CEDERBERG COMPLEX

PART OF THE
CAPE FLORAL REGION PROTECTED AREAS WORLD HERITAGE SITE

Western Cape, South Africa

Protected Area Management Plan 2019 – 2029

DATE APPROVED: 07 March 2019

MOST RECENT UPDATE: 28 February 2019

CapeNature

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Western Cape Government

United Nations Educational, Scientific and Cultural Organization

World Heritage Convention

CEDERBERG COMPLEX

Part of the
Cape Floral Region Protected Areas World Heritage Site
Western Cape, South Africa

Protected Area Management Plan 2019 – 2029

DATE APPROVED: 07 March 2019
MOST RECENT UPDATE: 28 February 2019

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

The Cederberg Complex comprises the following:

- Cederberg Wilderness was proclaimed in terms of Section 7(A) of the Forest Act (Act No. 72 of 1968) on 27 July 1973, Notice No. 1256 of 1973; the boundaries of which were amended in terms of the Act on 26 March 1976, Notice No. 476 of 1976;

- Hexberg remains a declared State Forest as proclaimed per Notice No. 2579 of 1977;

- Matjiesrivier Nature Reserve, proclaimed as a Provincial Nature Reserve in terms of Section 6(1) of the Nature and Environmental Conservation Ordinance (Act No. 19 of 1974) on 27 March 2000, Notice No. 16 of 2000.

Together these three protected areas form the Cederberg Complex. Only Cederberg Wilderness and Matjiesrivier Nature Reserve form part of the larger Cape Floral Region Protected Areas World Heritage Site.

AUTHORISATION

Approval:

The Protected Area Management Plan for the Cederberg Complex is approved:

TITLE	NAME	SIGNATURE AND DATE
NATIONAL MINISTER: Department of Environmental Affairs	Ms Nomvula Mokonyane	

Recommended:

TITLE	NAME	SIGNATURE AND DATE
PROVINCIAL MINISTER: Department of Environmental Affairs and Development Planning	Mr Anton Bredell	
CHAIRPERSON OF THE BOARD: Western Cape Nature Conservation Board	Assoc Prof Denver Hendricks	7/03/2019
CHIEF EXECUTIVE OFFICER: CapeNature	Dr Razeena Omar	7/3/2019

Review Date: 10 years from the date of approval by the Minister of Environmental Affairs.

ACKNOWLEDGEMENTS

CapeNature would like to thank everybody who participated and had input in the formulation of this management plan.

The Cederberg Complex management plan was prepared by the core reserve management planning team consisting of Marius Wheeler, Rika du Plessis, Daleen Burger, Antoinette Veldtman and Dean Impson. The planning team was supported with inputs from various internal and external partners for which the authors are grateful for. A word of thanks to our Scientific Services, Community Conservation and Conservation Services colleagues in particular. A special word of appreciation also goes to the whole CapeNature executive team that assisted with the revision of this document.

Natalie Hayward and Genevieve Pence are thanked for all their guidance on the Open Standards, Coral Birss and Andrew Turner for their technical support, Sheila Henning and Therese Forsyth for all their spatial analysis and inputs.

The authors would also like to express their gratitude to The Western Cape Department of Agriculture for supplying climatic geographic information; and Peter Slingsby for mapping more than 13 000 Clanwilliam cedar tree localities spatially and making the data available to CapeNature.

Ms Genevieve Pence, CapeNature – Conservation Planning Scientist for technical and scientific review.

Dr Ernst Baard, CapeNature – Executive Director Biodiversity Support for final peer review.

Dr Bruce Paxton, Freshwater Research Centre, for external review.

Prof Edmund February, Department of Biological Sciences, University of Cape Town, for independent review.

EXECUTIVE SUMMARY

In compliance with the National Environmental Management: Protected Areas Act (NEM: PAA) (Act No. 57 of 2003) and Chapter 4 of the World Heritage Convention Act (Act No. 49 of 1999), CapeNature is required to develop management plans for Protected Areas (PAs). In developing the management plan for the Cederberg Complex, CapeNature strives to establish biodiversity conservation as a foundation for a sustainable economy providing ecosystem services, access and opportunities for all.

PAs are declared as part of a national process to manage and conserve South Africa's rich biodiversity. Accordingly, the purpose of a management plan is to facilitate that process, to ensure that the natural and cultural values of a protected area are conserved and managed, as intended by NEM: PAA.

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 management plan facilitates the integration of various components and functions within CapeNature and in doing so, creates an enabling environment for the achievement of protected area objectives. A solid planning framework and effective implementation will ultimately support the Cederberg Complex's values and deliver a range of ecosystem services crucial for human well-being and progress.

PLANNING

The Open Standards for the Practice of Conservation is a Strategic Adaptive Management (SAM) framework that is robust, yet flexible, that is multi-disciplinary in approach, and inclusive of internal and external stakeholders, as well as the public at large. It enables management teams to develop effective conservation plans, based on the best available traditional, expert and scientific information. Key to this process is identifying the natural and cultural values representative of the area, determining what state they are in, and what threats they face. This forms the basis for establishing clear goals, strategies and objectives that are time bound.

Implementation and Review

Fundamental to implementation is pursuing the achievement of conservation outcomes and regular review of progress towards outcomes, not taking action alone. In order to meet the goals of the Cederberg Complex, strategies are selected that feed into short- to medium- term objectives and action plans. The Strategic Implementation Framework (section 5) forms the basis of the action plan. SAM integrates planning, management, and monitoring, and is used to systematically evaluate results, thus enabling management to "change direction" when needed; management intervention design elicits scientifically measurable results, the analysis of which informs future management decisions. Key to this process is the sharing of results, respectfully, honestly and transparently to facilitate learning, acknowledging that although success is not a given, learning is, through critical appraisal of conservation efforts.

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. CapeNature uses the Management Effectiveness Tracking Tool (METT) adopted by the National Department of Environmental Affairs and adapted to South African conditions (METT-SA), to assess the management effectiveness of all of its protected areas at a strategic level. Additionally, mechanisms for monitoring and evaluation are built into each aspect addressed by the Standard Implementation Framework.

An Overview of the Cederberg Complex

This management plan provides the basis for the management, development and operation of the Cederberg Complex over a timeframe of 10 years. The planning scope of the Cederberg Complex is defined as the Cederberg Wilderness, Matjiesrivier Nature Reserve and Hexberg State Forest. The Cederberg Complex forms the core conservation area within the Greater Cederberg Biodiversity Corridor landscape conservation initiative. In conjunction with conservation efforts by our neighbours, the Cederberg Complex hopes to contribute meaningfully towards building climate change resilience, enhancing water security, conserving the unique natural and cultural history of the region and contributing towards its socio-economic development. The vision of the Cederberg Complex epitomises this.

"A World Heritage Site with a wilderness character built on community and partnership, managed to sustain and promote water, biodiversity, ecotourism and heritage, for the benefit of all".

The Cederberg Wilderness and Matjiesrivier Nature Reserve have both been inscribed into the Cape Floral Region Protected Areas World Heritage Site. The Cederberg Complex meets two of the criteria for inscription: Criterion (ix) represents outstanding examples of significant ongoing ecological and biological processes in the evolution of terrestrial ecosystems and plant communities; and Criterion (x), as it contains important and significant natural habitats for *in-situ* conservation of biological diversity, including those containing threatened species, particularly related to science and conservation.

The Cederberg Wilderness was initially proclaimed as a Demarcated Forest in 1897, making it one of South Africa's oldest PAs. Hexberg State Forest was added during later proclamations. During 1973 the Cederberg Wilderness was declared as a Wilderness. Matjiesrivier Nature Reserve was purchased by the World Wide Fund for Nature, South Africa (WWF-SA) in 1995 and proclaimed as a Provincial Nature Reserve in 2000. The entire extent of the Cederberg Complex is 79 687 ha.

The Cederberg Complex is characterised by rugged high mountains and beautiful geological formations. The main vegetation unit is Cederberg Sandstone Fynbos but due to the topographic, geological and climatic diversity, the area spans two "Biodiversity Hotspots" namely the Cape Floristic Region and the semi-arid Succulent Karoo. The Cederberg Complex is rich in palaeontological, archaeological and historical heritage. Furthermore, the Cederberg Complex forms part of the greater Olifants-Doring River System, which has the highest number of endemic fish species of any river system in South Africa. The Cederberg Wilderness in particular, contributes significantly to clean water production and water security within the province.

The Cederberg Complex is a popular tourist destination. The surrounding economy is primarily sustained by a mix of citrus, grape and rooibos farming, game and livestock farming, and various tourism products. Small scale subsistence farming is practiced by many of the surrounding small impoverished rural communities. By default, CapeNature is viewed by many of its neighbours 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 that contribute towards sustainable development and social upliftment. The Cederberg Complex has committed itself by creating jobs with a focus on conservation and eco-tourism, enterprise development, training and capacity building, environmental education and awareness, and by working with partners and neighbours to find solutions to socio-economic challenges.

Focal Values and Threats

PA values that are healthy, provide the ecosystem services that support human welfare within the region. For the Cederberg Complex these include natural, cultural and human well-being aspects. Key ecological attributes (KEAs) and associated indicators were identified and served as the basis for assessing the current and future status of Cederberg Complex focal values.

Threats and contributing factors that degrade or destroy the Cederberg Complex focal values were identified and unpacked in a conceptual model to illustrate the current conservation situation, and to guide the formulation of mitigating strategies.

Natural Values

The **rivers and riparian zones** focal value includes all river channels, watercourses, and the associated buffer zone supporting riparian fauna and flora assemblages. Included are seasonal tributaries, seeps, wetlands and springs. Indigenous invertebrate, fish and vegetation species composition have been selected as KEAs.

The **indigenous fish** of the Cederberg Complex include various threatened and highly endemic fish species, including the Doring fiery redfin, Twee River redfin, fiery redfin, spotted rock catfish, and the Clanwilliam sandfish. A viable recruiting population and distribution range have been selected as KEAs.

The **Clanwilliam cedar tree** is a highly endemic and Critically Endangered conifer species facing numerous environmental and anthropogenic challenges. Seedling survival and the number of adult trees have been selected as KEAs.

A healthy **fynbos** and **succulent karoo vegetation mosaic** supports numerous fauna and flora species. The highly intact and well-connected nature of this vegetation mosaic promotes ecological functioning and resilience. Fire regime, particularly frequency, season and size, as well as indigenous plant species composition and corridor connectivity are KEAs.

HERITAGE VALUES

Palaeontological heritage includes fossil deposits and glacier floor remains. **Pre-colonial** heritage includes rock art and artefacts, and **historical structures** are those

that reflect the history of colonial occupation and activities since the early 1800s. The condition (state of alteration) is the main KEA considered.

Human Well-being Values

In partnership with various role players, the Cederberg Complex supports a substantial number of sustainable **tourism-based livelihoods** and contributes significantly to **social** and **economic development.** Additionally, **responsible resource utilisation** and **respect and care for the natural environment** have all been identified as human well-being values for the Cederberg Complex. The benefits provided by these values include green jobs, enterprise development, capacity and skills development (training), sustainable natural resource use opportunities (consumptive and non-consumptive), and increased environmental awareness. The key measureable attribute is typically the number of opportunities or interventions offered (for example, number of jobs, number of training interventions, *etc.*).

Goals for the Cederberg Complex World Heritage Site

Ten goals have been formulated to maintain or enhance the focal values of the Cederberg Complex. An asterisk * indicates the availability of detailed information is section 2.6.

1. By 2029, all riparian zones within the Cederberg Complex are maintained at 90-99% indigenous vegetation cover, have an instream macro-invertebrate South African Scoring System score above 8, and viable* indigenous fish communities are present in all nine priority rivers identified for fish conservation.
2. By 2029, the Cederberg Complex supports viable* recruiting populations and distribution ranges of all five priority indigenous fish species.
3. By 2029, the augmented Clanwilliam cedar tree recruitment rate is between 11-59% and the total number of adult* trees has increased to 20 000 individuals.
4. By 2029, the fire regime of the Cederberg Complex* supports viable fynbos veld age and size categories.
5. By 2029, two priority properties will have signed in perpetuity stewardship agreements and another two as biodiversity agreements or higher, in both the fynbos and succulent karoo vegetation mosaics.
6. By 2029, both the fynbos and succulent karoo vegetation mosaics within the Cederberg Complex will comprise 90-99% indigenous vegetation.
7. By 2029, human disturbances to heritage features within the Cederberg Complex have been limited, such that baseline conditions have been maintained, or where feasible, restored or improved upon.
8. By 2029, the Cederberg Complex will support sustainable tourism-based livelihoods and in partnership with role players contribute to economic and social upliftment in and around the complex.
9. By 2029, access to and utilisation of natural resources within the Cederberg Complex are in accordance with CapeNature policy and procedures.

10. By 2029, the Cederberg Complex environmental education, awareness and interpretation programme will promote all* ecological and human well-being values.

Sensitivity, Zonation, Zone of Influence and Expansion

The sensitivity analysis of the Cederberg Complex resulted in 91% of the overall area being identified as highly sensitive, predominantly due to the extent of steep slopes and perennial rivers. Due to this sensitivity, in combination with its extensive size and rural location, large areas of the Cederberg Complex are zoned as Wilderness and Primitive. Provision is also made for tourism and management activities through Nature Access and Development zones. The dominant factor affecting the Cederberg Complex through its Zone of Influence assessment is a high vegetation flammability index, affecting 65% of the surrounding zone. This holds a significant biodiversity and infrastructure risk due to the likelihood of fires starting outside of the protected area and moving into the Cederberg Complex. Illegal and unregulated resource use is an additional noteworthy factor, affecting 10.5% of the surrounding zone. This includes unregulated overgrazing by livestock and illegal resource collection, for example buchu poaching.

The expansion priorities for the Cederberg Complex are aimed at securing additional stewardship sites in support of corridor connectivity and increased conservation security through upgrading existing stewardship contract sites.

Strategic Implementation Framework

A thorough analysis of the Cederberg Complex's conservation situation, inclusive of the biological, social, economic, cultural and institutional systems that affect the protected area's focal values, formed the basis for developing conservation strategies and action plans. The aim was to find opportunities and strategic points where intervention is feasible and likely to have the biggest positive impact towards stated conservation outcomes. CapeNature will lead the implementation of the management plan, although achieving the Cederberg Complex's vision requires coordinated effort between various key external stakeholders. The Cederberg Complex conservation strategies include:

Strategy 1: Address Invasive Alien Fish control on priority rivers within the Cederberg Complex and its Zone of Influence.

Strategy 2: Address Invasive Alien Species control through the development of an Invasive Alien Species control plan for the Cederberg Complex.

Strategy 3: Through partnership, enhance the management and protection of the fynbos, Clanwilliam cedar tree and heritage values of the Cederberg Complex.

Strategy 4: Through partnership, share, evaluate and enhance the management and protection of the Cederberg Complex heritage values both internally and externally.

Strategy 5: The CapeNature Natural Resource Utilisation policy and Permit System must provide usage categories and guidelines for Cultural, Medicinal and Spiritual use.

Strategy 6: Incorporate protected area priorities and Zone of Influence outputs into municipal Integrated Development Plans and Spatial Development Frameworks.

Strategy 7: Promote the Cederberg Complex as a World Heritage Site and unique Wilderness destination for Spiritual Health.

Strategy 8: Inspire all stakeholders about the significance of indigenous fish species within the Cederberg Complex and its Zone of Influence.

Strategy 9: Through partnership, address Invasive Alien Plant clearing and compliance within the Zone of Influence of the Cederberg Complex.

Strategy 10: Enhance the management and restoration of the Clanwilliam cedar tree within the Cederberg Complex.

Strategy 11: Inspire all stakeholders about the significance of all heritage values within the Cederberg Complex.

Strategy 12: Through partnership, address illegal and un-sustainable resource utilisation practices which includes domestic animals, extra-limital game, poaching, overgrazing and land degradation within the Cederberg Complex and its Zone of Influence.

Strategy 13: Through partnership, address agricultural water use best practice and compliance with landowners within the Krom/Matjies/Driehoeks River systems.

Strategy 14: Enhance the protection and ecological functioning of the Cederberg core corridor through protected area consolidation and stewardship.

Strategy 15: Enhance and raise awareness of all ecological values within the Cederberg Complex and where appropriate its Zone of Influence.

Strategy 16: Through partnership, address socio-economic challenges of surrounding communities within the Zone of Influence of the Cederberg Complex.

Strategy 17: Support economic development through skills & capacity building and identifying sustainable work opportunities for surrounding communities within the Cederberg Complex and its Zone of Influence.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

STAKEHOLDER ENGAGEMENT REPORT (Appendix 7.1)

LIST OF MAPS (Appendix 7.2)

ABBREVIATIONS

ASPT	Average Score Per Taxon
CFR	Cape Floristic Region
CFRPA	Cape Floral Region Protected Areas
CMP	Conservation Measures Partnership
DEAT	Department of Environmental Affairs and Tourism (Old National)
DWAF	Department of Water Affairs and Forestry (Old National)
EPWP	Expanded Public Works Programme
FTE	Full Time Equivalent
GCBC	Greater Cederberg Biodiversity Corridor
GCFPA	Greater Cederberg Fire Protection Association
GTUP	Game Translocation and Utilisation Policy
IAP	Invasive Alien Plant
IAS	Invasive Alien Species
ICM	Integrated Catchment Management
IDP	Integrated Development Plan
IUCN	International Union for Conservation of Nature
KEA	Key Ecological Attribute
Ma	Million Years
MCA	Mountain Catchment Area
METT-SA	Management Effectiveness Tracking Tool for South Africa
MIS	Management Information System
MOU	Memorandum of Understanding
MTEF	Medium Term Expenditure Framework
NEMA	National Environmental Management Act
NEM: BA	National Environmental Management: Biodiversity Act
NEM: PAA	National Environmental Management: Protected Areas Act
NFEPA	National Freshwater Ecosystem Priority Areas
NRUG	Natural Resource User Group
PA	Protected Area
PAAC	Protected Area Advisory Committee
PAMP	Protected Area Management Plan
SABAP	South African Bird Atlas Project
SAM	Strategic Adaptive Management
SANBI	South African National Biodiversity Institute
SDF	Spatial Development Framework
SMME	Small, Medium and Micro Enterprises
SOG	Standard Operating Guideline
TMG	Table Mountain Group
WCDM	West Coast District Municipality
WCBSP	Western Cape Biodiversity Spatial Plan
WCPAES	Western Cape Protected Area Expansion Strategy
WWF-SA	World Wide Fund for Nature-South Africa
ZOI	Zone of Influence

1 INTRODUCTION

1.1 Purpose of Protected Area Management in the Western Cape

In compliance with the National Environmental Management: Protected Areas Act (NEM: PAA) (Act No. 57 of 2003), CapeNature is required to develop protected area management plans (PAMPs) for each of its protected areas (PAs). Protected area management planning is guided by the NEM: PAA, associated Norms and Standards for the management of protected areas in South Africa, regulations in terms of the NEM: PAA, and relevant requirements as set out in the National Environmental Management: Biodiversity Act (NEM: BA) (Act No. 10 of 2004) and the National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 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 natural and cultural historic heritage concerned in a manner which is consistent with the objectives of NEM: PAA, and for the purpose for which the protected area was declared.

