbos (VU) are the best represented vegetation types in the Boland Mountain Complex. Kogelberg Sandstone Fynbos (CR) is considered the heart of the Cape Floristic Region and is famed for the richness of the flora as well as many range-restricted species. An interesting element to note is that the Sandstone Fynbos (and Shale Band Vegetation) protected is biased towards mountainous regions and that the low altitude variants (especially where ecotonal with threatened vegetation types and edaphic interfaces) are both high in threatened species and under significant development pressure outside of protected areas.

A further consideration identified in the 2017 CapeNature State of Biodiversity report is that too frequent fires, which benefit resprouting species over reseeders (specifically *Proteacea*), will have a negative impact on water yield from an area (Jacobs *et al.* 2017). These areas are vital catchments for the greater City of Cape Town and effective management of biodiversity has the added benefit of contributing towards a dependable, high quality source of runoff. A future restoration project would be to identify areas where this resprouter/reseeder balance is suboptimal and reintroduce the reseeders from locally collected seed stock.

Swartland Shale Renosterveld has the highest concentration of threatened species of any South African vegetation type. Only 0.475% of the Provincial conservation target is met for the Critically Endangered Swartland Shale Renosterveld in the Boland Mountain Complex. This might sound insignificant but the national target of 26% of original extent of Swartland Shale Renosterveld (CR) is unattainable because there is only 6.8% left. Management interventions should potentially include some level of (strictly managed) grazing as it is likely that this vegetation held relatively high numbers of game in pre-colonial times.

The contribution to Provincial conservation targets of Breede Shale Fynbos (LT), Breede Shale Renosterveld (LT) and Elim Ferricrete Fynbos (CR) has less to do with the amount of hectares present in the Boland Mountain Complex and more to do with the effect that the edaphic interfaces with the respective Sandstone Fynbos types would have in terms of unique habitats and ecotonal species.

Breede Sand Fynbos (VU) is known for associations with numerous threatened species and is largely known from quite small remnants. Extensive areas of Breede Sand Fynbos were inundated due to the building of the Quaggaskloof and Brandvlei Dams.

Boland Granite Fynbos (VU) and Cape Winelands Shale Fynbos (VU) are similar in their positions in the landscape as well as the fact that lower altitude variants have been heavily impacted by agriculture. As a result, the ecotones with Renosterveld have been nearly completely lost in the Boland Mountain Complex.

4.2.4.2 Key Ecological Attributes

Fire regime and Serotinous Proteaceae

Over the last 60 years the Boland Mountain Complex has had a shortened fire regime with more large fires (Van Wilgen & Forsyth 2008, Schutte-Vlok *et al.* 2012). Even though Fynbos is a fire-driven ecosystem and all Fynbos species require periodic fires to stimulate regeneration and maintain species richness (Van Wilgen & Forsyth 2008; Forsyth *et al*. 2010), short return interval fires that occur before insufficient numbers of serotinous Proteaceae have reached maturity and set seed can lead to population declines or local extinction and cause dramatic structural changes in communities (Van Wilgen 1982, Van Wilgen & Forsyth 2008). It has also been shown that increased fire frequency can benefit sprouting species and that increases in sprouters lead to overall decreases in plant diversity (Vlok & Yeaton 1999).

Slow-maturing, serotinous Proteaceae species are used as indicator species to determine acceptable fire return intervals (Van Wilgen *et al.* 1992). These species have been shown to be good indicators for total ecosystem diversity (Vlok & Yeaton 1999, 2000). The minimum fire return period is dependent on the time it takes before 100% of the slowest maturing non-sprouting Proteaceae species have flowered at least once, or when 50% of the slowest maturing Proteaceae species have flowered at least 3 times (Kruger & Lamb 1978; Kruger 1983, Le Maitre & Midgley 1992). On the rare occasion when the fire return periods become too long, populations of serotinous Proteaceae will reach senescence, which result in declines in seed production. When fire frequency is too short or too long, post-fire recruitment in populations of serotinous Proteaceae could be inadequate to replace pre-fire populations (Van Wilgen & Forsyth 2008). The ratio of seedlings to parent plants measured 12 – 18 months after a fire should be more than five (Van Wilgen & Forsyth 2008).

Van Wilgen and Forsyth (2008) divided the Western Cape into five fire eco-zones based on the fire potential as defined by climate (see also Van Wilgen 1984). The Boland Mountain Complex falls within the western inland zone, which is characterized by strong seasonal variation in fire potential and a high mean fire potential in summer (Van Wilgen & Forsyth 2008). Winter fires are possible under exceptional, rare circumstances, but rarely occur (Van Wilgen & Forsyth 2008).

Within the Boland Mountain Complex the required fire frequency is that no more than 5 – 10% of the area burns twice in a 25 year period (Van Wilgen & Forsyth 2008). In addition, the proportion of area in each veld age class should be >5 % and <20 % (Van Wilgen & Forsyth 2008). CapeNature uses seven veld age classes (0-2 years, 2-4 years, 4-6 years, 6-10 years, 10-15 years, 15-25 years, >25 years) and the desired state is an even distribution of area in the different veld age classes. This will provide sufficient habitat for a full range of species requiring access to vegetation of different ages. Currently, 81.6% of the Boland Mountain Complex has burnt more than twice in the last 25 years. In addition, the proportion of veld in the different age classes is as follows (see Maps 7a and b):

0-2 years – 7.1%

2-4 years – 14.6%

4-6 years – 6.1%

6-10 years – 49.4%

10-15 years – 15.7%

15-25 years – 3.0%

>25 years – 0.9%

Approximately 3.2% of the area in the complex is of unknown age.

Fynbos in the Boland Mountain Complex is adapted to a fire regime of fires in the dry summer and autumn. Maximum flowering activity occurs in late winter and spring (Van Wilgen *et al.* 1992), and thus optimal seedling regeneration of serotinous Proteaceae is achieved after fires that occur between December and early April (Bond *et al*. 1984). Furthermore, research has shown that even the fynbos animal species are adapted to late summer - early autumn fires (Viviers 1983) and that their breeding habits are generally synchronised with the non-fire season. For example, fynbos birds (*e.g.* sugar birds & sunbirds) generally breed in winter (May to November), so winter fires would wipe out a whole year's breeding attempt (Winterbottom 1968). Adults of the typical fynbos reptiles survive summer fires by variably hiding in deep crevices, under rocks, bolders and rock slabs, in the ground, or in deep plant litter. Most of these species lay eggs in summer that hatch in early autumn, or are viviparous, with the young being produced in early autumn (Broadley 1983; Branch 1998). With both these reproductive strategies the young have the winter months to grow and become mobile before the fires of the next summer.

Therefore, the proportion of fires in the Boland Mountain Complex that burns in summer should be >80% (less than 20% winter fires) over a 15-year period (Van Wilgen & Forsyth 2008). The proportion of fires that has burnt within the summer months is 88% with only 12% of fires occurring in winter months.

Instead of similar areas being burnt each year, a few large fires, or a large number of small fires will also have undesired effects. Too many small fires are difficult and costly to manage, and will result in greater edge effects (*e.g.* predation of seed by rodents) and very large fires will upset the desired goal of maintaining an even distribution of veld ages (Van Wilgen & Forsyth 2008). Fire size is also important to the faunal elements of the fynbos. Large fires that result in vast areas of young veld can reduce food availability, and pose a problem to the dispersal of animals if the distance between older veld becomes too large. It is therefore critical to have a size mosaic of young and old veld (De Klerk *et al.* 2009). Large fire size and a lack of mosaics also create difficulties for seed dispersal into the burnt area and may leave large areas vulnerable to seed production collapse. Consequently, it would be imperative to keep fire out of such an area (De Klerk *et al.* 2009).

Although fire size is relative to the area of a particular protected area for the purposes of assessment at the Boland Mountain Complex scale, small fires are classified as 0-100 ha, medium fires as 100-2 000 ha, large fires as 2 000-5 000 ha and very large fires exceeds 5 000 ha. According to Van Wilgen & Forsyth (2008) the proportion of area that burnt that is larger than 1 000 ha should not constitute more than 75% of the total area. Over the past 8 years the Boland Mountain Complex has had a number of repeated very large fires. In 2004, 11 259 ha burnt down, followed in 2005 by another 41 684 ha burning. During 2008, 2009 and 2010, respectively 19 675 ha, 36 903 ha and 21 358 ha natural veld burnt down. In 2011, a further 56 700 ha burnt down, of which about 32 400 ha occurred on CapeNature reserves.

CapeNature's imperatives of integrated biodiversity management, as well as the compliance requisites of the National Veld and Forest Fire Act, 1998 (Act 101 of 1998) require that the entity is constantly prepared for the occurrence and management of fires that occur on or adjacent to CapeNature-managed land (Figure 4.2).

The CapeNature Veldfire Management Policy guidelines place emphasis on ecological management and the critical relationship between ecological findings and issues such as legislation and the socio-economic environment.

CapeNature carries out fire operations within the framework of integrated fire management. Integrated Fire Management is an approach to manage both damaging and beneficial fires within the context of the natural environments and socio-economic systems in which they occur by integrating the technical components of fire management (prevention, suppression and use) with key ecological attributes and socio-economic necessities of fire.

Figure 4.2. Fire management operations.

Indigenous vegetation species composition

The considerable biodiversity of the Boland Mountain Complex is threatened by alien plant invasions, which are rapidly increasing in extent and severity (see section 4.1.3.1 below). Therefore, the aim is to remove alien invasive vegetation and monitor whether indigenous vegetation persist after invasive alien clearing. Furthermore, the persistence of some of the highly restricted plant species (species that are found in a single population of less than 10 km²) must be monitored to assess the health of the Lowland and Mountain Fynbos in the Boland Mountain Complex. These species are

given in Table 4.9. Species within 1 km of the protected area boundary were included but species attractive to collectors were excluded from this list.

Table 4.9. List of Highly Restricted Species for the Boland Mountain Complex obtained from the SANBI Threatened Species Programme.

Location	Species	Redlist Status
Waterval	*Stylapterus ericoides* subspecies *ericoides*	Rare
	Pelargonium saxatile	Critically Rare
	Erica rehmii	Vulnerable
	Cliffortia pilifera	Vulnerable
	Euryops decipiens	Critically Endangered
Hawequa NR	*Cliffortia pilifera*	Vulnerable
	Euryops decipiens	Critically Endangered
	Erica cremea	Vulnerable
	Gnidia insignis	Endangered
	Erica feminarum	Critically Endangered
	Geissorhiza lapidosa	Critically Rare
	Amphithalea concava	Rare
	Cyclopia squamosa	Critically Endangered
	Gladiolus rhodanthus	Rare
	Erica alexandri subspecies *alexandri*	Critically Endangered
Theewaterskloof NR	*Acmadenia faucitincta*	Vulnerable
	Erica chrysocodon	Critically Endangered
	Leucadendron elimense subspecies *vyeboomense*	Critically Endangered
	Ixia reclinata	Critically Endangered
	Erica purgatoriensis	Vulnerable
Hottentots Holland NR	*Glischrocola formosa*	Critically Endangered
	Restio nuwebergensis	Vulnerable
	Agathosma hirsuta	Rare
	Aspalathus vacciniifolia	Critically Rare
	Liparia bonaespae	Vulnerable
	Acmadenia candida	Endangered
	Muraltia guthriei	Vulnerable
Groenlandberg NR	*Erica patens*	Endangered
	Erica perplexa	Critically Endangered
Houwhoek NR	*Metalasia humilis*	Critically Rare
	Restio verrucosus	Vulnerable
Kogelberg NR	*Erica cabernetea*	Critically Endangered
	Erica extrusa	Critically Endangered
	Erica latiflora	Critically Endangered
	Freylinia longiflora	Critically Endangered
	Stylapterus micranthus	Vulnerable
	Erica kogelbergensis	Critically Rare
	Gallium rourkei	Critically Rare

	Sorocephalus palustris	Critically Endangered
	Erica vallis-aranearum	Critically Endangered
	Liparia boucheri	Endangered
	Erica humidicola	Endangered
	Leucospermum cordatum	Endangered
	Erica cunoniensis	Endangered
	Erica cygnea	Rare
	Erica thomae	Rare
	Tritoniopsis flava	Critically Rare
	Erica leucotrachela subspecies *monicae*	Critically Rare
	Mimetes stokoei	Critically Endangered
Brodie Link NR	*Euryops indecorus*	Critically Endangered
Jonkershoek	*Serruria florida*	Critically Endangered
	Heliophila cuneata	Critically Endangered
	Glischrocola formosa	Critically Endangered
	Agathosma hirsuta	Rare
Simonsberg	*Osteospermum hispidum* variety *viride*	Vulnerable

Grey rhebok population density

See description under Swartland Alluvium Fynbos above.

4.2.4.3 Viability Assessment

Table 4.10 shows the viability assessment of the Mountain and Lowland Fynbos in the Boland Mountain Complex.

Table 4.10. Mountain and Lowland Fynbos Viability Assessment.

KEAs and Indicators for the Mountain and Lowland Fynbos						
Category	**Key Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**
Condition	Indigenous vegetation species composition (%)	% Indigenous Fynbos vegetation	0-75%	75-89%	90-99%	100%
Landscape Context	Fire Regime	Fire frequency % (The number of times that fires occur within complex in 25 year period)	>20% of area that has burned twice or more in the last 25 year	20% of area that has burned twice or more in the last 25 year	10% of area that has burned twice or more in the last 25 year	5% of area that has burned twice or more in the last 25 year
		Proportion of veld in different age classes (%)	Three or more of the age classes have exceeded >5% and <20% of protected area	Two of the age classes have exceeded >5% and <20% of protected area	One of the age classes have exceeded >5% and <20% of protected area	Zero of the age classes have exceeded >5% and <20% of protected area
		Fire Season (Period of the year during which fires occur in complex over the last 15 years)	<40% burned in winter (May-Nov inclusive) over the last 15 years	<30% burned in winter (May-Nov inclusive) over the last 15 years	<20% burned in winter (May-Nov inclusive) over the last 15 years	<10% burned in winter (May-Nov inclusive) over the last 15 years
		Size (The portion of area burnt in fires)	Small -25%, Medium-25%, Large - 30%, Very Large -20%	Small -25%, Medium-40%, Large - 25%, Very Large - 10%	Small -25%, Medium-45%, Large - 25%, Very Large -5%	Small -25%, Medium-50%, Large - 25%, Very Large - 0%
	Serotinous Proteaceae	Proportion of individuals that has flowered before a fire	Less than 25% of individuals have flowered 3 times	Less than 50% of individuals have flowered 3 times	50% of individuals have flowered at least 3 times, or all individuals have flowered once	All individuals have flowered more than 3 times

KEAs and Indicators for the Mountain and Lowland Fynbos						
Category	**Key Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**
	Serotinous Proteaceae	Recruitment, Parent to seedling ratio	No seedlings	Parent to seedling ratio is less than 1:5	Parent to seedling ratio is 1:5	Parent to seedling ratio is more than 1:5
Condition	Grey rhebok population density	Population density (distribution and size of observed groups) of Grey rhebok (*i.e.* are they stable and breeding)	No Grey rhebok	Decreasing	Stable	Increasing

4.2.5 Pre-colonial Heritage

4.2.5.1 Value description

Pre-colonial Heritage refers to all rock art and artefacts within the Boland Mountain Complex. According to the National Heritage Resources Act (NHRA, Act 25 of 1999) rock art is defined as any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10 m of such representation. Artefacts are the material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years. In the Boland Mountain Complex, rock art is scattered throughout the mountain ranges.

4.2.5.2 Key Ecological Attributes

State of alteration

According to NRHA, alteration to rock art refers to any action affecting the appearance or physical properties thereof by painting, plastering, decoration, *etc.* Heritage resources form an important part of the history and beliefs of communities and must be managed as such. Moreover, these resources contribute significantly to research, education and tourism and they must be developed and presented for these purposes in a way that ensures dignity and respect for cultural values.

Currently, the state of the rock art is good, meaning that natural disturbance is not influencing the features directly and that no unnatural alteration or disturbance is happening.

4.2.5.3 Viability Assessment

Table 4.11 shows the viability assessment of the Pre-colonial heritage in the Boland Mountain Complex.

Table 4.11. Pre-colonial Heritage Viability Assessment.

KEAs and Indicators for the Pre-colonial Heritage						
Category	**Key Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**
Condition	Condition (the conservation state of these rock art)	State of alteration	Any state of un-natural alteration or disturbance	Any natural alteration or disturbance directly influencing the rock art or artefacts	Any natural alteration or disturbance not influencing the rock art or artefacts directly	No alteration or disturbance

4.2.6 Artificial Historical Structures

4.2.6.1 Value description

Artificial Historical Structures refer to all artificial structures older than 70 years and the sites on which they are found. Artificial Historical Structures in the Boland Mountain Complex are shown on Maps 6a-f.

4.2.6.2 Key Ecological Attributes

State of alteration

State of alteration refers to any human action affecting the structure, appearance or physical properties of these heritage features. Restoration and maintenance work on artificial historical structures must be in accordance to methods and materials in line with the original structure in accordance with the NHRA. Management and restoration will be directed towards priority structures. Those structures listed on the User Asset Management Plan (U-AMP) are maintained by the Department of Public Works. Structures not listed on the U-AMP need to be evaluated and those that are of a high conservation priority should be maintained by CapeNature.

Currently, some of the heritage features have been altered and / or are showing signs of disrepair, but they have not fallen into total disrepair. Grading according to the NHRA will determine how much conservation effort will be put into the conservation of these heritage features. Conservation actions will be directed at priority sites.

4.2.6.3 Viability Assessment

Table 4.12 shows the viability assessment of the Pre-colonial heritage in the Boland Mountain Complex.

Table 4.12. Artificial Historical Structures Viability Assessment.

KEAs and Indicators for the Artificial Historical Structures						
Category	**Key Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**
Condition	Condition (of the structure older than 70 years)	State of alteration	The structure has fallen into total disrepair and has lost its potential for conservation	The structure's design has been altered or showing signs of disrepair	The structure's design is similar to its original design but some alterations have occurred	The structure has not been altered from its original state (the heritage value has not been compromised)

4.3 Threats Assessment

The viability assessment was followed by a threats assessment to identify and define the activities that may affect or degrade a value, or prevent it from achieving the established desired state *i.e.* the goal. Standard criteria that guided threat identification included similarity, and similarity in causation (therefore requiring similar strategies) (Conservation Measures Partnership 2013).

Direct threats were identified and articulated per value. Threats were then rated according to the scope and severity of impact, and reversibility of the effect of the threat. A threat rating was generated according to extent (the scope) and magnitude of the threat (a combination of threat severity and irreversibility).

To prioritise threats, threat ranks were amalgamated across natural and cultural historic values, and those having the highest overall rank form the subset of critical threats, *i.e.* those that require focussed conservation effort. Remaining lower ranking, but significant threats were also screened for consideration. Prioritised threats were then evaluated by analysing the conservation situation to better understand the casual factors, actors, and to identify opportunities and strategic intervention points. A conceptual model was developed to illustrate the conservation situation and guided the formulation of strategies.

The most critical threats to the values of the Boland Mountain Complex include:

- Invasive alien vegetation
- Inappropriate fire regime
- Over abstraction of groundwater
- Invasive alien fish
- Illegal utilisation (poaching and harvesting of fauna and flora)

All these threats have an impact on the indigenous vegetation of the Boland Mountain Complex and therefore impact indirectly on the values nested therein. In response to these threats the key management actions are to control invasive alien plant species, maintain an appropriate fire-return interval, and to avoid fires that burn too much (more than 25%) of the reserve in any one fire event.

Climate change was also identified as a very high threat to the biodiversity and ecosystem services (primarily water delivery) represented in the Boland Mountain Complex. Lee and Barnard (2012) suggest that at least three of the endemic bird species (the Cape Rock-jumper, the Protea Seedeater and Victorin's warbler) are directly and negatively affected by climate change. This is due to increased temperature rather than the predicted changes in precipitation. The concern, however, is how to reverse these population declines. Currently there is very little other than more stringent fire management that can be done within the Boland Mountain Complex to mitigate this threat, which needs to be addressed at a national and international level.

The assessment shown in Table 4.13 identifies threats to natural and cultural values, the abatement of which will enable the achievement of objectives towards the desired state of the Boland Mountain Complex

Table 4.13. Threat assessment for the Boland Mountain Complex.

THREATS	TARGETS						
	Freshwater Ecosystems	TMG Aquifer	Swartland Alluvium Fynbos	Mountain-lowland fynbos mosaic	Pre-colonial heritage (rock art and artefacts)	Artificial historical structures	Summary Threat Rating
The negative impact of Invasive alien vegetation on fire regime, biodiversity and water availability.	High	Medium	Medium	Very High			High
Impacts of over abstraction on groundwater dependent ecosystems.	Medium	Medium		Very High			High
Over abstraction of surface water for agriculture and domestic purposes	Low	Low					Low
Climate change	High	Medium	Very High	Very High			Very High
Inappropriate fire regime due to anthropogenic fires	Low	Low	Very High	Very High	Low	Low	Very High
Illegal abstraction of surface water for trade	Medium	Low					Low
Construction of dams on major river systems	Medium	Medium					Medium

THREATS	TARGETS						
	Freshwater Ecosystems	TMG Aquifer	Swartland Alluvium Fynbos	Mountain-lowland fynbos mosaic	Pre-colonial heritage (rock art and artefacts)	Artificial historical structures	Summary Threat Rating
Point source water pollution from human settlements	Low	Medium		Low			Low
Water pollution from agricultural run-off	Low	Medium		Low			Low
Edge effect of Plantations on infestations and fire regime	Medium	Medium	Low	Medium			Medium
Impact of invasive alien fish on indigenous species	High						Medium
Point source pollution from tourism and office complexes	Low	Low		Low			Low
Direct and indirect loss of biodiversity due to informal human settlement encroachment	Low			Low			Low
Loss of biodiversity due to inappropriate placement of tourism and recreation infrastructure	Low			Low			Low
Impacts on biodiversity due to inappropriate location,	Low			Low			Low

THREATS	TARGETS						
	Freshwater Ecosystems	TMG Aquifer	Swartland Alluvium Fynbos	Mountain-lowland fynbos mosaic	Pre-colonial heritage (rock art and artefacts)	Artificial historical structures	Summary Threat Rating
frequency and size of events							
Loss of biodiversity due to grazing by livestock	Low		Low	Low			Low
Loss of biodiversity due to placement, construction and maintenance of renewable energy infrastructure (wind farms)	Low		Low	Low			Low
Impacts on biodiversity by inappropriate placement and management of servitudes and high sites	Low			Medium			Low
Impacts on freshwater ecosystems due to water pollution from aquaculture in Du Toitskloof	Low						Low
Impacts of Transportation corridors on fire regime and migration of fauna				Medium			Low
Direct and indirect impacts on biodiversity due to poaching of fauna			High	Medium			Medium

THREATS	TARGETS						
	Freshwater Ecosystems	TMG Aquifer	Swartland Alluvium Fynbos	Mountain-lowland fynbos mosaic	Pre-colonial heritage (rock art and artefacts)	Artificial historical structures	Summary Threat Rating
The loss of biodiversity due to invasive and feral fauna			Medium	Medium			Medium
Loss of biodiversity due to poaching of flora for subsistence and commercial use			Medium	High			Medium
Impacts on the environment due to irresponsible environmental management			Medium	Low			Low
Impacts on the environment due to non-compliance of permit conditions (researchers)			Medium	Low			Low
Impacts on biodiversity due to unsustainable regulated harvesting				High			Medium
Geometric tortoise habitat destruction by feral pigs at Voëlvlei Nature Reserve			Medium				Low
Sedimentation from bulk water purification at Voëlvlei Nature Reserve			Low				Low

THREATS	TARGETS						
	Freshwater Ecosystems	TMG Aquifer	Swartland Alluvium Fynbos	Mountain-lowland fynbos mosaic	Pre-colonial heritage (rock art and artefacts)	Artificial historical structures	Summary Threat Rating
Vandalism to artificial historical structures						Low	Low
Effects on ecosystem services by managed honey bee colonies				Low			Low
Summary Target Rating	High	Medium	Very High	Very High	Low	Low	Very High

4.3.1 Inappropriate fire regime due to anthropogenic fires

The current state of the Boland Mountain Complex fire regime has raised concern due to the prevalence of fires with short return intervals and the associated ecological impacts. The situation is especially worrying given that several *Protea* species need fire return intervals of more than 12 years to ensure good seedling recruitment in this Complex (Schutte-Vlok *et al.* 2012). There is particular concern about *Protea stokoei*, (pink sugarbush) a slow maturing species endemic to the Boland Mountain Complex and listed as Endangered. Schutte-Vlok *et al.* (2012) showed that only 8% of the population flowered three times at 11 years, and 17% twice. A small population of eight individuals on the Groenland Mountain that have escaped the last two successive fires indicated that only 5 (62%) of the individuals had flowered three or more times in 21 years. At least four populations of *P. stokoei* have been lost (locally extinct), three of which occur in the Hottentots Holland Nature Reserve and one in the Kogelberg Nature Reserve. In addition, one population in the Hottentots Holland Nature Reserve has been markedly reduced from close to a 100 plants to only a few individuals. Furthermore, the population on Groenland Mountain appears to be in a state of decline that may lead to the local extinction of this population.

Schutte-Vlok *et al.* (2012) suggested a number of urgent management interventions:

- The minimum average fire return interval for the Boland Mountain Complex should be maintained at 17 years;
- CapeNature should not allow 80% (or more) of the area to burn again during the next decade. This requires the reduction of the total area that burns per decade to no more than 50% of the Boland Mountain Complex;
- Special precautionary measures must be taken to protect the areas with young veld and seepage areas (particularly high altitude seeps);
- All fires threatening such areas must be rapidly contained to limit spread and ecological damage;
- All the known sites where *P. stokoei* has previously been recorded, need to be revisited to determine the current status of the populations;
- Rapidly control the invasive alien plants in the area;
- An aggressive awareness-raising and education campaign is urgently needed, where neighbouring communities, schools, landowners, Fire Protection Associations, municipalities and politicians are informed and educated about the ecological, social and economic impacts of fires;
- Causes of all fires need to be fully investigated and recorded. All fires started through arson or due to negligence must be followed up with prosecution; and
- Investigate the possibility of rehabilitating populations of species that have been negatively affected.

The Boland Mountain Complex has many wetlands that form important frog habitats. These habitats are sensitive to inappropriate fire regimes with both too short and too long fire-return intervals being problematic. Initial estimation of appropriate fire-return intervals can be obtained from the post-fire and permanent *Protea* monitoring, and comparison to the Hottentots-Holland Nature Reserve fire-return intervals. Maintaining the fynbos and forest vegetation within these fire-return intervals should suffice to conserve the reptiles of the Boland Mountain Complex.

4.3.2 The negative impact of Invasive alien vegetation on fire regime, biodiversity and water availability

The major invasive alien plants present in the Boland Mountain Complex are pines, Australian *Acacia* species and hakea (see Table 4.14). Invasions by these alien tree species in particular have exacerbated habitat loss due to human activities (Cowling & Richardson 1995; Le Maitre *et al.* 2000; De Lange & Van Wilgen 2010; Moran & Hoffmann 2012). Invasive tree species have invaded an estimated 10 million hectares in South Africa by 1997 with the fynbos biome being the worst affected (Le Maitre *et al.* 2000; Van Wilgen *et al.* 2001). Furthermore, 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). 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 in the Boland Mountain Complex. The removal of invasive alien trees should be prioritised for maintenance of the riparian zones, especially for rivers in the high water yield catchments within the Boland Mountain Complex. 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).

Alien vegetation densities in the Boland Mountain Complex are classified as mainly scattered (5 – 25 % invaded) with areas of high densities (25 – 100 %) (Map 8a and b). These high density areas are north of the Theewaterskloof dam, Keerweerdersnek and Dwarsberg and predominantly invaded by pines (Map 8a and b). Heavily infested patches of black wattle (*Acacia mearnsii*) occur in the Rusbos area around the Theewaterskloofdam. Other alien species that also occur are: rooikrans (*Acacia cyclops*), port Jackson (*A. saligna*), *Hakea* spp., *Pinus pinaster* and *P. radiata* (see Table 4.13).

Table 4.14. Invasive alien plant species present within the Boland Mountain Complex.

Scientific Name	Common Name	Distribution
Acacia mearnsii	Black wattle	Widespread in Theewaterskloof area
Acacia saligna	port Jackson	Scattered
Acacia longifolia	Long leaved wattle	Widespread in water courses
Hakea sericea	Silky *Hakea*	Widespread throughout catchment area
Pennisetum clandestinum	Kikuyu grass	At Reserve office and hiking huts
Pinus pinaster	Italian stone pine	Widespread throughout catchment area

Pinus radiata	Monterey pine	Scattered, Old plantations
Rubus fruticosus	English bramble	Forest patches
Solanum mauritianum	Bugweed	In water courses

The spread of most invasive alien plant species is affected by fire, which in turn influences clearing activities and prioritisation thereof. Clearing and controlling invasive alien plant species are costly and given the limited funding available, prioritisation of areas to be cleared must be undertaken to maximise benefit. The prioritisation of areas for clearing is completed annually for all CapeNature reserves using the following process.

Initially, all reserves were divided into mini-compartments of 5 to 200 hectares depending on how badly each area was invaded. Each of these mini-compartments were assigned proper Natural Biological Alien (NBALs)numbers through the Water Information Management System system. Each mini-compartment was mapped and density, age class, clearing method and clearing stage for the five dominant invasive alien plant species in that mini-compartment were recorded. Thereafter, the mini-compartments are prioritised using results from scientific studies and expert knowledge. A priority list of invasive alien plant species were developed during comprehensive expert workshops using decision-weighting software (Van Wilgen *et al.* 2008, Forsyth *et al.* 2009). The two top species listed as priority were *Pinus* spp. and *Acacia mearnsii*, (black wattle) based on the extent of invasion and impact on water resources. Even though *Hakea* is also widely distributed, it received a lower priority because biological control is available for *Hakea* species. General principles of efficient clearing were also included, such as clearing from sparse to dense and effectively integrating invasive alien plant clearing and fires. The following criteria are driving prioritisation once veld age maps and invasive alien plant density maps are integrated:

- The major factor for CapeNature is cost of clearing, which is determined by clearing method. Therefore it was decided to focus on:
    - Taking on areas straight after a fire while non-mechanical and non-chemical clearing methods can be used, which are cheaper,
    - Clearing areas before they can set seed, and
    - Clear older veld where the risk of wild fires occurring is increasing.
- Different criteria were set for the different invasive alien plant (IAP) species.
- In addition to the densities and veld age criteria, accessibility of the Natural Biological Alien compartment was also considered. The accessibility directly affects the costs of clearing. Accessibility is determined by slope (the steeper the slope, the more specialised the teams must be and thus the more expensive the clearing) and the walking distance to the site. Sites within 3 km of a road were given higher priorities because that is the approximate distance the clearing teams can manage to walk in 2 hours with equipment in rough terrain.