PAs 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. Additionally, the management planning approach and structure of the management plan is guided by international best practice as set by the International Union for Conservation of Nature (IUCN) World Commission on Protected Areas, 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 2011).

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. The management plan facilitates the integration of the various components and functions within the organisation and directs the enabling environment towards the achievement of PA 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 PAs 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; and
- Performance indicators and accountability measures that provide for regular review of outcomes.

In working towards CapeNature's vision of conserving nature for a sustainable future, CapeNature 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 Cederberg 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 of planning rather than at the end of implementation.
- Invest in management response appropriate to the risk.
- Adapt strategies based on lessons learnt; 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 PA 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
- Adaptation.

SAM systematically evaluates results and uses this information in a community of practice (CMP 2013). It 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 (CCNet 2012). SAM

bridges management and decision science. When applied in this way, management intervention design elicits scientifically measurable results, the analysis of which informs future management decisions.

PA management planning requires a broad, holistic or strategic approach 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.* goals and objectives) of the protected area, develops management options that are then implemented, and evaluates management options in relation to progress towards goals and objectives (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 (CMP 2013).

SAM enables CapeNature to:

- Plan to manage complexity in a changing environment towards predetermined 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 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. It is based on a foundation where natural and cultural assets (also called features or, here, 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. In keeping with IUCN best practice, this management plan refers to conservation targets (CMP 2013) as 'values'.

The framework further assesses the health or condition (hereafter referred to as viability) of values, and identifies and ranks threats to values. This forms the basis for establishing long-term goals, or the 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 follows a systematic approach comprising 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 Cederberg Complex over time.

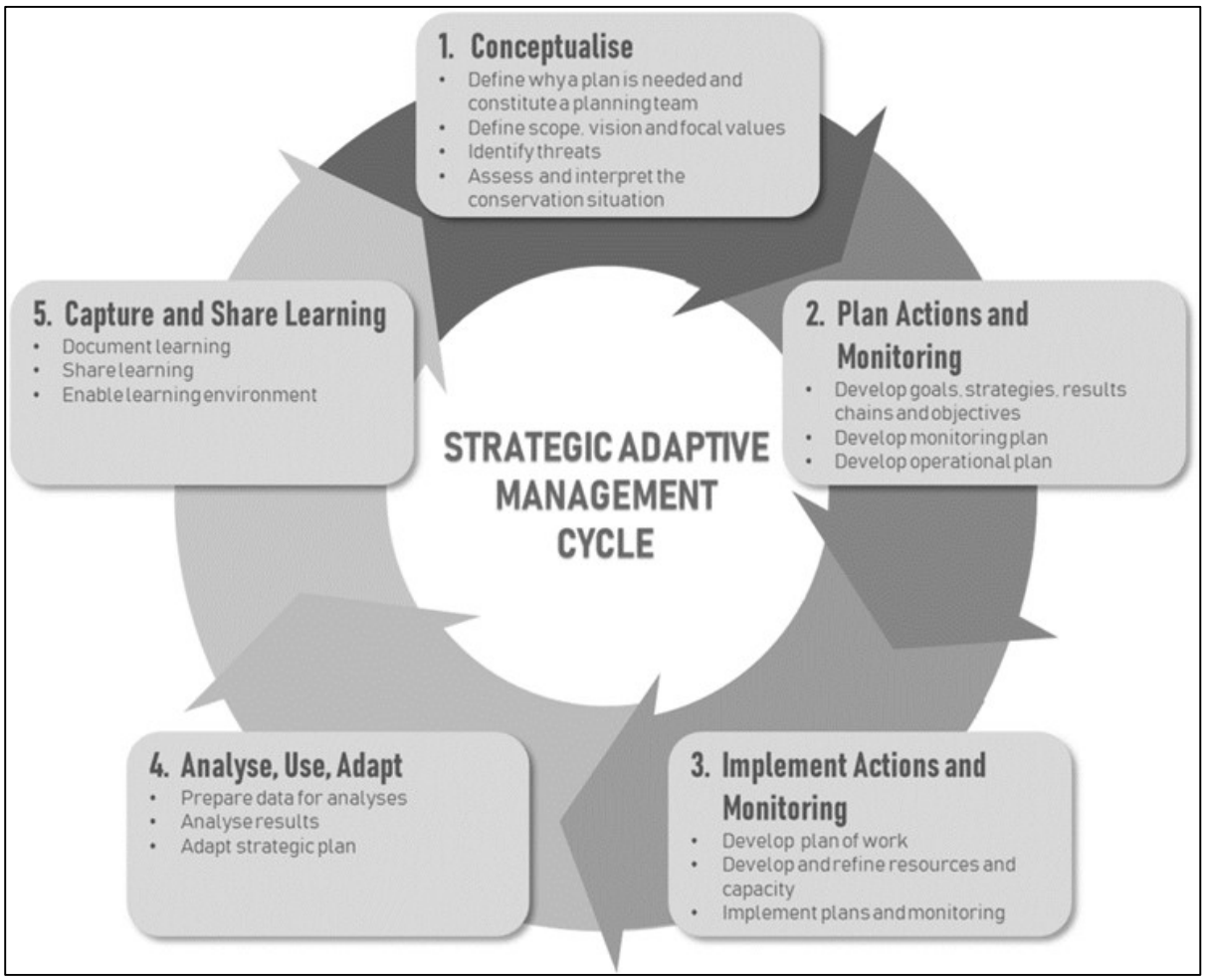


Figure 1.1: Strategic Adaptive Management Framework adapted from The Open Standards for the Practice of Conservation (CMP 2013).

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) (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?

PA 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 PA management follows a process that has six distinct stages or elements:

- it begins with understanding the **context** of existing values and threats,
- and progresses through **planning**,
- and allocation of resources (**inputs**),
- and as a result of management actions (**processes**),
- which eventually produces products and services (**outputs**),
- that result in impacts or **outcomes** (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 and adapted to South African conditions (METT-SA), is implemented to assess management effectiveness of the protected area at the strategic level. It does not replace fine scale monitoring and evaluation of specifics; rather the assessment is informed by the results of fine scale monitoring.

Strategically, CapeNature uses METT-SA results of its statutory protected area network to measure ecosystem health by the percentage PA coverage (ha's) in the 'Sound Management' category (*i.e.* a METT-SA result of 67% and above), as well as effectiveness of PA support mechanisms or structures.

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 five-year intervals.

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

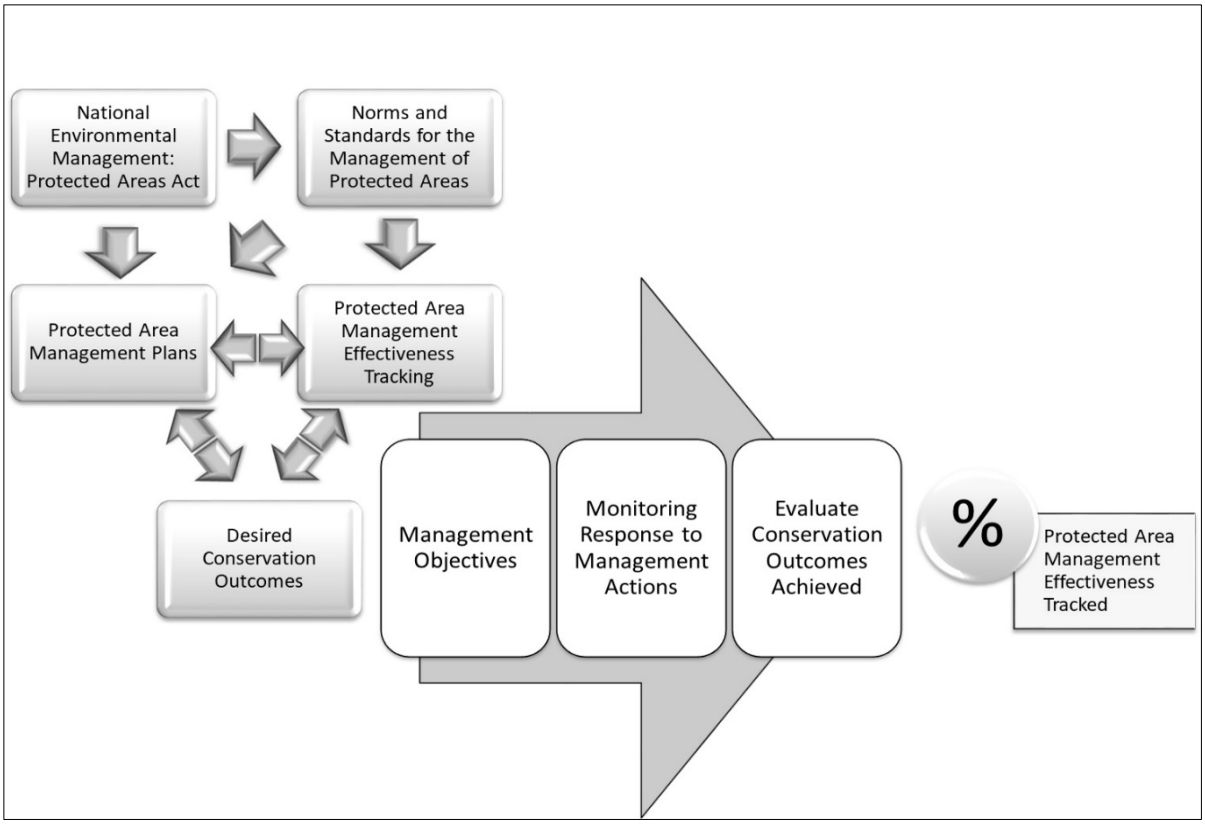


Figure 1.2: CapeNature Monitoring and Evaluation Framework.

1.5 Stakeholder Engagement

Participatory planning and management is needed in order to mainstream 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 (World Congress 2016). Integration of protected areas into the wider landscape is necessary and management must promote participation by relevant stakeholders.

Stakeholder engagement and understanding the context of the Cederberg Complex are two key processes that informed the planning process at the outset. Stakeholder engagement identifies and engages entities in dialogue in an attempt to determine what social and/or environmental issues matter to them, to communicate the purpose of the protected area and to promote participatory planning. Stakeholder engagement promotes transparency of planning processes and outcomes. It facilitates 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.

1.5.1 Participatory Planning and Management

During 2017-2018 a series of expert-facilitated stakeholder workshops, coordinated and hosted by CapeNature, were held. A range of stakeholders representing individuals or agencies with an interest in, and/or knowledge/expertise of the

landscape, and individuals or agencies with the capability to support the implementation of the Cederberg Complex PAMP were involved. Stakeholders included landowners and land managers (private and communal), and relevant land or resource management authorities. Workshops were aimed at developing a strategic framework for the Cederberg Complex to help coordinate efforts in the landscape towards a common Vision. The desired outcomes were to capacitate stakeholders in the understanding of the natural and cultural focal values in the Cederberg landscape and to identify mechanisms to maintain those values over time.

The outcomes of the above-mentioned process were precursors to the site-specific management planning process for the Cederberg Complex and formed the foundation for smaller working groups towards the development of the management plan. The Cederberg Complex management planning process was further facilitated by the core planning team comprised of CapeNature Conservation Managers, Regional Ecologist, Ecological Coordinator, Community Conservation Managers and Senior Management. A series of workshops and core planning team meetings were held with relevant internal and external stakeholders.

1.5.1.1 Key Stakeholder Groups

Key stakeholder groups engaged with include:

Landowners and neighbours

- CapeNature
- WWF-SA
- Surrounding communities
- Private landowners

Government departments

- Department of Water and Sanitation
- Western Cape Department of Agriculture
- Heritage Western Cape
- West Coast District Municipality
- Cederberg Municipality

Landscape initiatives

- Greater Cederberg Biodiversity Corridor (GCBC)
- Cederberg Tankwa Wilderness Corridor

Conservancies

- Cederberg Conservancy

Volunteer groups

- Eastern Cederberg Rock Art Group

Fire Protection Agencies

- Greater Cederberg Fire Protection Association (GCFPA)

Academic and Research Institutions

- South African Environmental Observation Network
- South African Institute for Aquatic Biodiversity
- University of Stellenbosh
- University of the Witwatersrand
- University of Cape Town

1.5.1.2 Workshops

Stakeholder Workshops had the following key themes:

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

1.5.1.3 Working Groups and Other Input Opportunities

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

- Share workshop outputs and progress and/or test the rationale of situation analyses, for example meetings with Scientific Services related to taxon and habitat specific planning or to address knowledge gaps in areas where needed (e.g. information relating to the Table Mountain Aquifer);
- Share workshop outputs with specialists and/or to test the rationale of situation analyses, for example engagements with archaeologist, palaeontologist and various ecologists;
- Engagement with various partners to obtain information on heritage and human well-being;
- Facilitate information sessions and registration of interest with community members.

The following established structures facilitate stakeholder engagement within the Cederberg Complex

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

Enhancing engagement and participation by relevant stakeholders around the Complex is a key focus area going forward. Current structures for stakeholder engagement include:

- Cederberg Complex Protected Area Advisory Committee
- Cederberg Conservancy
- Cederberg Heritage Route
- Clanwilliam Tourism
- Greater Cederberg Biodiversity Corridor
- Greater Cederberg Fire Protection Association

1.5.2 Stakeholder 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 stakeholder participation of the draft management plan was initiated by invitation to the public via the media (advertisements in two local newspapers), and notifications to approximately 110 stakeholders via e-mail, telephone and personal invitation, to register their interest. A stakeholder register, maintained by the reserve management committee, lists registered interested and affected parties.

Furthermore, the draft management plan was placed at public places such as the public libraries in Citrusdal and Clanwilliam. The draft management plan was also available at CapeNature offices at Algeria and Matjiesrivier and available on the CapeNature website. Written comment was invited on the draft management plan for a period of 30 days. The stakeholder participation process was initiated on the 16th of November 2018 and was concluded on the 11th of January 2019.

Registered interested and affected parties were invited to a public meeting and provided the opportunity to raise concerns and provide comment. Three meetings were held in Clanwilliam, Wupperthal and Citrusdal. In total 19 external stakeholders attended these meetings. Based on a comprehensive stakeholder engagement process 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 Appendix 7.1.

2 THE STRATEGIC MANAGEMENT FRAMEWORK FOR THE CEDERBERG COMPLEX

2.1 Management Intent and Desired State

This section provides the basis for the management, development and operation of the PA over a timeframe of 10 years. It epitomises the vision, purpose, values and desired state or goals of the Cederberg Complex and summarises threats and challenges.

Establishing the desired state of the Cederberg Complex was done by following the Open Standards' step-wise process whereby the planning team was taken from clarifying the purpose of the PA, to assessing values and key attributes, threats and drivers, to describing the ultimate condition that PA management is working to achieve in line with the purpose for which it is declared. The process facilitated enhanced understanding and defining aspects of the biodiversity and cultural historic heritage to effectively manage the site and mitigate threats at the appropriate scope and scale. The process used the best available knowledge of the biodiversity, cultural historic heritage and key attributes to test assumptions of responses to anthropogenic stressors, and socio-economic and governance factors.

Appreciating that protected areas establish biodiversity conservation as a foundation of a sustainable economy in terms of creating access, benefits and opportunities, the planning approach aimed to assess the current condition of values as a baseline against which to measure condition over time. In the case of international conventions such as Natural World Heritage, management focus is aimed at the maintenance of outstanding universal values. Furthermore, an effectively and equitably managed

natural resource base is the foundation towards the Convention on Biological Diversity'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 PAMP.

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 (WCBSP) and landscape ecology to guide conservation efforts beyond the boundaries of the Cederberg Complex to address threats and inadequacies in PA 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 (CMP 2013).

2.2 Scope and Vision

The planning scope of the Cederberg Complex is defined both conceptually and spatially, and guided by existing land use plans, spatial development plans and the WCBSP. The Cederberg Wilderness, Matjiesrivier Nature Reserve and Hexberg State Forest form the core conservation area within the Greater Cederberg Biodiversity Corridor (GCBC) landscape conservation initiative. The Cederberg Complex planning scope acknowledges the conservation efforts within the Zone of Influence (ZOI) surrounding the Cederberg Complex, in particular privately-owned stewardship sites. These conservation efforts all contribute towards building climate change resilience, enhancing water security, conserving the unique natural and cultural history and contributing meaningfully to tourism and socio-economic development in the area.

The vision of the Cederberg Complex is**: A World Heritage Site with a wilderness character built on community and partnership, managed to sustain and promote water, biodiversity, ecotourism and heritage, for the benefit of all.**

2.3 Purpose

The purposes for the declaration of an area as a protected area provide the foundation on which all future actions are based and is in line with the vision, mission and strategic objectives of CapeNature and the objectives of NEM: PAA.

According to Section 17 of NEM: PAA, the purpose of declaring protected areas are:

(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 protected areas comprising the Cederberg Complex were declared in terms of NEM: PAA and contribute to all of the above.

The Cape Floral Region Protected Areas (CFRPA) was proclaimed as a World Heritage Site based on the outstanding universal value of its significant on-going ecological and biological processes and the presence of some of the world's most important natural habitats for the conservation of biodiversity, meeting criteria (ix) and (x), respectively (DEAT 2003). The widespread and exceptional plant richness and endemism of the Cape Floristic Region (CFR) is related to its biophysical diversity. Carefully considered PAs, representative of all eight phytogeographic centres of endemism, were selected as the World Heritage Sites representative of this unique and globally significant region (DEAT 2003). The Cederberg Complex constitutes one of these, namely the North-Western Phytogeographic Centre of Endemism (Goldblatt & Manning 2000).

Moreover, seven of the eight inscribed protected area complexes in the CFRPA World Heritage Site 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) indicate that 27 vegetation types that are not conserved anywhere else in the CFR are conserved by the inscribed CFRPA World Heritage Site. A further 48 of the total 119 vegetation types currently recognised in the CFR (Mucina & Rutherford 2006), and that are not protected elsewhere, are protected by the extended CFRPA World Heritage Site bringing the total to 75 of 119 CFR vegetation types, protected nowhere else in the world.

The Cederberg- and Groot Winterhoek Wilderness, 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 south-western Cape.

2.4 Focal Values

PA 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 Cederberg 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 intangible or non-material human well-being 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 may include the physical, cultural and/or historic features from which human well-being values are derived.
- Human well-being values are the intangible or non-material values derived from tangible values, and which collectively represent the array of human well-being 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: drinking water, nature-based livelihoods, and spiritual and physical health.

The focal natural values selected for the Cederberg Complex are: Rivers and Riparian Zones, Indigenous Fish, Clanwilliam Cedar Tree, Fynbos Mosaic, Succulent Karoo Mosaic as well as Palaeontological Heritage, Pre-colonial Heritage and Historical Structures.

Human well-being benefits follow from the Cederberg Complex's natural and cultural assets including: security from natural disasters, water provision, economic and social benefits and opportunities, access to natural resources, respect and care for the natural environment and cultural and spiritual benefits.

All focal values are listed below and briefly described in Table 2.1. Those values considered to be 'nested' within, or benefitting from the conservation of the main values are noted, including some of the key human well-being values derived. Importantly, through a process of assessing the viability (health) of each focal value, its current status was determined. Human well-being values/benefits are those components of well-being affected by the status of tangible natural and cultural values, their viability 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 its status forms the basis for setting goals, carrying out conservation actions, and measuring effectiveness.

Overall, two focal values were determined to be in a poor state and require active management and restoration efforts to ensure they are not lost or become entirely unrestorable, these are indigenous fish and historical structures. The following focal values are currently in a fair state, meaning that aspects of their health or integrity are outside of an acceptable range of variation due to historical degradation, and active intervention is required to improve their status: rivers and riparian zones, Clanwilliam cedar tree, fynbos mosaic and palaeontological heritage. Meanwhile, the Cederberg Complex's succulent karoo vegetation and pre-colonial heritage features are currently in good condition, primarily requiring maintenance-level interventions. Section 4 provides more detail on focal value selection, viability ratings, and human well-being.

Table 2.1: Summary of the Cederberg Complex focal values and viability (2018).

Focal Values	Description, nested values & associated human well-being values	Current Status
Rivers and Riparian Zones	**Description:** Rivers and riparian zones value includes the river channel and associated buffer that supports riparian fauna and flora assemblages. Included are seasonal tributaries, sponges, seeps, wetlands and springs. **Nested values of note:** Indigenous fish; freshwater invertebrates; riparian vegetation; riparian fauna *e.g.* Namib Long-eared bat; seeps; wetlands; springs; aquifers. **Associated/Key human well-being value(s):** Security from Natural Disasters; Health & Sanitation; Economic Development; Responsible Utilisation of Natural Resources; Respect and Care for the Natural Environment; Tourism-based Livelihoods; Spiritual Health; Cultural Identity.	**Fair**
Indigenous Fish	**Description:** Various indigenous, threatened and highly endemic fish species associated with the Olifants-Doring River System that occur within the Cederberg Complex. **Nested values of note:** All other indigenous fish, for example Clanwilliam yellowfish, not specifically identified as focal values; freshwater invertebrates. **Associated/Key human well-being value(s):** Security from Natural Disasters; Health & Sanitation; Economic Development; Responsible Utilisation of Natural Resources; Respect and Care for the Natural Environment; Tourism-based Livelihoods; Spiritual Health; Cultural Identity.	**Poor***
Clanwilliam Cedar Tree	**Description:** A highly endemic, Critically Endangered conifer species that is facing numerous environmental and anthropogenic challenges. It is synonymous with the Cederberg and grows throughout the Cederberg Mountain range, at mid to high altitude, among rocky outcrops. **Nested values of note:** Possible species specific invertebrate and mammal associations. **Associated/Key human well-being value(s):** Economic Development; Social Development; Respect and Care for the Natural Environment; Tourism-based Livelihoods; Spiritual Health; Cultural Identity.	**Fair**
Fynbos Mosaic	**Description:** A healthy fynbos mosaic and vegetation structure supports numerous fauna and flora species. Supported by intact connectivity it promotes ecological functioning and resilience. The fynbos vegetation mosaic in the Cederberg Complex includes seven vegetation types that include among other shale, quartzite, sandstone, altimontane, riparian and freshwater types. **Nested values of note:** Various eco-typical faunal species e.g. grey rhebok; rare/endangered/endemic plants, example snow protea that grows within the Western Altimontane Sandstone Fynbos vegetation type; six associated vegetation types; Leopard; Verreaux's Eagle. **Associated/Key human well-being value(s):** Security from Natural Disasters; Health & Sanitation; Economic Development; Social Development; Responsible Utilisation of Natural Resources; Respect and Care for the Natural Environment; Tourism-based Livelihoods; Spiritual Health; Cultural Identity.	**Fair**

Focal Values	Description, nested values & associated human well-being values	Current Status
Succulent Karoo Mosaic	**Description:** A healthy succulent karoo mosaic and vegetation structure supports numerous fauna and flora species. Supported by intact connectivity it promotes ecological functioning and resilience. The succulent karoo vegetation mosaic includes three vegetation types that include quartzite, scrubland and vygieveld elements. **Nested values of note:** Various eco-typical faunal species; rare/endangered/endemic plants; three associated vegetation types Leopard; Verreaux's Eagle. **Associated/Key human well-being value(s):** Security from Natural Disasters; Health & Sanitation; Economic Development; Social Development; Responsible Utilisation of Natural Resources; Respect and Care for the Natural Environment; Tourism-based Livelihoods; Spiritual Health; Cultural Identity.	**Good**
Palaeontological Heritage (fossils & glacier floors)	**Description:** Palaeontological heritage comprises intact fossil deposits and glacier floor remains that provide a glimpse into geological time and offers a timeline into the past. **Nested values of note:** Fossilised fauna and flora; geological history. **Associated/Key human well-being value(s):** Economic Development; Social Development; Respect and Care for the Natural Environment; Tourism-based Livelihoods; Spiritual Health; Cultural Identity.	**Fair**
Pre-Colonial Heritage (rock art & artefacts)	**Description:** Pre-colonial heritage includes intact rock art and artefacts that provide a glimpse of human presence and activities within the area over the last 500 000 years, up until the arrival of European settlers. **Nested values of note:** Stone Age history and human interaction. **Associated/Key human well-being value(s):** Economic Development; Social Development; Respect and Care for the Natural Environment; Tourism-based Livelihoods; Spiritual Health; Cultural Identity.	**Good**
Historical Structures	**Description:** Historical structures reflect the history of colonial occupation and activities within the area since the early 1800s. **Nested values of note:** Colonial history and human interaction. **Associated/Key human well-being value(s):** Economic Development; Social Development; Care and Respect for the Environment; Tourism-based Livelihoods; Spiritual Health; Cultural Identity.	**Poor**

* A summary of the current status of various identified indigenous fish species within the priority rivers within the Cederberg Complex.

Through the planning process the following core service areas have been identified as priorities for the Cederberg Complex (Table 2.2), in that they are essential to the effective execution of the Cederberg Complex PAMP and achievement of its goals.

Table 2.2: Core Service Areas for the Cederberg Complex.

Core Service Areas	Description & associated benefits	Current Status
Tourism-based Livelihoods; Social Development; Economic Development	**Description:** The Cederberg Complex supports sustainable tourism-based livelihoods and in partnership with role players contribute to local economic and social upliftment. **Nested values:** Intact ecosystems; water; plants; non-consumptive resources; wilderness. **Associated benefits:** Green jobs; capacity and skills development; training opportunities; existing tourism infrastructure.	**Fair**
Responsible Utilisation of Natural Resources	**Description:** Provide access to and promote utilisation of consumptive and non-consumptive natural resources in the Cederberg Complex, underpinned by structures that promote and enable responsible, sustainable use. **Nested values:** Water; plants; non-consumptive resources; wilderness. **Associated benefits:** For recreational; economic; cultural; medicinal and spiritual use.	**Fair***
Respect and Care for the Natural Environment	**Description:** Provide an effective environmental education, awareness and interpretation programme that supports the values of the Cederberg Complex and promotes respect and care for the natural environment. **Nested values:** Intact ecosystems; advocacy; education and awareness. **Associated benefits:** Knowledge; respect and care for the Cederberg Complex.	**Fair**

*Good for non-consumptive resources but poor for consumptive natural resources.

2.5 Threats

Protected area management aims to mitigate threats to values. Threats are factors or processes that threaten, erode or inhibit values and their key attributes, from within or outside the protected area. Threats can also be factors within a management authority that undermines protected area values and inhibits the pursuit of the desired state. Threats could also be human activities as well as natural phenomena altered by human activities.

Through the planning process the direct threats and contributing factors are identified and unpacked in detail to understand and plan effective mitigation strategies. Critical threats are rated according to scope, severity and irreversibility to facilitate the allocation of limited resources, simplify complex scenarios and provides a systematic decision support method to focus efforts. Protected area management strives to remove or minimise these critical threats as best possible. Table 2.3 provides a summary of the focal values for the Cederberg Complex, whereby Table 2.4 provides a summary of the critical threats, putting the Cederberg Complex values at greatest risk. Section 4.3 provides more detail on the Cederberg Complex threats.

Table 2.3: Summary of critical threats highlighting the focal values of the Cederberg Complex at greatest risk.

Focal Values	Critical Threats	Threat Rating
Artificial Historical Structure	Fire damage to heritage values; Illegal alterations of historical structures; Lack of awareness of values; Natural damage to heritage features	Very High
Clanwilliam Cedar Tree	Climate change; High veld fire frequency (too many fires); Lack of awareness of values	High
Fynbos Mosaic	Climate change; High veld fire frequency (too many fires); Inappropriate agricultural development (Corridor Connectivity); Inappropriate infrastructure development (Corridor Connectivity); Invasive alien plants; Lack of awareness of values; Overgrazing; Poaching; Pollution; Recreation	High
Rivers and Riparian Zones	Alteration of riparian zones and beds; Diversion of flow; Invasive alien fish; Invasive alien plants; Pollution; Recreation; Surface water abstraction; Weirs (barriers)	Medium
Indigenous Fish	Alteration of riparian zones and beds; Diversion of flow; Invasive alien fish; Invasive alien plants; Lack of awareness of values; Pollution; Recreation; Surface water abstraction; Weirs (barriers)	Medium
Palaeontological Heritage	Alterations of fossil beds; Illegal removal of fossils and artefacts; Lack of awareness of values;	Medium
Pre-colonial Heritage	Copy and defacing of rock art; Fire damage to heritage values; Illegal removal of fossils and artefacts; Lack of awareness of values; Natural damage to heritage features	Medium
Succulent Karoo Mosaic	Climate change; Gravel pits; High veld fire frequency (too many fires); Inappropriate agricultural development (Corridor connectivity); Invasive alien plants; Overgrazing	Medium

Table 2.4: Summary rating of key threats for the Cederberg Complex.

Threats	Associated Values	Summary Threat Rating
Invasive Alien Fish	Rivers and Riparian Zones; Indigenous Fish.	Medium
Surface Water Abstraction	Rivers and Riparian Zones; Indigenous Fish.	Medium
High Veld Fire Frequency (Too Many Fires)	Clanwilliam Cedar Tree; Fynbos Mosaic.	High
Fire Damage to Heritage Values	Palaeontological Heritage; Pre-colonial Heritage; Historical Structures.	High
Inappropriate Agricultural Development (Corridor Connectivity)	Fynbos Mosaic; Succulent Karoo Mosaic.	Low
Invasive Alien Plants	Fynbos Mosaic; Succulent Karoo Mosaic; Rivers and Riparian Zones.	Low

Overgrazing	Fynbos Mosaic; Succulent Karoo Mosaic.	Low
Copying and Defacing of Rock Art	Pre-colonial Heritage.	Low
Alteration of Fossil Beds	Palaeontological Heritage.	Low
Illegal Removal of Fossils and Artefacts	Palaeontological Heritage; Pre-colonial Heritage.	Medium
Illegal Alteration of Historical Structures	Historical Structures.	High
Natural Damage to Heritage Features	Historical Structures.	High
Lack of Awareness of Values	Indigenous Fish; Clanwilliam Cedar Tree; Fynbos Mosaic; Heritage; Responsible Resource Utilisation; Respect and Care for the Natural Environment.	High

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 adaptive management itself. Goals are underpinned by strategies, objectives and indicators.

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 focal values and their key attributes. The goals set for the Cederberg Complex include:

1. By 2029, all riparian zones within the Cederberg Complex are maintained at 90-99% indigenous vegetation cover, have an instream macro-invertebrate South African Scoring System score above 8, and viable* indigenous fish communities are present in all nine priority rivers identified for fish conservation.
   *1 Boskloof = Very Good; *2 Heks = Fair; *3 Rondegat = Very Good; *4 Jan Dissels = Fair; *5 Driehoeks = Very Good; *6 Matjies = Good; *7 Krom = Good; *8 Heks Tributary = Very Good; *9 Doring = Fair.
2. By 2029, the Cederberg Complex supports viable* recruiting populations and distribution ranges of all five priority indigenous fish species.
   *1 Doring Fiery Redfin = Fair; *2 Fiery Redfin = See desired rating per river; *3 Twee River Redfin = Very Good; *4 Clanwilliam Sandfish = Good; *5 Spotted Rock Catfish = Very Good.
3. By 2029, the augmented Clanwilliam cedar tree recruitment rate is between 11-59% and the total number of adult* trees has increased to 20 000 individuals.
   *Adult = those that can be reliably identified on aerial imagery.
4. By 2029, the fire regime of the Cederberg Complex * supports viable fynbos veld age and size categories.
   *Excluding Swartruggens Quartzite Karoo areas.
5. By 2029, two priority properties will have signed in perpetuity stewardship agreements and another two as biodiversity agreements or higher, in both the fynbos and succulent karoo vegetation mosaics.

6. By 2029, both the fynbos and succulent karoo vegetation mosaics within the Cederberg Complex will consist of 90-99% indigenous vegetation.
7. By 2029, human disturbances to heritage features within the Cederberg Complex have been limited, such that baseline conditions have been maintained, or where feasible, restored or improved upon.
8. By 2029, the Cederberg Complex will support sustainable tourism-based livelihoods and in partnership with role players contribute to economic and social upliftment in and around the complex.
9. By 2029, access to and utilisation of natural resources within the Cederberg Complex are in accordance with CapeNature policy and procedures.
10. By 2029, the Cederberg Complex environmental education, awareness and interpretation programme will promote all* ecological and human well-being values.
    *Indigenous Fish; *Clanwilliam Cedar Tree; *Fynbos Mosaic; *Heritage; *Responsible Resource Utilisation; *Respect and Care for the Natural Environment.

The social and economic context of the PA, including the positive and negative socio-economic impacts of management should be well-understood and adequately addressed in the 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. Table 2.5 provides a summary of the strategies and objectives identified for the Cederberg Complex. The Strategic Implementation Framework (section 5) provides detail on these strategies.

Table 2.5: Summary of strategies and objectives identified for the Cederberg Complex.

Threats Abated	Strategy Type	Strategy	Objectives
Invasive Alien Fish	Value Restoration & Threat Reduction	**Strategy 1:** Address invasive alien fish control on priority rivers within the Cederberg Complex and its Zone of Influence.	**Objective 1.1:** By 2022, CapeNature have prioritised rivers within the Western Cape Province for Invasive Alien Fish control.
Invasive Alien Plants	Value Restoration & Threat Reduction	**Strategy 2:** Address Invasive Alien Species control through the development of an Invasive Alien Species control plan for the Cederberg Complex.	**Objective 2.1:** By 2022, CapeNature have revised and implemented the Cederberg Complex Invasive Alien Species control plan.
High Veld Fire Frequency (Too Many Fires), Fire Damage to Heritage Values.	Behavioural Change & Enabling Condition Actions	**Strategy 3:** Through partnership, enhance the management and protection of the fynbos, Clanwilliam cedar tree and heritage values of the Cederberg Complex.	**Objective 3.1:** By 2020, CapeNature have obtained commitment from partners to audit and implement all Fire Management Unit Plans within the Zone of Influence of the Cederberg Complex.
			Objective 3.2: By 2022, CapeNature have revised and implemented the Cederberg Complex environmental education, awareness and interpretation programme to include a fire awareness theme.
Fire Damage to Heritage Values; Copying and Defacing of Rock Art; Alteration of Fossil Beds; Illegal Removal of Fossils and Artefacts; Illegal Alteration of Historical Structures; Natural Damage to Heritage Features.	Behavioural Change & Enabling Condition Actions	**Strategy 4:** Through partnership, share, evaluate and enhance the management and protection of the Cederberg Complex heritage values both internally and externally.	**Objective 4.1:** By 2022, CapeNature have revised and implemented the heritage management Standard Operating Guideline.
			Objective 4.2: By 2025, CapeNature have a revised and approved heritage management plan for the Cederberg Wilderness.
			Objective 4.3: By 2026, CapeNature have an organisational heritage agreement with Heritage Western Cape.
			Objective 4.4: By 2026, CapeNature in partnership with relevant role players, have developed and implemented a training programme to enhance heritage management within the organisation.
Lack of Knowledge and Understanding within the Zone of Influence of the Cederberg Complex on the Sustainable Use of Natural Resources.	Behavioural Change & Enabling Condition Actions	**Strategy 5:** The CapeNature Natural Resource Utilisation policy and Permit System must provide usage categories and guidelines for Cultural, Medicinal and Spiritual use.	**Objective 5.1:** By 2023, CapeNature have revised and implemented the Natural Resource Utilisation policy and Permitting System.

Threats Abated	Strategy Type	Strategy	Objectives
	Enabling Condition Actions	**Strategy 6:** Incorporate protected area priorities and Zone of Influence into municipal Integrated Development Plans and Spatial Development Frameworks.	**Objective 6.1:** By 2020, CapeNature have formalised a process of incorporating protected area priorities and Zone of Influence into municipal Integrated Development Plans and Spatial Development Frameworks.
General lack of understanding and appreciation of the World Heritage Site status and values.	Behavioural Change	**Strategy 7:** Promote the Cederberg Complex as a World Heritage Site and unique Wilderness destination for Spiritual Health.	**Objective 7.1:** By 2022, CapeNature have developed and implemented a media & marketing campaign to promote the wilderness and spiritual values of the Cederberg Complex World Heritage Site.
Invasive Alien Fish	Behavioural Change	**Strategy 8:** Inspire all stakeholders about the significance of indigenous fish species within the Cederberg Complex and its Zone of Influence.	**Objective 8.1:** By 2022, CapeNature have revised and implemented the Cederberg Complex environmental education, awareness and interpretation programme to include a fish theme.
Invasive Alien Plants	Value Restoration & Behavioural Change & Enabling Condition Actions	**Strategy 9:** Through partnership, address Invasive Alien Plant clearing and compliance within the Zone of Influence of the Cederberg Complex.	**Objective 9.1:** By 2021, CapeNature have prioritised neighbouring properties within the Zone of Influence of the Cederberg Complex for Invasive Alien Plant clearing and/or compliance action. **Objective 9.2:** By 2022, CapeNature have obtained commitment from partners to assist with Invasive Alien Plant clearing and compliance within the Zone of Influence of the Cederberg Complex.
	Value Restoration	**Strategy 10:** Enhance the management and restoration of the Clanwilliam cedar tree within the Cederberg Complex.	**Objective 10.1:** By 2023, CapeNature have developed and implemented a Clanwilliam cedar tree restoration plan.
Fire Damage to Heritage values; Copying and Defacing of Rock Art; Alteration of Fossil Beds; Illegal Removal of Fossils and Artefacts; General Lack of Cultural Knowledge and Understanding amongst Neighbours, Communities, Tourists, and CapeNature Staff; Clanwilliam Cedar Tree.	Behavioural Change	**Strategy 11:** Inspire all stakeholders about the significance of all heritage values within the Cederberg Complex.	**Objective 11.1:** By 2022, CapeNature have revised and implemented the Cederberg Complex environmental education, awareness and interpretation programme to include a heritage theme.