The invasive alien plant clearing prioritisation maps are then generated to support the compilation of annual plans of operation for clearing. These maps are generated annually using the annual updated invasive alien plant densities map and the annual veld age map. However, it might happen that the sites with high priority for clearing are inaccessible for clearing teams. Therefore, some deviation from the prioritisation

maps takes place. In addition, during the compilation of the Natural Resource Management Bid for 2017 – 2020 a regional alien vegetation management strategy was drawn up for the region and the prioritisation was refined and adjusted to facilitate realistic and achievable goals. The prioritisation of invaded NBALs of the Boland Mountain Complex is given in Map 8a and b.

The goal of the Boland Mountain Complex is that, by 2029 Alluvium fynbos consists of 90% - 100% indigenous species, and Mountain and lowland fynbos consists of more than 75% indigenous species. Currently, the Kogelberg Nature Reserve Complex is in maintenance phase. Therefore, the main aim is to get all NBALs in Jonkershoek Nature Reserve Complex (except new initial blocks) in maintenance phase by 2029. In the Hottentots-Holland section a strategic approach of working from south to north and linking with Jonkershoek and Franschhoek projects will be followed, while for Limietberg Nature Reserve Complex the approach would be to start in the south at Franschhoek area to Sachariashoek, bringing that area to maintenance phase. In the Waterval Nature Reserve Complex alien clearing is taking place from Nuwekloof towards Bastianskloof in the south. Mountain peaks will be cleared by high altitude teams.

The clearing of invasive alien plants bordering the Boland Mountain Complex will be supported through the Fire Protection and Catchment Management agencies, and the Kogelberg Biosphere Company supports the clearing of alien vegetation close to the Kogelberg Boundaries. The prioritisation process needs to be checked on an annual basis against the achievement of this goal.

IAP clearing is funded either through Working for Water, or through other sources, such as CapeNature directly, integrated catchment management funding, Working on Fire, Pioneer Foods, and the Table Mountain Fund. Given the limited funding available for invasive alien clearing and the inaccessibility of many of these invaded sites, other ways of dealing with invaded sites must be found.

Biological control was hailed as a cost-effective and successful method of control when used as part of an integrated alien clearing plan (Van Wilgen *et al.* 2013). This method is an important approach for dealing with invasive alien plants where prevention and eradication are no longer options for management and other means of control are too expensive or ineffective (Van Wilgen *et al.* 2013). Biological control has been implemented in South Africa for more than 100 years and has been DEA: NRMP-funded since 1997 (Van Wilgen *et al.* 2012). By 1998, biocontrol has reduced management costs by 20% and it has the potential to further reduce the costs by 40% (De Lange & Van Wilgen 2010). Fifty six percent of invasive alien plants in South Africa are under good biological control. Biological control agents primarily reduce seed production, and some can cause die-back of their host plants. Of the 48 invasive alien plant species on which biological control agents have established, ten species are under complete control (21%) and 18 species are under substantial control (38%) (Klein 2011). However, 14 of the 48 species are under negligible control (29%) whereas the status of five species (10%) is still unknown (Klein 2011). Invasive pines which are one of the primary invasive alien plants in the Western Cape have not yet been subject to any biocontrol.

The CapeNature Integrated Catchment Strategy requires that reserve management intensify the application of biocontrol as a clearing method in integrated catchment management. Subsequently, CapeNature drafted a biological control implementation strategy to improve the use of biological control as a clearing method in Integrated

Catchment Management in the Western Cape so that, in combination with other invasive alien species management tools, invasive alien plants are brought under control, and highlights how biological control will be implemented as part of the CapeNature Integrated Catchment Strategy (CapeNature 2017).

4.3.4 Impact of invasive alien fauna on biodiversity

The impact of invasive alien fish on indigenous species were identified as a high threat specific to the freshwater ecosystems, while the loss of biodiversity due to invasive and feral fauna were identified as a medium threat to the Swartland Alluvium and Mountain and Lowland Fynbos.

Impact of invasive alien fish on indigenous species

A number of non-indigenous fish species, many of them invasive, are also present within the rivers of the reserve complex. These comprise species that are not indigenous to the country such as the families Salmonidae (salmon and trout) and Centrarchidae (bass and sunfish), as well as species that are indigenous to South Africa but invasive to the CFE such as the sharptooth catfish (*Clarias gariepinus*). The main vector for initial non-indigenous fish introductions into South Africa, and thus by definition the Western Cape, was recreational angling supported by state hatcheries such as Jonkershoek (Ellender & Weyl 2014). This enabled the introduction of both brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*) into the country in the late 1890s, followed by the introduction of bluegill sunfish (*Lepomis macrochirus*) and various black basses (*Micropterus* spp.) in the 1930s (de Moor & Bruton 1988). These species are now established in the rivers of the Boland Mountain Complex and many have widespread distributions on formally protected areas where trout favour the cooler headwater reaches of rivers while bass species are more often associated with middle to lower reaches of rivers. Other species of non-indigenous fishes were introduced for aquaculture and biological control purposes and additional pathways of introduction include the ornamental trade, inter-basin transfers and conservation translocations (Ellender & Weyl 2014).

The presence of non-indigenous fish species is considered the greatest threat to indigenous fishes of the Boland Mountain Complex, followed by the loss of habitat (Tweddle *et al.* 2009; Weyl *et al*. 2014). Many sections of the Boland Mountain Complex are located in the headwaters of their respective catchments and are thus safeguarded against impacts that may result in loss of habitat (*e.g.* unsustainable water use patterns, pollution and disturbance of instream habitat) and non-indigenous fish are often the only threat to indigenous fishes in these areas. Many rivers of the Boland Mountain Complex are pristine in terms of water quality, habitat and aquatic invertebrate community, yet in some cases are now devoid of an indigenous fish due to the effects of invasive alien fish. Examples are the Elandspad, Molenaars River and the lower Witte River downstream of an invasion barrier, both within Haweqwa Nature Reserve. Non-indigenous fish species affect indigenous fishes through predation, habitat alteration, competition for resources, the introduction of diseases and the disruption of ecological processes (de Moor & Bruton 1988). The primary impact is predation and this has resulted in the extirpation of most indigenous species from mainstream rivers and many tributaries within the CFE (Weyl *et al.* 2014, Van der Walt *et al*. 2016). The majority of viable populations of indigenous species are now limited to upper reaches of tributaries above waterfalls and other barriers where many alien species cannot invade (Skelton 2001, Chakona *et al*. 2013; Jordaan *et al*. 2012).

In the case of the Boland Mountain Complex, the invasion, establishment and impacts of non-indigenous fishes have been significant (Table 4.15). Rivers on the reserve complex where the majority of the indigenous fish fauna has been lost include the Palmiet River (Kogelberg Nature Reserve), Du Toits River (Hottentots Holland Nature Reserve) as well as Molenaars and Holsloot Rivers (Haweqwa Nature Reserve). In these rivers, rainbow trout and black bass have had deleterious effects on the indigenous fish fauna and presently these indigenous fishes have been reduced to fragmented populations in uninvaded areas. Trout distribution within invaded areas is largely driven by temperature (Ellender *et al*. 2016, Shelton *et al*. 2018) and there is evidence that their impacts on indigenous fish are density related (Shelton *et al*. 2014a). This has enabled co-occurrence between indigenous fish and non-indigenous trout in areas where environmental conditions become seasonally marginal for trout. This shifting "invasion front" has been observed in the upper Berg River in Jonkershoek Nature Reserve (Shelton *et al*. 2018) and the Olifants and Drakenstein tributaries of the Haweqwa Nature Reserve where trout co-occur with Berg River redfins, Cape kurper and Cape galaxias.

In contrast, the presence of trout and smallmouth bass has led to the complete extirpation of the indigenous fish community of the Elandspad and Molenaars River within the Haweqwa Nature Reserve with the exception of a small Giant redfin population in the Krom River tributary of the Molenaars River. Similarly, smallmouth bass and sharptooth catfish have invaded the Witte River up to a waterfall that is an invasion barrier to their upstream migration. Downstream of this barrier indigenous fish have been extirpated while an intact natural fish community exists upstream (Shelton *et al*. 2014b). Alien fish invasion within the Hottentots Holland and Theewater Nature Reserves is presently limited to smallmouth bass in the Du Toit's River up to a barrier weir and a fish community dominated by non-indigenous species within Theewaterskloof Dam (Dredge 2016). Estuarine round herring (*Gilchristella aestuaria*) also occurs in Theewaterskloof Dam. Anglers introduced this species as a fodder fish for bass in co-operation with CapeNature (D. Impson pers. comm). Within Kogelberg Nature Reserve, situated on the lower reaches of the Palmiet system, alien fish species including spotted bass (*Micropterus punctulatus*), smallmouth bass (*Micropterus dolomieu*) and bluegill sunfish (*Lepomis macrochirus*) dominate the main Palmiet River (River Health Program report, 2003). The presence of rainbow trout (*Oncorhynchus mykiss*) in the Palmiet system is likely as a result of past and present aquaculture activities in the catchment (*e.g.* Arrieskraal Dam).

Management goals for the Boland Mountain Complex should focus on non-indigenous fish management interventions, preventing new introductions and improving information on baseline distributions and population trends for indigenous fishes. With regard to alien fish management on the reserve complex, the focus should be on the conservation requirements of the Giant redfin (*P. skeltoni*). Given the highly threatened status and limited distribution of this species, controlling trout in the Haweqwa Nature Reserve in the Krom River population is a high priority. Achieving this, however, will potentially be challenging given the current utilisation of the rivers on the reserve for recreational trout angling. Presently the Cape Piscatorial Society manages the river fishery on the reserve. The current management strategy, based on an outdated management agreement with CapeNature, is focused on sustainability of the trout population (Weyl *et al*. 2015). In addition, there are large trout hatcheries in the upper reaches of the Smalblaar and Elandspad catchment, operated by Molapong Aquaculture, which compromise trout management in these rivers. The impacts of

trout on indigenous fishes has been illustrated both locally (Woodford & Impson 2004, Shelton *et al*. 2014, Shelton *et al.* 2018) and globally (Simon & Townsend 2003) and the current management arrangement is to the detriment of the Giant redfin and in conflict with CapeNature's conservation mandate. As a short-term goal, the formal management agreement between the Cape Piscatorial Society and CapeNature should be amended to exclude the Krom River as a trout water as proposed by Weyl *et al.* (2015). This will enable the development and implementation of a trout management plan for the Krom River to remove trout and prevent their re-invasion through construction of a barrier weir near its confluence with the Molenaars / Smalblaar River. This should enable the Krom River population of *P. skeltoni* to increase both in numbers and in area of occupancy and to be considered a viable population. Baseline surveys and monitoring of the Tierkloof population should be initiated to determine the size and trend in this population. Management actions for the Upper Riviersonderend River should include fine scale surveys from the reserve downstream to the dam to determine the fish community composition, habitat quality and presence of instream barriers to invasion into the reserve. Once these actions have been achieved, the feasibility of conservation translocations for *P. skeltoni* can be investigated with the aim of establishing an additional viable population, preferably on a reserve.

Table 4.15 gives the known distributions of the alien fish species present in the Boland Mountain Complex.

Table 4.15. Known distributions of alien fish species present within the Boland Mountain Complex.

Scientific Names	Common Names	Distribution	Impact
Oncorhynchus mykiss	rainbow trout	Widespread, including but not limited to Eerste, upper Berg, Olifants, Drakenstein, Lourens, Hugos, Palmiet, Holsloot and Molenaars Rivers	Predation and competition
Salmo trutta	Brown trout	Upper Witte	Predation and competition
Micropterus salmoides	largemouth bass	Theewaterskloof Dam and lower reaches of some tributaries	Predation and competition
Micropterus dolomieu	smallmouth bass	Lower Witte River, Palmiet River, Theewaterskloof Dam	Predation and competition
Micropterus punctulatus	spotted bass	Theewaterskloof Dam, Du Toits River, Palmiet River	Predation and competition
Lepomis macrochirus	Bluegill	Palmiet River	Predation and competition
Cyprinus carpio	common carp	Theewaterskloof Dam	Competition
Clarias gariepinus	Sharptooth catfish	Lower Witte River, Theewaterskloof Dam	Predation and competition

Geometric tortoise habitat destruction by Feral Pigs at Voëlvlei Nature Reserve
Feral pig (*Sus scrofa*) populations became established in the Western Cape over the last century. In the 1940s and 1950s feral pigs were present in state forests at Franschoek, Lebanon, Swellendam, Garcia, Jonkershoek, Nuweberg, Highlands and

Kleinmond. Most populations originated from escaped domestic pigs, but in some areas, populations of the Eurasian boar were purposely introduced by the Department of Forestry for the biological control of the pine tree emperor moth (Bowland & Bowland 1997). An effective insecticide introduced in 1956 made the pigs redundant. However, many thriving pig populations remain.

Feral pigs can have considerable negative environmental, agricultural, economic, and human and animal health impacts. Their ability to survive cooler conditions in mountainous areas, and overcome terrain obstacles, distinguish them from domestic pigs (Mayer & Brisbin 1999). Conservation agencies have also been concerned for some time about the negative ecological impacts caused by localised feral pig populations in the Western Cape Province.

Feral pigs degrade ecosystems through rooting, trampling and consumption of plants, animals and soil organisms. Rooting disrupts the composition of soil micro-organisms and as a result, the nutrient recycling processes. Large disturbed areas disrupt the regeneration of plants, change the composition of plant communities, facilitate soil erosion and exacerbate alien plant invasion. Feral pigs also physically destroy vegetation through trampling in their pathways and in areas where they wallow. Of particular concern are impacts in the area around the Voëlvlei Dam, the Waterval Nature Reserve, Elandsberg and Krantzkop Nature Reserves. The area represents the largest remaining piece of Critically Endangered Lowland Renosterveld (Driver *et al.* 2005). Renosterveld is known for its large number of red data plant species, including local endemics, and is rich in geophytes and other plants vulnerable to utilisation by feral pigs. In 2003, CapeNature estimated the loss of Renosterveld in Voëlvlei due to uprooting to be approximately 5 hectares/annum (Peter Viljoen pers. comm.). A further concern is the potential for feral pigs to prey on geometric tortoise eggs and hatchlings in addition to the destructive effects they have on the habitat of this Critically Endangered species.

The Elandsberg feral pigs were introduced by the National Department of Forestry to control the pine tree emperor moth problem in the Wolseley plantations in the early 1900's. Six Eurasian wild boars originally from Austria (see Hignett 2006) were relocated from the Groote Schuur Zoo and interbred with escaped domestic pigs. They occur in an area from Voëlvlei Dam in the north to the towns of Wellington in the south and Wolseley in the east. The population is estimated at 500 pigs. The Kasteelberg/Porseleinberg population is estimated to number between 100 and 200 feral pigs and is thought to have resulted from animals introduced from Elandsberg.

Figure 4.3. Damage caused by feral pigs at Voëlvlei Nature Reserve. Photo by Riaan van der Walt.

The Swartland Feral Pig project was initiated to mitigate the negative impacts that feral pigs have on biodiversity in the Swartland Region of the Western Cape Province. The project initially started in the Kasteelberg/Porseleinberg area as a pilot project and has expanded to include Elandsberg, Voëlvlei Nature Reserve, Groenberg and Tulbagh. The Swartland project provided an opportunity for learning and developing best practice guidelines to be rolled out in the rest of the Western Cape, and potentially, even at a national level. The project made use of an integrated approach for the control of feral pigs as this has been internationally proved to be more successful than a singular approach. Both hunting and trapping have been used as a combined strategy to control feral pigs in the project.

The objectives of the plan was to 1) build and maintain partnerships with key role-players including the public, volunteer hunters and conservation community; 2) Contribute to CapeNature's State of Biodiversity database through the collection and reporting of data; 3) Develop and assess control methods for feral pig management; and 4) to assess and mitigate the impacts of feral pigs on biodiversity. The plan is aligned with the CAPE Invasive Alien Species Strategy and was implemented under the auspices of the CAPE Invasive Animal Working Group.

Local awareness about the impact of feral pigs on both biodiversity and agricultural resources was further increased through establishment of the Renosterveld Conservancy. This conservancy provides an effective mechanism to engage with landowners around the issue of feral pig management. This is particularly important as feral pigs move vast distances over many properties, and any approach to the

management of the feral pig problem will need to be co-ordinated involving all the landowners. Landowners and members of the public were originally involved in informal and uncoordinated culling of feral pigs. This situation was not desirable as it almost certainly aggravated the problem by causing the pigs to become shy of humans and encouraging dispersal. *Ad hoc* interventions will compromise future control or eradication efforts and should be ceased. (Barret & Birmingham 1994; Braysher 1993; Land-Protection 2004).

The loss of biodiversity due to invasive and feral fauna

There is one invasive alien frog species from the eastern and northern parts of South Africa, the painted reed frog (*Hyperolius marmoratus*), that is present in the Assegaaibosch Nature Reserve (Jonkershoek valley) section. Fortunately, the invasive *H. marmoratus* is generally a lowland species (that breeds in farm dams and similar artificial water bodies) and is unlikely to invade the montane fynbos habitats of the Boland Mountain Complex but surveillance is required to monitor this. Its impacts are unknown but are unlikely to be dramatic as it does not occupy the niche of any other frog naturally present in the complex. It is however ecologically similar to the arum lily frog (*Hyperolius horstockii*) which may require conservation action in future.

There are two reptile species from elsewhere in South Africa that have been introduced to the Boland Mountain Complex: the leopard tortoise (*Stigmochelys pardalis*), and the Cape dwarf day gecko (*Lygodactylus capensis*). It is unknown what the effects of these species are on the local environment.

Alien and invasive arthropod species cover representatives of most insect orders, arachnids and other non-insect arthropods (Picker & Griffiths 2011). Several of these species were introduced deliberately (*e.g.* as biological control agents) while many invasive invertebrate species are still introduced by accident and may have dire consequences if left unmanaged.

An example of two invasive invertebrate species that were introduced by accident and may have dire consequences if left unmanaged is the European or German wasp, *Vespula germanica* and the European paper wasp, *Polistes dominula* (Fig. 4.4). These species are indigenous to Europe, North Africa and temperate parts of Asia but have, in recent times, also become established in parts of New Zealand, Australia, Chile, Argentina and North America. The arrival of this alien wasp in these parts of the world has in all cases been accidental and a result of inter-continental transport of air cargo. Wherever they have become established the wasps have been regarded as pests and in certain countries as a major threat to both the ecology and to commercial enterprises (Tribe & Richardson 1994).

Figure 4.4. The two invasive wasps. *Vespula germanica* (left) and *Polistes dominula* (right). Photos by Simon van Noort (Iziko Museums).

Vespula germanica is still confined to a relatively small area within the Western Cape, which now include on the fringes: Ceres, Wellington, Grabouw, Somerset West, Franschhoek and Constantia (Veldtman *et al*. 2012; Haupt 2014) (Fig. 4.5). *Vespula germanica* populations have been found in both undisturbed natural vegetation (Richardson *et al.* 1992) and in highly disturbed areas, but it is suspected to thrive in the latter (Mooney & Hobbs 2000) due to increase in food source availability. Current findings indicate that *V. germanica* nests are found almost exclusively next to permanent rivers. Given its distribution in the Western Cape, this includes all permanent river tributaries of the Berg and Breede rivers, along which this wasp seems to be spreading slowly above and below stream where suitable foraging areas are in close proximity. In the odd exception where a nest is found away from a river or permanent water resource, there is always freshwater in close proximity and other forage available such as grape and other fruit waste. This means that the area in which *V. germanica* currently occurs is much smaller than previously estimated, likely due to the current drought conditions experienced.

Figure 4.5. Present distribution of *V. germanica* in the Western Cape, South Africa based on nests found between 2013 and 2016.

The larvae of *V. germanica* require fresh protein (mainly in the form of soft-bodied insects), while the adults require a sugar source for energy and wood to make the paper nest. Wasps prey primarily on spiders, caterpillars, ants, flies and bees (Beggs 2001), but will consume any available protein, even killing newly-hatched birds (Spradbery 1988). Few studies have been undertaken in other ecological biomes where *V. germanica* has become established, but the massive nests and huge populations of over-wintering wasps in the southern hemisphere pose an obvious threat to biodiversity (*e.g.* Fordham 1991; Moller *et al*. 1991). When abundant, European wasps destroy practically all other insect life and even nestling birds (Spradbery 1988). Competition for nectar alone could have a major effect on the indigenous fauna, and the out–competing of indigenous pollinators (including indigenous wasps that also need soft-bodied insects) could interfere with seed formation and the gene flow of indigenous plants. The harvesting of insect prey by the wasps will also serve to reduce the numbers of indigenous pollinators, and hence also impact on pollination and biodiversity.

In South Africa, however, *V. germanica* is currently not abundant and is unlikely to have such severe impacts as seen in New Zealand. Habitat suitability is much lower where the wasp currently occurs in South Africa compared to New Zealand, and the absence of similar honey dew resources explains why wasp abundance is low. Given *V. germanica*'s current distribution and low nest density, it is unlikely that this species has more than a negligible impact on South Africa's invertebrate and insectivore biodiversity. Further studies will have to be conducted to determine whether this prediction is true.

The second species, the European paper wasp, *Polistes dominula* (Fig. 4.4) is a new arrival (post 2005, see Eardley *et al.* 2009) but seems to already occupy a similar range to *V. germanica*, despite the latter having arrived 35 years earlier (Fig. 4.6,

Veldtman *et al.* 2012, Benadé *et al.* 2014). The invasion pattern of *P. dominula* is potentially very different, being a much more recent establishment and fast-spreading, theoretically having different biodiversity impacts than *V. germanica*. Findings show that wasp densities are highest in peri-urban and agricultural areas, intermediate on natural fringes and very low inside natural areas. There is also no evidence of the invasive species impacting on indigenous paper wasps (*Polistes* and other paper wasp genera). The high abundance in human-modified habitats is likely due to increased prey density of cosmopolitan and exotic species. Research thus suggests *P. dominula*'s impact as an invasive species is largely confined to human-modified landscapes (Veldtman *et al.* 2012, Benadé *et al.* 2014). The wasp is thus less of a threat to biodiversity than it is to human health, urban quality of live and agricultural labour practices.

Figure 4.6. Current estimated distribution range of *Polistes dominula* in the Western Cape based on field observations, reports form the public and observations on the species habitat selection.

4.3.4 Impacts of over abstraction on groundwater dependent ecosystems

With water augmentation pressures increasing with the onset of the drought in 2015, groundwater abstraction was touted to be a feasible and cost-effective option in the short term. However, increased abstraction of groundwater will introduce some ecological impacts for groundwater-dependent freshwater (rivers and wetlands) and terrestrial ecosystems in the catchment. Some work has been done in the Boland Mountain Complex area, to determine the extent and effect of potential impacts (Colvin *et al*. 2009), however, the long-term effects of increased groundwater abstraction can only be guessed at. One example of the detrimental effects of over abstraction of groundwater in the Kammanassie Nature Reserve was assessed and documented in a study done by Cleaver *et al.* (2003). In this study observed impacts included those associated with plant water stress, reduction in surface water flow (Vermaaks River)

and the drying up of natural springs. 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.

Additionally the spatial and temporal scope of this groundwater abstraction is concerning as it is for bulk water supply of not only the CoCT, but also the Stellenbosch, Drakenstein, Berg River and Swartland municipal areas and is planned as part of a long term strategy for continuous water provision. The sustainability of abstracting water from the aquifers remains questionable and over-abstraction is considered to be a high rated threat for all the ecosystems contained within the Boland Mountain Complex. It is not surprising then that adaptive management is essential in ensuring some form of sustainable use of groundwater (*e.g.* Seward *et al*. 2006).

4.3.5 Illegal resource utilisation

Illegal resource use includes various unregulated human activities such as overgrazing by livestock, illegal harvesting of fauna and flora (poaching), informal human settlement encroachment, and dumping. For the purpose of this section focus will be on illegal harvesting of fauna and flora.

Impacts on biodiversity due to unsustainable regulated harvesting

The harvesting of wild flora is considered a threat largely to the Mountain Fynbos if not managed for sustainability. Due to habitat transformation and habitat loss, protected areas are increasingly becoming the primary repository of wild flora stock. Flowers of the Fynbos are unique and the flower industry continues to grow, driven by demand at local and commercial scales, along with a growing nursery trade. A consistent approach to the regulation of flower picking guided by policy is necessary to address the increasing pressure on the resource, accompanied by site-specific management guidelines to ensure that picking of flora is environmentally responsible and managed within sustainable limits.

Loss of biodiversity due to poaching of fauna and flora for subsistence and commercial use

Illegal harvesting of fauna and flora is considered a medium threat to fynbos ecosystems. Illegal harvesting may be driven by demand generated by the illegal pet trade (primarily invertebrates and reptiles), a lucrative flower industry, the muti trade, tourism industry (for animal products) and bush meat (ecotypical game species). Contributing factors may include financial gain, traditional belief systems and poverty. Informal human settlement surrounding protected areas of the Boland Mountain Complex are on the increase and correlated with municipal poverty nodes. Flora and fauna of the fynbos are considered unique, and protected area boundaries may not be well-defined to the public, while major highways intercept protected areas and offer easy access to resources. Environmental Compliance monitoring and enforcement contributes to environmental objectives and protection of ecosystems that in turn support livelihoods and development. Poaching, however, perpetuates a cycle of unfair competitive advantage and financial gain when a state of non-compliance exists. Regulatory divisions and differing priorities of the relevant law enforcement and compliance entities place differing emphasis on compliance monitoring of transport networks. A closer collaboration between conservation and relevant entities along with more effective environmental awareness and compliance monitoring can help alleviate the pressure on ecosystems.

4.4 Sensitivity Analysis

Sensitivity mapping of reserve biodiversity, heritage and physical environment is the primary informant of spatial planning and decision-making in protected areas. It is intended to:

- highlight areas containing sensitive biodiversity and heritage features;
- inform all planned and *ad hoc* infrastructure development *e.g.* location of management and tourism buildings and precincts, roads, trails, firebreaks;
- inform holistic reserve planning and designation of utilisation areas, type of use, access points and type of access by means of a Reserve Zonation Scheme; and
- support conservation management decisions and prioritisation of management actions.

Sensitivity mapping allows for direct comparison of sites both within and between reserves to support CapeNature's planning at local and regional scales. 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 higher environmental impacts, and/or higher construction and on-going maintenance costs; as well as
- areas where there is significant environmental risk to infrastructure.

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.

The process uses both expert-derived information and objective scientific data and the decisions are defensible and based on a transparent process.

Biodiversity, heritage and physical features are rated on a standard scale of 1 to 5, where 1 represents no or minimal sensitivity and 5 indicates maximum sensitivity (See Figure 4.7). Additional features such as visual sensitivity, fire risk and transport costs can also be included. Higher scores represent areas that should be avoided for conventional access and infrastructure, or where specific mitigation would be required in order to address identified environmental sensitivity. A score of 5 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. For biodiversity features highest scores represent high priority sites where conservation management cannot be compromised.

Sensitivity maps cannot replace all site-scale investigations, but they are ideal for rapidly reviewing known environmental risks, and guiding whole-reserve planning to minimise overall negative environmental impact.

A decision tree / hierarchical approach is used for the sensitivity analysis. This method is based on the premise that if a portion of the landscape is demarcated as highly sensitive in one of the categories considered in the analysis then, regardless of the sensitivity in other categories, that portion will be considered to be highly sensitive in

the overall scoring. The decision tree approach thus allocates the highest allocated sensitivity in any of the input categories as the ultimate sensitivity class for that particular portion. The benefits of using this approach is that a landscape unit which is scored as highly sensitive for one feature category but has low sensitivity in all other feature categories will retain the high sensitivity scoring. Furthermore, as new and improved data become available, there is the possibility of adding these data to the sensitivity layer without having to re-analyse it from the beginning.

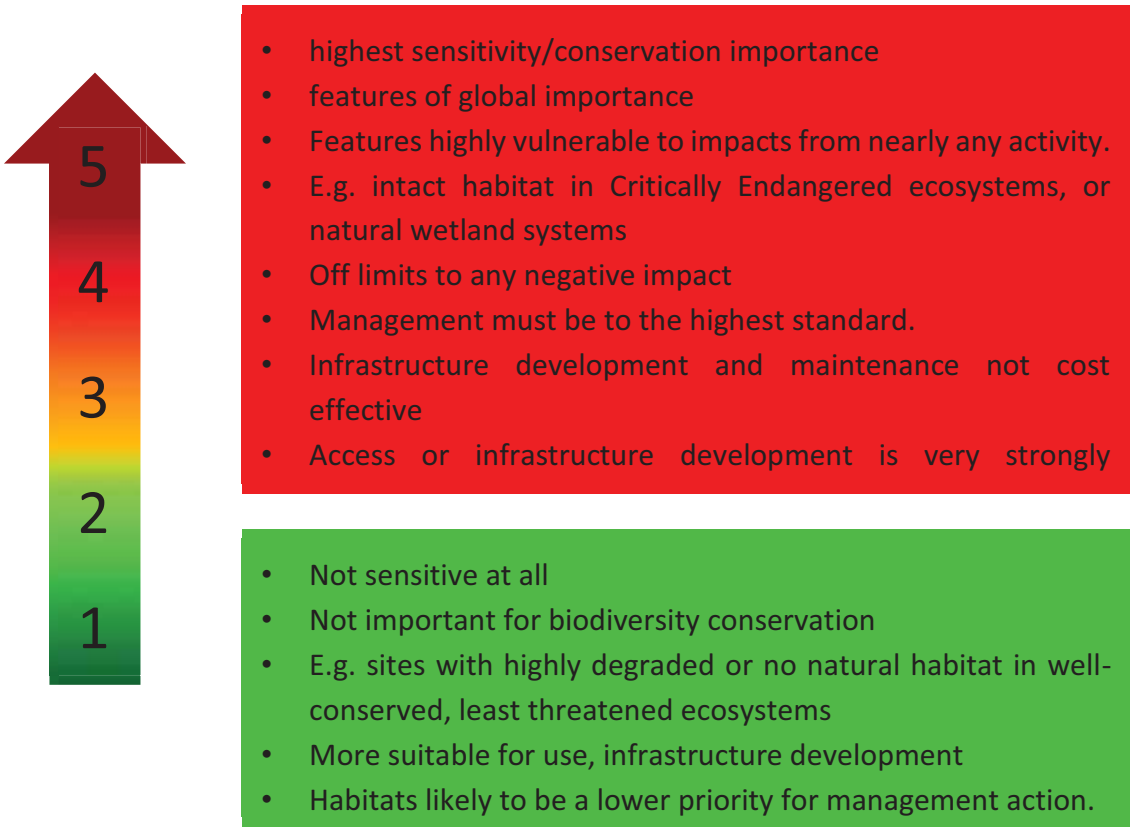

Figure 4.7 CapeNature Method for Sensitivity Scoring and Synthesis.