Threats Abated	Strategy Type	Strategy	Objectives
Overgrazing; Lack of Knowledge and Understanding within the Zone of Influence of the Cederberg Complex on the Sustainable Use of Natural Resources.	Behavioural Change & Enabling Condition Actions	**Strategy 12:** Through partnership, address illegal and un-sustainable resource utilisation practices which includes domestic animals, extra-limital game, poaching, overgrazing and land degradation within the Cederberg Complex and its Zone of Influence.	**Objective 12.1:** By 2020, CapeNature have ensured that all game farmers within the Zone of Influence of the Cederberg Complex are compliant with the Game Translocation and Utilisation Policy (GTUP).
			Objective 12.2: By 2023, CapeNature have obtained commitment from partners and landowners to address un-sustainable resource utilisation practices within the Cederberg Complex and its Zone of Influence.
Surface Water Abstraction	Behavioural Change & Enabling Condition Actions	**Strategy 13:** Through partnership, address agricultural water use best practice and compliance with landowners within the Krom/Matjies/Driehoeks River systems.	**Objective 13.1:** By 2022, CapeNature have supported the establishment of a Matjies/Krom/Driehoeks River water user's forum with relevant partners.
			Objective 13.2: By 2023, CapeNature have obtained commitment from partners and landowners to address agricultural water use best practice and compliance within the Krom/Matjies/Driehoeks River systems.
Inappropriate Agricultural Development (Corridor Connectivity)	Behavioural Change & Enabling Condition Actions	**Strategy 14:** Enhance the protection and ecological functioning of the Cederberg core corridor through protected area consolidation and stewardship.	**Objective 14.1:** By 2020, CapeNature have incorporated priority properties for stewardship into the revised Conservation Action Priority map.
			Objective 14.2: By 2028, CapeNature have secured stewardship agreements with eight or more priority properties and all properties of the Cederberg Complex have been declared under NEM: PAA.
Lack of Awareness of Values	Behavioural Change	**Strategy 15:** Enhance and raise awareness of all ecological values within the Cederberg Complex and where appropriate its Zone of Influence.	**Objective 15.1:** By 2026, CapeNature have developed and implemented an interpretation (signage) plan to raise awareness of all ecological values within the Cederberg Complex, and where applicable in the Zone of Influence.

Lack of Basic Infrastructure to Enable Economic and Social Development within the Greater Wupperthal Community; Lack of Training Opportunities for the Surrounding Communities; Lack of Ability Among the Youth to Utilise Available Opportunities for Social and Personal Growth.	Enabling Condition Actions	**Strategy 16:** Through partnership, address socio-economic challenges of surrounding communities within the Zone of Influence of the Cederberg Complex.	**Objective 16.1:** By 2022, CapeNature have facilitated the establishment, and have become an active member, of the Wupperthal Stakeholder Forum.
			Objective 16.2: By 2024, CapeNature have engaged with partners to identify and promote opportunities for economic development within the Zone of Influence of the Cederberg Complex.
Lack of Training Opportunities for the Surrounding Communities; Lack of Ability Among the Youth to Utilise Available Opportunities for Social and Personal Growth.	Enabling Condition Actions	**Strategy 17:** Support economic development through skills & capacity building and identifying sustainable work opportunities for surrounding communities within the Cederberg Complex and its Zone of Influence.	**Objective 17.1:** By 2021, CapeNature have collated recommendations from existing reports that support tourism livelihoods and economic development in the Zone of Influence of the Cederberg Complex.
			Objective 17.2: By 2023, CapeNature have developed and implemented a policy to guide capacity building and contractor development within communities located in the Zone of Influence of protected areas.
			Objective 17.3: By 2023, CapeNature have identified and prioritised viable economic development projects for implementation within the Cederberg Complex and its Zone of Influence.

3 PROTECTED AREA COMPLEX OVERVIEW AND BACKGROUND

3.1 Legal Status and Designation

The Cederberg Wilderness was initially proclaimed as a “Demarcated Forest” in 1897, under the Cape Forest Act (Act No. 28 of 1888), Notice No. 491 (Clayton 1954). Additional proclamations, including the addition of Hexberg, have included notice numbers 950 of 1898; 734 of 1904; 1126 of 1907; 1647 of 1913; 597 of 1914; 1641 of 1931; 447 of 1960; 1925 of 1960; 2579 of 1977 and 2753 of 1979.

Subsequently, the entire extent of the Cederberg State Forest (Demarcated Forest) has been declared as a Wilderness in terms of Section 7(A) of the Forest Act (Act No. 72 of 1968) on 27 July 1973, Notice No. 1256 of 1973. On 26 March 1976, the Wilderness boundaries were amended in terms of Section 7(A), Notice No. 476 of 1976. Hexberg remains a declared State Forest and no other declarations have been made.

Matjiesrivier Nature Reserve was purchased by the WWF-SA in 1995 and proclaimed as a Provincial Nature Reserve in terms of the Nature and Environmental Conservation Ordinance (Act No. 19 of 1974) on 27 March 2000, Notice No. 16 of 2000. No land claims have been lodged on any of the Cederberg Complex land parcels.

3.1.1 World Heritage Site Status

The World Heritage Convention Act (Act No. 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 with outstanding universal values for all humanity and to ensure their protection through a closer co-operation among nations.

The Cederberg Wilderness was inscribed as a World Heritage Site by the World Heritage Convention, part of the United Nations Educational, Scientific and Cultural Organisation, in 2004, as part of the Cape Floral Region Protected Areas (CFRPA) World Heritage Site. The CFRPA World Heritage Site 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).

During the CFRPA World Heritage Site extension designation in 2014, Matjiesrivier Nature Reserve was nominated to extend the inscription to form the extended Cederberg Complex, thereby increasing the total land area inscribed for the Cederberg Complex from 65 133 ha to 78 009 ha.

The Cederberg Complex is supported by a wide network of adjacent conservation areas that include Private Nature Reserves, Stewardship sites and Mountain Catchment Areas (MCA), all forming part of the Greater Cederberg Biodiversity Corridor (GCBC) landscape initiative.

The Cederberg Complex meets two of the 10 criteria for the inscription as a World Heritage Site. Criterion (ix) is considered to be of universal value in that it represents outstanding examples of significant ongoing ecological and biological processes in the evolution of terrestrial ecosystems and plant communities (DEAT 2003). The Cederberg Complex has been identified in the Cape Action for People and the

Environment project as a component of one of three mega-reserves for the CFR that will require further land acquisitions to create conservation corridors (Cowling *et al*. 1999, Appendix 5). The Cederberg Wilderness is large enough to safeguard the long-term persistence of the area as a wilderness.

As a consequence of its relatively large size, several important ecological processes continue operating in this region. Important among these are a relatively natural fire regime, which is vital to fynbos conservation, as well as the natural flow of water through the area, supporting a unique indigenous fish assemblage as well as supplying water for various sectors of which agriculture is the most important. The importance of these ecological processes benefits the reproductive biology of fynbos, which is dependent on fire as well as pollination and seed dispersal agents.

As a result of its linkages with other PAs, the Cederberg Complex is an important ecological corridor allowing species migration, gene flow, dispersal, *etc.* along the Cape Fold Mountains. Currently, these processes function well within the Cederberg Complex, because if local extinctions were to occur, recolonization will be possible owing to the substantial connections to adjacent privately-owned natural areas.

The mountainous terrain of the Cederberg Complex results in steep altitudinal gradients within the PA. These gradients provide a combination of physical features that are valuable for the conservation of biodiversity and potential buffering against climate change.

The Cederberg Complex is an important water catchment area. The mountain fynbos in the region has a high conservation priority due to its water and soil-holding capacity. Tributaries of the Olifants and Doring rivers within the PA represent a diverse riverine system with vital habitats for various threatened and endemic fish species and associated indigenous biota.

Secondly, the Cederberg Complex meets criterion (x) as it contains 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 (DEAT 2003). It is located in one of the most species-rich areas of the CFR (Lombard 2000) and has one of the highest concentrations of threatened plant species, especially Proteaceae species. The plant assemblages of the Cederberg Complex do not overlap greatly with those of other areas within the CFR; the geographic location of the protected area ensures the conservation of plant assemblages unique to this northern area.

In addition, expanding the inscribed World Heritage Site to include Matjiesrivier Nature Reserve added a number of other species of interest and most importantly an additional fynbos vegetation type: Swartruggens Quartzite Fynbos. Presently this vegetation type is not formally protected elsewhere, nor in the inscribed CFRPA World Heritage Site (Bradshaw & Holness 2013). Matjiesrivier Nature Reserve lies on the ecotone gradient between the wetter fynbos in the west and the arid Karoo in the east, supporting increased habitat diversity that, in turn, leads to enhanced species diversity.

The Cederberg Complex is a centre of endemism for plants, amphibians, small mammals as well as a major hotspot for endemic and threatened freshwater fish, such as the Endangered Clanwilliam sandfish (*Labeo seeberi*). Furthermore, there are a high number of threatened and endemic plant species such as the Clanwilliam cedar

tree (*Widdringtonia cedarbergensis*), Kalkoentjie gladiolus (*e.g. Gladiolus delpierrei*) and mammals such as the leopard (*Panthera pardus*).

3.2 Location Extent and Highest Point

The Cederberg Complex, situated between latitudes 32º 06' and 32º 45' South and longitudes 18º 56' and 19º 31' East, has an extent of approximately 79 687 ha, and is situated on both the Cederberg and Kouebokkeveld Mountain ranges. The Cederberg Complex is bordered by private game farms, agricultural lands worked by subsistence and commercial farmers, contract nature reserves and small rural communities. The Cederberg Complex covers an area of 79 687 ha and consists of the Cederberg Wilderness (65 133 ha), Matjiesrivier Nature Reserve (12 876 ha), and the Hexberg State Forest (1 678 ha) (Appendix 7.2, Map 1).

The Cederberg Complex is located approximately 250 km north of Cape Town and stretches from just north of Middelberg Pass in the south, to just north of Pakhuis Pass in the north. It extends approximately from Clanwilliam in the west, to the Doring River in the east; the latter forms the eastern boundary of Matjiesrivier Nature Reserve. The north/south extent of the Cederberg Wilderness is approximately 70 km and the east/west extent is 32 km.

The main access route to the office at Algeria is via a 17 km stretch of gravel road (DR 01487) off the N7 main route. This same road carries through to the Matjiesrivier Nature Reserve office further south. The R364 public road from Clanwilliam over Pakhuis Pass provides access to the northern parts of the Cederberg Complex (Appendix 7.2, Map 1). Algeria is situated approximately 30 km south-east of Clanwilliam and 23 km north-east of Citrusdal.

The Cederberg Wilderness is characterised by high rugged mountains, with the highest points being Krakadouw at 1 744 meters above sea level (m.a.s.l.) in the northern part of the complex, Tafelberg at 1 969 m.a.s.l. in the central part and Sneeuberg at 2 027 m.a.s.l. in the south-west.

Matjiesrivier Nature Reserve is situated south-east off the Cederberg Wilderness. The Doring River flows along the eastern boundary and borders the Tankwa Karoo and Northern Cape Province. The north/south extent of this reserve is approximately 15 km and the east/west extent, approximately 22 km (Appendix 7.2, Map 1). The Matjiesrivier Nature Reserve office is situated approximately 70 km south-east of Clanwilliam and 120 km north of Ceres. The reserve is characterised by a rugged central mountainous section with altitudes decreasing towards the western and eastern parts of the reserve. The highest point within the Matjiesrivier Nature Reserve is towards Keurbosberg at approximately 1 260 m.a.s.l.

Hexberg State Forest is situated approximately 8 km south of the Cederberg Wilderness and is accessed via the R303 road from Citrusdal towards Ceres. The highest point in the Hexberg State Forest is Hexberg Peak at 1 801 m.a.s.l.

The Cederberg Complex consists of the following land parcels (Table 3.1).

Table 3.1: Land parcels constituting the Cederberg Complex.

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number	Conservation status
Cederberg Wilderness	Portion 2 of the Farm Kleinfontein No. 464, Clanwilliam	T28535/1948	6506/1944	CI-5AC - 4536	Declared Wilderness
Cederberg Wilderness	Portion 1 of the Farm Vark Fontein Extension No. 189, Clanwilliam	T21657/1948	6509/44	CH-2 - 4464	Declared Wilderness
Cederberg Wilderness	The Farm Middle Berg No. 285, Clanwilliam	T12685/1938	372/1821	CI-3 - 4532	Declared Wilderness
Cederberg Wilderness	The Farm Middle Berg No. 279, Clanwilliam	Unregistered State Land	Not Available	CI-1 - 4528	Declared Wilderness
Cederberg Wilderness	Portion 1 of the Farm Grasvallei No. 288, Clanwilliam	T15731/1958	10234/1957	CI-1 - 4528	Declared Wilderness
Cederberg Wilderness	Portion 1 of the Farm Arieskraal No. 334, Clanwilliam	T21355/1948	6510/1944	CI-5 - 4534	Declared Wilderness
Cederberg Wilderness	Portion 2 of the Farm Driehoek No. 331, Clanwilliam	T5105/1939	Unknown	CI-3 - 4532	Declared Wilderness
Cederberg Wilderness	Portion 1 of the Farm Ezelsbank No. Farm 299, Clanwilliam	T1918/1958	367/1819	CI-3 - 4532	Declared Wilderness
Cederberg Wilderness	Portion 3 of the Farm Driehoek No. 331, Clanwilliam	T5105/1939	1063/1873	CI-3 - 4532	Declared Wilderness
Cederberg Wilderness	Portion 6 of the Farm Driehoek No. 331, Clanwilliam	T20128/1964	4322/1949	CI-3 - 4532	Declared Wilderness
Cederberg Wilderness	The Farm Annex Welbedacht No. 333, Clanwilliam	T5105/1939	252/1923	CI-3 - 4532	Declared Wilderness
Cederberg Wilderness	Remaining extent of Portion 1 of the Farm Driehoek No. 331, Clanwilliam	T18098/1964	2182/1950	CI-3 - 4532	Declared Wilderness
Cederberg Wilderness	The Farm Middle Berg No. 283, Clanwilliam	Unregistered State Land	483/1913	CI-3 - 4532	Declared Wilderness
Cederberg Wilderness	The Farm Rheeboks Vlei Extension No. 185, Clanwilliam	Unregistered State Land	624/1974	CI-1 - 4528	Declared Wilderness
Cederberg Wilderness	The Farm Annex Boskloof No. 281, Clanwilliam	Unregistered State Land	6516/1944	CI-1 - 4528	Declared Wilderness
Cederberg Wilderness	The Farm No. 440, Clanwilliam	T24577/1969	1975/1862	CI-5AA - 4535	Declared Wilderness

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number	Conservation status
Cederberg Wilderness	The Farm Bothas Berg No. 182, Clanwilliam	Unregistered State Land	825/1914	CI-1 - 4528	Declared Wilderness
Cederberg Wilderness	The Farm Rheboks Valij No. 184, Clanwilliam	T11218/1939	312/1822	CI-1 - 4528	Declared Wilderness
Cederberg Wilderness	The Farm Annexe Boskloof No. 278, Clanwilliam	Unregistered State Land	6515/1944	CI-1 - 4528	Declared Wilderness
Cederberg Wilderness	The Farm Rooi Kloof No. 280, Clanwilliam	Unregistered State Land	Not Available	CI-1 - 4528	Declared Wilderness
Cederberg Wilderness	The Farm Rocklands No. 277, Clanwilliam	Unregistered State Land	297/1869	CI-1 - 4528	Declared Wilderness
Cederberg Wilderness	The Farm Middle Berg No. 287, Clanwilliam (Sneeuwberg Forest)	Unregistered State Land	569/1889	CI-5 - 4534	Declared Wilderness
Cederberg Wilderness	The Farm Taaibosch Kraal No. 276, Clanwilliam	Unregistered State Land	299/1869	CI-1 - 4528	Declared Wilderness
Cederberg Wilderness	The Farm Krakadouw Heights No. 180, Clanwilliam	Unregistered State Land	1960/1875	CI-1 - 4528	Declared Wilderness
Cederberg Wilderness	The Farm Groen Berg No. 181, Clanwilliam	Unregistered State Land	769/1875	CI-1 - 4528	Declared Wilderness
Cederberg Wilderness	The Farm Van Rooyens Kraal No. 339, Clanwilliam	T24577/1969	285/1870	CI-5AA - 4535	Declared Wilderness
Cederberg Wilderness	The Farm Middle Berg No. 282, Clanwilliam	Unregistered State Land	Not available	CI-3 - 4532	Declared Wilderness
Cederberg Wilderness	The Farm Cederberg Forest Reserve No. 286, Clanwilliam	Unregistered State Land	11351/2003	CI-3 - 4532	Declared Wilderness
Hexberg State Forest*	The Farm Heks Rivier No. 59, Ceres	T15381/1964	375/1831	CI-5 - 4534	State Forest
Hexberg State Forest*	The Farm Hexberg No. 58, Ceres	T15381/1964	578/1889	CI-5 - 4534	State Forest
Matjiesrivier Nature Reserve	The Farm Vyfhoek No. 313, Clanwilliam	T79231/1994	Unknown	CI-5 - 4534	Provincial Nature Reserve
Matjiesrivier Nature Reserve	The Farm Matjesrivier No. 324, Clanwilliam	T79231/1994	369/1819	CI-5 - 4534	Provincial Nature Reserve
Matjiesrivier Nature Reserve	The Farm Nieuwe Gift No. 312, Clanwilliam	T79231/1994	5108/1907	CI-5 - 4534	Provincial Nature Reserve

Reserve component	Farm name and number	Title deed number	Diagram number	Noting sheet number	Conservation status
Matjiesrivier Nature Reserve	The Farm Moordhoek No. 325, Clanwilliam	T79231/1994	587/1989	CI-5 - 4534	Provincial Nature Reserve
Matjiesrivier Nature Reserve	The Farm Riffels No. 323, Clanwilliam	T79231/1994	1797/1889	CI-5 - 4534	Provincial Nature Reserve
Matjiesrivier Nature Reserve	The Farm Truitjeskraal No. 326, Clanwilliam	T79231/1994	153/1888 & 483/1037	Unknown	Provincial Nature Reserve
Matjiesrivier Nature Reserve	The Farm Vaalvlei No. 314, Clanwilliam	T79231/1994	3015/1907	CI-5 - 4534	Provincial Nature Reserve
Matjiesrivier Nature Reserve	The Farm Wildehondskloof No. 311, Clanwilliam	T79231/1994	3018/1907	CI-5 - 4534	Provincial Nature Reserve
Matjiesrivier Nature Reserve	Remaining extent of the Farm Nieuwe Gift No. 312, Clanwilliam	T79231/1994	459/1838	CI-5 - 4534	Provincial Nature Reserve

* Land parcels not inscribed into the Cederberg Complex World Heritage Site.