Physical and biodiversity sensitivities were included in the analysis as per Table 4.16 below.

Table 4.16. Physical and biodiversity sensitivities included in the sensitivity analysis of the Boland Mountain Complex.

	Category		Dataset	Criteria	Sensitivity score	
Physical	Slope (degrees)		Slope calculated from 20 m resolution DEM	> 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
				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
Biodiversity	Rivers		1: 50 000 NGI Rivers	Within 200 m of perennial river.	Highest sensitivity	5
				Did not to include the non-perennial river buffers due to "over estimation" of sensitivity.	High sensitivity	4
	Wetlands & Seeps		NFEPA wetlands (Nel & Driver 2012) and Seeps	Wetland and seeps.	Highest sensitivity	5
				Within 200m of wetlands and seeps.	High sensitivity	4
	Vegetation status / Ecosystems threat status		Ecosystem Threat Status based on Cape's	Critically Endangered – Elgin Shale Fynbos, Elim Ferricrete Fynbos, Kogelberg Sandstone Fynbos, Swartland Alluvium	Highest sensitivity	5

	Category		Dataset	Criteria	Sensitivity score	
			2014 or 2016 assessments per veg type (SANBI 2006-)	Fynbos, Swartland Shale Renosterveld.		
				Endangered – Hangklip Sand Fynbos, Breede Alluvium Fynbos	High sensitivity	4
				Vulnerable – Boland Granite Fynbos, Breede Sand Fynbos, Cape Winelands Shale Fynbos, Hawequas Sandstone Fynbos.	Moderate sensitivity	3
				Least threatened – Breede Shale Fynbos, Breede Shale Renosterveld, Cape Coastal Lagoons, Cape Lowland Freshwater Wetlands, Cape Seashore Vegetation, Overberg Dune Strandveld, Southern Afrotemperate Forest, Western Afromontane Sandstone Fynbos, Western Coastal Shale Band Vegetation, Winterhoek Sandstone Fynbos.	Lowest sensitivity	1
	Rare and endangered plant species		Rare and endangered plant spp extracted from CapeNature Biodiversity Database, All threatened Species (SANBI 2015)	All plant species rated as Critically Endangered, Critically Rare, Declining, Endangered, Near Threatened, Rare or Vulnerable. Point localities buffered by 5 m.	Highest sensitivity	5
Heritage	Archaeological & cultural sites		Cultural and Heritage Sites (CapeNature Infrastructure register)	Heritage sites as extracted from the reserve's infrastructure register and buffered by 100 m.	Highest sensitivity	5

4.4.1 Results of Sensitivity Analysis

The sensitivity of the Boland Mountain Complex is shown in Map 9a and b.

The sensitivity of the Boland Mountain Complex was dominated by ecosystem threat status per vegetation type, slope, NFEPA wetlands and perennial rivers (Table 4.17). The sensitivity based on ecosystem threat status per vegetation type resulted in the complex being scored either as moderately sensitive (49.5%) or highest sensitivity (46.4%) (Table 4.17). Due to the steep topography of the area, the sensititvity has been scored as moderate to very high for approximately 81% of the complex (Table 4.17).

Table 4.17. Sensitivity scores for the Boland Mountain Complex.

	Total sensitivity score		Slope sensitivity		Perennial rivers - buffer 200m		NFEPA wetlands + 200m buffer		Ecosystems threat status per vegetation type		Threatened plant species - buffer 5m		Rare and endangered spp (CREW) - buffer 5m		Spp of special concern - TOTAL (buffer 5m)		Heritage and cultural sensitive sites - buffer 100m	
Sensitivity score	Area (ha)	% of total	Area (ha)	% of total	Area (ha)	% of total	Area (ha)	% of total	Area (ha)	% of total	Area (ha)	% of total	Area (ha)	% of total	Area (ha)	% of total	Area (ha)	% of total
1	59	0.0	11 190	8.9	0	0.0	0	0.0	4 894	3.9	0	0	0	0	0	0	0	0
2	218	0.2	13 198	10.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0	0	0
3	16 894	13.4	31 622	25.1	0	0.0	0	0.0	62 377	49.5	0	0	0	0	0	0	0	0
4	20 813	16.5	33 665	26.7	0	0.0	16 441	13.0	222	0.2	0	0	0	0	0	0	0	0
5	88 039	69.9	36 348	28.8	18 169	14.4	3 779	3.0	58 530	46.4	25	0.0	15.6	0.0	40.1	0.0	43.2	0.0

4.5 Zonation

Protected area zonation provides a standard framework of formal guidelines for conservation, access and use for particular areas and is underpinned by the sensitivity analysis. Zonation goes beyond natural resource protection and must also provide for:

- appropriate visitor experience;
- access and access control;
- environmental education; and
- commercial activities, in keeping with the protected area objectives and sensitivity analyses.

Ideally, zonation development should be done at the same time as infrastructure development planning. Good planning must aim to reduce cumulative environmental impacts and the long-term operating costs of all activities. Zonation and infrastructure development planning must be guided by:

- sensitivity analysis;
- existing infrastructure and use;
- potential future infrastructure and access requirements; and
- careful evaluation of overall impact, construction costs and operating costs vs. likely benefits.

Zonation requires input from all appropriate internal CapeNature stakeholders, and is a key component of the management plan which is to be evaluated during the Public Participation Process.

CapeNature's zonation categories (See Table 4.18) were developed by an internal workshop process completed in September 2010. Existing protected area zoning schemes worldwide were examined to develop a simple and powerful scheme that provides for the required range of visitor experience, access and conservation management. Particular effort was made to maintain consistency with the best developed South African zonation schemes, in particular those of SANParks and Ezemvelo Kwa-Zulu Natal Wildlife. CapeNature's zonation categories have fewer tourism-access categories, but provide more detailed and explicit guidelines with regard to zone objectives and characteristics. Furthermore, CapeNature's zonation includes new zones specifically required in the context of highly sensitive biodiversity sites and zoning of privately owned Contract Nature Reserves.

Table 4.18. Guide to CapeNature Zones on the Boland Mountain Complex.

Wilderness / Wilderness	Areas with pristine landscape. Includes area with sensitive or threatened habitats. Very limited access.
Primitive	Areas providing natural landscape in solitude with limited access. Normally a buffer area to wilderness zones.

Nature Access	Providing easy access to natural landscape. Includes areas such as roads and trails, and popular viewing sites and 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 normally 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.
Development - Production	Commercial or subsistence farming (only applicable if privately owned and managed as contract nature reserve).
Development – Private Areas	Private dwelling and surrounds (only applicable if privately owned and managed as contract nature reserve).
Species / Habitat / Cultural Protections	Protection zone – Protection of species or habitats of special conservation concern.
Cultural Species / Habitat Visual Natural Resource Access	Special management overlays provide an indication of areas requiring special management intervention within the above zone.

Underlying decision-making rules used by Holness and Skowno (2008) in the zonation process:

1. The zonation process is aimed a striking a balance between environmental protection and the development required to meet the broader economic and social objectives of the park.
2. The zoning process takes into account existing development footprints and tourism access routes.
    - This is based on the underlying principle that all else being equal, an existing transformed site is preferable to a greenfields site from a biodiversity perspective.
    - Infrastructure costs are dramatically increased when developments take place away from existing infrastructure.
    - Existing tourism nodes and access routes are a reality of the economic landscape, and it would not be possible to shut down existing tourism sites compromising the development objectives of the park.
3. Where existing development nodes, tourist sites and access routes occur in areas with high sensitivity-value, then the broad use zoning aims to keep the

development footprint as small as is realistically possible, preferably within the existing transformed site.
4. Where possible, sites with high biodiversity sensitivity-value are put into stronger protection zones. Peripheral development is favoured.

The zonation of the Boland Mountain Complex is shown in Map 10a and b. The Boland Mountain Complex is zoned as follows:

Wilderness (not declared): The main part of the Kogelberg Nature Reserve is zoned as wilderness. This section of the protected area has entirely natural areas where no built infrastructure, roads or vehicular access should be permitted.

Primitive: All the protected areas in the Boland Mountain Complex are zoned as "Primitive"except for the areas zoned for wilderness (Kogelberg), and any other areas zoned for nature access and development. A 1 km buffer along the inside of the protected area boundary is zoned as "Primitive".

Nature Access: Nature access zones allows for access and appropriate management of the most popular day visitor sites. Public roads with unrestricted access (such as the Houwhoek Pass, Franschhoek Pass, Bainskloof, N1 and other minor roads) were buffered by 25 m, except where the area was zoned for development:

- Brodie/Kogelberg – Road that leads to existing buildings.
- Kogelberg Sonchem – Area to the west that incorporates Buffelsrivier Dam, two old quarry areas and the water works. The rest of reserve east of the road is zoned as "Primitive".
- Kogelberg – Area east of Rockview Dam were zoned as "Nature Access". The area around the Oudebosch accommodation and trails that lead up the river to Louws Bos, except for areas zoned for development, are zoned as "Nature Access".
- Rooiels – The trail that leads to the boardwalk and bird hide were buffered by 2.5 m.
- Limietberg – The area known as Zachariashoek up to the Drakenstein river is zoned as "Nature Access". The area around the Tweede Tol campsite and area running north up Wolwekloof except for the areas at the actual camping terrain that are zoned for development.
- Voëlvlei – The road that leads to the water works is buffered by 25 m and zoned as "Nature Access".

Development – Low Intensity: The following areas are zoned for low intensity development:

- Brodie/Kogelberg – The area where there are existing buildings, uphill from Pringle Bay.
- Brodie Link – The areas around two existing structures.
- Rooiels – Parking area for trail and boardwalk to bird hide.
- Kogelberg Sonchem – Two historic quarry areas were zoned for low intensity development.
- Kogelberg – The area around the new eco-friendly holiday resort at Oudebosch.
- Simonsberg – The area near Kanonkop.

- Assegaaibosch – The area around the CapeNature offices were captured as low intensity.
- Limietberg – The area around the Tweede Tol campsite and the extension of the private picnic area south of the river.

Development – Management: Management zones provide for staff accommodation, stores, and administration facilities. In Kogelberg Nature Reserve the area around the Conservation Manager's house is zoned as such. At the Nuweberg Forest Station the area around the office complex is also zoned for management development. The entire office and housing complex for CapeNature's Central Region and Scientific Services Department is located in and around the Assegaaibosch Nature Reserve and this area is thus zoned as a management development node. In addition, the area around the repeater station is also zoned as a management development area. The staff house at Tweede Tol is also zoned for management purposes.

All dams, whether private or state-owned, were zoned as management development zones. The area around the water treatment plant in the Kogelberg Sonchem area, and the road that leads to it, is also zoned as a management development area.

Species and Habitat Protection: Botrivier – An area adjacent to the Bot vlei at the northern tip of the Kogelberg Nature Reserve is zoned for special species habitat protection.

4.6 Access

Access points must be easily accessible to relevant user groups, but controlled by protected area staff. Access points on Boland Mountain Complex for the public are listed in Table 4.19. Access and specific facilities are spatially mapped in Map 11a and b.

The different types of access points include controlled and uncontrolled entrances to the protected areas for various activities. Controlled access is through established, manned entrance gates while uncontrolled access is regulated with displayed signage only.

Table 4.19. Access points to the Boland Mountain Complex.

Locality	Name	Type of Access	Activity
Kogelberg Nature Reserve	Kogelberg Rondawel Access Gate	Controlled Access	Tourism
Kogelberg Nature Reserve	Kogelberg Rock View Entrance Gate	Controlled Access	Management
Kogelberg Sonchem link Nature Reserve	Buffelstal Main Gate	Controlled Access	Tourism
Kogelberg Nature Reserve	Oudebosch Main Access Gate	Controlled Access	Tourism

Rooisand (Botriver) Nature Reserve	Rooisand Gate	Uncontrolled Access	Tourism
Mt Hebron Nature Reserve	Dekka Stasie Entrance	Uncontrolled Access	Tourism
Brodie Link Nature Reserve	Hangklip Access Gate	Controlled Access	Tourism
Houwhoek Nature Reserve	Korteshoven Farm Access Gate	Uncontrolled Access	Tourism
Groenlandberg Nature Reserve	Groenlandberg Access Gate	Controlled Access	Tourism
Hottentots-Holland Nature Reserve	Nuweberg Entrance Gate	Controlled Access	Tourism
Hottentots-Holland Nature Reserve	Hansekop	Uncontrolled Access	Management
Hottentots-Holland Nature Reserve	Rhusbos entrance	Uncontrolled Access	Management
Hottentots-Holland Nature Reserve	Mooiwater iniation entrance	Uncontrolled Access	Cultural
Hottentots-Holland Nature Reserve	Twaalffontein entrance	Uncontrolled Access	Management
Hottentots-Holland Nature Reserve	Groenlandberg entrance	Controlled Access	Tourism
Hottentots-Holland Nature Reserve	Beeskloof entrance	Uncontrolled Access	Management
Jonkershoek Nature Reserve	Assegaaiboschkloof Access Gate	Controlled Access	Management
Jonkershoek Nature Reserve	Jonkershoek Entrance Gate	Controlled Access	Tourism
Assegaaibosch Nature Reserve	Assegaaibosch Entrance Gate	Controlled Access	Tourism
Assegaaibosch Nature Reserve	Assegaaibosch Caravan Gate	Controlled Access	Management
Haweqwa Nature Reserve	Tweede Tol Entrance	Controlled Access	Tourism
Haweqwa Nature Reserve	Miaspoort Entrance	Uncontrolled Access	Tourism
Haweqwa Nature Reserve	Krom - Elands Entrance	Uncontrolled Access	Tourism

Haweqwa Nature Reserve	Eerste Tol Entrance	Uncontrolled Access	Tourism
Waterval Nature Reserve	Waterval Main Entrance Gate	Controlled Access	Tourism

A number of servitude agreements exist for Boland Mountain Complex where the respective entities are provided access to land managed as part of the Protected Area. Current servitudes are listed in Table 4.20 and mapped in Map 11a and b.

Conditional access regulated through management agreements and servitude includes agreements with neighbouring Landowners/Land Managers, (*e.g.* fire belt maintenance agreements), or servitudes, (*e.g.* water user-rights, rite of passage, powerlines, telephone lines, pipelines, service roads).

Table 4.20. Servitudes and management agreements of the Boland Mountain Complex.

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected
Hottentots Holland Nature Reserve Complex				
6 Jun 1952	User Rights - Water	Charl Jacobus Roux	Not specified	Amandel River 15/0 Rus Valley 81/0 Zwarte Stomp 79/0
23 Sep 1959	User Rights – Water	Petrus Jacobus Van Zyl	Not specified	Amandel River 15 Rus Valley 81/0 Zwarte Stomp 79/0 Palmiet Valley 319/0
16 Aug 1922	Deed of Grant - Road	Crooks Brothers	Not specified	Dagbreek (Ou Werf) 21/0
23 Sep 1959	Deed of Grant - Road	Gerald Ernest Gerstner	Not specified	Palmiet Valley 319/0
08 Mar 1945	Deed of Grant - Water	Charles Henry Brandt Leonard	Not specified	Purgatory 1135/0
15 Mar 1898	Deed of Grant - Road	Charles Maidment	Not specified	Sterhuis River 18/0 Noordekloof 19/0
16 Jan 2014	User Rights - Water	Gary Baumgatan La Ormarins	Not specified	Franschhoek Forest Reserve 1023/0
14 Feb 2013	User Rights - Access	Rian Larkman – Canopy Tours	10 Years	Moordenaarskloof 93/0
Jonkershoek Nature Reserve Complex				
16 Jan 2014	Servitude- Water Pipe line		Not specified	Franschhoek Forest Reserve
Kogelberg Nature Reserve Complex				
1990	Deed of Grant- Powerline	Eskom transmission	Not specified	Kogelberg Nature Reserve 939/0

Date of Agreement	Type of Agreement	Partner	Duration of Agreement (years)	Area Affected
				Mier Nest 468/0 & Farm 440/0
2000	Deed of Grant - High-site	MTN Cellular mast	20 Years	Hangklip 559/186 (Buffelstal)
1990	User Rights – Water (Buffelstal Dam)	Overstrand Municipality	Not specified	Hangklip 559/186 (Buffelstal)
2 Mar 2001	Deed of Grant - High-site	MTN Cellular mast	20 Years, renewable	Betty's Bay Erf 2411 (Stony Point NR)
Historical	User Right - Water Pipeline	Remhoogte Boerdery	Not specified	Kogelberg Nature Reserve 939/0 (Elgin Basin: Somersfontein Farm
Historical	User Rights – Water (Boomerang Dam)	Groenland Water User Association (Barkai Farm	Not specified	Mier Nest 468/0
Limietberg Nature Reserve Complex				
	MOU- access to Donkerkloof area, old Du Toitskloof pas	Rastafarian Nyhabhingi church	No Info	Limietberg
Waterval Nature Reserve Complex				
07 Jun 1948	Servitude-Road	Department of Water and Sanitation	In perpetuity	Voëlvlei (Vogel Valley 207; Vogel Vallij 253)
1953 (E395/53)	Servitude-Powerline	Eskom transmission	In perpetuity	Voëlvlei (Vogel Valley 207; Vogel Vallij 253)
1971 (E2258/71)	Servitude- Pipeline (Not in use)	City of Cape Town	In perpetuity	Voëlvlei (Vogel Valley 253); Waterval (Kasteels Kloof 255)
02 Oct 1979	Servitude-Powerline.	Eskom transmission	In perpetuity	Voëlvlei (Vogel Vallij 253)

4.7 Concept Development Plan

Tourism product and related infrastructure developments at CapeNature are considered as investments and are intended to:

i. Harness and enhance the income generation potential of protected areas with a view to achieving long term business sustainability and;
ii. The provision of safe, informative and purpose built access to protected areas for all users, visitors and stakeholders.

4.7.1 Project selection

Potential tourism product developments (Figure 4.8) are selected based on internal consultation and approval where factors such as appropriateness, environmental approval, financial feasibility and the apparent return on investment are considered. Where external approval for developments is required, these are sought from the relevant authorities prior to the commencement of any development activities. In general terms, identified potential tourism investments are likely to receive more favourable consideration where benefits are relatively obvious; the approval process will likely be unchallenged and where these are able to be concluded within the constraints of a single fiscal year.

The organisation may elect to operate tourism products and services internally or via other mechanisms described in the Public Finance Management Act (no.1 of 1999) such as concessions or public private partnerships. The CapeNature Concept Development Framework for the implementation of tourism products on protected areas is shown in Figure 4.8 below.

Figure 4.8. Concept Development Framework for the implementation of tourism products on protected areas.

4.7.2 Methodology

Tourism products and infrastructure within CapeNature protected areas are designed and implemented as responsive to their overall sensitive locations and are intended as prime examples of responsible and sustainable commercial developments. These often include: off-grid bulk water and energy services; passive-design efficiencies; enhanced resource utilisation and resource-saving features. Tourism developments are intended to comply with prevailing zonation schemes and sensitivity analyses 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.

4.7.3 Tourism Management and Development

The Boland Mountain Complex is a popular tourist destination in the Western Cape Province due to its locality close to Cape Town and surrounds. CapeNature continues to lead the way in sustainable tourism as shown by its continued commitment to nature-based recreational and tourism facilities for locals and internationals to enjoy and explore. A case in point is the award-winning Oudebosch tourist accommodation in Kogelberg Nature Reserve that consists of five eco-cabins that have been carefully planned using green building technology incorporating composting toilets, atmospheric water generators, grey water recycling, rain water harvesting and an ecopool.

Overnight huts are available at Landroskop and Boesmanskloof in Hottentots Holland Nature Reserve. In addition, CapeNature has partnered with Cape Canopy Tours, who runs guided zipline experiences through the Hottentots Holland Mountains. In peak season Cape Canopy Tours guides up to 18 trips per day.

The Tweede Tol camp and picnic site is located at the original tollgate of the beautiful Bainskloof Pass, built in 1853, in the Limietberg Nature Reserve. The campsite has 20 standard sites, and six fenced-off private campsites.

A number of future tourism products have been identified in the Boland Mountain Complex. These projects are dependent on the availability of internal and/or external funding, financial feasibility and approval before commencement.

Two such developments are an additional camp-site and private picnic area at Tweede Tol and a second phase of eco-cabins at Oudebosch. Phase Two of the Oudebosch development has started and will include three six-sleeper units to accommodate larger groups with ease, as well as five two-sleeper units for couples and an additional eco-pool. This development will boost the local economy with job creation opportunities for people from the surrounding community.

4.8 Protected Area Expansion

The expansion of protected areas in South Africa is informed by the National Protected Area Expansion Strategy (NPAES) (SANBI & DEAT 2008). This strategy provides a broad national framework for protected area expansion in South Africa by identifying large areas which should be targeted for formal declaration and introduces a suite of mechanisms which could aid in achieving this.

In response to the NPAES which calls on provinces to develop implementation plans in support of the NPAES and in support of provincial conservation efforts and priorities, CapeNature has produced a Western Cape Protected Area Expansion Strategy 2015-2020 (Maree *et al*. 2015). This CapeNature strategy addresses the formal declaration of priority natural terrestrial habitats in the Western Cape Province as protected areas to secure biodiversity and ecosystem services for future generations. Although aligned to the concepts and goals of the NPAES, this strategy is informed by immediately available resources and therefore highlights some different spatial priorities.

The Complex expansion will be done in line with the Western Cape Protected Areas Expansion Strategy (WCPAES). These sites have been identified through systematic conservation planning that culminated in the Western Cape Biodiversity Spatial Plan

and include sites that contain Critical Biodiversity Areas (Pence 2017). The Conservation Action Priority Map, spatial representative of the WCPAES which includes a subset of CBAs is used as an informative that guides expansion initiatives.

Previous expansion of the Complex was achieved primarily through implementation of the CapeNature Stewardship Programme signing agreements with private landowners. The main mechanism for expansion for this Complex is through the acquisition of priority areas. Klipfontein and Forestry Exit Areas including Highlands, Lebanon, CoCT (Steenbras), Hottentots-Holland (Nuweberg), Jonkershoek, La Motte and Hawequas are examples of state land properties which are in process of being transferred to the province to be vested with CapeNature for management and declaration as part of the Complex (Map 12a and b).

The Bot-Kleinmond Estuarine System was recently designated (31st January 2017) as a Ramsar wetland. It consists of an estuarine lake and is also included as an Important Birding Area. There are a number of sites within the Overstrand Municipality which have been assessed and identified as being of conservation significance, worthy of protected area status.

4.9 Zone of Influence: Protected Area Integration and Mainstreaming

The purpose of the zone of influence is to ensure that the protected area is integrated into the landscape so that land and water use planning take due consideration the objectives of the protected area and do not impede the achievement of objectives. The Zone of Influence is intended to integrate mechanisms in the landscape that enable protected area expansion, the maintenance of existing expansion nodes, and seeks to proactively encourage compatible land and water use in collaboration with relevant stakeholders.

Sensitivity analysis and the objectives of Boland Mountain Complex are primary informants for the establishment of the Zone of Influence. The delineation of the zone of influence was further based on existing land- and water use, current levels of compatibility, and identified areas of incompatibility. The process accommodates both expert-derived information and more objective scientific data and the decisions are defensible and based on a transparent process. Feature data were limited to 10 km from the proclaimed boundary around the Boland Mountain Complex, which is the distance according to the Environmental Impact Assessment Regulations Listing Notice 3 of 2014 that serves as a buffer area.

The features used in the zone of influence calculation are rated on a standard scale of 1 to 4: Low (1), Medium (2), High (3), and Very high (4). These ratings were assigned to each input feature within the zone of influence. Higher scores represent areas where many features overlap and influence on the complex would be higher.

Table 4.21 lists the features, criteria and rating that were used to develop the zone of influence of the Boland Mountain Complex. Map 13a and b shows the zone of influence for the Boland Mountain Complex, which has a total extent of 354 646.4 ha.

Approximately 9% of the zone of influence resulted in high fire frequency in the Boland Mountain Complex (Table 4.20). The latter was delineated as fire hotspot areas based on frequent ignitions and anthropogenic causes.

Illegal resource use, which includes various unregulated human activities such as overgrazing by livestock, illegal harvesting of fauna and flora, informal human settlement encroachment, and dumping, affected the largest portion of the zone of influence (Table 4.21). This was followed by invasive alien plants and mountain catchment areas.

Table 4.21. The criteria used for defining the zone of influence of the Boland Mountain Complex.

Feature	Dataset and criteria	Rating	Zone area (ha)	% of zone
Fire hazards (high fire frequency)	Inappropriate fire frequency due to anthropogenic fires.	Very high (4)	31 197.5	8.80
Illegal resource use	Illegal resource use, which include various unregulated human activities such as overgrazing by livestock, illegal harvesting of fauna and flora, informal human settlement encroachment, and dumping. The layer was generated by buffering human settlements by 1500 m.	Very high (4)	122 944.6	34.67
Invasive alien plants (IAP)	Stands of IAPs or plantations within a radius of the Protected Area are a source of re-infestation of IAP. All NBALs marked as plantations and areas with densities greater than 50% from the CapeNature IAP 2017 map. The Working for Water Project Managers provided a list of adjacent properties to the reserves that have IAPs, including the densities and dominant spp. These layers were intersected with the remnants to remove agricultural areas.	High (3)	83 327.4	23.50
Invasive alien fish	Rivers identified for conservation intervention due to the presence of threatened indigenous fish species. Three rivers were listed for the presence of the Giant redfin (*Pseudobarbus skeltoni*); Upper Riviersonderend, Krom, and Tierkloof (all part of the Upper Breede river and represent the remaining natural range of this fish species.	Medium (2)	89.8	0.03
Invasive fauna	Impact of invasive fauna on or adjacent to protected areas. Included the project domain of the feral pig eradication project.	Medium (2)	49 120.8	13.85
Over abstraction of water (surface and	Groundwater abstraction - A point layer containing groundwater abstraction points were used to generate a buffer of 100 m.	High (3)	668.0	0.19

groundwater)	Surface water abstraction - the two main rivers, namely Eerste and Palmiet were buffered by 32 m as these rivers mainly represent areas where surface water for agricultural use is abstracted.	Low (1)	668.0	0.19
Water pollution from aquaculture	Area where nutrient pollution occur from trout farming. Point localities were buffered by 500 m.	Low (1)	196.6	0.06
Renewable energy	Installation of renewable energy, both wind and solar, adjacent to protected areas within the 10 km buffer zone. There are currently 2 layers available for the renewable energy development zones, one for Phase 1 and two for Phase 2. Phase 1 has gone through the EIA process and has been approved. Please note that Phase 2 is in its initial stages. Additional data are available on wind and solar energy from the CSIR. The 3 layers were combined into one layer and then clipped to the 10 km buffer area for the Boland Mountain Complex.	Low (1)	26 114.7	7.36
Illegal access along routes	Transportation and service corridors dissect the complex. Illegal access is reported along these corridors. The corridors include major roads, railway lines and powerlines. Buffered by 100 m.	Low (1)	30 295.9	8.54
Sedimentation	Sedimentation from bulk water purification. The influence of the clearing of the sediment from the Voëlvlei dam and dumping thereof. Buffer an area of 100 m around the Voelvlei dam.	Low (1)	117.9	0.03
Managed honey bee colonies	The impact on non-managed honey bees due to horticulture / viticulture within 1 km from protected areas. Extracted all agricultural fields (2013) listed for horticulture / viticulture from the layer provided by the Dept. of Agriculture.	Low (1)	8 279.2	2.33
Game farming	The threat of game farming adjacent to reserves can stem from introduction of extra-limital game species, or fencing that limits the movement of natural wild species. Extracted all game farms adjacent to the Protected Area boundary from the Western Cape Game Database, last update November 2017.	Low (1)	13 878.5	3.91
Mountain Catchment	Included all adjacent Mountain Catchment Areas into the zone of	Low (1)	69 372.0	19.56

Areas	influence.			
Local Authority Nature Reserves	Included all the adjacent local authority nature reserves in the zone of influence. There are only three, namely Kleinmond, Mont Rochelle, and Villiersdorp.	Low (1)	2 855.3	0.81
Stewardship sites	Select the stewardship sites that have direct land- and/or water management responsibilities and that contribute to Protected Area values and appropriate Protected Area design (connectivity and extent).	Low (1)	18 713.1	5.28
Areas identified in WCPAES	Include areas identified for the WCPAES.	Low (1)	16 165.3	4.56
Estuaries	Monitoring of ecological health of estuaries and monitoring impacts from various threats. The Botrivier is a major estuary falling with in the zone.	Low (1)	1 278.7	0.36
Coastal areas and marine protected areas	Marine protected areas have a direct aquatic fauna and coastal ecosystems management responsibility and contributes to the overall protected area value and design. Extracted the marine protected areas plotting along coast within 10 km proximity of the complex.	Low (1)	2 166.1	0.61

5 STRATEGIC IMPLEMENTATION FRAMEWORK

An analysis of the conservation situation was undertaken for the Boland Mountain Complex to enable a common understanding of the context of the Complex inclusive of the biological environment and the social, economic, cultural and institutional systems that influence values. The aim of the situation analysis was to understand drivers of direct threats and explore contributing factors to find opportunities and strategic points where intervention is possible and considered to have the most impact. This formed the basis for developing strategies and action plans for the Boland Mountain Complex.

Strategies were ranked, and those strategies that were anticipated to be the most effective and feasible were tested using Results Chains to test the theory of change and establish objectives and intermediate results. Where relevant, strategies were aligned with existing complementary plans to address gaps, and promote and reinforce existing efforts.

Strategies can be grouped as follows:

- Value Restoration/Stress Reduction Actions
- Behavioural Change/Threat Reduction Actions
- Enabling Condition Actions

A summary of the Boland Mountain Complex focal ecological and service areas, goals and assosiated strategies are provided in Table 5.1. The Strategic Implementation Framework is provided in Table 5.2. The monitoring, evaluation and reporting framework is provided in Table 5.3.

CapeNature will lead the implementation of the management plan, although achieving the vision requires coordinated effort. The following groups and organisations are key partners in delivery:

- All our neighbours and surrounding stewardship properties
- Franschhoek, Groenlandberg and Theewaterskloof Conservancies
- Kogelberg and Cape Winelands Biosphere Reserves
- All volunteer groups
- Cape Winelands, West Coast and Overberg District Municipalities and the City of Cape Town Municipality
- Winelands, Cape Peninsula and Greater Overberg Fire Protection Association
- Breede Gouritz Catchment Management Agency
- Department of Water Affairs and Sanitation Proto-Catchment Management Agency (Berg-Olifants)
- National Department of Agriculture, Forestry and Fisheries
- National Department of Environmental Affairs
- National Department of Water and Sanitation
- City of Cape Town – Bulk Water
- South African Environmental Observation Network
- Universities of Cape Town and Stellenbosch
- Western Cape Department of Agriculture
- Western Cape Department of Environmental Affairs and Development Planning

Table 5.1. Targets, goals and strategies identified for the Boland Mountain Complex.

Target	Goals	Strategies
Freshwater Ecosystems	By 2029 the condition of delineated wetlands is in a natural* to near-natural condition**. *Unmodified ** A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1 2 3
	By 2029 the upper to middle reaches of rivers supporting macro-invertebrate species composition represent an ASPT of 6-8, rivers supporting Giant redfin are 90% to 100% clear of alien fish species and amphibian species composition is representative of relevant sites*. *All species represented, population estimates for all species exceeding 10 individuals.	8
	By 2029 river flow of abstracted rivers is maintained at above 80%.	1
TMG Aquifer	By 2029 groundwater dependant freshwater ecosystems are in good* condition (*see wetland ecosystem health).	2
Swartland Alluvium Fynbos	By 2029 Swartland Alluvium fynbos has an ecologically healthy fire regime*, is comprised of 90% - 100% indigenous species, containing species of conservation concern** and is connected and intact***. * <20% of area has burned twice or more in the last 25 years; *Not more than 2 of the age classes are below 5% or above 20%; * >80% of the area burnt during December-April, mostly medium sized fires. ** Recruiting populations of Geometric tortoise and grey rhebok. ***More than 3 000ha of veld type secured in conservation.	1 3 4 5 6 7 9 11
	By 2029 Swartland Alluvium fynbos supports all three size classes of geometric tortoise and selected grey rhebok populations are stable.	5 6 7

Mountain and Lowland Fynbos	By 2029 Mountain and lowland fynbos has an ecologically healthy fire regime* and consists of more than 75 % indigenous species and reseeding proteas species are represented as per historic data**. The selected grey rhebok populations are stable. *<20% of area has burned twice or more in the last 25 years; *Not more than 2 of the age classes are below 5% or above 20%; * >80% of the area burnt during December-April. **According to the Protea Atlas data.	1 3 5 6 7 9 11
Pre-Colonial Heritage Artificial Historical Structures	By 2029 all unnatural disturbances to heritage features are limited to maintain current conditions within the Boland Mountain Complex.	10
Personal agency, tourism & nature based economic opportunities	By 2029 access to environmentally responsible infrastructure* intact ecosystems and abundant wildlife adding economic value to ecotourism products and socio economic development is facilitated and maintained. *Aligned with the Zonation Scheme.	10
	By 2029 the Boland Mountain Complex provides managed opportunities for accessing nature and nature-based activities in a manner which is not harmful to the natural environment.	10
Responsible utilisation of natural resources	By 2029 consumptive utilisation capacity informs sustainable harvesting according to policy while monitoring and evaluation enable adaptive management.	5 7

Table 5.2. Strategic Implementation Framework for the Boland Mountain Complex.

STRATEGY 1:	**Update and implement the existing long term Alien Invasive Clearing Plan for the Boland Mountain Complex with relevant management authorities to abate the negative impact that invasive alien vegetation has on fire regime, biodiversity and water availability.**
GOALS:	**By 2029 the condition of delineated wetlands is in a near natural to natural condition.** **By 2029 river flow of abstracted rivers is maintained at above 80%.** **By 2029 Swartland Alluvium Fynbos has an ecologically healthy fire regime, is comprised of 90% - 100% native species, containing species of conservation concern and is connected and intact.** **By 2029 Mountain and lowland fynbos has an ecologically healthy fire regime and is comprised of more than 75 % native species and reseeding Protea species are represented as per historic data. The selected grey rhebok populations are stable.**
THREATS:	**The negative impact of Invasive alien vegetation on fire regime, biodiversity and water availability.**

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
By 2020 the Central Region Invasive Alien Plant Management Resource Strategy has been revised and updated using current data and implemented in the Boland Mountain Complex.	Update Central Region Alien Vegetation Management Resource Strategy, including high altitude, intermediate and normal alien clearing.	Project Managers, Conservation Managers, Ecological Coordinator, Catchment Manager, Regional Ecologist	Within first year of implementation	Updated Central Region Invasive Alien Plant Management Resource Strategy	Central Region Central Region Invasive Alien Plant Management Resource Strategy
By 2021 and beyond the Central Region Invasive Alien Plant Management	Collect density verification data all NBALS within the Boland Mountain Complex boundary	Project Managers, Conservation Managers, EC, Catchment Manager	Annually	Density data spreadsheet	Standard annual procedure

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
Resource Strategy is implemented.	Compile prioritization maps for the Boland Mountain Complex.	Scientific Services – GIS Unit	Annually	Maps and Shapefiles	
	Compilation of Integrated Work Plan, APO of the Boland Mountain Complex	Conservation Manager, Ecological Coordinator, Catchment Manager	Annually	Integrated Work Plan and APO	
	Compile progress report on implementation of APOs.	Project Managers, Conservation Managers	Annually	Progress report, Management Information System report	
By 2020, and beyond river flow of NFEPA rivers are being monitored in line with CapeNature protocol.	Monitor river flow of NFEPA rivers where water is being abstracted	Freshwater Scientist	Annually	Stream flow report	CapeNature river flow monitoring protocol.

STRATEGY 2:	**Determine through empirical evidence the impact of groundwater abstraction on groundwater dependent ecosystems.**
GOALS:	**By 2029 groundwater dependant freshwater ecosystems are in good condition.** **By 2029 the condition of delineated wetlands is in a near natural to natural condition.**
THREATS:	**Impacts of over abstraction on groundwater dependent ecosystems.**

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
By 2019 partnerships with relevant monitoring agencies such as the South African Environmental	Comment and provide input on permit applications for research on the effects of abstraction on groundwater	Regional Ecologist, Ecological Coordinator, Conservation Manager	Annually	Permits, comments and recommendations	CapeNature permitting system

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
Observation Network are established and maintained to obtain relevant data on groundwater dependant ecosystems.	dependent ecosystems.				
By 2020 groundwater dependant ecosystems (wetlands and seeps) within the Boland Mountain Complex have been identified and monitoring of these are initiated to determine baseline before abstraction of groundwater commences.	Monitor groundwater dependent ecosystems according to monitoring protocol.	Freshwater Scientist, Conservation Manager	Twice yearly from first year of implementation	Monitoring data & analysed reports	CapeNature monitoring protocol for freshwater ecosystems
By 2019, and beyond amphibian species communities are monitored to determine species presence and population estimations in the Boland Mountain Complex.	Monitor amphibian species communities to determine species presence and population estimations.	Herpetologist	Six times a year	State of Biodiversity Report	Monitoring protocol

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
By 2019 and beyond, water abstraction quantity and water quality of CapeNature boreholes on Waterval and Jonkershoek Nature Reserves are being monitored.	Monitor water abstraction quantity and water quality of CapeNature boreholes on Waterval and Jonkershoek Nature Reserves where abstraction is taking place according to CapeNature monitoring protocol.	Freshwater Scientist, Conservation Manager	Annually	Monitoring report	Monitoring protocol

STRATEGY 3:	**Enhance the implementation efficiency of the Alien Vegetation Management and Fire Programmes in the Boland Mountain Complex to abate the negative effect that invasive alien plants and inappropriate fire regimes have on biodiversity and water availability.**
GOALS:	**By 2029 the condition of delineated wetlands is in a near natural to natural condition.** **By 2029 Alluvium fynbos has an ecologically healthy fire regime, is comprised of 90% - 100% native species, containing species of conservation concern and is connected and intact.** **By 2029 Mountain and lowland fynbos has an ecologically healthy fire regime and is comprised of more than 75 % native species and reseeding Protea species are represented as per historic data. The selected grey rhebok populations are stable.**
THREATS:	**The negative impact of Invasive alien vegetation on fire regime, biodiversity and water availability.** **Inappropriate fire regime due to anthropogenic fires.**

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
By 2019 the internal efficiency of Alien Vegetation Management and	Identify barriers, limitations and opportunities to improving	Regional Manager, Protected Areas Manager, Project Managers,	Within first year of implementation	Limitation and Opportunities Report (SWOT analysis)	

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
Fire Programmes is critically evaluated and shortcomings have been reported.	implementation (SWOT analysis).	Conservation Managers, Ecological Coordinator, Catchment Manager			
By 2021 the identified shortcomings have been addressed.	In partnership with implementation entities and funders implement identified corrective measures.	Regional Manager, Protected Areas Manager, Project Managers, Conservation Managers, Ecological Coordinator, Catchment Manager	Within third year of implementation	Corrective measures are implemented and implementation efficiency has improved from 2019 baseline	
	Monitor effectiveness of corrective measures implemented.	Protected Areas Manager, Project Managers, Conservation Managers, Ecological Coordinator, Catchment Manager	Ongoing		
	Implement adaptive management if necessary	Protected Areas Manager, Project Managers, Conservation Managers, Ecological Coordinator, Catchment Manager	Ongoing		
By 2019 and beyond, the fire regime in the Boland Mountain Complex is determined to support	Analyses of fire frequency, fire return interval, fire size and season for Swartland Alluvium Fynbos and Mountain and Lowland Fynbos.	Regional Ecologist, Ecological Coordinator, Catchment Manager, GIS Scientist	Annually	Post-fire season executive summary	Post-fire season executive summary

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
management decisions with regards to fire and invasive alien vegetation management.	Conduct post-fire and permanent *Protea* monitoring to determine fire return intervals.	Conservation manager, Ecological Coordinator and Regional Ecologist	Annually	Analysed data	Monitoring protocols
	Implement Integrated Fire Management Plan for the Boland Mountain Complex.	Catchment Manager, Conservation manager, Ecological Coordinator and Regional Ecologist	Annually	Healthy fire regime in the Boland Mountain Complex.	Integrated Fire Management Plan for the Boland Mountain Complex

STRATEGY 4:	**Enhance the management and protection of the geometric tortoise population at Voëlvlei Nature Reserve to ensure persistence of the species.**
GOALS:	**By 2029 Alluvium fynbos has an ecologically healthy fire regime, is comprised of 90% - 100% native species, containing species of conservation concern and is connected and intact.**
THREATS:	**The negative impact of Invasive alien vegetation on fire regime, biodiversity and water availability.** **Inappropriate fire regime due to anthropogenic fires.** **Predation by feral pigs on geometric tortoise population at Voëlvlei Nature Reserve.**

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
By 2019 an approved standardised monitoring protocol for monitoring of the geometric tortoise population exists.	Compile a monitoring protocol of the Geometric tortoise population based on the draft BMP-s.	Scientific Services, Conservation Managers, Ecological Coordinator, Regional Ecologist	Within first year of implementation	Geometric tortoise population database	Draft Geometric tortoise BMP-s and SOP
By 2020 and beyond, the approved	Implement identified actions in the monitoring protocol in	Scientific Services, Conservation Managers, Ecological	Within second year of implementation	Geometric tortoise population database	Draft Geometric tortoise BMP-s and SOP

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
standardised monitoring protocol for monitoring of the geometric tortoise population is implemented.	Voëlvlei Nature Reserve	Coordinator, Regional Ecologist			
By 2019, and beyond feral pigs are controlled and eradicated in partnership with the implementing entity in accordance with the Swartland Feral Pig Project.	Implement existing feral pig eradication plan.	Implementing agent, Conservation Services, Conservation Manager	Annually	Reduction in tortoise mortalities due to predation by feral pigs	Swartland Feral Pig Project
By 2019 and beyond, the fire regime in the Swartland Alluvium Fynbos is managed to support management decisions with regards to geometric tortoise conservation.	Implement Integrated Fire management Plan for the Boland Mountain Complex.	Catchment Manager, Conservation manager, Ecological Coordinator and Regional Ecologist	Annually	Healthy fire regime	Integrated Fire management Plan for the Boland Mountain Complex

STRATEGY 5:	**Update the CapeNature Natural Resource Utilisation policy and Permit System to provide usage categories and guidelines for Cultural, Medicinal and Spiritual use, and implement.**
GOALS:	**By 2029 Alluvium fynbos supports all three size classes of geometric tortoise and selected grey rhebok populations are stable.** **By 2029 Alluvium fynbos has an ecologically healthy fire regime, is comprised of 90% - 100% native species, containing species of conservation concern and is connected and intact.** **By 2029 Mountain and lowland fynbos has an ecologically healthy fire regime and is comprised of more than 75 % native species and reseeding Protea species are represented as per historic data. The selected grey rhebok populations are stable.** **By 2029 consumptive utilisation capacity informs sustainable harvesting according to policy while monitoring and evaluation enable adaptive management.**
THREATS:	**Direct and indirect impacts on biodiversity due to poaching of fauna.** **Loss of biodiversity due to poaching of flora for subsistence and commercial use.** **Impacts on biodiversity due to unsustainable regulated harvesting.**

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
By 2023 the CapeNature Sustainable Resource Utilization Policy has been updated and implemented.	Revise and implement the approved Natural Resource Utilisation policy and Permitting System.	Biodiversity Support Director; Law Administration Manager; Community Conservation Manager; Conservation Manager	Within fourth year of implementation	Approved policy; Amended Permit System; CNRC NRUG permits issued	Draft Sustainable Utilisation policy
	Identify relevant partners to engage with, with regards to possible harvesting areas.	Community Conservation Manager, Conservation Manager	Within first year of implementation	MOU	

	Identify projects and opportunities on identified sites along with partners	Community Conservation Manager, Conservation Manager, EC	Within first year of implementation	User database	
	Establish site specific monitoring protocols to ensure sustainable harvesting principles are complied with.	SS, EC, Conservation Manager, Community Conservation	Within first year of implementation	Monitoring Protocol Permits conditions	

STRATEGY 6:	**Implement the integrated compliance and enforcement plans for the Boland Mountain Complex and identify common obstacles to their effective implementation and develop focal projects that will address common issues that require elevated coordination, capacity, and specialised skills/equipment (*i.e.* working smarter with the right tools).**
GOALS:	**By 2029 Swartland Alluvium fynbos supports all three size classes of geometric tortoise and selected grey rhebok populations are stable.** **By 2029 Swartland Alluvium fynbos has an ecologically healthy fire regime, is comprised of 90% - 100% native species, containing species of conservation concern and is connected and intact.** **By 2029 Mountain and lowland fynbos has an ecologically healthy fire regime and is comprised of more than 75 % native species and reseeding Protea species are represented as per historic data. The selected grey rhebok populations are stable.**
THREATS:	**Direct and indirect impacts on biodiversity due to poaching of fauna.** **Loss of biodiversity due to poaching of flora for subsistence and commercial use.**

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
By 2024 increase successful compliance interventions* from 2019 baseline.	Identify common issues that require elevated effort and focus.	Conservation Manager, Conservation Services Manager, Ecological Coordinator	Within first year of implementation	Number of action plans that renders a positive effect.	Reserve specific Integrated Compliance Plans

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
*Prevention, apprehension and prosecution.	Establish baseline of focal fauna and flora poaching-related 2019 compliance interventions.	Conservation Manager, Conservation Services Manager, Ecological Coordinator	Within first year of implementation	Number of successful compliance interventions in 2019	
	Develop and implement action plans for the focal issues.	Conservation Manager, Conservation Services Manager, Ecological Coordinator	Within five years of implementation	Number of successful compliance interventions in 2024	

STRATEGY 7:	**Address non-compliance with regards to the Game Translocation and Utilisation Policy, and ensure implementation of policies and bylaws with regards to damage causing, nuisance, rehabilitated, or confiscated animals in the Boland Mountain Complex and Zone of Influence.**
GOALS:	**By 2029 Alluvium fynbos supports all three size classes of geometric tortoise and selected grey rhebok populations are stable.** **By 2029 Alluvium fynbos has an ecologically healthy fire regime, is comprised of 90% - 100% native species, containing species of conservation concern and is connected and intact.** **By 2029 Mountain and lowland fynbos has an ecologically healthy fire regime and is comprised of more than 75 % native species and reseeding Protea species are represented as per historic data. The selected grey rhebok populations are stable.** **By 2029 consumptive utilisation capacity informs sustainable harvesting according to policy while monitoring and evaluation enable adaptive management.**
THREATS:	**Loss of biodiversity due to grazing by livestock.** **Direct and indirect impacts on biodiversity due to poaching of fauna.** **The loss of biodiversity due to invasive and feral fauna.**

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
By 2020 CapeNature have ensured that all game farmers within the Zone of Influence of the Boland Mountain Complex are compliant with the Game Translocation and Utilisation Policy.	Ensure that adequate enclosure and fencing of adjacent game farms are addressed on PA boundaries as per policy and SOGs.	Conservation Services, Conservation Manager, Regional Ecologist, Ecological Coordinator, Regional Manager	Annually	Adequate Enclosure fencing, Inspection and fence patrol reports	Fencing policy, Permitting system, Game Translocation and Utilisation Policy
By 2019 damage causing animals are managed in the Boland Mountain Complex in accordance with the CapeNature damage causing animal protocols.	Manage damage causing animals (primates) on protected areas to mitigate potential impact as per protocol.	Conservation Manager	Annually	Reduction in incidents of damage causing animals on protected areas.	Baboon protocol
	Manage damage causing animals originating from PA and causing damage/losses on private property.	Conservation Services	Annually	Reduction in incidents of damage causing animals on private property.	NEM:PAA and Policy and procedures. Damage Causing Animal Protocol
	Ensure that municipal bylaws with regards to impoundment of domestic and feral animals are in place.	Conservation Manager, Conservation Services	Annually	Reduction in transgressions	Municipal bylaws
By 2019 no unconditional releases of nuisance, rehabilitated, or	Ensure that no nuisance, rehabilitated, confiscated animals may be	Conservation Manager, Conservation Services	Annually	No unconditional releases	SOGs and Protocols and policies

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
confiscated animals are taking place in the Boland Mountain Complex.	unconditionally released on PA.				

STRATEGY 8:	**Through existing partnerships implement alien invasive fish control and/or removal, guided by legislation and policy in priority rivers in Boland Mountain Complex.**
GOALS:	**By 2029 the upper to middle reaches of rivers supporting macro invertebrate species composition represent an ASPT of 6-8, rivers supporting Giant redfin are 90% to 100% clear of alien fish species and amphibian species composition is representative of relevant sites.**
THREATS:	**Impact of invasive alien fish on indigenous species.**

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
By 2029 CN has implemented eradication plans that are aligned to legislation, informed by risk assessments and surveys, and trout levels in priority rivers have decreased and new introductions are being prevented.	Complete risk assessment to identify extent of alien fish invasion.	Freshwater Scientist, Conservation Manager, Ecological Coordinator	Within second year of implementation	By 2022 Risk Assessments is complete	
By 2020, CapeNature is implementing and enforcing its new guidelines	Compile and implement reserve specific alien invasive fish eradication plan that give effect to	Scientific Services, Conservation Manager, Ecological Coordinator	Within second year of implementation	Guidelines are completed.	Draft guidelines on the presence, control and removal of trout in protected areas

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
regarding the presence, control and removal of trout in protected areas.	CapeNature's new guidelines regarding the presence, control and removal of trout in protected areas.			Reserve specific alien invasive species eradication plan	
	Engage with Piscatorial Society to implement catch and removal of invasive alien fish	People and Conservation Manager, Marketing Section, Conservation Manager	Within second year of implementation	Number of events or activities that promote the removal of Alien invasive fish species. Promotional Media from the Piscatorial Society supporting catch and remove	
	Engage with trout farms to ensure that mitigation measures are put in place to prevent escape of trout into priority rivers.	People and Conservation Manager, Conservation Manager	Within second year of implementation	Mitigation measures against trout escapes are in place at trout farms.	
	Conduct SASS 5 monitoring in identified priority rivers.	Freshwater Scientist, Conservation Manager, Ecological Coordinator	Annually	By 2019 and beyond implement SASS 5 and monitoring in priority rivers. SASS 5 report	SASS 5 method
	Conduct fish survey according to the CapeNature freshwater fish monitoring and baseline data collection protocol to determine indigenous	Freshwater Scientist, Conservation Manager, Ecological Coordinator	Annually	By 2019 and beyond implement CapeNature freshwater fish monitoring and baseline data collection protocol in priority rivers.	CapeNature freshwater fish monitoring and baseline data collection protocol

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
	fish diversity and in a manner that aids in early detection and rapid response to identify escapees from trout farms or illegal stocking.				

STRATEGY 9:	**Refine and implement a targeted environmental education and awareness plan through key partnerships to decrease ignition points of anthropogenic fires and to improve the understanding of the impacts of invasive alien vegetation on fire risk, biodiversity and water supply.**
GOALS:	**By 2029 Alluvium fynbos has an ecologically healthy fire regime, is comprised of 90% - 100% native species, containing species of conservation concern and is connected and intact.** **By 2029 Mountain and lowland fynbos has an ecologically healthy fire regime and is comprised of more than 75 % native species and reseeding Protea species are represented as per historic data. The selected grey rhebok populations are stable.**
THREATS:	**The negative impact of Invasive alien vegetation on fire regime, biodiversity and water availability.** **Inappropriate Fire Regime due to anthropogenic causes.**

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
By 2022 there is a decrease in ignition points within the targeted hotspot areas from the 2019 baseline,	Identify internal and external stakeholders.	People and Conservation Manager, Conservation Manager, Catchment Manager	Within first year of implementation	Reduction in ignition points	Fire response plan hotspots and fire data base ignition points

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
and the understanding of the impacts of invasive alien vegetation on fire risk, biodiversity and water supply is improved.	Coordinate and streamline efforts among stakeholders/partners within the agreed hotspots.	People and Conservation Manager, Conservation Manager, Catchment Manager	Annually		
	Identify specific target groups within the hotspots (*e.g.* schools, community forums, landowners, *etc.*).	People and Conservation Manager, Conservation Manager, Catchment Manager	Within first year of implementation and beyond		
	Compile or update environmental education and awareness material and information aligned with the school curriculum.	People and Conservation Manager, Conservation Manager, Catchment Manager, Regional Ecologist, Ecological Coordinator	Within second year of implementation, and beyond		
	Coordinated, joint implementation of the environmental education and awareness plan.	People and Conservation Manager, Conservation Manager, Catchment Manager	Within third year of implementation, and beyond		

STRATEGY 10:	**Develop and implement a comprehensive, progressive and adaptive management plan to facilitate sustainable, responsible access and tourism.**
GOALS:	**By 2029 the Boland Mountain Complex provides managed opportunities for accessing nature and nature-based activities in a manner which is not harmful to the natural environment.** **By 2029 access to environmentally responsible infrastructure* intact ecosystems and abundant wildlife adding economic value to ecotourism products and socio economic development is facilitated and maintained.** **By 2029 all unnatural disturbances to heritage features are limited to maintain current conditions within the Boland Mountain Complex.**
THREATS:	**Loss of biodiversity due to inappropriate placement of tourism and recreation infrastructure.** **Impacts on biodiversity due to inappropriate location, frequency and size of events.** **Vandalism to artificial historical structures.** **Impacts on the environment due to irresponsible environmental management.**

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
By 2019 initial reserve specific carrying capacity (type, number and frequency) for all non-consumptive utilisation are set in line with sensitivity analysis and detailed zonation scheme (science based).	List all activities and current and desired infrastructure (including initiation sites), and collate information on user groups, current numbers, projected future use and limits thereon.	Conservation manager, Regional Ecologist, Ecological Coordinator, Catchment Manager, Tourism Manager	Within first year of implementation	Detailed zonation scheme and rules that addresses the full suite and diversity of non-consumptive uses desired in the Complex	Zonation Scheme
	Translate information into a detailed zonation scheme and related rules based on sensitivity information.	Conservation manager, Regional Ecologist, Ecological Coordinator,	Within first year of implementation	Detailed zonation scheme and rules that addresses the full suite and diversity of non-consumptive uses	Zonation Scheme

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
		Catchment Manager, Tourism Manager		desired in the Complex	
By 2020 sustainable access* for a diversity of spiritual and cultural uses is determined, agreed upon, communicated and implemented. *Where, what, how much, frequency and compliant	Identify sustainable sites suitable for spiritual and cultural activities (*e.g.* initiation, Zion church) and set site specific carrying capacities for each activity.	Conservation manager, Regional Ecologist, Ecological Coordinator, Catchment Manager, People and Conservation Manager	Within second year of implementation	Sustainable sites with carrying capacities suitable for spiritual and cultural activities have been identified.	Zonation Scheme
By 2025, if needed, update reserve specific carrying capacity (type, number and frequency) for all non-consumptive utilisation are set in line with sensitivity analysis and detailed zonation scheme	As needed, update the detailed reserve zonation based on available information.	Conservation manager, Regional Ecologist, Ecological Coordinator, Catchment Manager, People and Conservation Manager	By sixth year of implementation	Updated detailed reserve zonation based on available information	Zonation Scheme
By 2028, a Conservation Development Framework that aligns future development (commercial and	Investigate and evaluate responsible tourism facilities, products and services for commercial and recreational use.	Conservation manager, Regional Ecologist, Ecological Coordinator, Catchment Manager, Tourism Manager	Within eighth year of implementation	Conservation Development Framework	Zonation Scheme

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
non-commercial) with zonation of the Boland Mountain Complex has been drafted and implemented.					
	Integrate into an updated CDF in preparation for the update of the Boland Mountain Complex PAMP (2030 - 2040).	Conservation manager, Regional Ecologist, Ecological Coordinator, Catchment Manager, Tourism Manager	Within eighth year of implementation	Conservation Development Framework	Zonation Scheme

STRATEGY 11:	**Secure and protect conservation worthy areas surrounding the Boland Mountain Complex.**
GOALS:	**By 2029 Alluvium fynbos has an ecologically healthy fire regime, is comprised of 90% - 100% native species, containing species of conservation concern and is connected and intact.** **By 2029 Mountain and lowland fynbos has an ecologically healthy fire regime and is comprised of more than 75 % native species and reseeding Protea species are represented as per historic data. The selected grey rhebok populations are stable.**
THREATS:	**The negative impact of Invasive alien vegetation on fire regime, biodiversity and water availability.** **Inappropriate Fire Regime due to anthropogenic causes.** **Direct and indirect impacts on biodiversity due to poaching of fauna.** **Loss of biodiversity due to poaching of flora for subsistence and commercial use.**

Objectives	Actions	Responsibility	Time-frame	Measurable Outputs	Existing Procedures
By 2029, all forestry exit areas identified as priorities for CapeNature are secured and NEM: PAA compliant.	Transfer and declaration of exit areas.	Legal Services Manager, Protected Area Expansion and Stewardship Senior Manager	Within 10 years of implementation	Exit Areas are designated as Nature Reserves in terms of S23 of NEMP: PAA.	State land process of requisition followed by declaration in terms of NEMP: PAA.

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7 APPENDIX 1. LANDPARCELS CONSTITUTING THE BOLAND MOUNTAIN COMPLEX.