3.3 Administrative Context

In terms of the Municipal Systems Act (Act No. 32 of 2000), local municipalities in South Africa are required to use integrated development planning to plot future development in their mandated management areas. The municipal Integrated Development Plan (IDP) is a 5-year strategic plan that sets the strategic and budget priorities for development. It aims to 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. Some of the key components of an IDP are disaster management plans and a Spatial Development Framework (SDF), which are essentially the spatial reflection of a municipality's IDP. An SDF must include basic guidelines for a municipality's land-use management system and should be used to guide changes in land-use rights and public investment in infrastructure. Municipal IDPs and SDFs are updated every five years.

Local municipalities are responsible for producing and co-ordinating IDPs and SDFs, but they must consult other stakeholders in the area who can impact, or be impacted, by development and other land-use changes in the area. All government departments working within a municipal area should refer to the relevant IDP to ensure their work is aligned. In essence, SDFs and IDPs are tools for integrating social, economic, and environmental issues. As biodiversity is a fundamental component of sustainable development, IDPs and SDFs offer an opportunity to ensure that biodiversity priorities are incorporated into municipal planning processes. In turn, the identification of biodiversity-related projects for the IDP can support local economic development and poverty alleviation.

The Cederberg Complex falls within the boundaries of the West Coast District Municipality (WCDM) as well as the local Cederberg Municipality. The current

IDP/SDF cycle runs from 2017-2022 (WCDM-IDP 2017). It is important that the Cederberg Complex's conservation priorities are appropriately reflected in the relevant district and local municipal IDPs and SDFs during the next revision phase (section 2.6).

Three of the five objectives of the WCDM-IDP (2017) and three of the six objectives of the Cederberg Municipality-IDP (2017) align with the strategies of the Cederberg Complex (Table 3.2).

Table 3.2: Alignment of objectives of the West Coast District and Cederberg Municipalities' Integrated Development Plans with that of the strategies of the Cederberg Complex.

West Coast District Municipality	Cederberg Municipality	Cederberg Complex and Zone of Influence
OBJECTIVE		**STRATEGY**
Ensure the environmental integrity of the district is improved.	Enable a resilient, sustainable, quality and inclusive living environment and human settlements.	**Strategy 1:** Address invasive alien fish control on priority rivers within the Cederberg Complex and its Zone of Influence. **Strategy 3:** Through partnership, enhance the management and protection of the fynbos, Clanwilliam cedar tree and heritage values of the Cederberg Complex. **Strategy 9:** Through partnership, address Invasive Alien Plant clearing and compliance within the Zone of Influence of the Cederberg Complex. **Strategy 2:** Address Invasive Alien Species control through the development of an Invasive Alien Species control plan for the Cederberg Complex.
Pursue economic growth and the facilitation of job opportunities.	Aggressively facilitate, expand and nurture sustainable economic growth and eradicate poverty.	**Strategy 17:** Support economic development through skills & capacity building and identifying sustainable work opportunities for surrounding communities within the Cederberg Complex and its Zone of Influence. **Strategy 6:** Incorporate protected area priorities and Zone of Influence into municipal Integrated Development Plans and Spatial Development Frameworks.
Promote the social well–being of residents, communities and targeted social groups in the district.	Facilitate social cohesion, safe and healthy communities.	**Strategy 12:** Through partnership, address illegal and un-sustainable resource utilisation practices which includes domestic animals, extra-limital game, poaching, overgrazing and land degradation within the Cederberg Complex and its Zone of Influence. **Strategy 16:** Through partnership, address socio-economic challenges of surrounding communities within the Zone of Influence of the Cederberg Complex. **Strategy 5:** The CapeNature Natural Resource Utilisation policy and Permit System must provide usage categories and guidelines for Cultural, Medicinal and Spiritual use.

According to the 2017-2022 Cederberg Municipal IDP (Cederberg Municipality 2017a), the total population of the Cederberg Municipality in 2016 was 52 949 individuals. The age class distribution is 25% (0-14 years), 68% (15-65 years) and 6% (65+ years).

The race groups are 12% (Black), 76% (Coloured) and 12% (White). The unemployment rate for the municipal area stands at 10.5%, which can mainly be attributed to low literacy levels and a lack of meaningful formal education. Most employable people fall in the semi- and un-skilled category.

In light of the above demographics and challenges, economic and social development in many of the smaller communities around the Cederberg Complex remain a challenge, particularly those situated along the eastern boundary. These communities are small, isolated and often lack basic infrastructure such as electricity, communication infrastructure and adequate road infrastructure. Generally, literacy levels are low, and unemployment, adequate training opportunities, schooling, and service delivery remain major challenges. This has been highlighted as a major contributing factor towards reaching and/or enhancing human well-being values within the ZOI of the Cederberg Complex (section 2.6).

3.4 Internal Rules

In terms of Section 52 of NEM: PAA, as amended in Act 31 of 2004, 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 NEM: PAA 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 PA is governed by the Nature Conservation Regulations published in Provincial Notice No. 955 of 1975. In addition, the Regulations for the Proper Administration of Nature Reserves No. 99 of 2012 and the Norms and Standards for the Management of Protected Areas in South Africa No. 382 of 2016 do provide additional guidelines on how the protected area should be governed. If applicable, the PA may draft additional internal rules in terms of the National Environmental Management Act (NEMA) (Act No. 107 of 1998), the Specific Environmental Management Acts or the Nature and Environmental Conservation Ordinance (Ordinance No. 19 of 1974).

3.5 History of the Cederberg Complex

3.5.1 Early Human History

The original inhabitants of the region were hunter-gatherers who lived more than half a million years ago during the Earlier Stone Age. People of our own species, Homo sapiens sapiens, made Middle Stone Age artefacts in the Cederberg at least a 100 000 years ago, and Later Stone Age people, ancestors of the San (Bushmen), occupied many rock shelters in the Cederberg Complex during the last 10 000 years (Deacon & Deacon 1999; Parkington & Dlamini 2015). Some of these shelters contain rock paintings made within the last 7 000 years or more. The art, in the form of fine-line paintings, illustrates the beliefs and rituals of the indigenous hunter-gatherers. Ethnographic accounts from the 19th and 20th centuries have helped to interpret the images and demonstrate the religious nature of the rock art (Lewis-Williams 1990; Deacon 1998). As the San fine-line paintings in the area include some sheep, but very rarely cattle, it is generally believed that the hunter-gatherers stopped painting in the fine-line tradition at least a 1 000 years ago. By the mid-18th century, historical records suggest that there were very few hunter-gatherers still living independently in communities, economically distinct from herders in the Cederberg (Penn 2005).

A major change in the demographics of the Western Cape took place about 2 000 years ago when Khoekhoe herders migrated southwards from Eastern Africa with sheep, and later cattle (Figure 3.1). This had a major impact on their hunter-gatherer neighbours long before European settlers arrived in the mid-17th century. The displacement of the hunter-gatherer groups eastwards into the Great Karoo resulted in brutal wars between tribes during 1659 and 1673-1677 (Deacon 1998; Deacon & Deacon 1999; Parkington & Dlamini 2015). As the herders moved constantly to take advantage of grazing for their livestock, they lived mostly in camps consisting of mat-covered huts that could be rolled up and carried on the backs of oxen from one camp to the next. From an archaeological point of view, apart from stone tools, grindstones and pottery, they left few traces of their presence behind. It is therefore difficult to accurately identify, date and record the distribution of herder camps in the landscape, but potsherds found amongst stone artefacts are strong evidence of the presence of herders in the area. The Guriqua are the most likely group to have lived in the Cederberg in the late 17th to early 18th century (Maingard 1931).

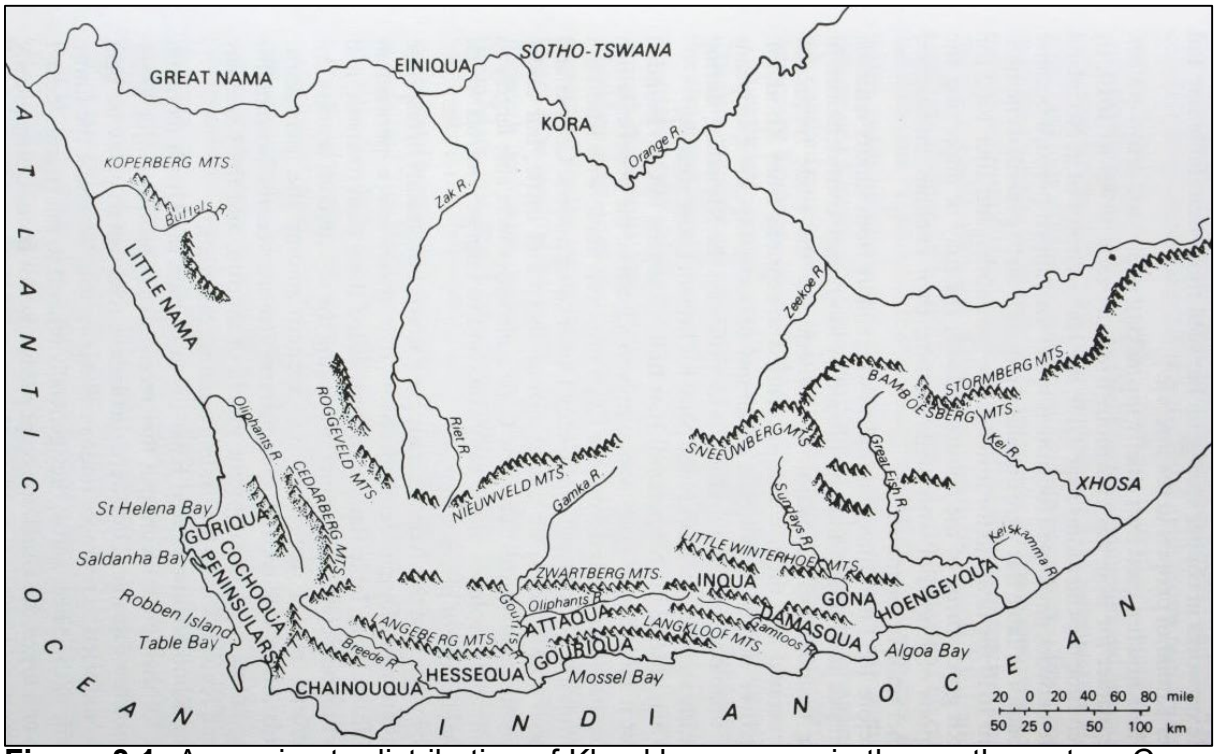


Figure 3.1: Approximate distribution of Khoekhoe groups in the south-western Cape at the time of European contact (reprint from Maingard 1931).

Early European stock farmers settling inland in the southwestern Cape were mainly free burghers eager to move beyond the management controls of the Dutch East India Company. They expanded outwards from Cape Town and northwards to Piketberg and the Land van Waveren (Tulbagh Valley) in the first decade of the 18th century. The interaction between them and the Khoekhoe groups (known mainly as the Cochoqua and Guriqua), was plagued by stock theft from both sides which often led to violent confrontations (Penn 2005). Within a few years from 1701-1705, the open trade in livestock had led to the disintegration of traditional Khoekhoe societies and inaugurated a period of anarchy (Penn 2005). In addition, the smallpox epidemic of 1713 had a major impact on the Khoekhoen, weakening their position on the land and leading to many entering the service of European colonialists. As late as 1725, the

high mountains of the Cederberg and Bokkeveld, west and south of Matjiesrivier, were still occupied by Khoekhoe groups because the area was too far away for pioneer farmers to risk settlement (Penn 2005). However, the frontier moved quickly and by around 1750, the European settlers had broken the political power of the indigenous leaders and their followers became the rural underclass, working for the settlers on farms and in rural villages. The process of colonial domination continued once the British defeated the Dutch in 1806 and the Cape became part of the British Empire. In 1809 it was reported that neither San hunter-gatherers nor Khoekhoe herders were living independently in the Cederberg (Penn 2005).

As European settlers and missionaries moved into the Cederberg area during the late 1600s and early 1700s, the lives of local Khoe inhabitants were severely affected. Land was taken over by European farmers and the establishment of a timber forest at Algeria brought a whole new social dynamic to the region. Prior to that, people in the area practiced subsistence farming for a livelihood (Hanekom 2012). Colonial development and spread continued unabated. During the Anglo Boer War, the vastness of the Cederberg became known and by 1921 the first group of South African Mountain Club members visited and started exploring the mountains. Visitors to the region often made use of the Algeria forestry station as a stop-over point. Hikers also often used the forestry stations' donkeys to cart their hiking equipment up the mountains (Nieuwoudt 2015).

3.5.2 Algeria

According to Andrag (1977), the first Europeans explored the area in 1661 under the leadership of Dutch explorer Jan Danckaert, while research conducted by Nieuwoudt (2015) indicated that sailors, anchored at Lambert's Bay, were the first people who settled at Algeria in the early 1700s. They married local Khoe women and constructed huts and gardens along the stream below Middelberg and called the area Garskraal (Nieuwoudt 2015). At the beginning of the 18th century, the first farmers settled along the Olifants River and on the 1st of February 1808, the Clanwilliam district was proclaimed as a sub-magisterial district of Tulbagh. During 1830, Johan Leipoldt founded the mission station at Wupperthal.

The first "forest ranger", J.F. Butler (Figure 3.2) was appointed during 1876 in Clanwilliam to control the "Crown-Land" in the Cederberg (Andrag 1977). Descendants from the sailors that settled at Garskraal were the backbone of the first forest station at Garskraal (Nieuwoudt 2015). In 1882, Count M. de Vasselot de Regné, the superintendent of woods and forestry in the Cape Government, visited the Cederberg area which reminded him of the Atlas Mountains in Algeria and it is likely that he proposed the name Algeria. In 1897, the area was declared as a Demarcated Forest under the old Cape Forest Act (Clayton 1954). The first hiking trail from Garskraal to Middelberg was constructed in 1899 (Andrag 1977).

Figure 3.2: Historic inscription of J.F. Butler at Stadsaal Cave. Photo: Dr Jeanette Deacon.

During the Anglo Boer War (1899-1902), there was turmoil in the area due to the presence of Boer commandos. George Bath was appointed as the second "forest ranger" in 1905. After his appointment he changed the name of the forest station from Garskraal to Algeria. During his tenure, Bath constructed the huts at Middelberg and Crystal Pool, as well as the hiking trail from Middelberg to Heuningvlei. When he passed away in 1919, his oldest son Walter Bath took over as the forester (Nieuwoudt 2015).

During the 1900s, the Department of Forestry bought a number of properties to be included in the Cederberg Demarcated State Forest; these included De Rif, Welbedacht, Hoogvertoorn, Eikeboom and Syferfontein (Nieuwoudt 2015). During 1973, the former Demarcated State Forest was proclaimed as a Wilderness (Andrag 1977) and in 1976, sections of privately owned MCA were proclaimed around the Cederberg.

During the 1950s, the Algeria forestry village was formally established to provide accommodation for the workers of the then Department of Forestry. In 2004, the land of the Algeria forestry village was expropriated and handed over to the community. Today the village has 40 houses with approximately 188 people living in the community, with some families having had a long history with forestry and conservation activities at Algeria.

3.5.3 Matjiesrivier

The first permanent occupant of Matjiesrivier was Elias Kamfer. When the area was surveyed in 1819, there were no buildings on the property and it is believed that Kamfer had some fruit trees, planted wheat and grazed the area with livestock (Nieuwoudt 2015). During the 18th century, settler farmers moved into the greater Matjiesrivier area from the Koue Bokkeveld region and started farming with livestock.

By 1832, Matjiesrivier was owned by Barend Lubbe who sold it to brothers Gerrit and Hermias Nieuwoudt (Nieuwoudt 2015). The brothers bought Vogelvallei (today known as Vogelfontein) to the south and Matjiesrivier was used as an outpost for their livestock for a number of years (C. du Plessis, Cederberg Conservation Manager, 1997, unpublished data).

In 1848, Carel Christiaan Philip Wagener, a Rhenish missionary carpenter, originally from Niederwerbe in Germany, settled on Matjiesrivier farm. Livestock (sheep and goats) were the main source of income, including tobacco, fruit and vegetables. Matjiesrivier farm stayed in the Wagener family for at least 130 years. During 1995, WWF-SA purchased the farm Matjiesrivier which was subsequently proclaimed as a Provincial Nature Reserve in 2000 (WKNB 1997). Matjiesrivier Nature Reserve was inscribed as a World Heritage Site as part of the CFRPA extension in 2014.

3.5.4 Historic Management of the Cederberg Mountains

Before the appointment of the first “forest ranger”, J.F. Butler in 1876, the utilisation of the “Crown Land” was free for all and had been used for grazing, harvesting of plant resources, as well as hunting (Andrag 1977). After the appointment of Butler, permits were required for any form of resource utilisation, however it proved difficult for one person to control the area and illegal activities continued. During 1891, a notice was issued banning all forms of grazing on “Crown Land”, but as this was difficult to implement, it was reversed in 1910. Grazing was once again stopped in 1937, except for two short periods during droughts in the 1960s and 1981. Since the proclamation of the Cederberg as a Wilderness in 1973, grazing on the whole was not permitted (Andrag 1977; Manders 1986).

In 1900, firebreaks were already in use to help with firefighting operations and in doing block burns (Andrag 1977). From 1900-1956 certain areas were burned on a three-year rotation to stimulate rooibos tee and buchu growth for harvesting while fire was kept out of areas where Clanwilliam cedar trees occurred (Andrag 1977). During the 1970s and 80s the principle of burning certain areas on a 12-year rotation was re-instated and a number of prescribed burns were conducted in the Cederberg (Andrag 1977). After the management of the Cederberg was handed over to the Cape Department of Nature Conservation in 1987, this prescribed burning practice was abandoned.

3.5.5 Clanwilliam Cedar Plantations

The sailors who settled at Garskraal (Algeria) during the early 1700s explored the area and began harvesting Clanwilliam cedar trees as timber and carted it to Tulbagh where the wood was sold (Nieuwoudt 2015). The first mention of Clanwilliam cedar trees was by W.A. van der Stel in the 1700s who reported to the Here Sewentien (Dutch East India Company) about the valuable timber in the Cederberg that could be used by people wanting to settle in the area (Andrag 1977). The first report on the use of Clanwilliam cedar trees was contained in a report by de Mist's Livestock and Agricultural Commission in 1805 (Smith 1955), which reported that half-castes made a living from cutting Clanwilliam cedar timber extracted from the Cederberg Mountains. They produced substantial beams (3 m long, 15 cm square) and planks (30-40 cm wide, 4 cm thick) for distribution to the wider area. The Clanwilliam cedar "forest" was recorded as being 40 km long and 3 km wide.

The de Mist Commission, including various other people, including the British geographer, Sir James Alexander, expressed concern at the wasteful and uncontrolled

method of exploitation of cedars, as well as pasture burning practices that destroyed many young trees (Hubbard 1937). They recommended that Clanwilliam cedar seeds be sown into the species' natural habitat and obtained agreement from the local harvesters to do so. This was the first attempt to conserve any forest species in South Africa (Smith 1955).

European settlers, however, continued to make use of the durable and beautiful Clanwilliam cedar wood. A vehicle track was built from Grootlandsvlaktes down to Welbedacht for transporting the harvested timber which supplied the requirements for fences, furniture, floors, doors, coffins and telephone poles. In 1879, over 7 000 Clanwilliam cedar poles were used for the telephone line between Piketberg and Calvinia (Andrag 1977).

During late 1879, the Clanwilliam cedar "forest" was closed for the harvesting of living trees and only dead plants were allowed to be sold to recognised wood harvesters (Luckhoff 1971). This measure proved to be too little, too late and by that time the Clanwilliam cedar resource had been devastated. In 1883, the superintendent of Woods and Forests deplored the loss of adult and young trees such that there were virtually no accessible trees of commercial value remaining. He noted that "the largest cedar standing was about 18 ft. (5.5 m) in girth and 70 ft. (21,3 m) in height but it is a dwarf compared to the big trees whose stumps are still standing as evidence of what they were. These past giants must have been nearly double the girth of any now standing." (Hubbard 1937). This correlates with Sir Alexander's description half a century before of "a large tree of 36 ft. (11 m) in girth, with 1 000 ft. (305 m) of plank sawn out of its giant arms" (Smith 1955). In 1967, the harvesting of dead Clanwilliam cedar trees was also stopped as deliberate incendiarism was suspected by prospective users (Luckhoff 1971).

Of interest in this regard are the sizes of current large Clanwilliam cedar trees. Higgins *et al.* (2001) record that the three largest trees in a survey of 531 living trees were respectively 12/8/4 m high and 5.5/5.5/6.2 m in circumference. Almost 130 years later, the largest trees remain significantly smaller than those of earlier times.

In order to create a supply of readily available timber, and to alleviate pressure on natural populations, large numbers of Clanwilliam cedars were re-established in about 120 ha at Middelberg and Heuningvlei from 1896-1914. This was achieved both by sowing seed, and the planting of approximately 78 000 seedlings reared at a nursery in Algeria; it was recorded that from 1900-1902 over 4 300 kg of Clanwilliam cedar seed was collected and used (Andrag 1977). As a result of numerous rehabilitation attempts from 1805-1914, plantations of Clanwilliam cedar trees were formed at the following locations, Middelberg, Heuningvlei, Krugerseland, Geelvlei, De Rif, Agter Tafelberg and Algeria; some of these still exist to the present day.

3.5.6 Pine Plantations

After part of the Cederberg was declared in 1897, a plantation of fast-growing alien trees was established at Algeria to provide an alternative source of timber (Taylor 1996). Rudolf Andrag (private, 2011, pers. comm.) stated that in 1897, apart from planting Clanwilliam cedar trees, a start was made to plant Eucalyptus for poles and firewood as well as Pines for saw timber and poles. These exotic plantations were mostly on the banks and lower slopes of the Rondegat River and valley, where the Algeria campsite is today, including the river flowing down from Middelberg above

Algeria. At the time, a variety of alien trees were planted in an “arboretum” to evaluate their potential for commercial use (R.H. Andrag, private, 2011, pers. comm.).

Andrag (private, 2011, pers. comm.) mentions that it was clear from the beginning that the Cederberg was a marginal area for afforestation. Soon staff were needed to manage the catchment area, in making and maintaining footpaths, fire-belts and to fight fires. By having a plantation, the workforce could be optimally utilised, especially in winter when there was not much work in the catchment. After World War II there was a surge in afforestation and in the Cederberg a number of new plantations were established around the Algeria area. During 1970, the last Pine and Eucalyptus plantations were planted on the slopes of Vensterberg above Algeria. According to Andrag (private, 2011, pers. comm.) the Algeria plantations totalled 283 ha of Pines and 41 ha of Eucalyptus. When the management of the Cederberg was handed over to the Cape Department of Nature Conservation in 1987, a decision was made to phase out all exotic plantations and to allow natural veld recovery. All exotic plantations have since been harvested or have been destroyed by wildfire.

3.6 Cultural Historic Heritage

Heritage has been identified as one of the key values of the Cederberg Complex. The area is particularly rich in terms of archaeological, palaeontological and historical heritage. Furthermore, the Cederberg Complex has been inscribed as a World Heritage Site, mainly for its natural, ecological functioning and biodiversity significance.

3.6.1 Palaeontological Heritage

The Cederberg Mountains comprises of sandstone-dominated sedimentary rock (Aldridge *et al.* 1994). The Cedarberg Formation comprises of the Soom Shale Member and the Disa Siltstone Member and dates back to the last Ordovician age and were deposited under the last glacial episode 488 million years (Ma) ago (Gabbott *et al*. 2016). Glacial pavements were cut into the upper layers of Peninsula Formation by moving ice. Remnants of these glacier floors can be seen in the northern part of the Cederberg at Pakhuis pass (De Beer 1998). According to Aldrige (1994) organism that lived in the waters during this Ordovician age were trapped in the deposit layers of the Soom Shale Member and the Disa Siltstone Member, these are called Hirnantian Fauna. These fossils are extremely rare and the Cederberg is currently the only known place in South Africa where they can be found (Gabbott *et al*. 2016). These fossils include samples of arthropods, molluscs, annelids, brachiopods, primitive chordates as well as algae and plankton (Gabbott *et al*. 2016) (Figure 3.3).

Figure 3.3: a) Fossilised algae, b) A eurypterid (Arthropod) with preserved soft tissue, c) Conodonts (primitive chordates) (reprint from Gabbott *et al.* 2016).

According to Penn-Clarke (2016) the fossils found at Matjiesrivier Nature Reserve are overwhelmingly abundant within the rocks of the Bokkeveld Group which lie along the eastern part of the reserve. The fossils present within these rocks are well-documented and belong to a unique biogeographic fauna known as the Malvinokaffric Realm Fauna. The Malvinokaffric Realm was a marine biogeographic realm which persisted ~300-350 Ma from the Silurian to Middle Devonian where it terminated at the end of the Eifelian and was wholly restricted to south-western Gondwana. Fossils of the Malvinokaffric Realm are highly endemic and are only present in South Africa, Argentina, Bolivia, Brazil, Antarctica and the Falkland Islands and possibly Ghana, Guinea and south eastern Senegal.

The Silurian-Middle Devonian was a period of marked endemism worldwide with noticeable faunal provincialism. During this period, three major biogeographic realms existed, namely the Old World, Eastern Americas (Appalachian) and Malvinokaffric Realms (Figure 3.4). These biogeographic realms were initially discriminated for on the basis of endemic brachiopod fossils but were expanded to include trilobite, rugose coral and gastropod fossils (Penn-Clarke 2016). Of the three biogeographic realms, only the Malvinokaffric Realm is wholly restricted to Gondwana.

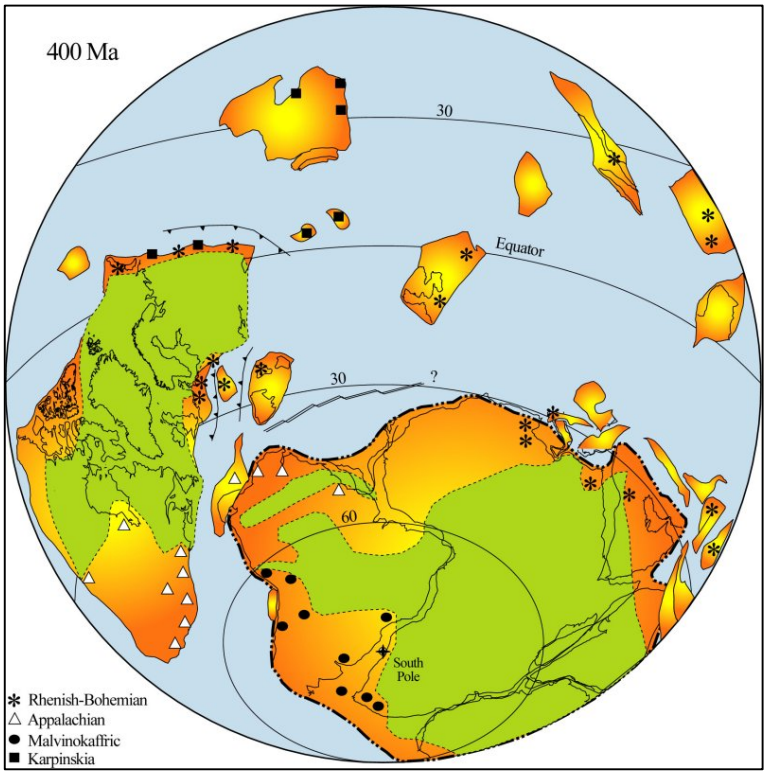


Figure 3.4: Palaeogeographic reconstruction of Gondwana and Laurussia during the Devonian Period showing limits and occurrences of Old World, Appalachian and Malvinokaffric biogeographic realms. Green indicates approximate limits of terrestrial land whilst orange indicates portions of marine incursion upon continental masses. South polar projection shown (reprint from Penn-Clarke 2016).

According to palaeoclimatic, palaeomagnetic and palaeogeographic reconstruction data contained in Penn-Clarke (2016), it's estimated that during the Late Silurian to Late Devonian period, the palaeo-south pole was situated within what is today south-central Argentina. It was within these high polar latitudes (~60°-90°S) that the Malvinokaffric Realm persisted. Faunally, the Malvinokaffric Realm is characterised as having a low diversity of fauna with high endemism of certain fossils. The Malvinokaffric Realm has been typified by several genus and species specific terebratulid, strophomenid and spiriferid brachiopod taxa with a total exclusion of rhynchonellids with certain index taxa being unique (*Australospirifer* sp., *Australocoelia* sp.) (Figure 3.5 a & b) and has been expanded to include phacopidiid trilobites of which the entire family Calmonidae is unique to the Malvinokaffric Realm (Figure 3.5 c & d), as well as several species of specific molluscs. Conulariids, tentaculitiids and hyolthiids are abundant whilst reef-building bryozoan and rugose corals are rare and stromatoporoid sponges, conodonts, nautoloids and graptolites are entirely absent (Figure 3.5 e, f & g) (Penn-Clarke 2016).

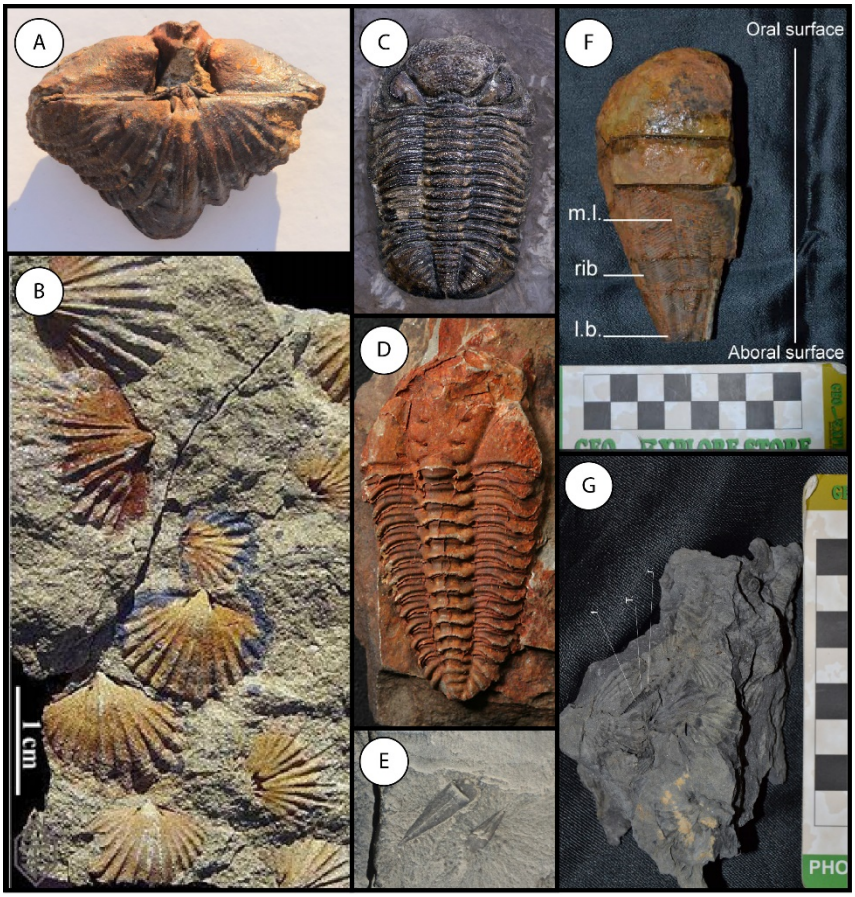


Figure 3.5: Selection of fossils unique to the Malvinokaffric Realm: Brachiopods: A= *Australospirifer sp.*, B= *Australocoelia sp.* Select calmoniid trilobites: C= *Phacops sp.*, D= *Typhloniscus sp.*, E= a representative hyolith (not from the Malvinokaffric Realm), F= a conularian, *Conularia sp.*, G= a tentaculitiid, *Tentaculites sp.* (reprint from Penn-Clarke 2016).

Although the fossils associated with the Malvinokaffric Realm mentioned are abundant within the rocks of the Bokkeveld Group, Matjiesrivier Nature Reserve is the only place in South Africa where these occur along with the other identified sites worldwide (Penn-Clarke 2016).

3.6.2 Archaeological Heritage

The art, in the form of fine-line paintings, illustrates the beliefs and rituals of the indigenous hunter-gatherers, ancestors of the San. Paintings in this tradition depict human figures and therianthropes, bags and other artefacts, animals – particularly eland and elephant, handprints and dots in monochrome, bichrome, polychrome as well as shaded polychrome (Deacon 1998). Ethnographic accounts from the 19th and 20th centuries have helped to interpret the images and demonstrate the religious nature of the rock art (Lewis-Williams 1990; Deacon 1998). As the San fine-line paintings in the area include some sheep, but not cattle which were introduced some 800 years later, it is generally believed that the hunter-gatherers stopped painting in the fine-line tradition at least a 1 000 years ago. The finger-painting tradition with geometric patterns and stylised animals and human figures is more recent than the fine-line images and is believed to have been made mainly by Khoekhoe herders. By the mid-18th century, historical records suggest that there were very few hunter-gatherers still living independently in communities, economically distinct from herder

in the Cederberg (Penn 2005). In caves where rock art is found, Later Stone Age artefacts are often seen scattered on the cave floor and in the area in front of the cave or overhang (Figure 3.6 a & b). The Cederberg Complex has approximately 250 recorded rock art sites. These heritage features are non-renewable assets and careful management is required to preserve them in the landscape.

Figure 3.6: (a) Bi-chrome fine line paintings of Elephants and (b) Later Stone Age artefacts found in a cave in the Cederberg Complex. Photos: Rika du Plessis.

3.6.3 Historical Structures

Various historic buildings and structures depicting life and activities of European occupants of the area are found throughout the Cederberg Complex. Stone kraal and shepherd shelters could date as far back as 1819 when Elias Kamfer was the first to permanently settle and farmed with his livestock at Matjiesrivier. When European settlers moved in to the area during the 18th century they constructed houses, sheds and watermills. Many of these structures have succumbed to environmental factors but some are still in use today. During the Anglo Boer War, a number of Block Houses were constructed in the Cederberg, these structures have unfortunately collapsed over the years. As livestock farmers started experiencing problems with predators, they constructed stone cages to catch the 'vermin'. A number of these stone traps are found throughout the Cederberg Complex. As people settled in the area over the years, a number of marked and unmarked grave sites developed (Figure 3.7 a & b).

Figure 3.7: (a) Wagener family graveyard at Matjiesrivier office, and (b) Unmarked graves at Pienaarsvlak, Matjiesrivier. Photos: Dr Jeanette Deacon and Rika du Plessis.

The oldest buildings at Algeria is the original farm house (Garskraal) constructed in 1910 and Rietdak (1941). Both these buildings have been altered over the years and is currently being used for tourist accommodation. All buildings around the Matjiesrivier office date back to the time when Matjiesrivier was utilised as a farm (Figure 3.8). Harding house was the first dwelling built at Matjiesrivier but the construction date is not known (WKNB 1997). The Wagener house was built in 1849 by C.C.P. Wagener and the woodwork in the house showcases the carpentry skills of the time. Clanwilliam cedar wood was extensively used for wood furnishings in the house. The building was altered in the 1960s and is currently used as the Matjiesrivier office. The watermill (1850) was used to grind wheat flour and is still visible next to the Harding house. The Rupert house (1860) was also constructed by Wagener and currently serves as rented accommodation for researchers.

Figure 3.8: Historical image taken around 1927 of the main buildings at the Matjiesrivier office (WKNB 1997).

According to the WKNB (1997), the Du Preez (1901) and Suurberg (1960) buildings were used to accommodate share-croppers (*bywoners*) that worked on the farm. These buildings are still largely original in form but have been altered on the inside and currently serve as staff and research accommodation. The old school at Matjiesrivier office was constructed in 1938 and in 1960 the “teacher’s house” was added to accommodate a fulltime teacher. This small rural school taught children from Matjiesrivier, Rietvlei, Trekkloof and Keurbosfontein (WKNB 1997). The school closed down during 1985 due to low numbers of children attending. Some of these last scholars still live in the area (A. Beukes, Keurbosfontein farm manager, 2018, pers. comm.). The latter buildings were renovated during 2016 and today serves as accommodation and a function venue.

Additional information on the heritage features of the Cederberg Complex is available in the heritage management plan for Matjiesrivier Nature Reserve as well as the Rock art management guidelines for the Cederberg Wilderness (Deacon 1993; Deacon *et al*. 2016). All heritage information within the Cederberg Complex is collected and recorded on the reserve heritage inventory, as well as the national South African Heritage Resource Agency Information System database. The Cederberg Complex has a partnership with heritage management agencies that include Heritage Western Cape and the Eastern Cederberg Rock Art Group.

3.7 Bio-physical Context

3.7.1 Climate and Weather

The Cederberg Complex falls predominantly in the winter rainfall zone of South Africa, with hot, dry summers from October to April, and cold, wet winters from May to September. Within the Cederberg Wilderness and Hexberg State Forest, the hottest months are generally January and February and the coldest July and August. Rain normally follows a cold front moving across from the southwest, however thunderstorms are not uncommon, particularly in spring and autumn. These convection storms are more common in the eastern portions of the Cederberg Wilderness (Bands 1978). Minimum temperatures in winter (June to September) can drop below freezing and frost is common, particularly on the higher plateaux (Figure 3.11). Snowfall is generally restricted to the higher mountain peaks and can occur at any time between June and October but these events are generally short-lived. Summer (November to March) temperatures frequently rise to over 30°C and extremes of over 40°C are not uncommon (Bands 1978). Mist is common on the high-altitude peaks throughout the year.