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number
Kogelberg Nature Reserve	portion 92 of the farm hangklip no. 559, caledon,	T34877/1999	4666/1959	AH-4B 3301
Kogelberg Nature Reserve	portion 92 of the farm hangklip no. 559,	T10057/2002	4666/1956	AH-4BDB 3307
Kogelberg Nature Reserve	portion 1 of the farm no. 342	No information	4208/1902	AI - 1CDA 3323
Kogelberg Nature Reserve	Portion 3 of the farm elgin forest reserve no 295, caledon.	No Information	2523/966	AI -1CAC 6286
Kogelberg Nature Reserve	portion 9 of the farm elgin forest reserve no 295, caledon,	No information	181/1999	AI -1CAC 6286
Kogelberg Nature Reserve	portion 92 of the farm hangklip no. 559, caledon,	T34877/1999	4666/1959	AH - 4B 3301
Kogelberg Nature Reserve	portion1 of the farm 468 mier nest	No information	No information	No information
Kogelberg Nature Reserve	Remaining extent of portion 2 of the farm elgin forest reserve no 295, Caledon.	No information	9950/1956	AI - 1CA - X11 384 AI - ICA - X13 387
Kogelberg Nature Reserve	Remaining extent of portion 3 of the farm elgin forest reserve no 295, caledon	No information	2523/966	AH - 2DBB 6054
Kogelberg Nature Reserve	Remaining extent of portion 3 of the farm elgin forest reserve no 295, caledon.	No information	2523/966	AI - 1CA - X11 384
Kogelberg Nature Reserve	remaining extent of portion 3 of the farm elgin forest reserve no 295, caledon,	No information	2523/966	AI - ICA - X13 387
Kogelberg Nature Reserve	Remaining extent of the farm elgin forest reserve no 295, caledon.	No information	B442/1931	AH - 2DBD 6055

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number
Kogelberg Nature Reserve	Farm blaauw steen no. 460, caledon,	No Information	B4335/1920	AH - 4B 3301
Kogelberg Nature Reserve	Farm dwarsrivier no. 463, caledon.	No information	300/1831	AH - 4B 3301
Kogelberg Nature Reserve	Farm isaacs rivier no. 548, caledon.	No information	30/1876	AI - 3A 3342 AI - 3AC3248
Kogelberg Nature Reserve	Farm laaste gift no. 549, caledon,	No information	22/1876	AH - 4BDB 3307 AI - 3A 3342 AI - 3AAA 3343 AI - 3AC 3348
Kogelberg Nature Reserve	Farm mount lebanon no. 343 caledon	No information	769/1873	AI-1CB 3317 AI-1CD 3322
Kogelberg Nature Reserve	Farm no. 461, caldedon.	No information	495/2006	AH - 2D 3294 AH - 4B 3301
Kogelberg Nature Reserve	Farm rock view no 311, caledon.	No information	4564/1919	AH - 2D 3294 AH - 2DBD 6055
Kogelberg Nature Reserve	portion 92 of the farm hangklip no. 559, caledon,	T34877/1999	4666/1959	AH-4B 3301
Theewaterskloof	Remainder of Portion 2 of The Farm Amandel Rivier No. 15 Caledon.	T4949/1979	6397/50	B1-7C 3892
Theewaterskloof	Portion 3 of the Farm Amandel Rivier No.15 Caledon.	T31575/1973	6398/50	A1-1AB 3312 BI-7C 3892
Theewaterskloof	Portion 6 of the Farm Amandel Rivier No. 15 Caledon	No longer Exists	10813/1970	B1-7C 3892
Theewaterskloof	Remainder of the Farm Amandel Rivier No. 15 Caledon.	T28267/1973	160/1932	B1-7C 3892 AI-1AB 3312
Theewaterskloof	The Farm Hebron No. 10 Caledon.	T10462/1937	1857/1877	B1-7C 3892
Theewaterskloof	The Farm Tyger Kloof No.11 Caledon.	T10462/1937	982/1877	B1-7C 3892

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number
Theewaterskloof	The Farm Vondeling No. 23 Caledon.	T10462/1937	937/1877	B1-7C 3892 BI-7DC 3901 AI-1BA 6071
Theewaterskloof	The Farm Eenzaamheid No.1 Caledon.	T10462/1937	946/1877	B1-7C 3892 B1-7A 3886
Theewaterskloof	The Farm Baviaanskerk No. 2 Caledon.	T10462/1937	964/1877	B1-7C 3892
Theewaterskloof	The Farm Uitkomst No. 3 Caledon.	T10462/1937	970/1877	B1-7C 3892
Theewaterskloof	The Farm Aasvogel Berg No. 4 Caledon.	T10462/1937	947/1877	B1-7C 3892 BI-7DC 3901
Theewaterskloof	The Farm Uithoek No. 17 Caledon.	T10462/1937	978/1877	B1-7C 3892
Theewaterskloof	The Farm Noorde Kloof No. 19 Caledon.	T10462/1937	945/1877	B1-7C 3892 AI-1AA 3311
Theewaterskloof	The Farm Vergelen No. 94 Caledon.	T10462/1902	803/1875	A1-1AC 3313 AH-2BD 3291
Theewaterskloof	Remainder of Portion 2 of The Farm Amandel Rivier No. 15 Caledon.	T4949/1979	6397/50	B1-7C 3892
Theewaterskloof	Portion 3 of the Farm Amandel Rivier No.15 Caledon.	T31575/1973	6398/50	A1-1AB 3312 BI-7C 3892
Theewaterskloof	Portion 6 of the Farm Amandel Rivier No. 15 Caledon.	No longer Exists	10813/1970	B1-7C 3892
Theewaterskloof	Remainder of the Farm Amandel Rivier No. 15 Caledon.	T28267/1973	160/1932	B1-7C 3892 AI-1AB 3312
Theewaterskloof	The Farm Hebron No. 10 Caledon.	T10462/1937	1857/1877	B1-7C 3892

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number
Theewaterskloof	The Farm Tyger Kloof No.11 Caledon.	T10462/1937	982/1877	B1-7C 3892
Theewaterskloof	The Farm Vondeling No. 23 Caledon.	T10462/1937	937/1877	B1-7C 3892 BI-7DC 3901 AI-1BA 6071
Theewaterskloof	The Farm Eenzaamheid No.1 Caledon.	T10462/1937	946/1877	B1-7C 3892 B1-7A 3886
Theewaterskloof	The Farm Sterhuis Rivier No. 18 Caledon.	T10462/1937	973/1877	A1-1AA 3311 B1-7C 3892
Theewaterskloof	The Farm Baviaanskerk No. 2 Caledon.	T10462/1937	964/1877	B1-7C 3892
Theewaterskloof	The Farm Uitkomst No. 3 Caledon.	T10462/1937	970/1877	B1-7C 3892
Theewaterskloof	The Farm Aasvogel Berg No. 4 Caledon.	T10462/1937	947/1877	B1-7C 3892 BI-7DC 3901
Theewaterskloof Nature Reserve	Portion 18 of the Farm Ou Werf No. 21 Caledon.	T52375/1994	9680/89	A1-1AA 3311
Theewaters Nature Reserve	The Farm Twist Niet No. 7 Caledon.	No longer exists	3711/1938	B1-7D 3898
Theewaters Nature Reserve	Portion 13 of the Farm Ou Werf No. 21, Caledon.	T8847/1977	8550/76	AI-1AB 3312 AI-1AA 3311
Theewaters Nature Reserve	Portion 14 of the Farm Ou Werf No. 21, Caledon.	T8847/1977 (Requested but currently not available)	8551/1976	AI-1AA 3311 AI-1AB 3312
Theewaters Nature Reserve	Portion 19 of the Farm Ou Werf No. 21, Caledon	T52375/1994	9682/89	AI-1AA 3311
	Portion 21 of the Farm Ou Werf No. 21, Caledon.	T80244/1997	7031/1994 7032/1994 9695/1989	AI-1AB 3312
Theewaters Nature Reserve	Portion 20 of the Farm Ou Werf No. 21, Caledon	T52375/1994	9681/1989	AI-1AA 3311

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number
Theewaters Nature Reserve	Portion 4 of the Farm Amandel Rivier No. 15, Caledon.	T30877/1973	5263/53	AI-1AB 3312
Theewaters Nature Reserve	Portion 13 of the Farm Ou Werf No. 21, Caledon.	T8847/1977	8550/76	AI-1AB 3312 AI-1AA 3311
Theewaters Nature Reserve	Portion 14 of the Farm Ou Werf No. 21, Caledon	T8847/1977 (Requested but currently not available)	8551/1976	AI-1AA 3311 AI-1AB 3312
Theewaters Nature Reserve	Portion 19 of the Farm Ou Werf No. 21, Caledon.	T52375/1994	9682/89	AI-1AA 3311
	Portion 21 of the Farm Ou Werf No. 21, Caledon.	T80244/1997	7031/1994 7032/1994 9695/1989	AI-1AB 3312
	Portion 20 of the Farm Ou Werf No. 21, Caledon	T52375/1994	9681/1989	AI-1AA 3311
Theewaters Nature Reserve	Portion 4 of the Farm Amandel Rivier No. 15, Caledon.	T30877/1973	5263/53	AI-1AB 3312
Theewaterskloof	The Farm Noorde Kloof No. 19 Caledon.	T10462/1937	945/1877	B1-7C 3892 AI-1AA 3311
Theewaterskloof	Remainder of the Farm Palmiet Valley No. 14 Caledon.	T28266/1973	254/1819	B1-7C 3892
Theewaterskloof	The Farm Noorde Kloof No. 19 Caledon.	T10462/1937	945/1877	B1-7C 3892 AI-1AA 3311
Theewaters Nature Reserve	The Farm No. 1287 Paarl.	T28489/1982	2650/1917	BI-7C 3882
Theewaters Nature Reserve	Portion 9 of the Farm Bosjesmans Kloof No. 20 Caledon.	T8847/1977	8548/76	AI-1AA 3311 AI-1AB 3312
Theewaters Nature Reserve	Portion 15 of the Farm Rus Valey No. 81 Caledon.	T2652/1976	3960/74	AI-1AB 3312
Theewaters Nature Reserve	Portion 10 of the Farm Bosjesmans	T8847/1977	8549/76	AI-1AA 3311 AI-1AB 3312

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number
	Kloof No. 20 Caledon.			
Theewaters Nature Reserve	Portion 5 of the Farm Klipfontein No. 82, Caledon.	T8847/1977	4956/1975	AI-1AB 3312
	Portion 1 of the Farm Van Rhynevelds Dal No. 95, Caledon. (This farm information added on Patric's request)	T1397/1903	1169/1996	AH-2BD 3291 AI-1AC 3313
Theewaters Nature Reserve	Remainder of Portion 2 of Farm 14 Palmiet Valley Caledon.	No info	No info	No info
Hottentots Holland	The Farm Rusbosch No. 16 Caledon.	T10462/1937	977/1877	B1-7C 3892
Hottentots Holland	The Farm Rusbosch No. 16 Caledon.	T10462/1937	977/1877	B1-7C 3892
Hottentots Holland	The Farm Sterhuis Rivier No. 18 Caledon.	T10462/1937	973/1877	A1-1AA 3311 B1-7C 3892
Hottentots Holland	The Farm Moordenaars Kloof No. 93 Caledon	T31A/1951	981/1877	A1-1AC 3313 A1-1AA 3311
Hottentots Holland Nature Reserve	Remainder of the Farm Purgatory Outspan No. 1135 Paarl.	G17/1945	4125/1944	B1-7C 3892 B1-7CBC 3897
Hottentots Holland Nature Reserve	The Farm Zoete Hoop No. 91 Caledon.	T5059/1961	942/1977	A1-1AA 3311
Hottentots Holland Nature Reserve	The Farm Outspan No. 852, Stellenbosch.	STQ 19-1/1892	445/1891	AHNK-2144 M4525 AHNK-2171 M4526 AHNK-2173 M4528 AHNK-2172 M4527
Hottentots Holland Nature Reserve	The Farm No. 859, Stellenbosch.	T101/1938	1156/1938	AH-2DBB 6054

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number
Hottentots Holland Nature Reserve	Portion 1 of the Farm Purgatory Outspan No. 1135 Paarl.	G35/1945	4126/44	BI-7C 3882
Hottentots Holland Nature Reserve	Remainder of the Farm Eensbedrogen No. 92, Caledon.	T5059/1961	948/1877	AI-1AA 3311
	The Farm Uithoek No. 17 Caledon.	T10462/1937	978/1877	B1-7C 3892
Groenlandberg Nature	Remainder of the Farm no. 88 Caledon.	T43731/1993	576/93	A1-1AC 3313
	The Farm Bankroets Rivier No. 103 Caledon	T31A/1951 (T31/1951 is available but T31A/ 1951 is not available)	933/1877	A1-1AD 3314 AI-1CB 3317
Move to Kogelberg	The Farm Mount Lebanon No. 343 Caledon.	T11112/1937	769/1873	A1-1CD 3322 A1-1CB 3317
Groenlandberg Nature Reserve	The Farm Doorn Kloof No. 101 Caledon	No longer exists	974/1877	A1-1AC 3313 AI-1CAB 6497
Groenlandberg Nature Reserve	The Farm Welgemoed No. 100 Caledon.	No longer exists	975/1877	A1-1AC 3313
Groenlandberg Nature Reserve	The Farm Tydsgenoeg No. 102 Caledon.	No longer exists	934/1877	A1-1AD 3314
Groenlandberg NatureReserve.	The Farm No. 104 Caledon.	No longer Exists	441/2008	A1-1AD 3314
Groenlandberg Nature Reserve	The Farm Doornkloof No. 101, Caledon.	No info	974/1877	AI-1AD 3314
Jonkershoek	Jackals rivier, farm 283	No information	No information	No information
Jonkershoek	Bosjemans kloof, farm 1144	No information	**26951/1860**	No information
Jonkershoek	1659	T2202 of 1934	No information	No information
Jonkershoek Nature Reserve	Bang jonker	155/0	No information	C0670000000001 5500000

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number
Assegaibosch Nature Reserve	Farm 359	359/0		C0670000000003 5900000
Assegaibosch Nature Reserve	Unknown	0/6		C0670000000000 0000006
Jonkershoek Nature Reserve	French hoek forest reserve	1023/0		C0550000000010 2300000
Jonkershoek Nature Reserve	Jonkershoek	358/0		C0670000000003 5800000
Jonkershoek Nature Reserve	Stellenboch forest reserve	365/0		C0670000000003 6500000
Simonsberg Nature Reserve	Johannes dal annex	1200/0		C0550000000012 0000000
Simonsberg Nature Reserve	Farm 967	967/0		C0550000000009 6700000
Simonsberg Nature Reserve	Farm 46	46/0		C0670000000000 4600000
Theewaters Nature Reserve	Purgatory outspan	1135/0		C0550000000011 3500000
Theewaters Nature Reserve	Klipfontein	15/2		C0130000000000 1500002
Theewaters Nature Reserve	Vygeboom	11/0		C0130000000000 1100000
Hawequa Nature Reserve	Remaining Extent of the Farm Wagenbooms Berg No. 504 Worcester	T12205/1967	**1269/187**	BI-7B 3889
Hawequa Nature Reserve	The Farm Eilands Kloof Mountain No.16, Paarl	No longer exist	1321/2011	BI-5AC 3832 BI-5AA 3829

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number
Hawequa	The Farm Mount Lebanon No. 343, Caledon	T11112/1937	769/1873	A1-1CD 3322 A1-1CB 3317
Haweqwa Nature Reserve	The Farm "Kortberg" No. 394, Worcester	T10462/1937	1363/1888	BI-5CB 3845 BI-5ABD 3831
Haweqwa Nature Reserve	The Farm "Bain's Berg" No. 396, Worcester	T10462/1937	253/1888	BI-5AC 3832 BI-5AD 3834 BI-5CB 3845
Haweqwa Nature Reserve	The Farm "Wolven Koof" No.395, Worcester	T10462/1937	252/1888	BI-5AD 3834 BI-5AA 3829
Haweqwa Nature Reserve	The Farm Bains Kloof Forest Reserve No. 228, Paarl	No longer exist	1319/2011	BI-5AC 3832
Haweqwa Nature Reserve	Remaining Extent of the Farm Bainsfor No.229, Paarl	G167/1951	10037/49	BI-5CAB 3842 BI-5AC 3832
Haweqwa Nature Reserve	The Farm Klein Drakenstein Mountain Forest Reserve No.584, Paarl	No longer exist	1222/2010	BI-7A 3886
Haweqwa Nature Reserve	The Farm Manganese Mine No.588, Paarl	No longer exist	127/1904	BI-5CC/3846 BI-7A 3886
Haweqwa Nature Reserve	Portion 1 of Daljosaphat Forest Reserve No.582, Paarl	T99862/1999	9785/1996	BI-5CC/3846
Haweqwa Nature Reserve	The Farm Louwers Hoek No. 523, Worcester	No longer exist	1615/2007 1224/2010	BI-7B 3889 BI-7D 3898

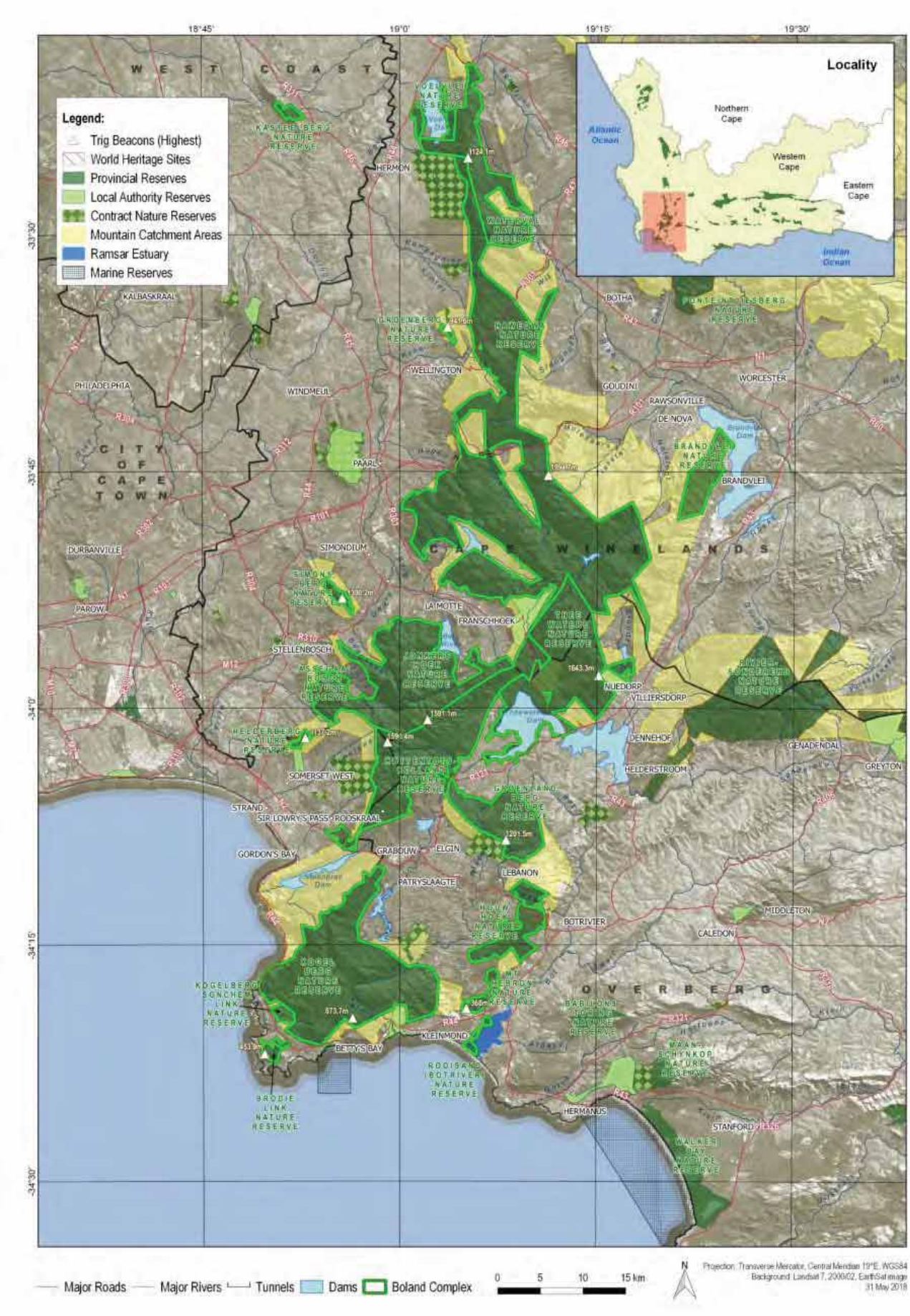
Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number
				BI-7C 3892
Haweqwa Nature Reserve	Portion 3 of The Farm Zachariashoek No.874, Paarl	T4772/1940	1448/1940	BI-7ACC 3888 BI-7A 3886
Haweqwa Nature Reserve	The Farm Wemmershoek Forest Reserve No.1031, Paarl	No longer exist	1223/2010	BI-7A 3886 BI-7ACC 3888
Brandvlei Nature Reserve	Portion 4 (Portion of Portion 2) of the Farm Brandvlei No. 437, Worcester	T5741/1965	4278/53	BI-5D 3850 BI-5DD 3858
Brandvlei Nature Reserve	Portion 2 of the Farm Wagenbooms Berg No. 504, Worcester	T19159/1977	12144/1965	BI-7BB 3890 BI-7B 3889
Brandvlei Nature Reserve	Remaining extent of Farm No. 503, Worcester	T18425/1964	A1977/1925	BI-7BB 3890 BI-5DD 3858
Brandvlei Nature Reserve	Portion 1 of the Farm Sidouws Berg No. 436, Worcester	T4771/1965	149/1918	BI-5DD 3858
Brandvlei Nature Reserve	Portion 2 of the Farm Sidouws Berg No. 436, Worcester	T5741/1965	4277/53	BI-5DD 3858
Brandvlei Nature Reserve	Remaining extent of the Farm Sidouws Berg No. 436, Worcester	T25295/1964	1272/1879	BI-5DD 3858
Haweqwa Nature Reserve	Remaining extent of the Farm Daljosaphat Forest Reserve No. 582, Paarl	T48685/1997	1183/1916	BI-5CCA 3847 BI-5CAC 3843 BI-5CC 3846

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number
Haweqwa Nature Reserve	The Farm No. 223	No longer exists		
Haweqwa Nature Reserve	Portion 16 of the Farm Hawequas No. 295 Paarl	T17585/1961	N/A	N/A
Waterval	Portion 1 of the Farm Watervals Berg No. 250, Tulbagh	T9150/1913	773/1887	BI-3AC 3805 BI-3C 3810
Waterval	Portion 4 of the Farm Watervals Berg No. 250 Tulbagh	T970/1913	3730/1906	BI-3AC 3805 BI-3C 3818
Waterval	The Farm Kloofsberg No. 209 Tulbagh	T38112/1990	774/1877	BH-4DA 6063 BH-4DB V1 854 (Registered under Mr Vlok)
Waterval	Extent of 252, Tulbagh	T20006/1948	2034/2010	BI-3AC 3805
Waterval	Farm of 252/1	T20091/1948	452/1875	BI-3C 3810
Waterval	Elandskloof Forest Reserve No 313, Tulbagh	N/A	1322/2011	BI-3C 3810 BI-3CD 3813 BI-5AA 3829 BI-5A 3828
Waterval	Remaining Extent of the Farm Watervals Berg No. 250 Tulbagh	T150/1913	773/1877	BI-3C 3810
Waterval	Remaining Extent of the Zevefontein 249,Tulbagh	T150/1913	520/1816	BI-3AC 3805
Waterval	Remaining Extent of the Zevefontein 249,Tulbagh	T970/1913	3731/1906	BI-3AD 3806
Waterval	Remaining Extent of the Farm Waterval Outspan No. 214 Tulbach	T28070/1979	600/1884	BI-3AC 3805

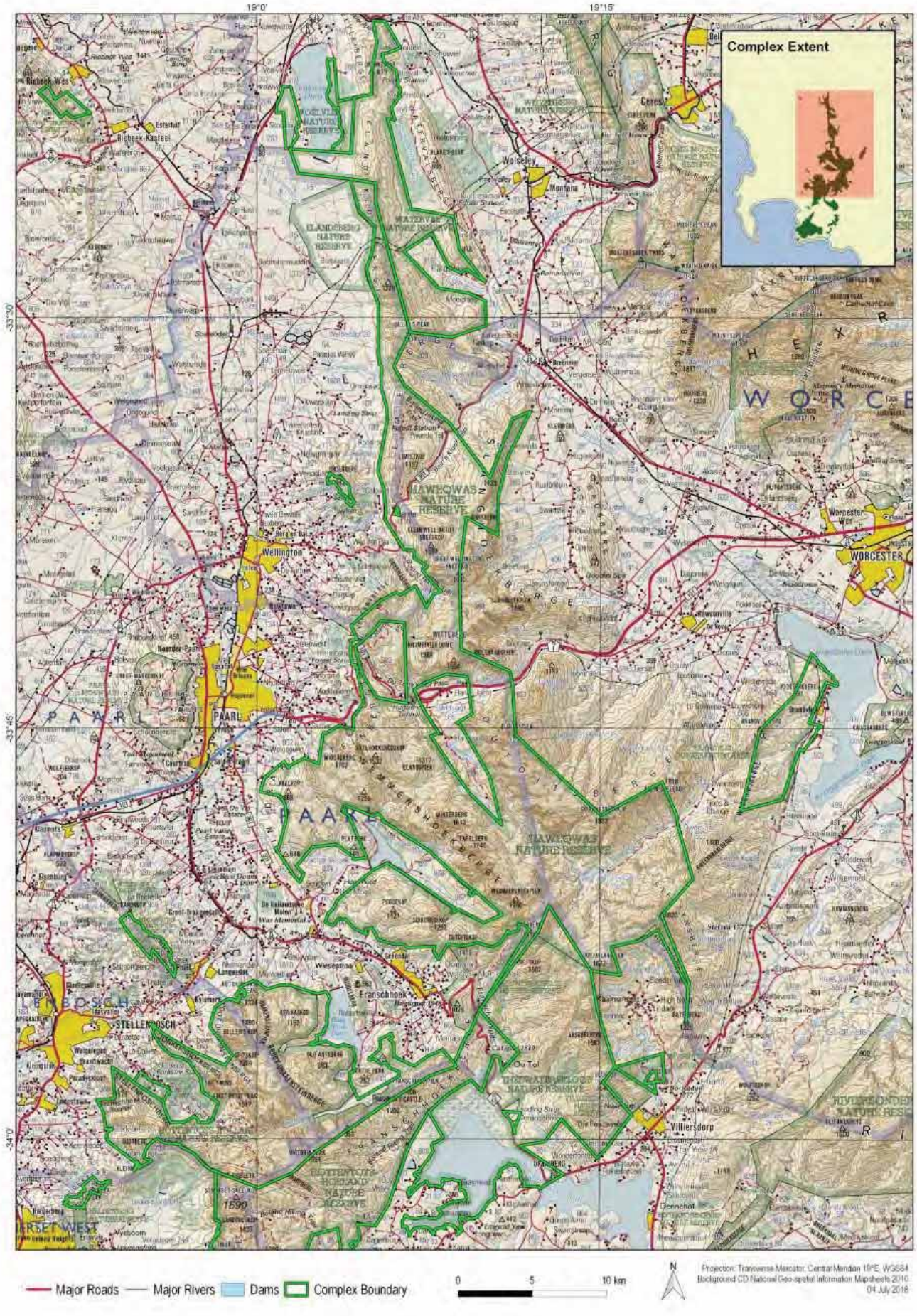
Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number
Waterval	The Farm De Tronk No. 194 Piketberg	T29350/1976)	881/1869	BI-1A 3788
Waterval	Remainder of the Farm No. 382 Tulbagh	T76009/2008	4521/1994	BI-3AC 3805
Waterval	Portion 4 of the Farm Watervals Berg No. 250 Tulbagh	No info	7470/1998	BI-3AC 3805 BI-3C 3810
Waterval	Portion 6 of the Farm Watervals Berg No. 250 Tulbagh	No info	7470/1998	BI-3AC 3805 BI-3C 3810
Waterval	Portion 7 of the Farm Watervals Berg No. 250, Tulbagh	No Info	487/1999	BI-3AC 3805 BI-3C 3810
Waterval	The Farm Kasteels Kloof No. 255, Tulbagh	T20091/1948	451/1875	BI-3C 3810
Witzenberg nature reserve	The Farm Schalken Berg No. 228 Tulbagh	No Longer Exists	2015/1879	BI-3AD 3806
Witzenberg nature reserve	The Farm Bothas Berg No. 230 Tulbagh	No Longer Exists	2013/1979	BI-3AD 3806
Witzenberg nature reserve	The Farm Neethlings Berg No.231 Tulbagh	No Longer Exists	2012/1879	BI-3BC 3809 BI-3AD 3806
Witzenberg nature reserve	The Farm Boontjes Riviers Berg No. 263 Tulbagh	No Longer Exists	2011/1879	BI-3BC 3809 BI-3DA 3816 BI-3CBB 3811
Kasteelberg	The Farm Mountain View Annexe No. 625, Malmesbury	None	941/1929	BH-4DA 6063
Kasteelberg	The Farm Remhoogte Annexe No. 635, Malmesbury	T38112/1990	945/1929	BH-4DA 6063 BH-4 DB/V1 854

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number
Kasteelberg	RIEBFOR FOREST RESERVE 636; Malmesbury RD	None	1320/2011	BI-4BC 3697 BH-4BD 3698 BH-4DA 6063
Voëlvlei	Vogel Vallij Restant 253,	T20091/1948	289/1818	BI-3C 3810
Voëlvlei	The Farm Vogel Valley No. 207, Tulbagh.	The Farm Vogel Valley No. 207, Tulbagh	The Farm Vogel Valley No. 207, Tulbagh	The Farm Vogel Valley No. 207, Tulbagh
Bokkerivier	The Farm No. 346 ,Ceres	Not Available	321/1876	BI-4 3817
Bokkerivier	Farm No. 355 Ceres	T1456/1897	2871/1876	BI-4 3817
Bokkerivier	Farm No. 354 Ceres	T11456/1897	2935/1876	BI-4 3817
Bokkerivier	Portion 1 of the Farm Karbonaatjies Kraal No. 38 Worcester	T1456/1897	224/1840	BI-4 3817
Bokkerivier	The Farm Witte Berg No. 40, Worcester	T210/1888	2392/1878	BI-4 3817 BI-4DA 3824

8 APPENDIX 2. MAPS OF THE BOLAND MOUNTAIN COMPLEX.

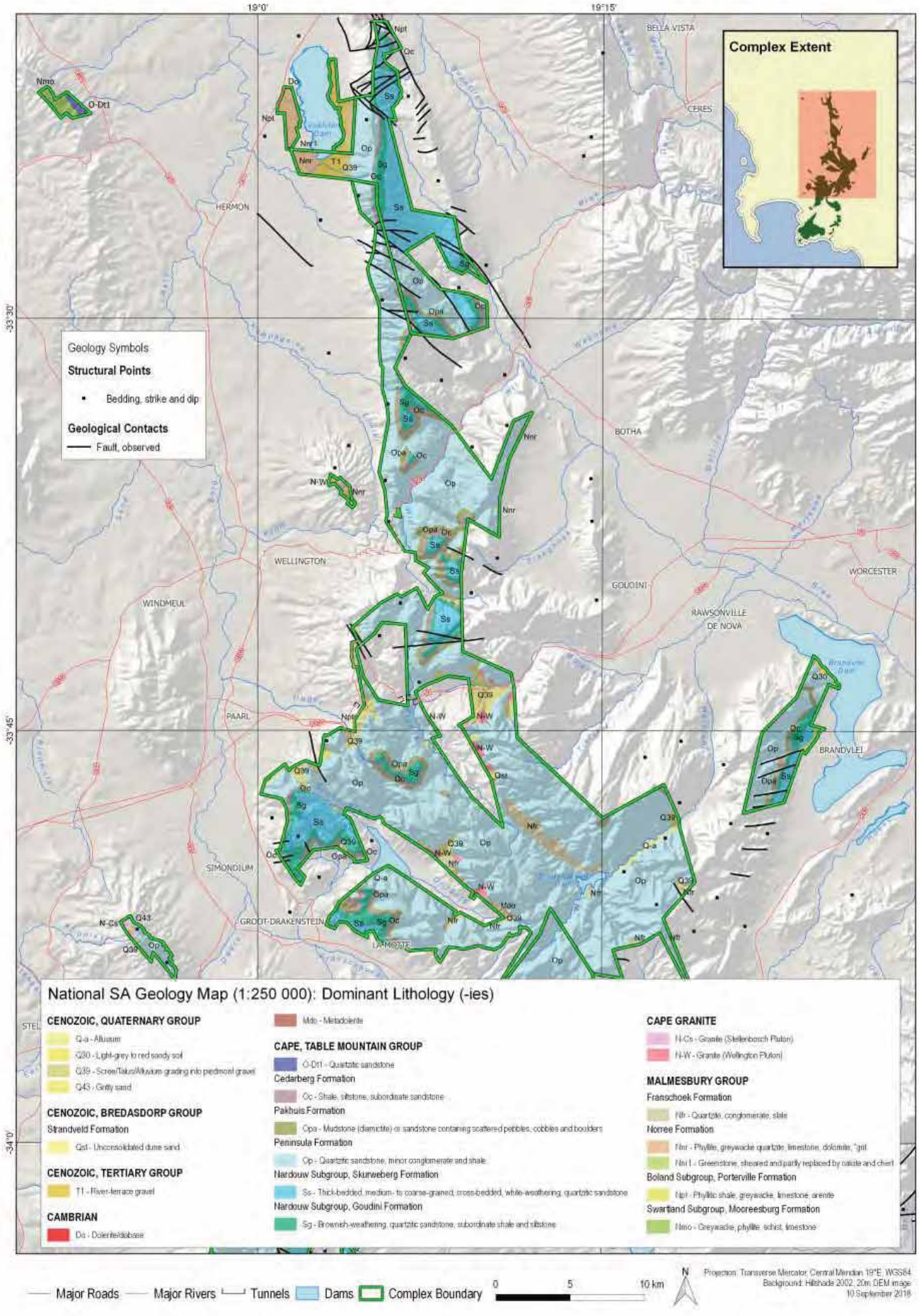


Map 1 Location and extent of the Boland Mountain Complex.

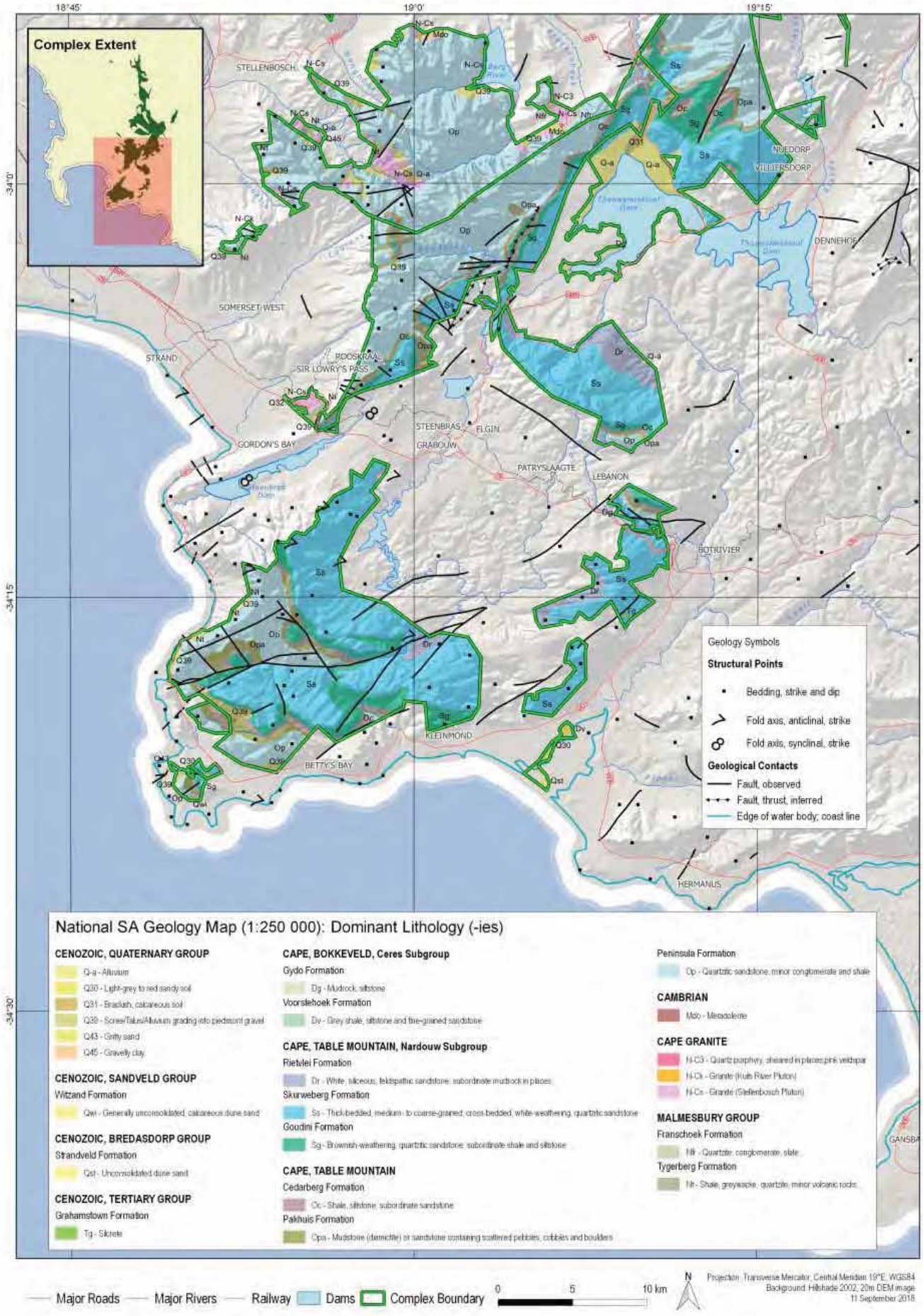


Map 2a Topography of the northern section of the Boland Mountain Complex.

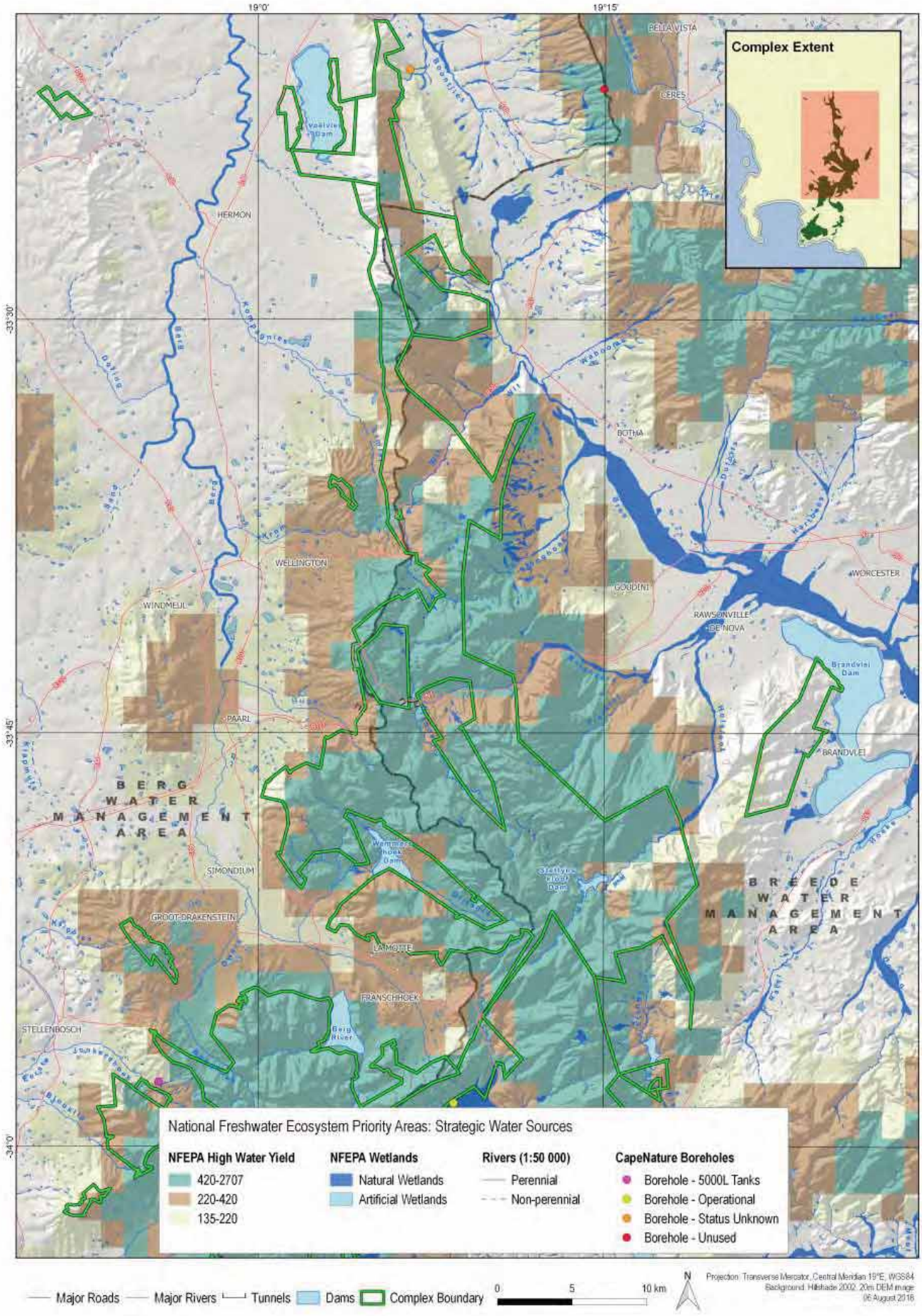
Map 2b Topography of the southern section of the Boland Mountain Complex.



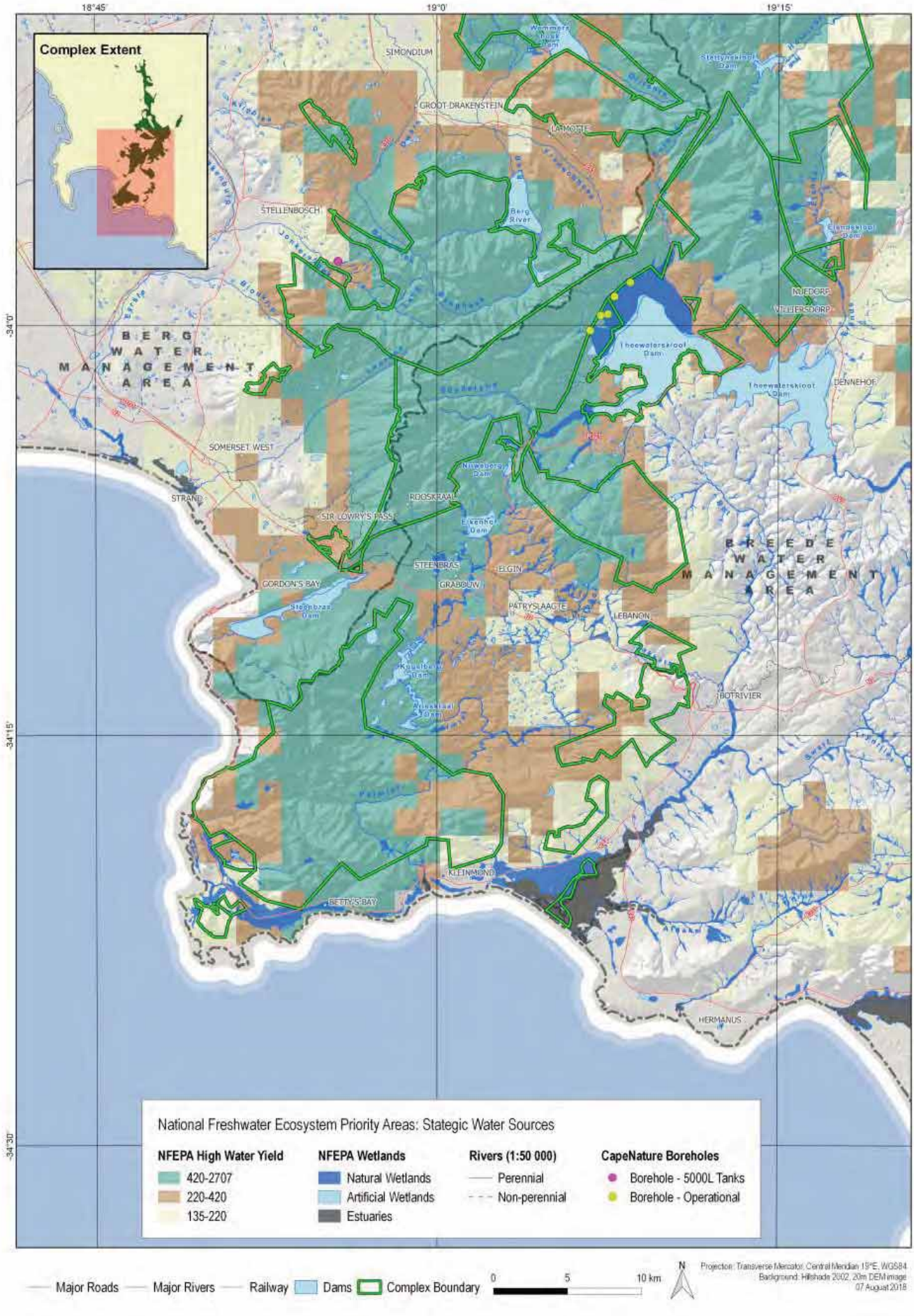
Map 3a Geology of the northern section of the Boland Mountain Complex.



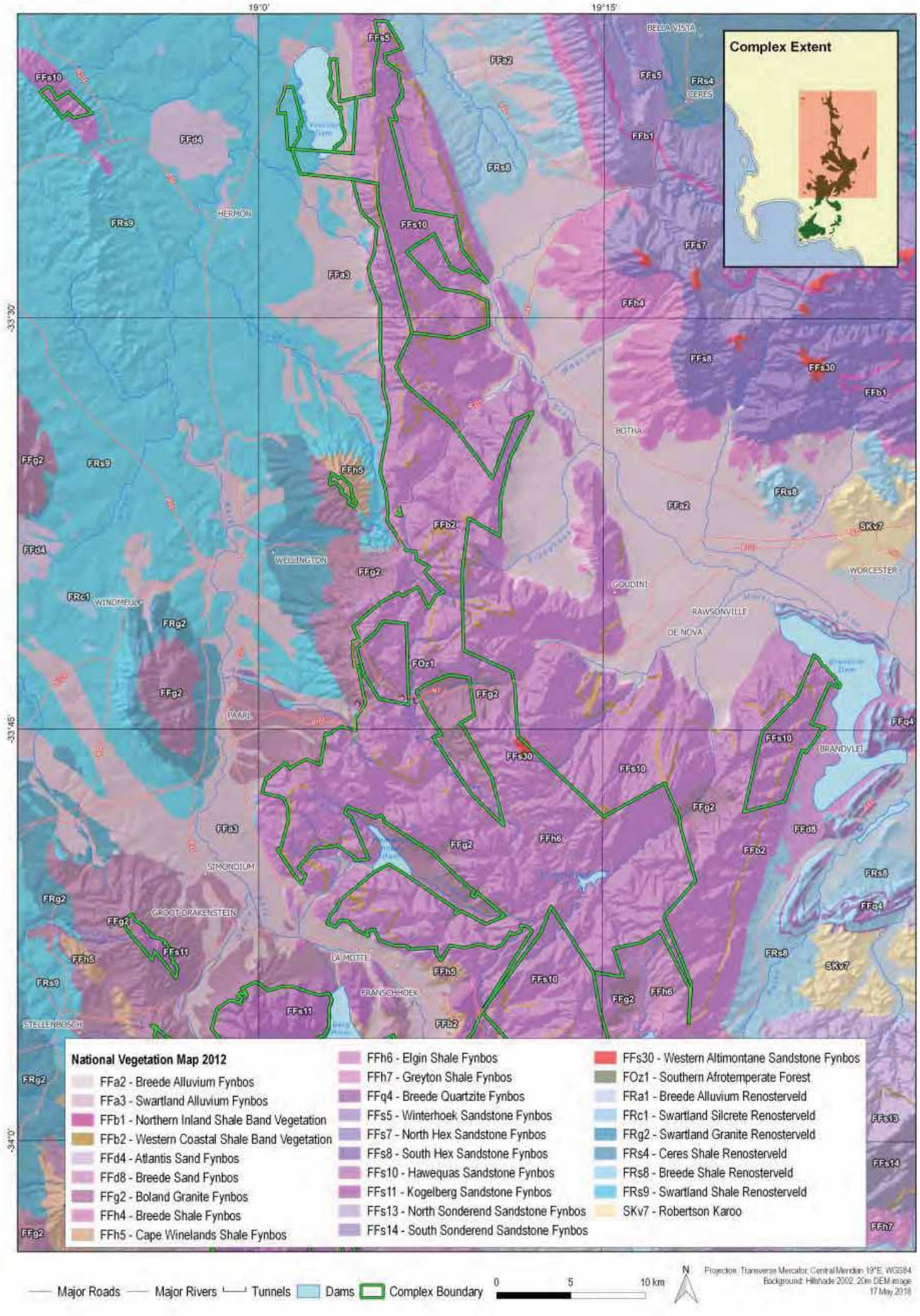
Map 3b Geology of the southern section of the Boland Mountain Complex.



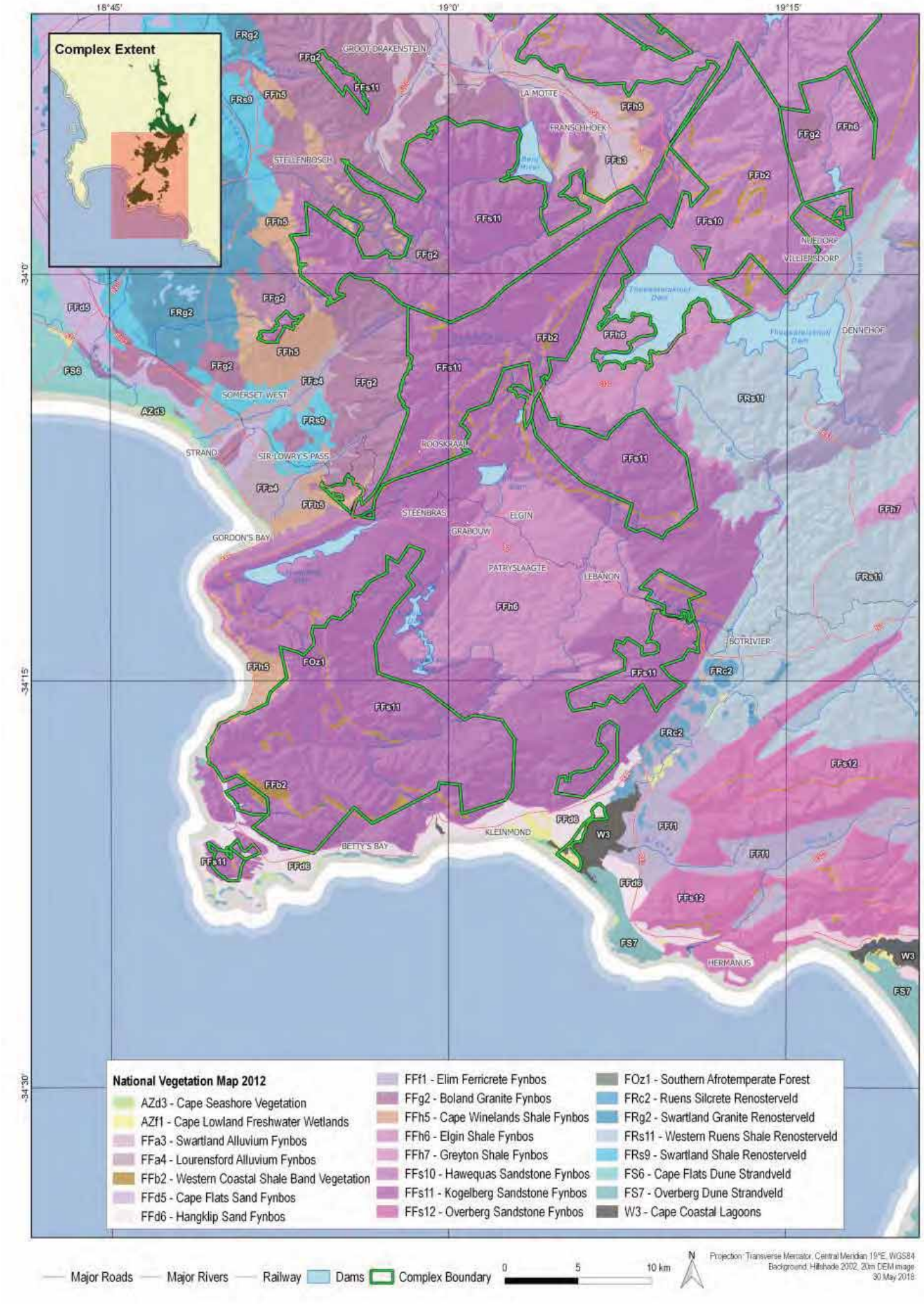
Map 4a Aquatic systems of the northern section of the Boland Mountain Complex.



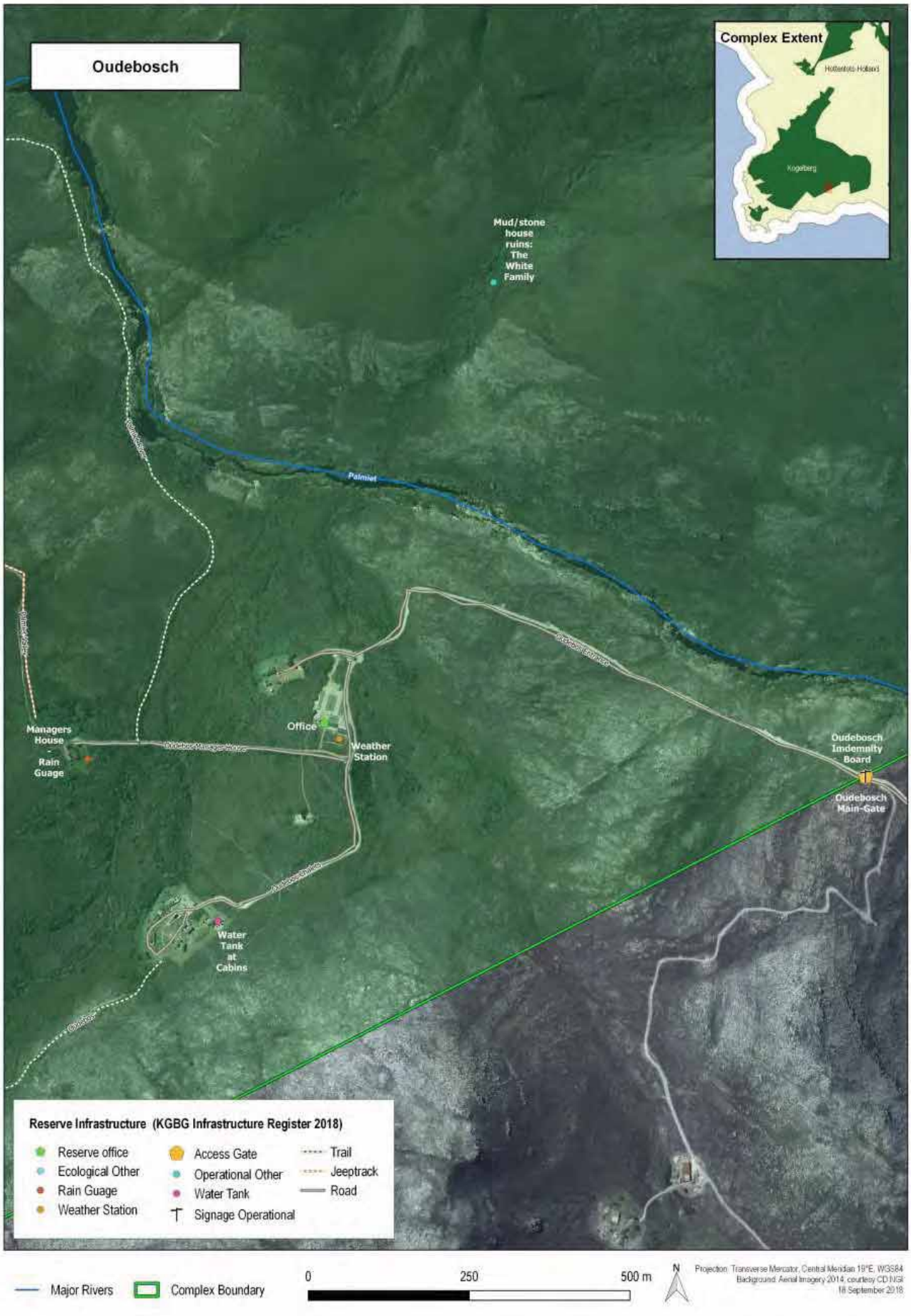
Map 4b Aquatic systems of the southern section of the Boland Mountain Complex.



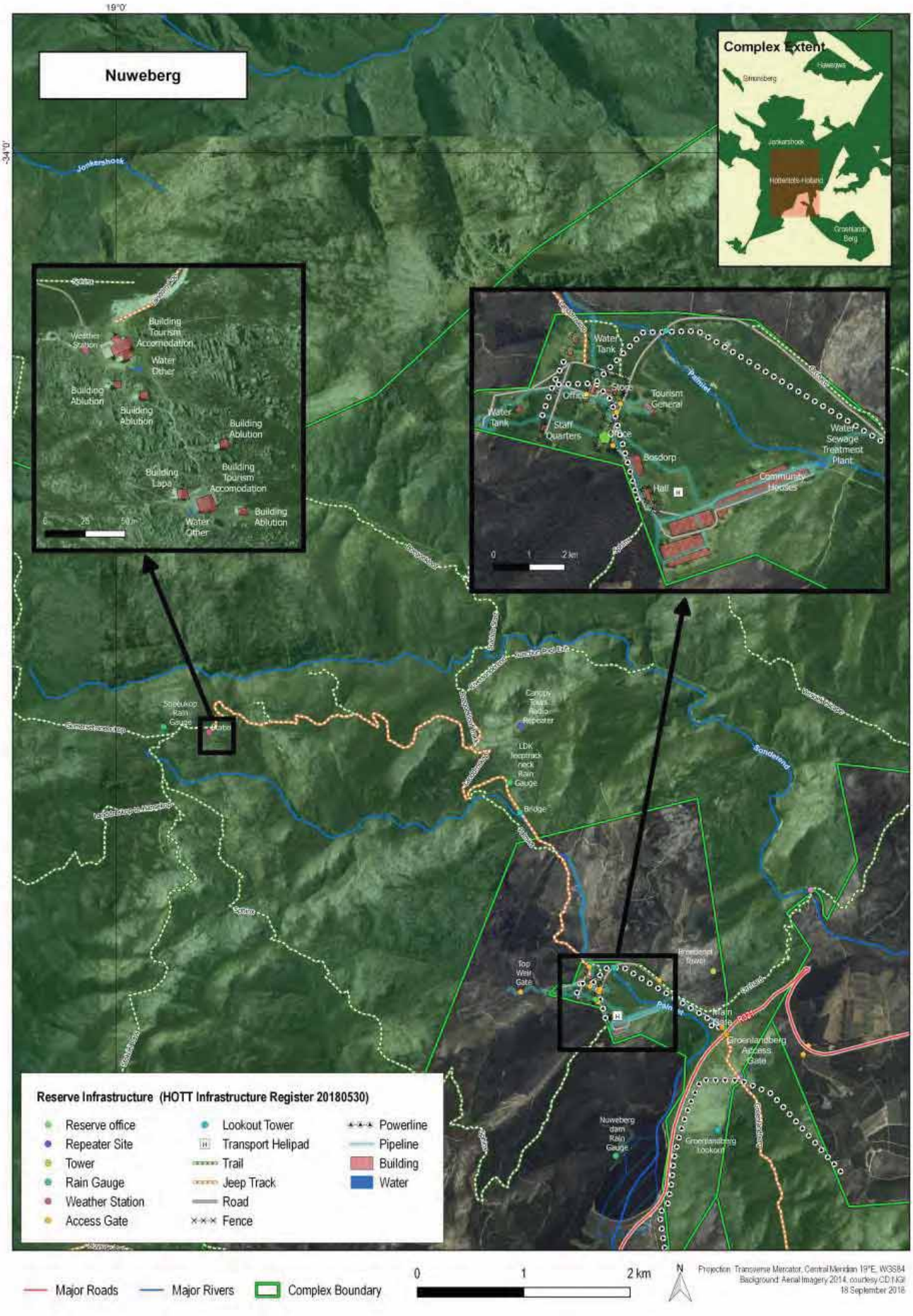
Map 5a Vegetation of the northern section of the Boland Mountain Complex (SANBI 2006-).



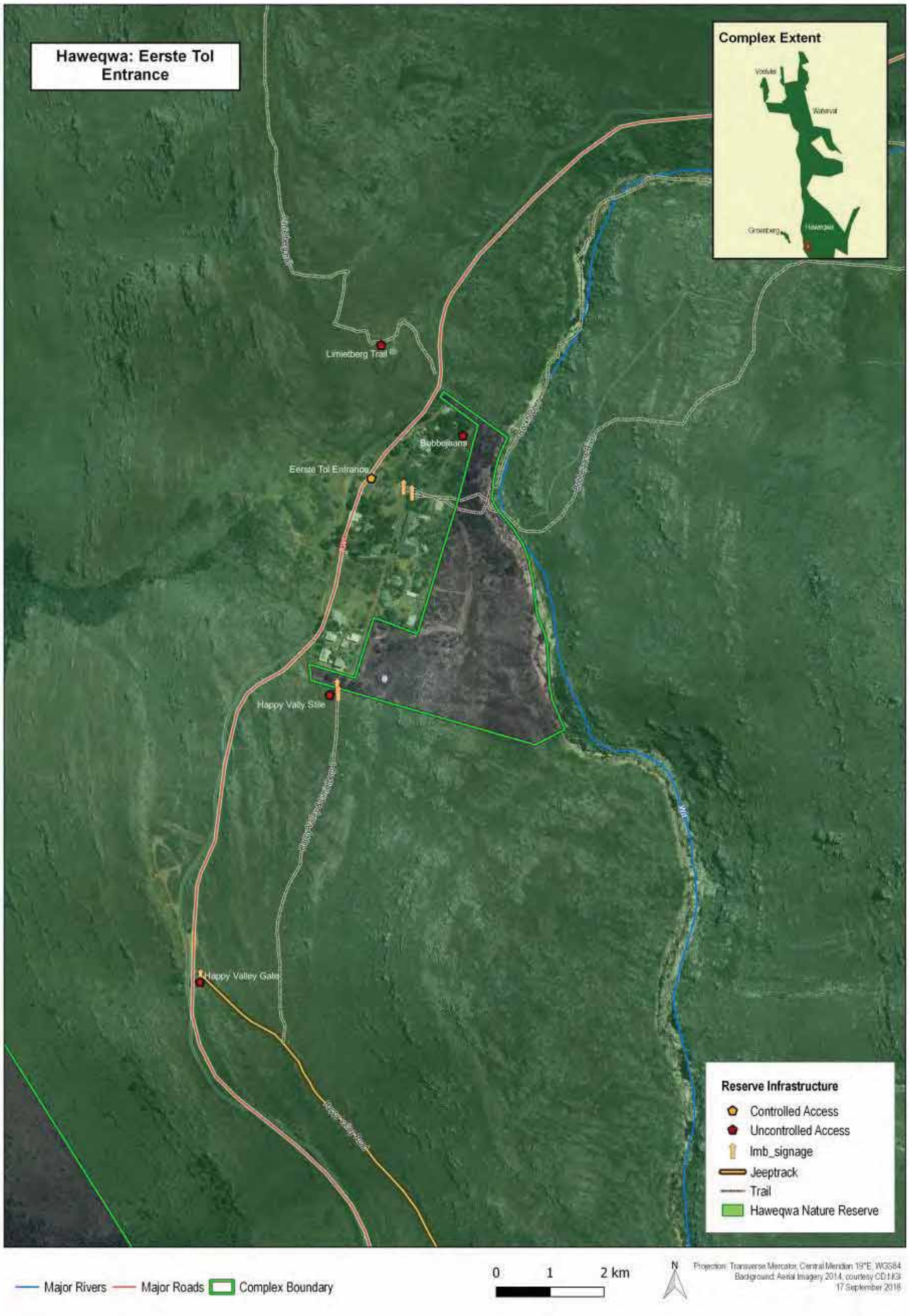
Map 5b Vegetation of the southern section of the Boland Mountain Complex (SANBI 2006-).