Although the Cederberg Wilderness receives at least 80% of its rain during winter, its annual total is lower than in most other Cape mountains (Taylor 1996). The long term average for the Cederberg Wilderness is approximately 757 mm per annum. Rainfall measured at the Algeria station indicates a sharp peak during June and July (Figure 3.9). During the drought of 2017 the lowest ever annual rainfall, since record keeping started in the early 1950s, was recorded at Algeria with a total of only 256 mm. The mountain peaks above 1 000 m, receive appreciably more precipitation than the valleys, much of it in the form of mist. A general pattern of higher winter rain in the west, with precipitation levels decreasing eastwards exists (Figure 3.12). Within this pattern, precipitation tends to increase rapidly with altitude.

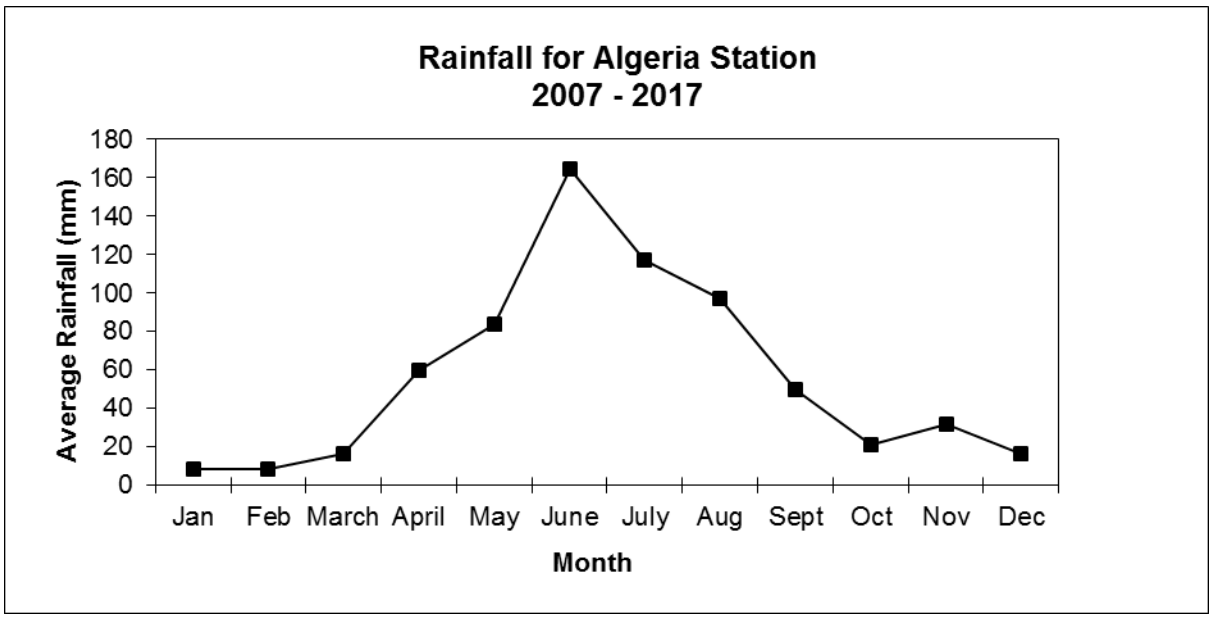


Figure 3.9: Mean annual rainfall for the Algeria station.

The lower annual average (201 mm) rainfall at Matjiesrivier Nature Reserve results in a habitat that is semi-arid in the west to arid in the east. A variance of approximately 100 mm exists between the rainfall at the western and eastern edges of the

Matjiesrivier Nature Reserve (Figure 3.12). This variation occurs over a distance of approximately 20 km resulting in relatively big variances in microclimates. The steep slopes and rugged terrain create rain-shadowed valleys and dry eastern slopes, while western slopes and high-lying areas receive more rain (Lechmere-Oertel 1998). Figure 3.10, indicates the average monthly rainfall recorded at the Matjiesrivier station. Similarly, to Algeria, the Matjiesrivier station recorded its lowest annual rainfall, since record keeping began in 1998, during the 2017 drought at a 106 mm.

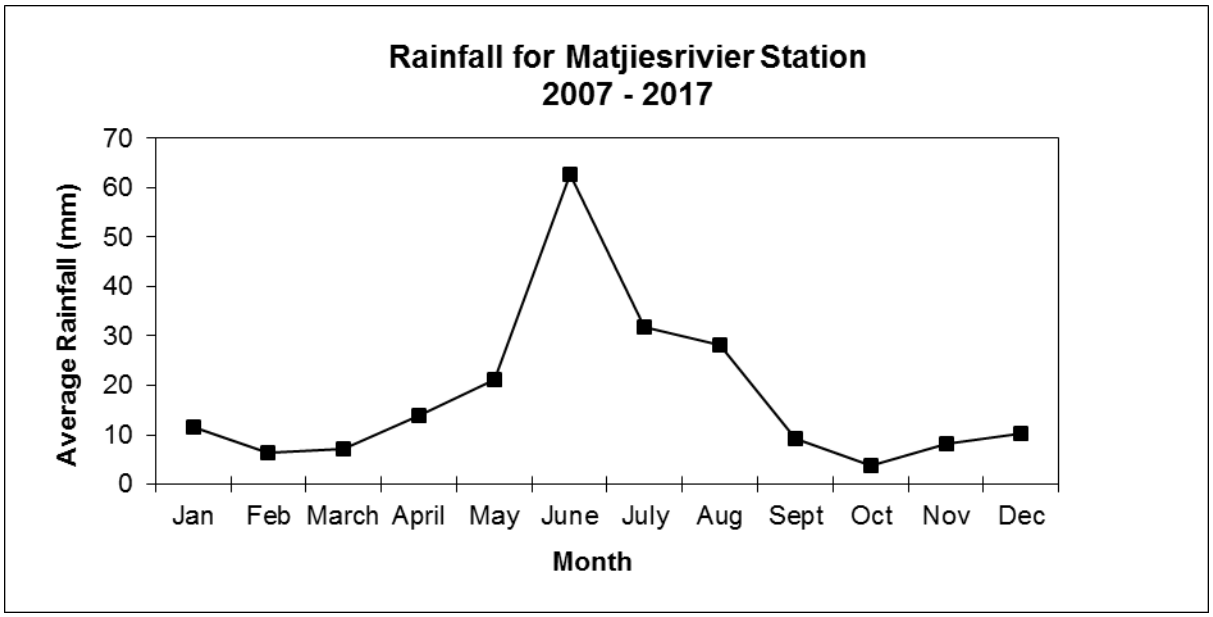


Figure 3.10: Mean annual rainfall for the Matjiesrivier station.

Within the Matjiesrivier Nature Reserve, winter months are associated with north-westerly winds, while south-easterly winds are associated with thunderstorm activity during the summer months (Barnard 1996). Maximum temperatures regularly rise to 40°C during the dry, summer months, while minimum temperatures drop well below 0°C in winter, with frost occurring between May and September (Barnard 1996). Snow is uncommon in Matjiesrivier Nature Reserve.

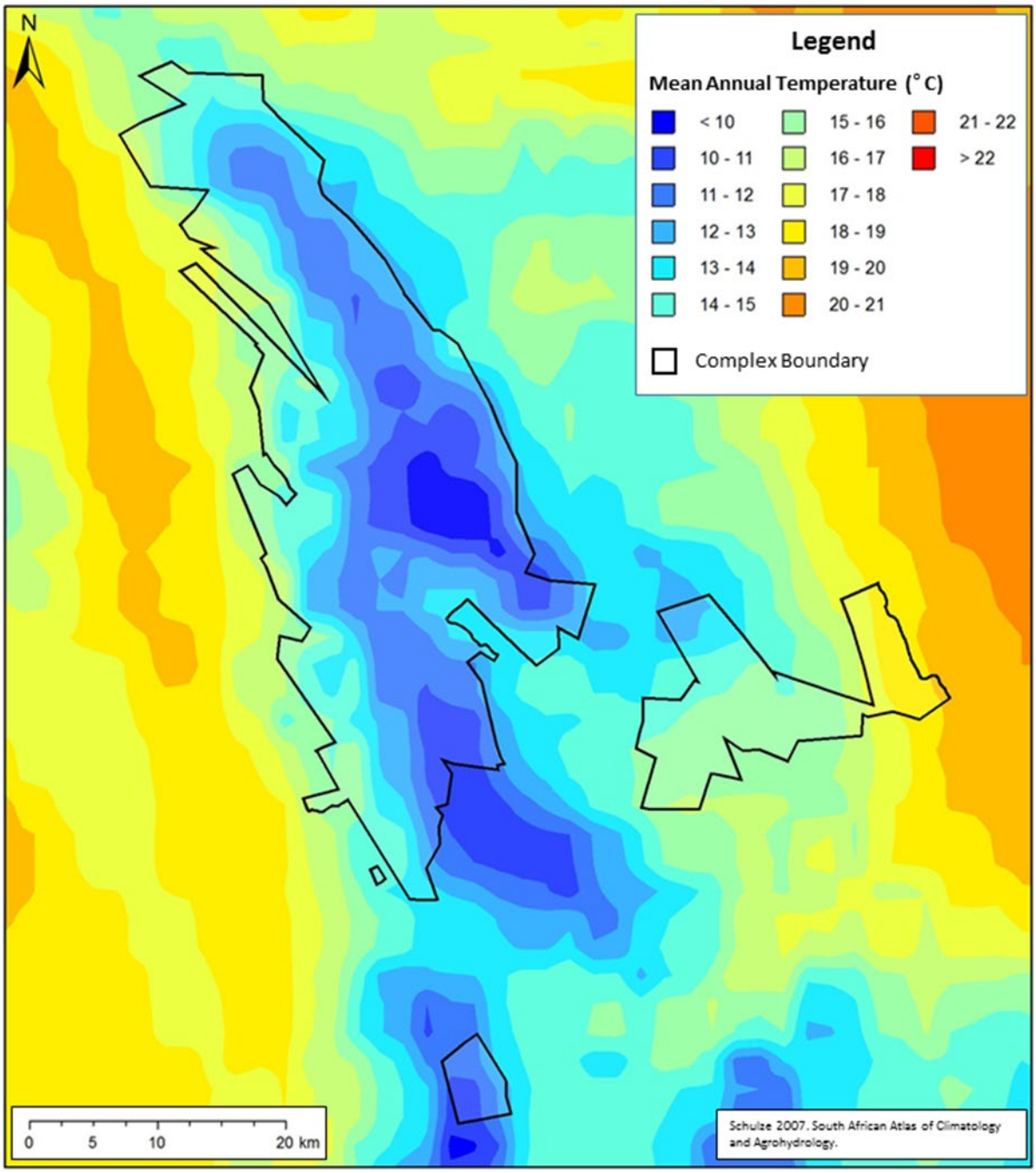


Figure 3.11: Mean annual temperature of the Cederberg Complex (Schultz 2007).

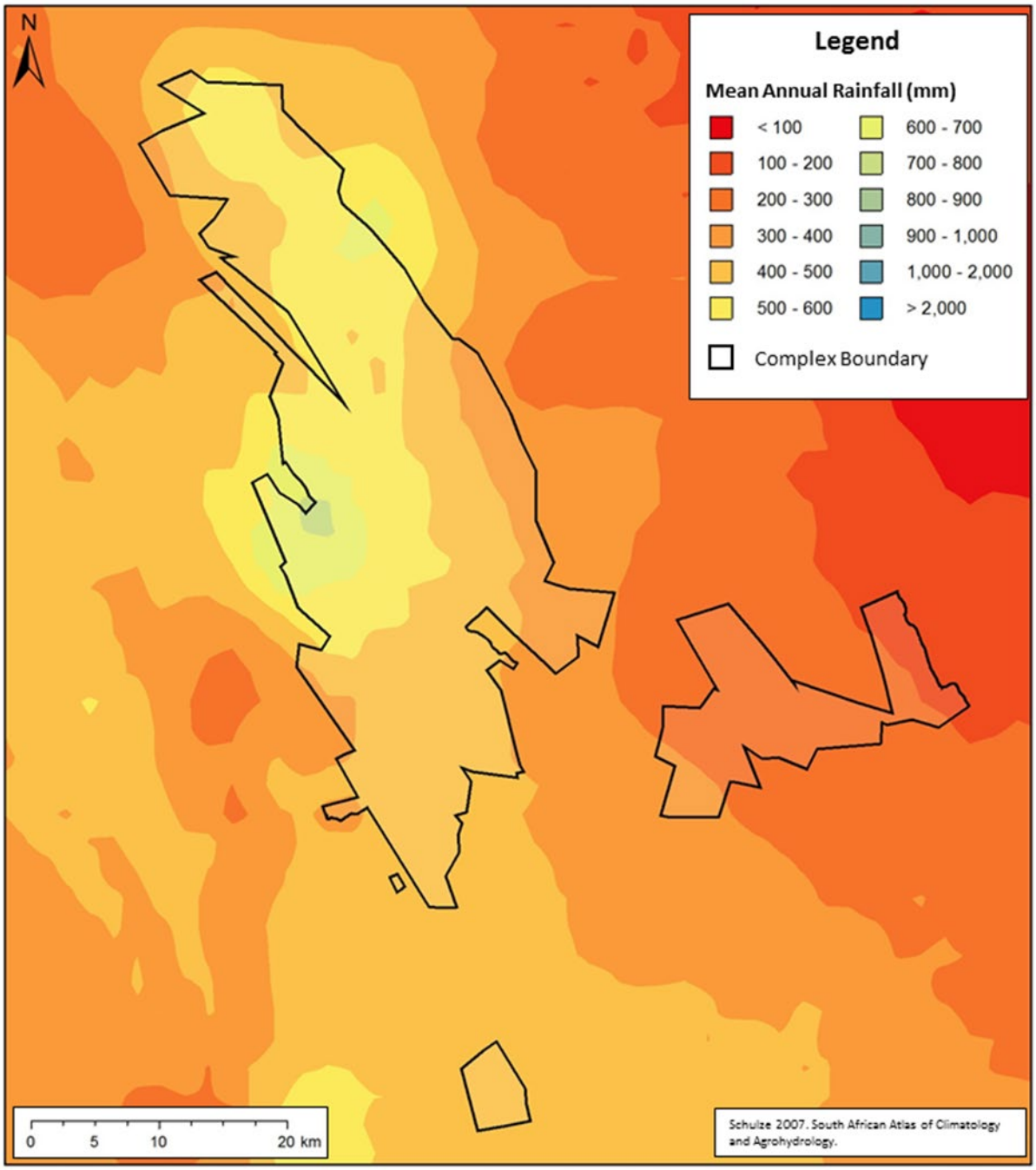


Figure 3.12: Mean annual rainfall of the Cederberg Complex (Schultz 2007).

3.7.2 Edaphic Factors

3.7.2.1 Topography

The Cederberg Wilderness consists of rugged mountains running in a north-south direction, where high mountain peaks (*e.g.* Sneeuberg 2 027 m.a.s.l.) (Figure 3.13) with high cliffs on the western aspect, and plateaus with deep valleys characterise the area (Appendix 7.2, Map 2). The central valley, which runs in a southeast direction from Clanwilliam in the north to Matjiesrivier Nature Reserve in the south, roughly divides the Cederberg Wilderness in two components (north & south). The topography of Matjiesrivier Nature Reserve is variable and rugged, with steep valley sides and high ridges with sporadic valley floors and plateaus (Barnard 1996). The area has a

north-south orientation with the exception of the Matjies River valley that runs west-east (Appendix 7.2, Map 2).

The highest and lowest points in the Cederberg Wilderness and Hexberg State Forest are: Sneeuberg 2 027 m.a.s.l, Tafelberg 1 969 m.a.s.l, Sneeukop 1 930 m.a.s.l and Krakadouw 1 744 m.a.s.l. with the Jan Dissels valley at the lowest altitude of 240 m.a.s.l. The highest point within the Matjiesrivier Nature Reserve is towards Keurbosberg at approximately 1 260 m.a.s.l. The lowest point is at Wildehondskloof on the eastern boundary at approximately 350 m.a.s.l. (Appendix 7.2, Map 1; Map 2).

Figure 3.13: View from Truitjieskraal. Sugarloaf Peak is in the foreground with Sneeuberg Peak at the back. Photo: Patrick Lane.

3.7.2.2 Geology

Stratigraphy

The Cederberg Mountains were formed about 485-350 Ma ago and consists of the Early Ordovician-to Early Carboniferous-aged Cape Supergroup formations (C.R. Penn-Clarke, private, 2016, pers. comm.). The geological evolution of Southern Africa, in the region of the Cape Supergroup, as well as that of the Cederberg Mountains, had large control over local and regional soil geochemistry. Along with the climatic character of the area, it forms the primary basis and sustenance of the Fynbos and Succulent Karoo biomes (C.R. Penn-Clarke, private, 2016, pers. comm.).

Since the breakup of Gondwanaland some 130 Ma ago (Barnard & Greeff 1993), the stratigraphy of the Cederberg shows eastward dipping of the Cape Supergroup strata (Table Mountain Group, Bokkeveld Group and Witteberg Group), overlain by the Karoo Supergroup (Dwyka Group, Ecca Group and Beaufort Group) (Reid *et al*. 2000).

The Table Mountain Group (TMG) (2 200 meters in diameter), which is dominated by sandstone of the Peninsula Formation and the Nardouw Subgroup, records the succession filling of a fast receding ocean by eroded sandy material 700-600 Ma ago. About 450 Ma ago, these sandy deposits were exposed to glacial activity.

Subsequently, rock fragments, mud and fine sand that were deposited after the ice melted gave rise to the next stratigraphic layer, the Pakhuis Formation. The melted ice accumulated in lo- lying areas and created marine environments. Silt and mud accumulated in the marine environments to form the Cederberg Formation (Reid *et al.* 2000).

The Cape Supergroup was formed by a succession of sandstone, silt, mud and sand sedimentation in a mixed deltaic and marine environment. According to Penn-Clarke (2013), the area of the current day Cederberg Complex was submerged in the Clanwilliam Sub-Basin Sea with beaches and delta channels to the east (Figure 3.14). Approximately 390-370 Ma ago, shale and sandstone were deposited in river deltas and the Bokkeveld Group was formed. An abundance of marine invertebrate fossils (crustaceans and bivalves) occurs in this stratigraphic shale layer. The last sedimentation succession that took place before major climatic changes happened about 370-430 Ma ago with the accumulation of sandstone, siltstone and shale that formed the Witteberg Group, the last of the Cape Supergroup formations.