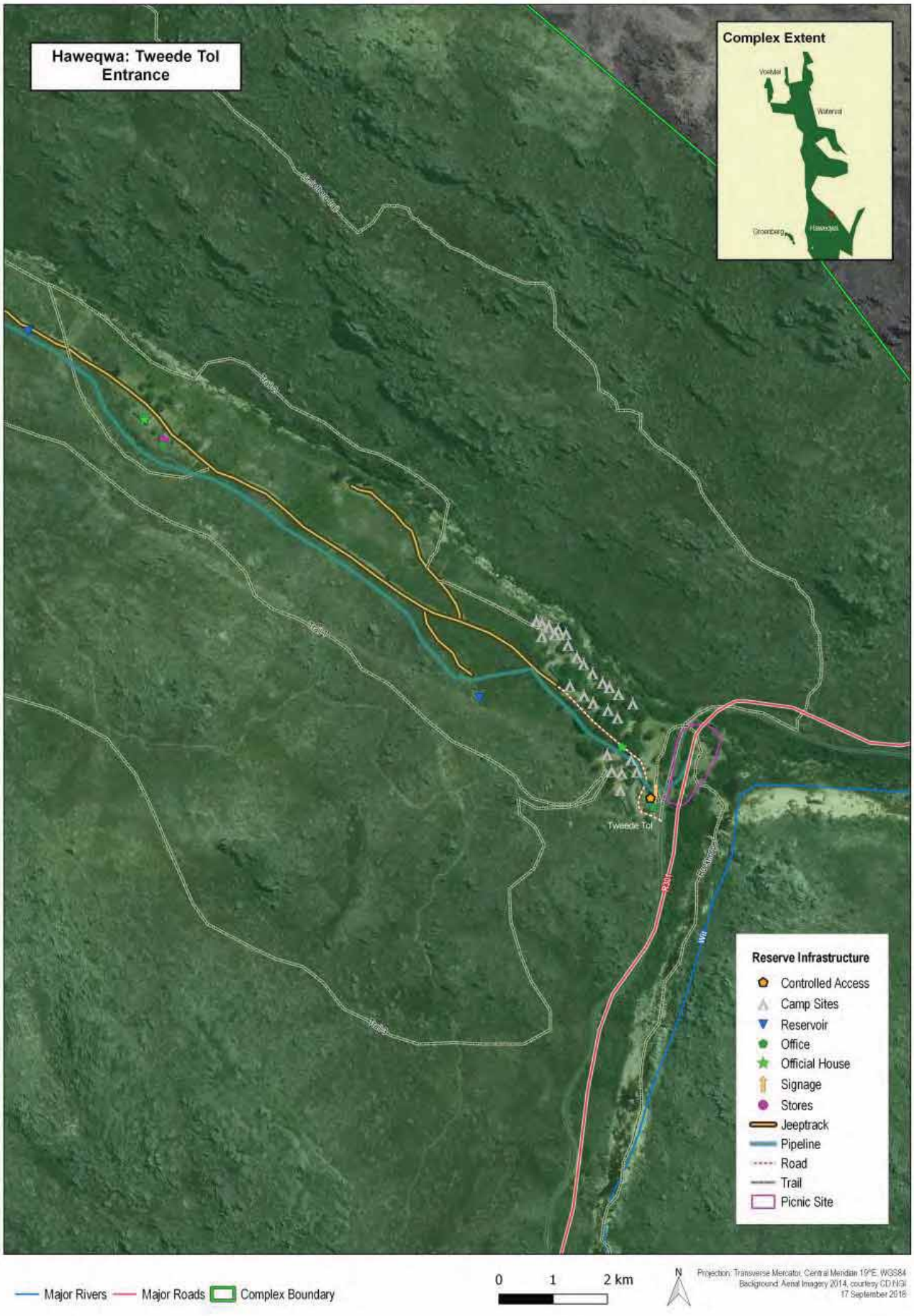
Map 6a Infrastructure map of Oudebosch in the Kogelberg Nature Reserve.



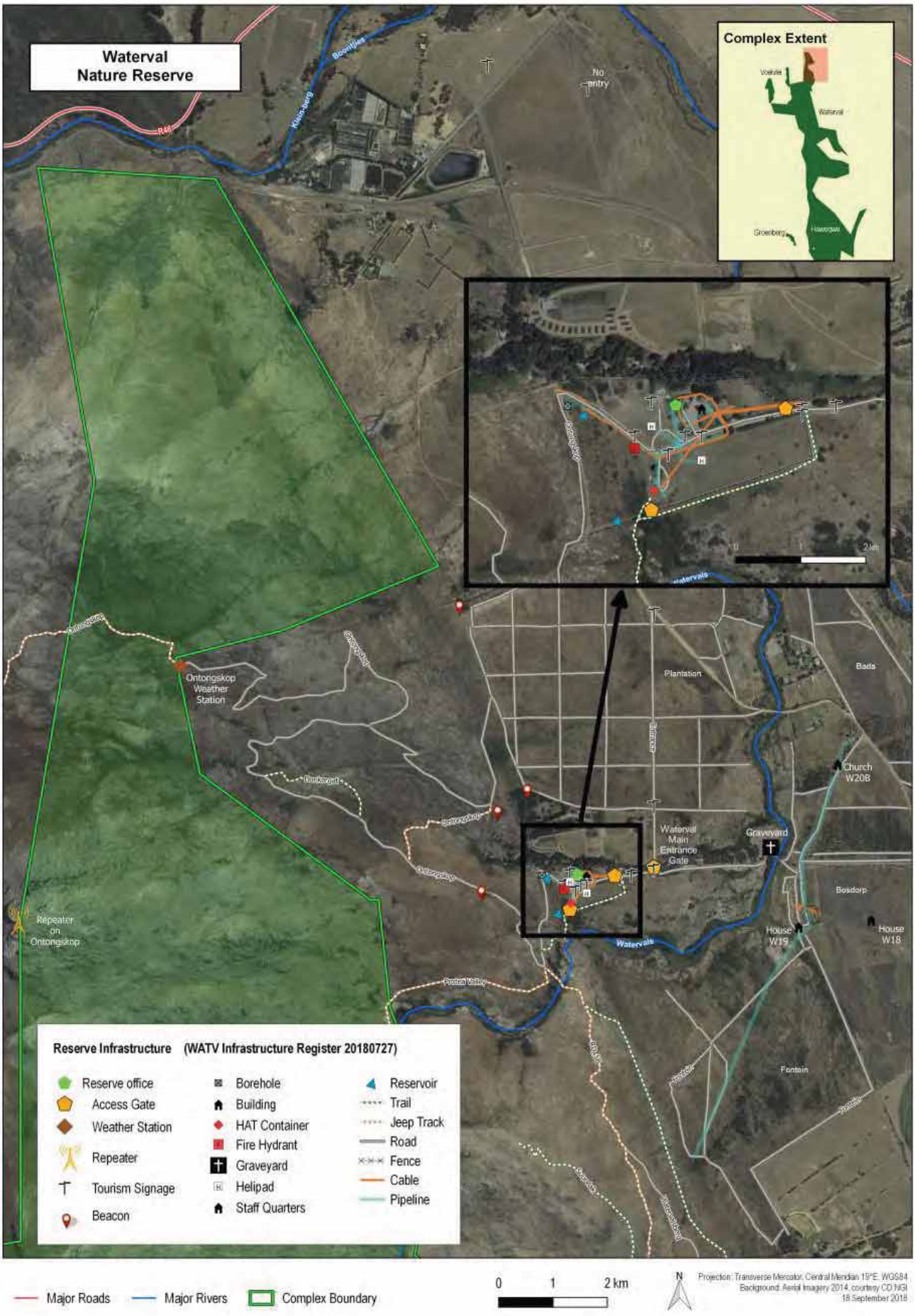
Map 6b Infrastructure map of Nuweberg in the Hottentots Holland Nature Reserve.



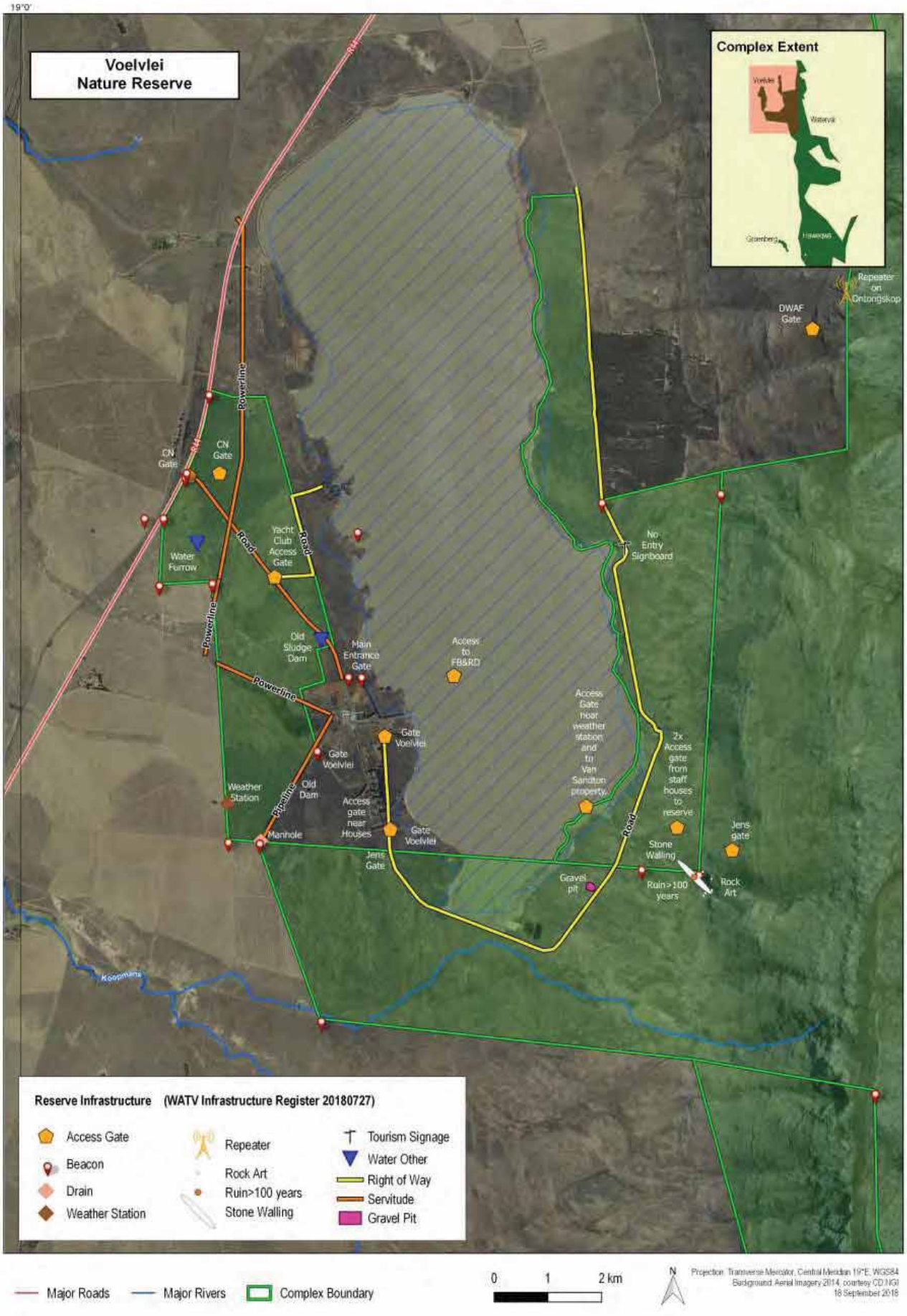
Map 6c Infrastructure map of Hawequa: Eerste Tol in the Limietberg Nature Reserve.



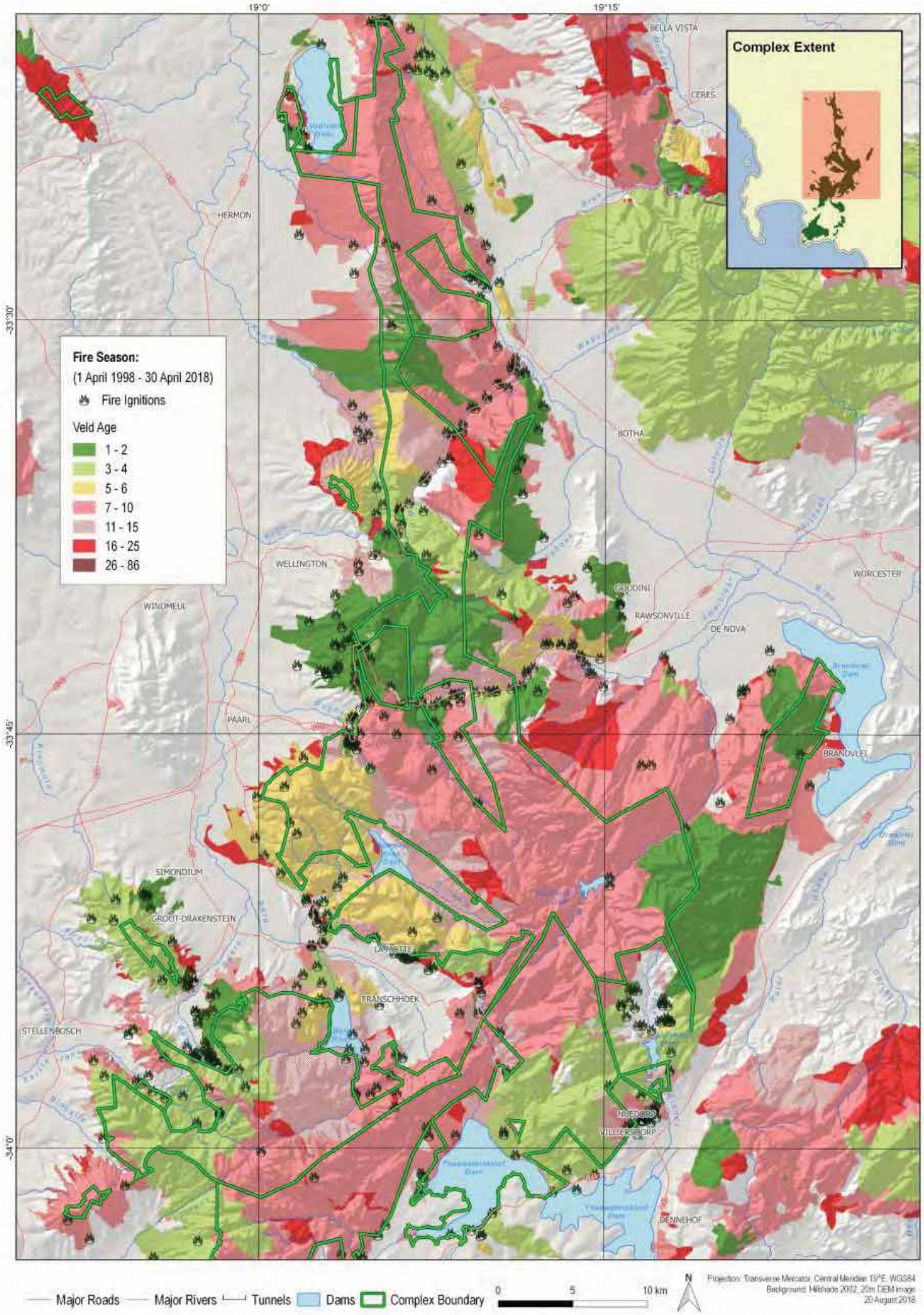
Map 6d Infrastructure map of Hawequa: Tweede Tol in the Limietberg Nature Reserve.



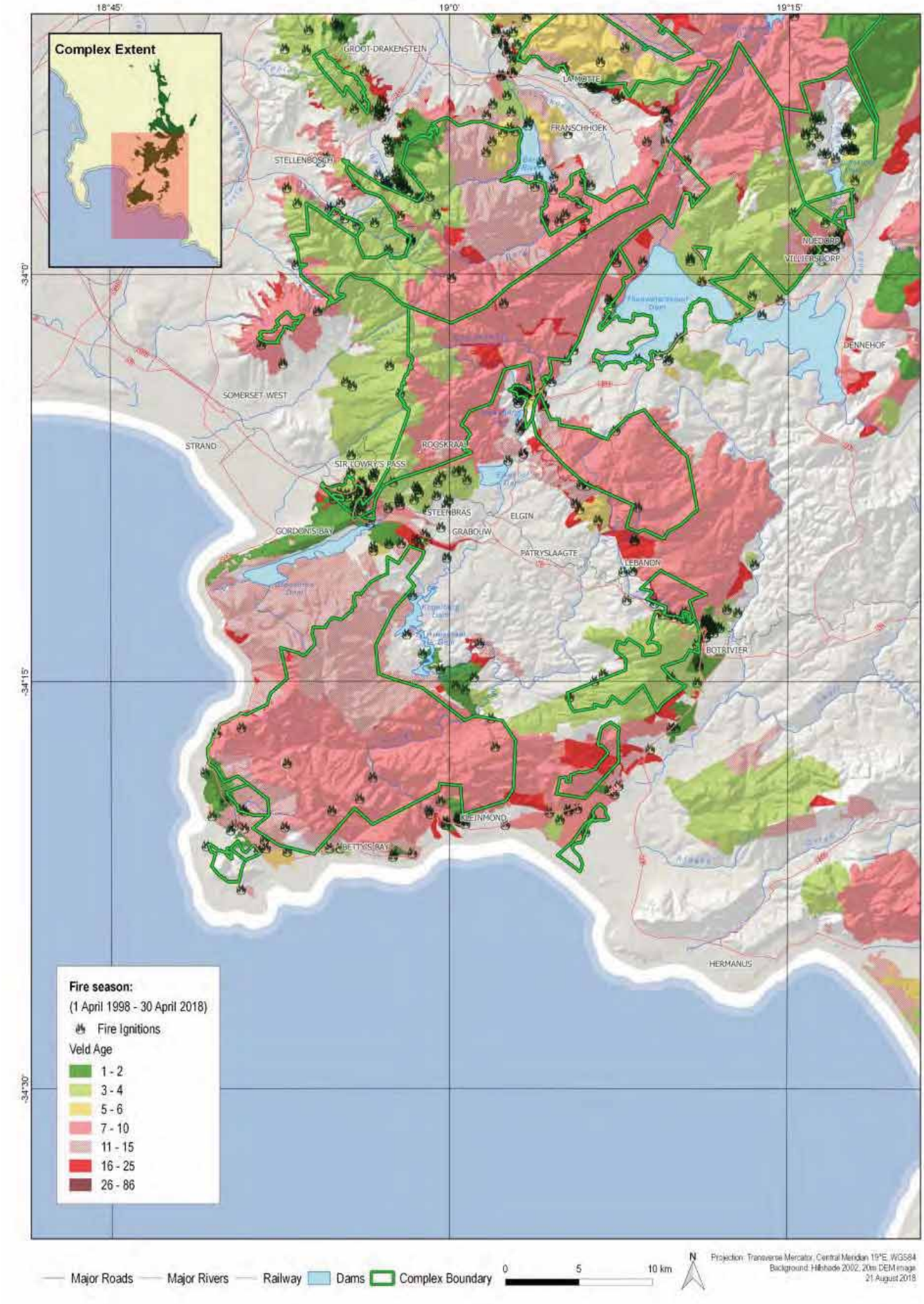
Map 6e Infrastructure map of the Waterval Nature Reserve.



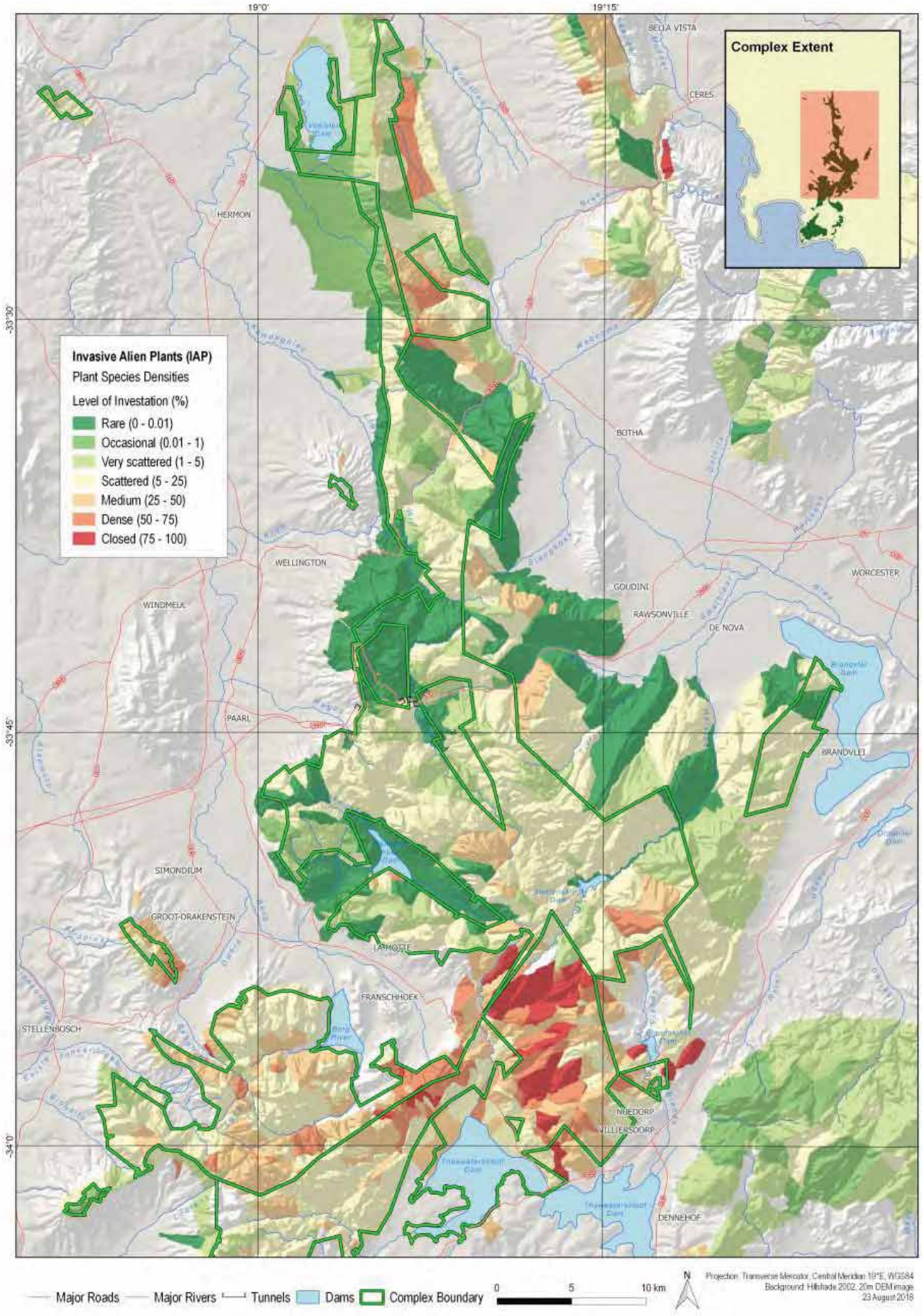
Map 6f Infrastructure map of the Voëlvlei Nature Reserve.



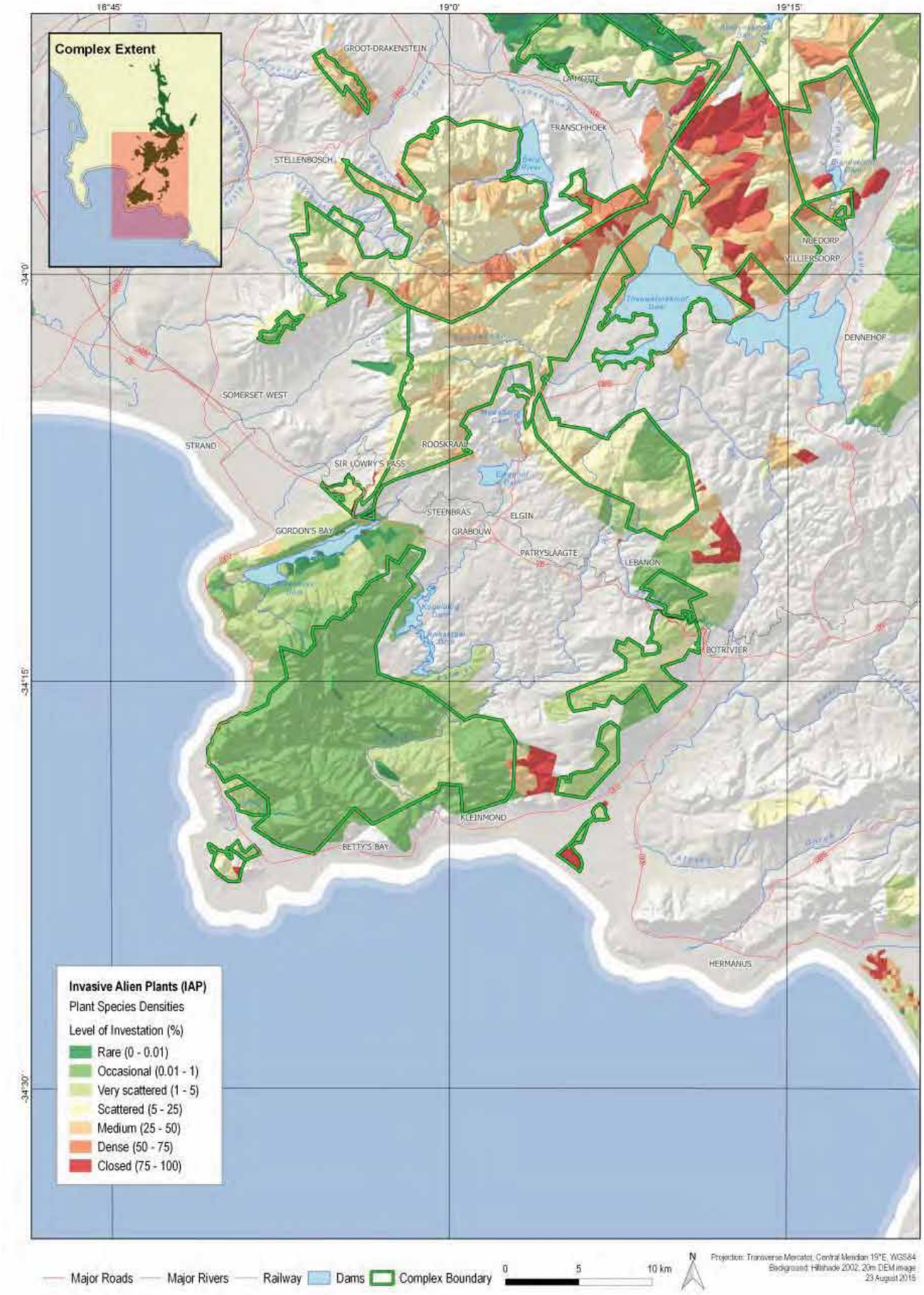
Map 7a Veld age map of the northern section of Boland Mountain Complex.



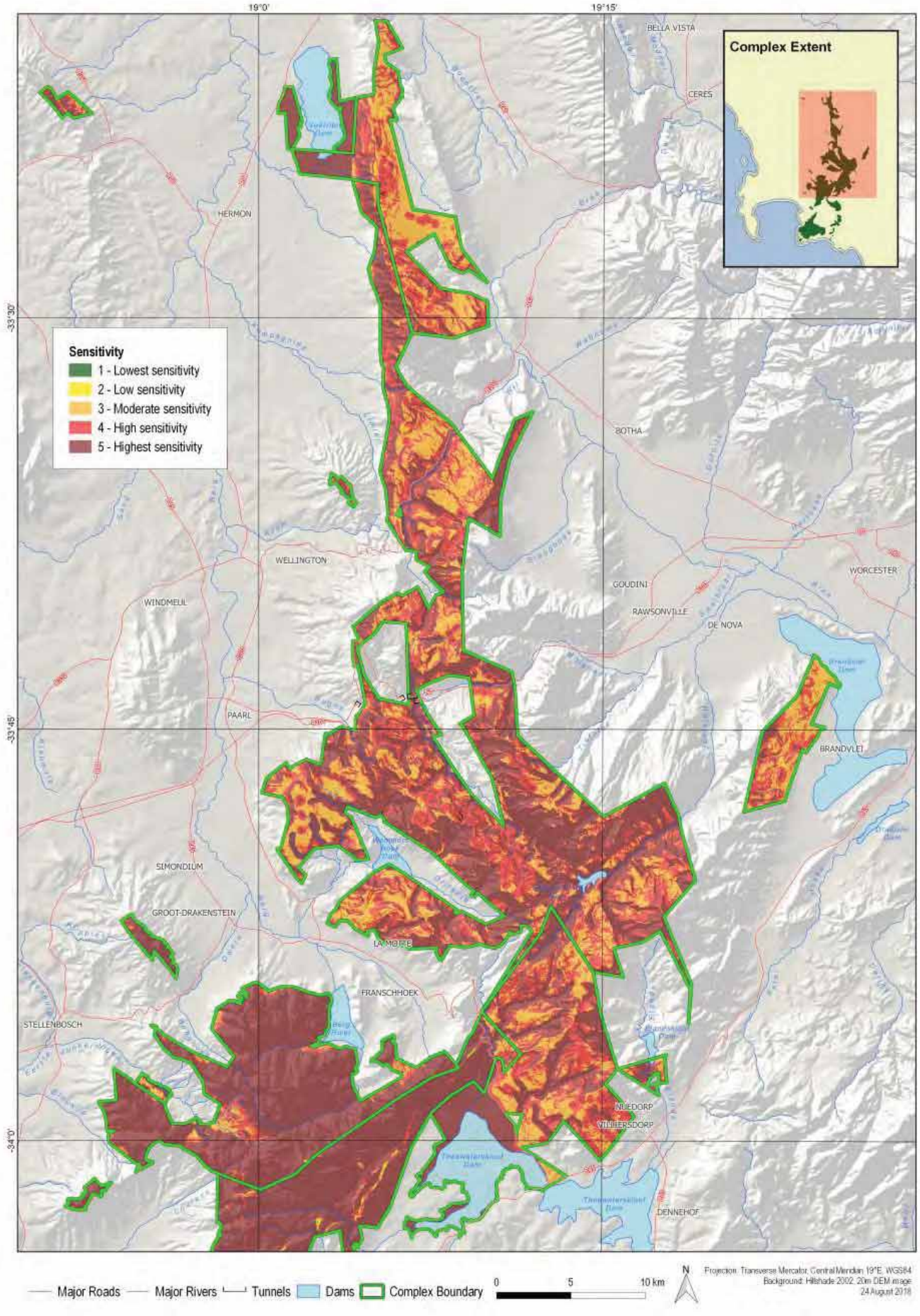
Map 7b Veld Age map of the southern section of Boland Mountain Complex.



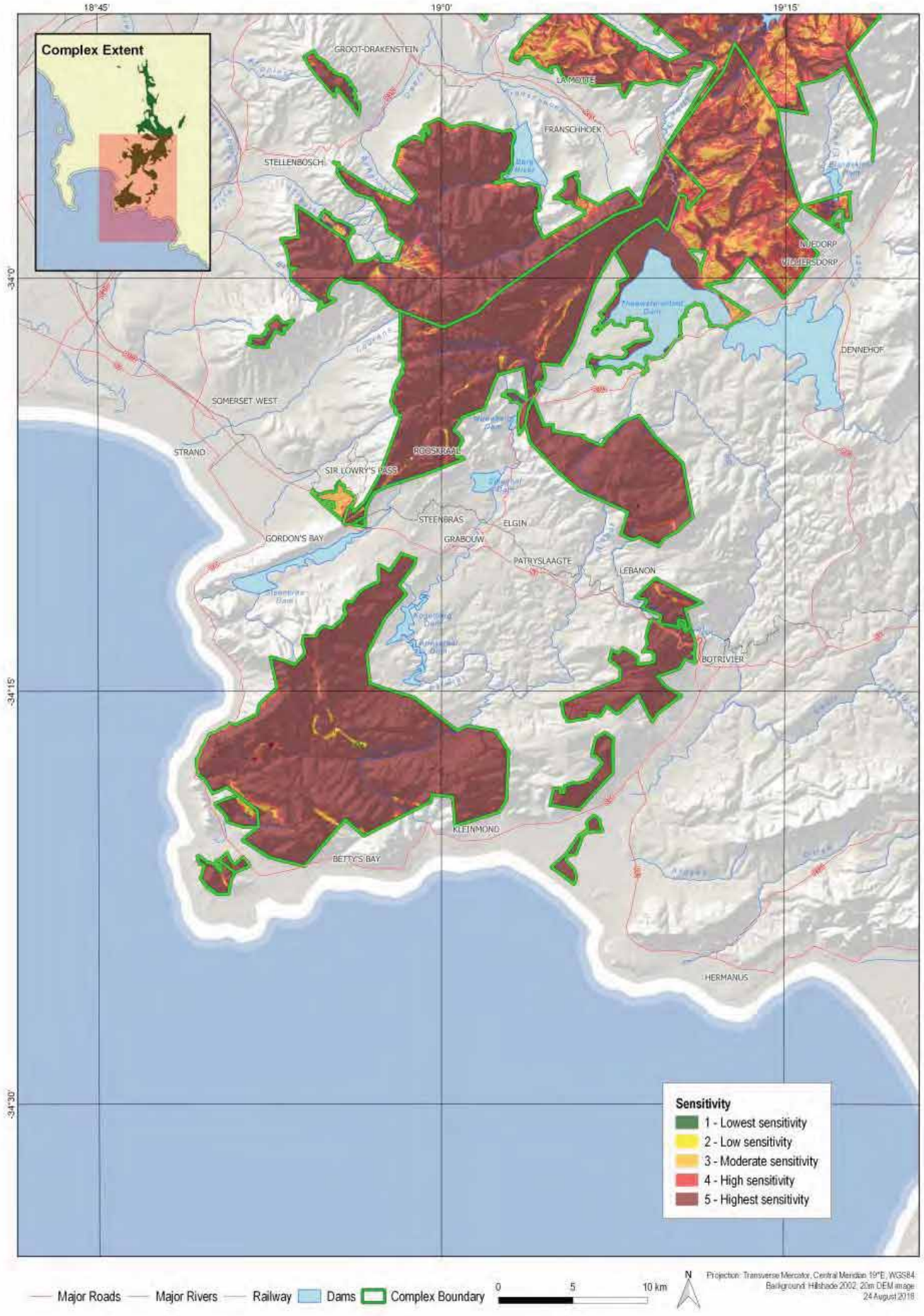
Map 8a Invasive alien vegetation map and management compartments of the northern section of the Boland Mountain Complex.



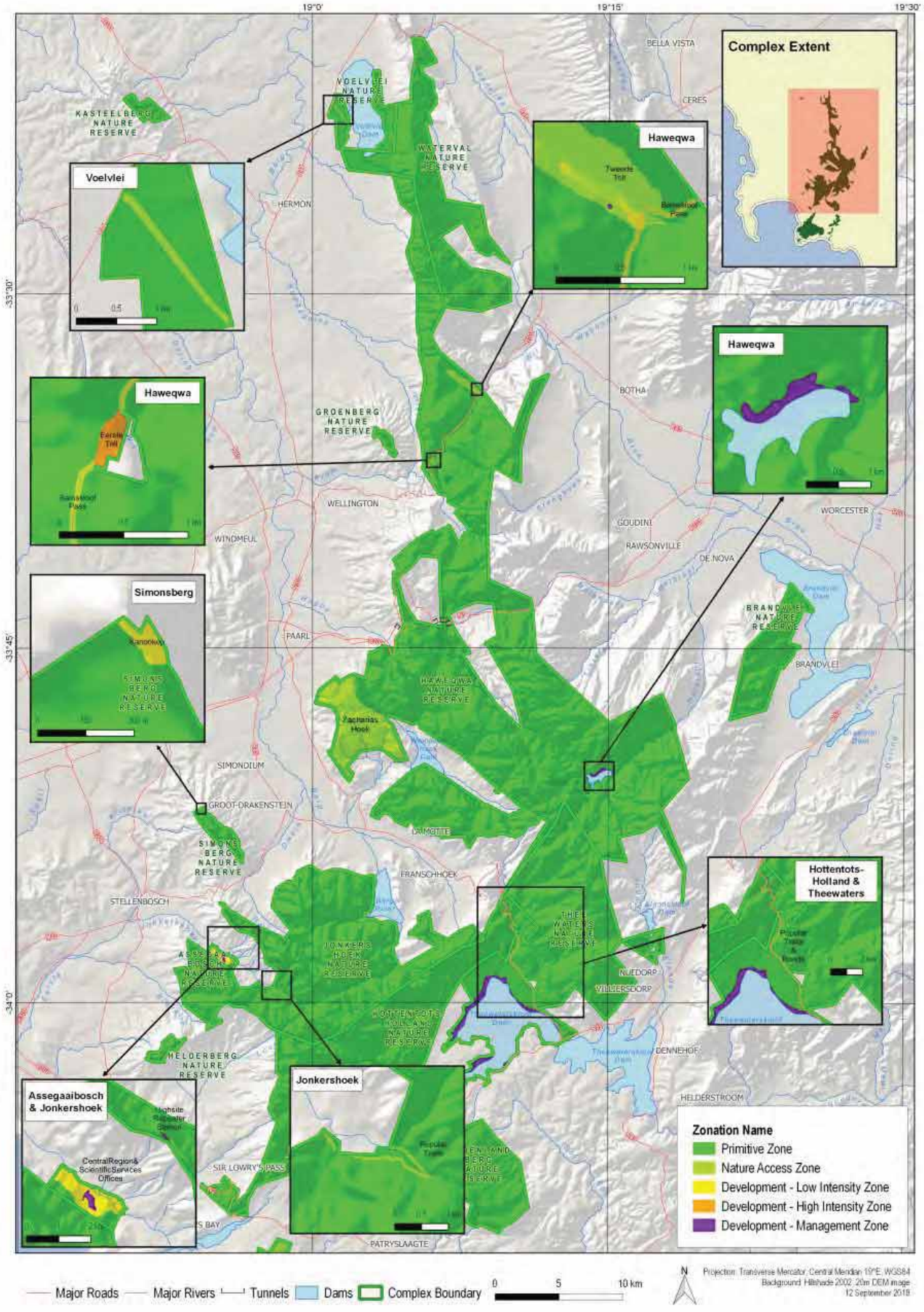
Map 8b Invasive alien vegetation map and management compartments of the southern section of the Boland Mountain Complex.



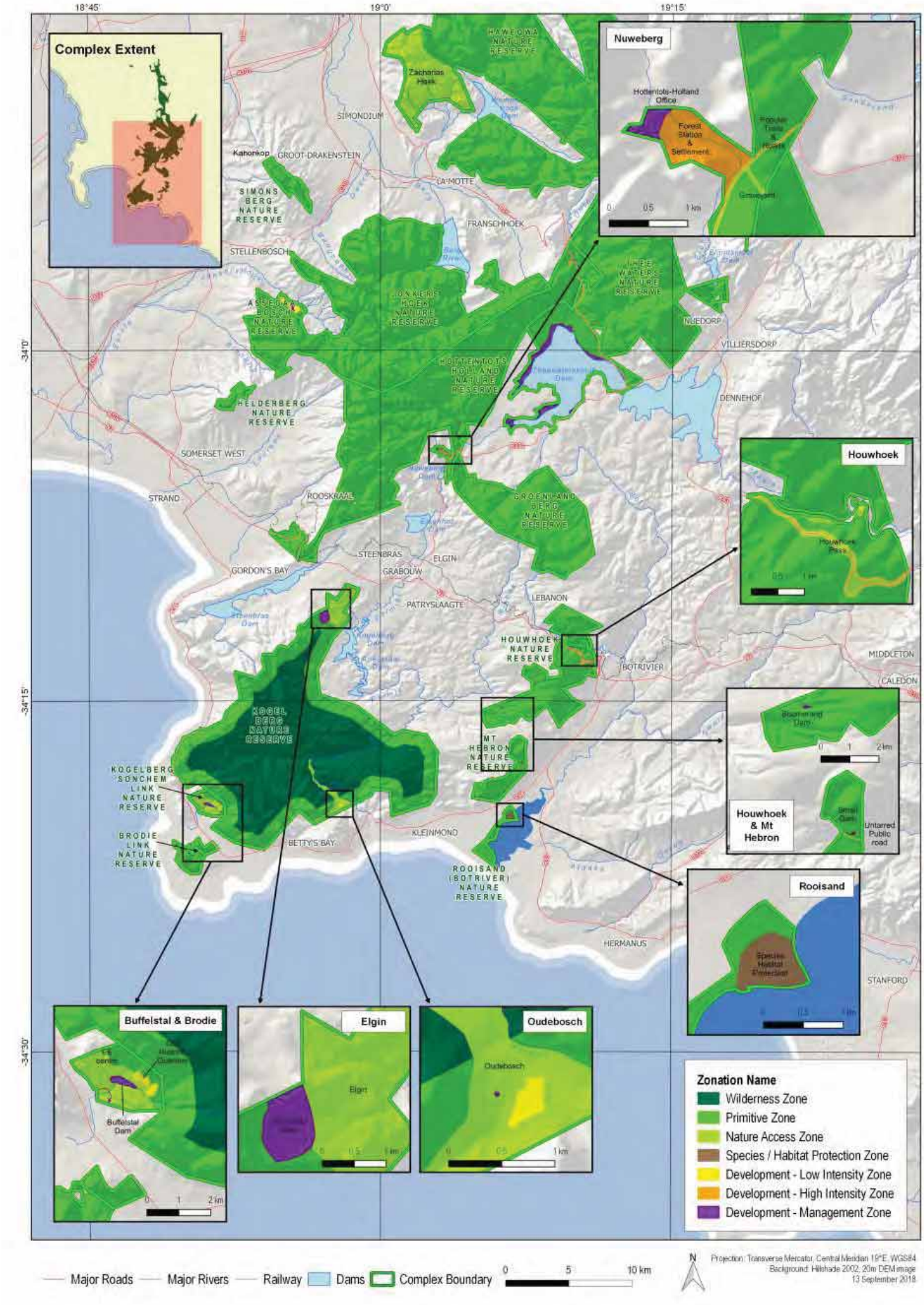
Map 9a Sensitivity map of the northern section of the Boland Mountain Complex.



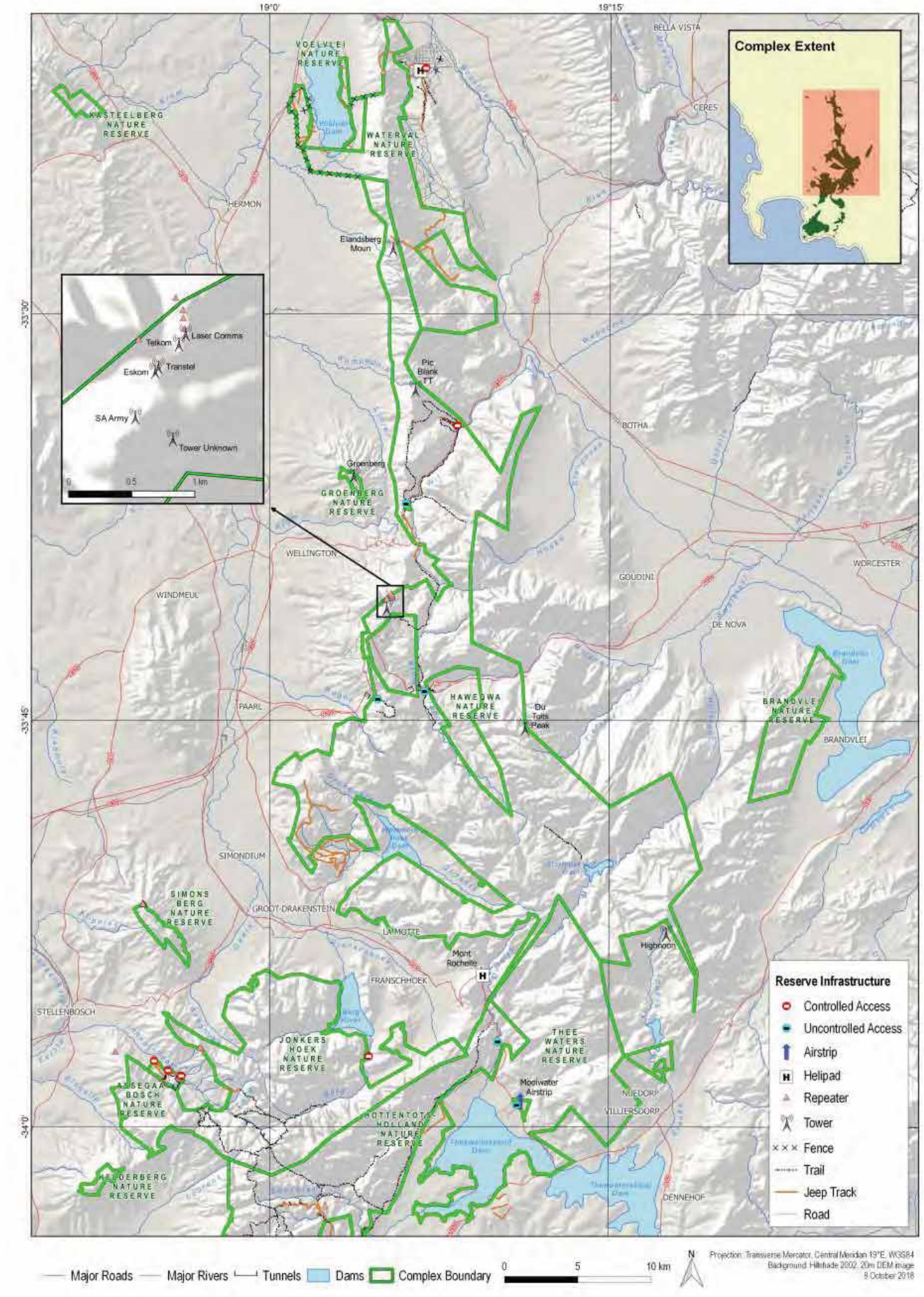
Map 9b Sensitivity map of the southern section of the Boland Mountain Complex.



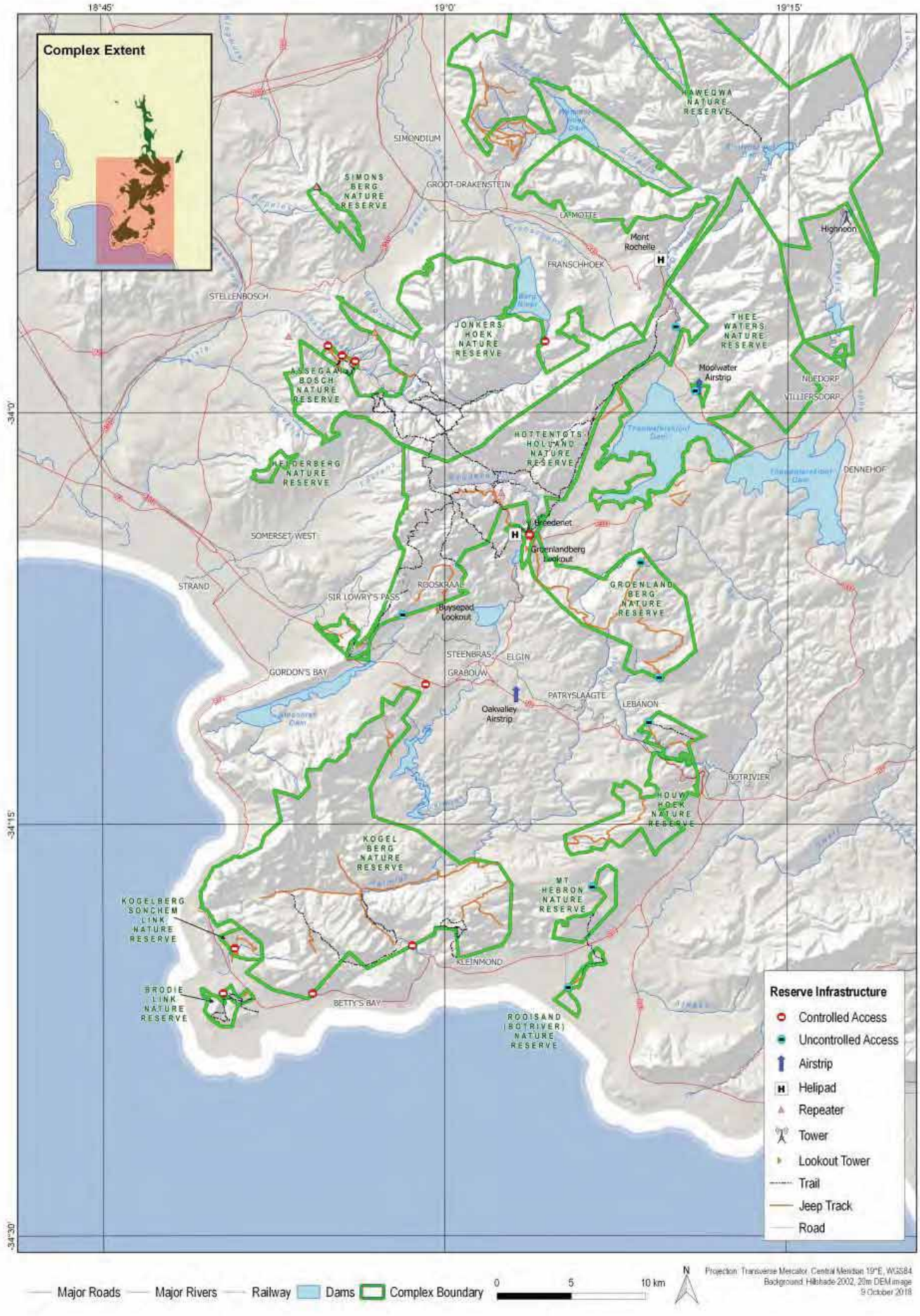
Map 10a Zonation map of the northern section of the Boland Mountain Complex.



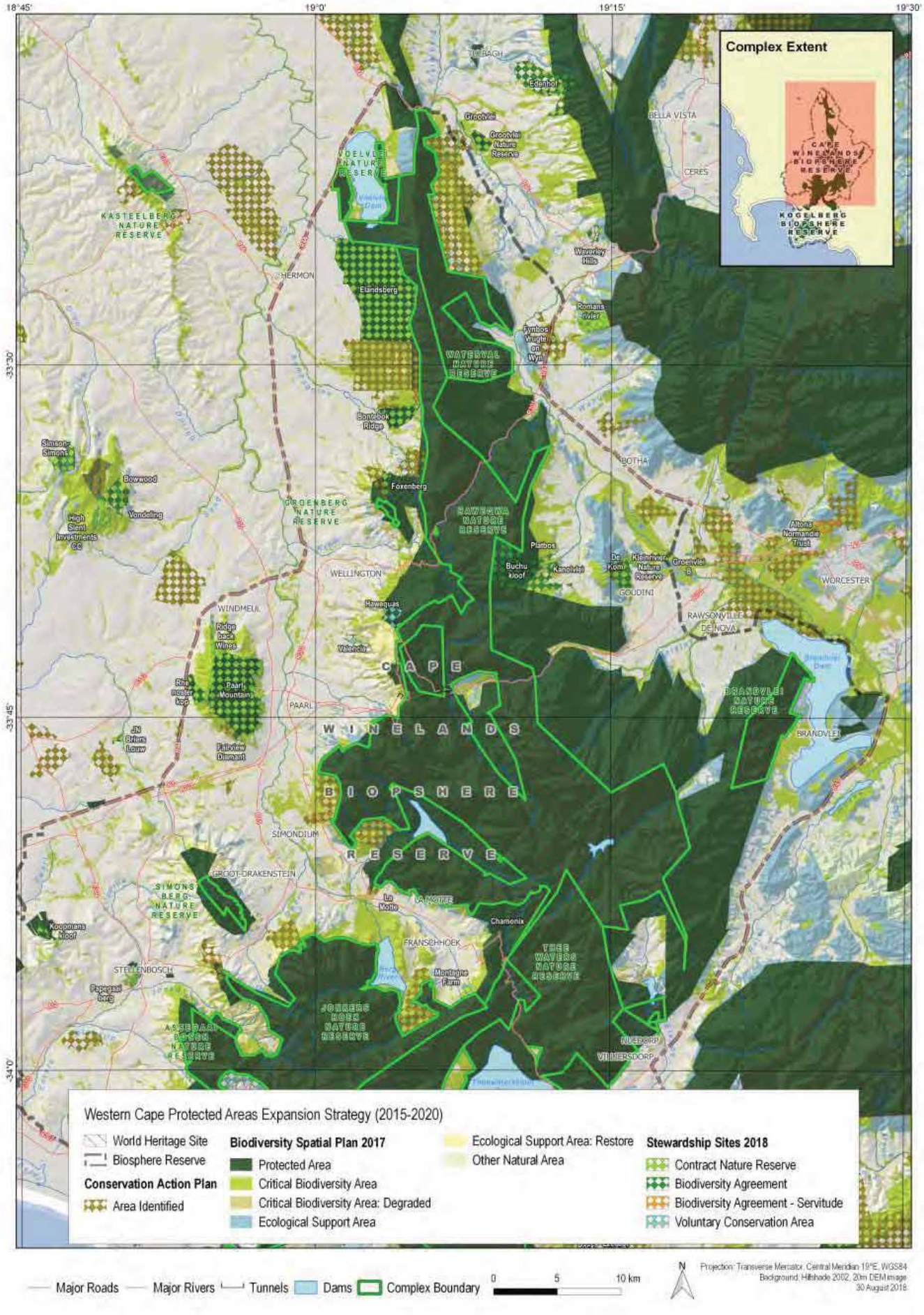
Map 10b Zonation map of the southern section of the Boland Mountain Complex.



Map 11a Access on the northern section of the Boland Mountain Complex.

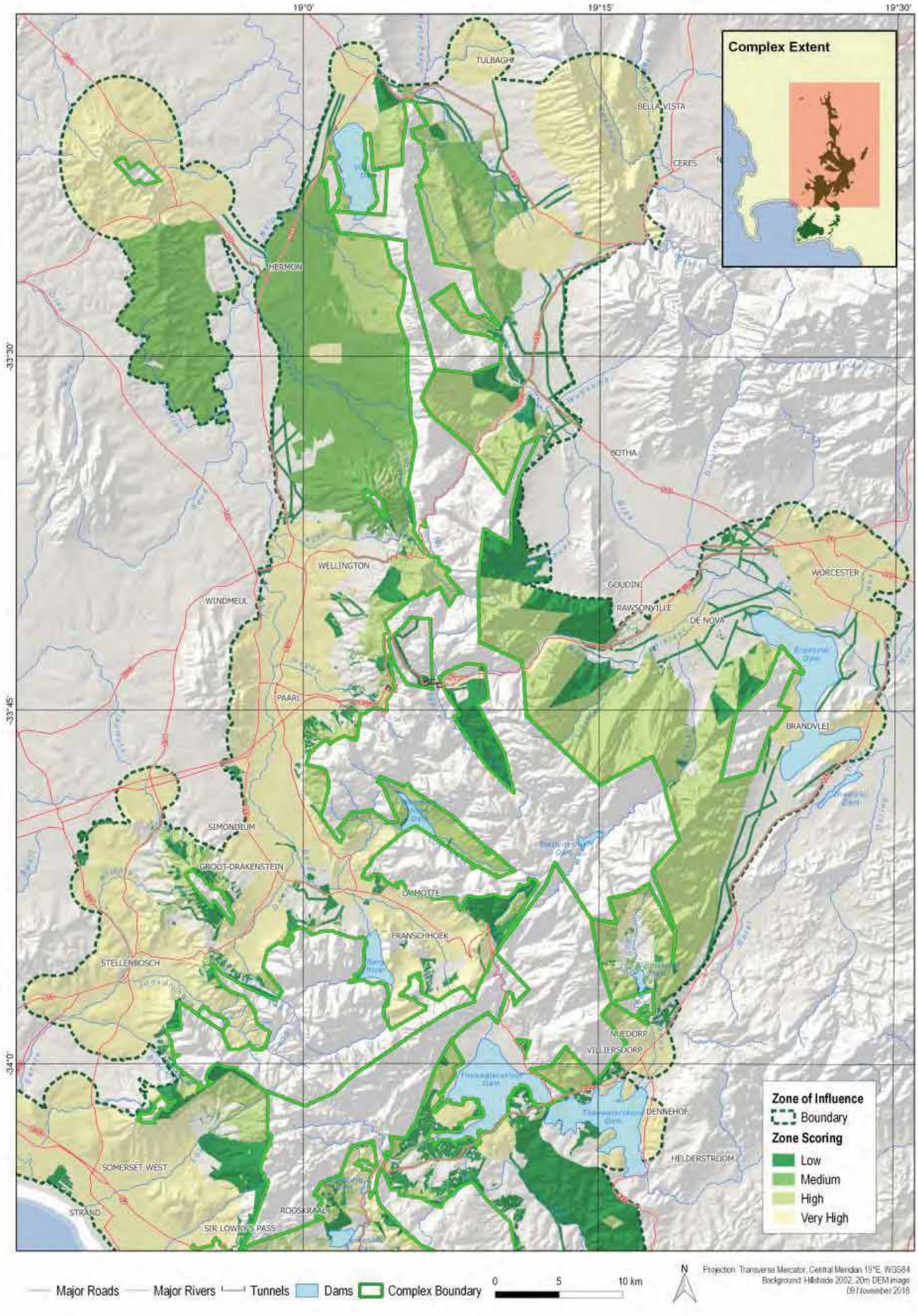


Map 11b Access on the southern section of the Boland Mountain Complex.

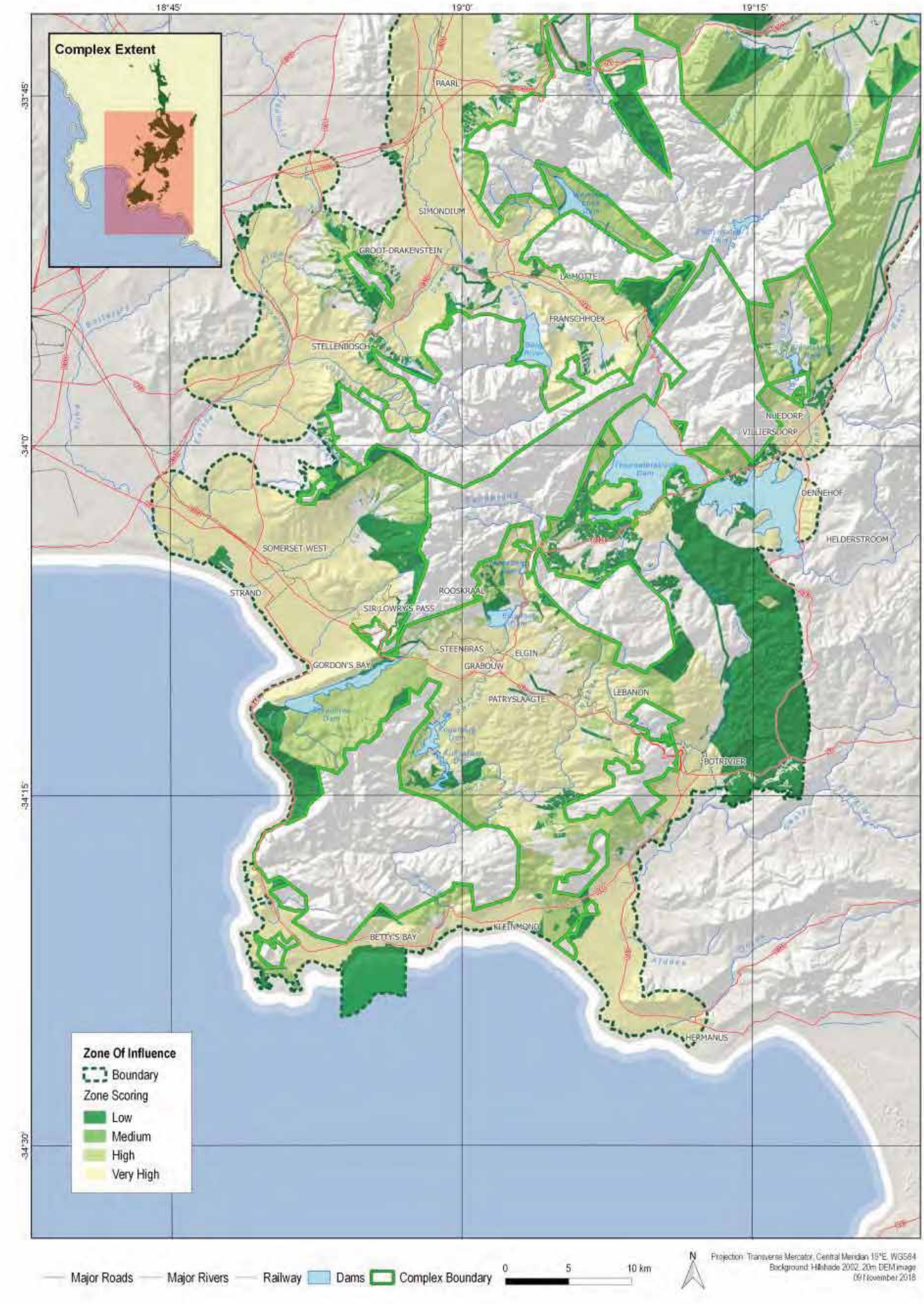


Map 12a Expansion of the northern section of the Boland Mountain Complex.

Map 12b Expansion of the southern section of the Boland Mountain Complex.



Map 13a Zone of Influence of the northern section of the Boland Mountain Complex.



Map 13b Zone of Influence of the southern section of the Boland Mountain Complex.