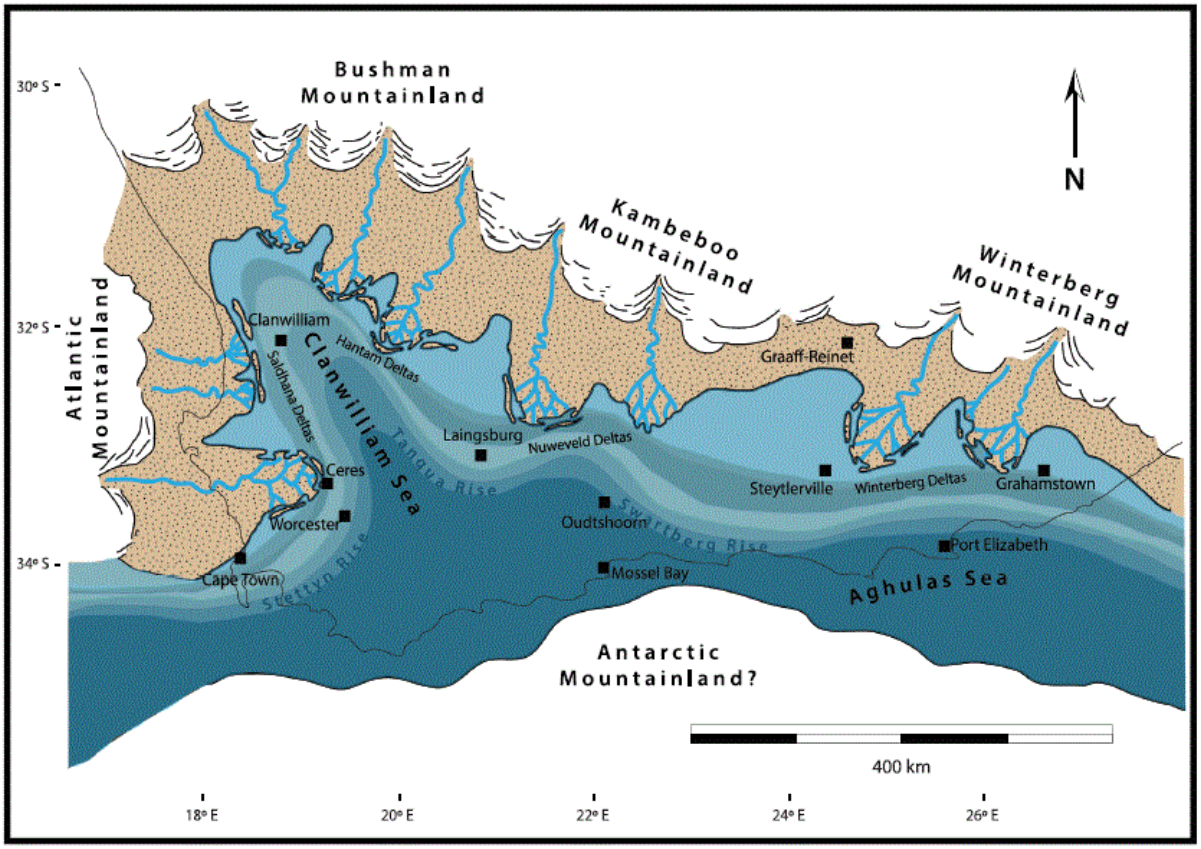


Figure 3.14: Palaeontological reconstruction showing the Clanwilliam Sea, associated shoreline and river deltas (reprint from Penn-Clarke *et al.* 2018).

Climatic change set in about 330 Ma ago and the rapid growth of a continental ice sheet resulted in a drop in sea level which exposed the upper Witteberg Group sediments that could now be eroded. This process was enhanced by scouring actions of large continental glaciers moving over these exposed layers. Around 310 Ma ago, the icy conditions subsided and the deposits from the glaciers formed the Dwyka Group, the first stratigraphic layer of the Karoo Supergroup. These deposits gave rise to the sedimentary Karoo Basin which was filled with shale, mudstone and sandstone deposited by rivers flowing down from the west and south, over the Cape Supergroup,

that had been lifted due to intercontinental forces. Further sedimentation gave rise to the Ecca and Beaufort Groups.

Structural Geology

The following is an extract from Taylor (1996):

"The Cederberg Wilderness lies close to the northern limit of the Cape Fold Belt of mountains that dominate the Cape Region. The mountains were formed by up thrusting and folding of the sedimentary rocks and subsequent extensive faulting. The drainage follows fault lines and angular lines of weakness in the sandstone beds, giving rise to a typical rectangular pattern. The quartzitic sandstones are relatively resistant to weathering, the shales and mudstones of the shale bands less so. The Cederberg is built almost entirely of the sedimentary rocks of the Table Mountain Group within the Ordovician to Devonian Cape Supergroup, with some remnants of the older Malmesbury shales near the Olifants River in the West (*e.g.* at Patrysberg) and an abrupt transition to the younger Bokkeveld formations along the Moordenaarsgat River to the east. Four formations of the Cape Supergroup are represented in the Cederberg" (Appendix 7.2, Map 3). From top to bottom these are:

- **The Nardouw Formation**, consisting of coarse grained orthoquartzites, with occasional pebbles and lenses of vein quartz (Truswell 1970). It is characteristically redder than the Peninsula Formation and the dense linear drainage or weathering pattern is distinguishable on aerial photographs. In the Cederberg, this formation is prominent in the plateau-like summits north of Pakhuis Peak and on Sneeukop, Tafelberg and other peaks above the shale band. North of the Cederberg, it builds the Nardouw Escarpment, and in the south forms the Skurweberg Range of the Bokkeveld.
- **The Cederberg Formation** (the shale band) is composed of shale and siltstone inter-bedded with fine-grained sandstone. It is a feature in the landscape, forming a narrow green band that contrasts sharply with the bare rocky quartzites below. It is fossiliferous, and lacks the pock marks or "heuweltjies" characteristic of the Malmesbury and Bokkeveld shales.
- **The Pakhuis Formation** is the thin layer of tillite, or glacial mudstones and related rocks, immediately below the shale band. It contains random-sized pebbles some of which have been facetted and striated during the movement of ice over the underlying rock pavement. On Pakhuis Pass and at Groenberg, remnants of the glacial pavement are exposed, showing the deep irregular grooves made by the passage of ice.
- **The Peninsula Formation**, like the Nardouw, is a very thick deposit of coarse-grained quartzitic sandstones with occasional white quartz pebbles. Sand-shale lenses of various sizes occur throughout this formation. This formation comprises all those parts of the Cederberg from which the upper strata have been eroded away, *i.e.*, southward from Pakhuis Pass, including Krakadouw, Middelberg, Vensterberg and Maraisberg, but excluding the eastern peaks from Sneeukop to Sandfontein".

For a simplified cross section of the greater Cederberg geology see Figure 3.15.

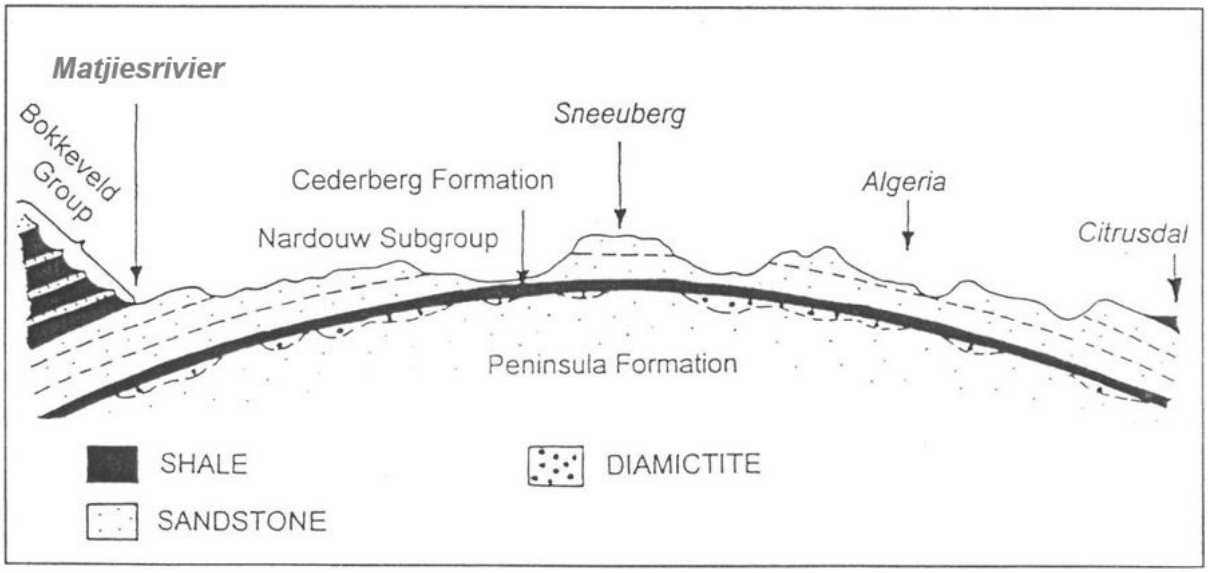


Figure 3.15: Cross section of the greater Cederberg geology indicating the location of Matjiesrivier and Algeria (reprint from De Beer 1998).

The overlying strata of the Nardouw Subgroup, Bokkeveld Group, Witteberg Group and Dwyka Formation are observed on Matjiesrivier Nature Reserve from west to east. The Stadsaal caves and Truitjieskraal are erosion remnants of the resistant and thick-bedded sandstone of the Nardouw Subgroup. The Dwyka Formation overlies the white Witteberg Group in the east of Matjiesrivier Nature Reserve at Sandlaagte where rock fragments from glacier deposits are scattered. On Matjiesrivier Nature Reserve, the fynbos vegetation grows on the shales and sands of the TMG while the succulent karoo vegetation is found on the Bokkeveld, Witteberg, and Dwyka Formations (Low & Rebelo 1996). In the west of the reserve, up until the main road to Ceres, the sandstone is part of the TMG. The majority of the sandstone found in the reserve, from the middle to the eastern side of the reserve, is associated with the Witteberg Group. The rock strata have been considerably folded to form synclines and anticlines that give rise to the rugged topography.

Soils and Sediments

Sandy loam to clay loam soils are generally derived from the shales and mudstones of the Cederberg Formation *in situ* or as transported materials in the valleys. Cederberg soils are generally highly leached acid sands, low in nutrients with a low moisture retaining capacity (Barnard 1996). The soils on the sandstone slopes are typically unstratified and sandy, often with high grit content in places. In many areas, the bedrock is close to the surface and is frequently exposed. In the flatter run-on areas such as around Stadsaal Cave, deep aeolian sands are found (WKNB 1997). Within these fine-grained aeolian sands, localised patches of what appears to be coarse-grained sands have been found. The soils derived from the shale bands are finer-grained and more fertile than those derived from the quartzite. According to Barnard (1996) these finer-grained soils are often concealed by an over-burden of quartzitic debris from a sandstone source further upslope. Throughout the Matjiesrivier Nature Reserve, there are localised patches of gravel (approximate pebbles size between 5 and 20 mm in diameter) that appear to be from a tertiary planation surface. The pebbles themselves are probably derived from conglomerates commonly found in Table Mountain Sandstone that have broken down during the erosion of the landscape, thus releasing the pebbles (WKNB 1997).

3.8 Biodiversity Context: Ecosystems

3.8.1 Freshwater Ecosystems

The higher peaks of the Cederberg Mountains, especially within the Cederberg Complex, receive highest rainfall during the wet winter season. The Cederberg Mountain catchment forms the northern spine of the watershed between the Olifants River to the west and the Doring River towards the east. Together these two river systems form the bigger Olifants-Doring River catchment, which plays a vital role in sustaining life in the Greater Cederberg area by providing a sustained flow of good quality water (Appendix 7.2, Map 4). The Cederberg Wilderness has numerous perennial rivers that flow east and west into the Doring and Olifants Rivers respectively. In contrast, and although the north-western section of Matjiesrivier Nature Reserve is declared as a MCA, the reserve has a low rainfall and contributes relatively little water into the catchment (Appendix 7.2, Map 4).

The Cederberg Complex forms a key part of the catchment for one of the West Coast's most important dams, the Clanwilliam Dam, located in the Olifants River. Several key tributaries of the Olifants River (*e.g.* Boskloof, Rondegat, and Heks) arise within the Cederberg Complex.

A mosaic of wetland types, with the majority consisting of sensitive hillslope seeps and valley-bottom wetlands, form part of the freshwater ecosystems found within the Cederberg Complex. Some of these wetlands are dependent on groundwater and/or aquifer water sources and may contribute to the sustained base flow in several of the perennial rivers of these catchments. These catchments serve as important recharge zones for the aquifers underlying the mountains and lower-lying areas. Generally intact riparian and wetland buffer zones prevail, with a small degree of intrusion by Invasive Alien Plant (IAP) species. The freshwater ecosystems and their buffer zones contained within the Cederberg Complex provide important refugia for several species, including indigenous fish species, amphibians, mammals, plants and many invertebrates, some of which can be used as indicators of ecosystem condition.

Pressures on the hydrological functioning of the aquatic systems in these catchments include the ever-increasing water demands for the agricultural sector in the Olifants River catchment, as well as municipal water supply. With the onset of the current drought conditions, groundwater abstraction in particular has seen an exponential increase (2017-2018). It is considered to be an easy and affordable form of water augmentation to utilise available water sources during the prevailing drought conditions and beyond.

Generally, the rivers and wetlands located within the Cederberg Complex boundaries are found to be in at least 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. Furthermore, they serve as migration corridors for several species, into and out of, the Cederberg Complex.

For these freshwater ecosystems, a key management intervention is the clearing and effective control of IAPs, especially within riparian zones and wetlands as well as adjacent Mountain Catchment Areas. Other stressors include surface water abstraction, poor land-use practices and tourism impacts that negatively affect river water quality and climate change. Mitigation for the effects of climate change is challenging and here adaptive management that is informed thorough scientific

monitoring, including the collection of rainfall and ambient temperature data, is of the utmost importance.

3.8.1.1 Groundwater and Aquifers

The groundwater systems associated with the Cederberg Complex generally fall within the TMG aquifers, which extend from near Niewoudtville in the northwest, down to Cape Agulhas and eastwards toward Port Elizabeth (Frame & Killick 2004). Other aquifer groups present include the Bokkeveld and Witteberg groups. The Peninsula formation is considered to have the highest potential for recharge and the Peninsula aquifer (exposed, unconfined to confined sections) contributes mainly to rivers through surface run-off, hillslope interflow and base flow of larger river systems. In many cases, the springs emanating from the confined sections of this aquifer tend to be perennial and generally thought to be less impacted by groundwater abstraction and seasonal variation, as is the case in the Boland (Colvin *et al*. 2009).

When considering water supply, the TMG aquifers are high-yielding systems of good quality water. The likelihood for aquifer contamination in the general area is thought to be moderate, with some intrusion in the southern part of the complex. This is reflected in the Department of Water Affairs and Forestry - Aquifer Vulnerability Map, where these aquifer systems are shown to be a major groundwater source (high-yielding system of good quality water) with a medium to high susceptibility to contamination by anthropogenic activities in especially the lower-lying areas within the catchment (Parsons & Conrad 1998; DWAF 2000). Moreover, water quality is mostly good and does not have high levels of salt content, with electrical conductivity values of 0-70 mS/s, and pockets of slightly salty intrusions, values ranging from 70- 150 mS/s, in the most northern and most southern parts of the Cederberg Complex (DWAF 2000).

TMG aquifers are prevalent leading to a high groundwater recharge in these areas and have been identified as such through the National Freshwater Ecosystem Priority Areas (NFEPA) project (Nel *et al*. 2011a) (Appendix 7.2, Map 4). Due to these characteristics, *i.e.* high yield of good quality water, these systems may be subject to increased groundwater abstraction in future. Expectations are that increased abstraction of groundwater, even if outside the Cederberg Complex boundaries, will introduce some ecological impacts for the freshwater and terrestrial ecosystems in the catchment. Some work has been conducted in the Boland area, to determine the extent and effect of potential impacts (*e.g.* 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 area was assessed and documented by Cleaver *et al*. (2003). In this study, impacts observed 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, do not bode well for the ecosystems that are associated with groundwater and/or aquifers.

With regards to groundwater use within the Cederberg Complex, no known boreholes are currently located in the Cederberg Wilderness or Hexberg State Forest. Two boreholes are located on Matjiesrivier Nature Reserve, one at the office and the other at Sandlaagte in the eastern part of the reserve. Water from the borehole at the office is occasionally used for garden irrigation and human consumption. The borehole at Sandlaagte is currently not utilised but contains water of high quality. Current utilisation practices do not require that the boreholes be registered. The sustainability of abstracting water from the aquifers remains questionable, however, this has not been

identified as a significant threat to the freshwater ecosystems contained within the Cederberg Complex.

3.8.1.2 Rivers

Thirteen rivers originate in the Cederberg Wilderness and Hexberg State Forest, all of which drain west and east into the Olifants and Doring Rivers respectively (Appendix 7.2, Map 4). The annual average flow of the Olifants River measured at Clanwilliam above the Clanwilliam Dam, is 404 200 million cubic litres/annum (F. van Heerden, Department of Water Affairs and Forestry, 2011, pers. comm.). It is estimated that the Jan Dissels River, which arises in the Cederberg Complex and enters the Olifants River below the Clanwilliam Dam contributes an annual average of approximately 40 million cubic litres/annum to the system (B. Paxton, Freshwater Research Centre, 2018, pers. comm.). Apart from the two perennial rivers, the Matjies and Krom, that traverse the Matjiesrivier Nature Reserve, there are a number of seasonal streams that start to flow after summer downpours. Matjiesrivier Nature Reserve is bounded in the east by the Doring River, which flows in a northerly direction. The Doring River enters the Olifants River at Trawal, approximately 40 km north of Clanwilliam. Nel *et al.* (2011a; 2011b).

The low to medium threats that have been identified for the river ecosystems located within the Cederberg Complex include the presence of IAP species within the riparian zones, as well as the presence of invasive alien fish species within the instream habitat (section 2.5). With regards to the maintenance of the riparian zones of rivers, the removal of invasive alien trees should be prioritised, especially in the high water yield catchments within the Cederberg Complex. This will be beneficial for water production and aquatic macro-invertebrates (Samways *et al*. 2010b).

For river management it is important to consider activities in the entire catchment of a particular river. This is especially important for rivers and sub-quaternaries that are considered national priorities (Nel *et al.* 2011a & 2011b).

3.8.1.3 Other Freshwater Aquatic Systems (wetlands, springs, pans)

Not many additional wetlands (such as sponges, seeps and high altitude wetlands) have been mapped within the Cederberg Complex but there are bound to be a higher number of wetlands, especially high altitude seepage areas, which have not been mapped to date (Nel *et al.* 2011a & 2011b). However, within those that have been mapped, several are considered to be NFEPA wetlands (Appendix 7.2, Map 4). Within the Cederberg Wilderness this includes higher and lower altitude seeps and channelled valley bottom wetlands, as well as a depression wetland in the Matjiesrivier Nature Reserve. The wetland vegetation varies from Northwest Sandstone Fynbos within the Cederberg Wilderness, to Northwest Quartzite Fynbos wetlands in the Matjiesrivier Nature Reserve. The mapped wetlands are considered to be least threatened and vary from being moderately protected (Northwest Sandstone Fynbos channelled valley-bottoms and seeps) to poorly protected for the Northwest Quartzite Fynbos depression. (Gouws *et al*. 2012; Nel & Driver 2012). According to the NFEPA wetlands map layer data, all of the wetlands mapped within the Cederberg Complex's boundary are in a good to natural condition (Nel *et al*. 2011a; Ollis *et al*. 2013).

Within the Cederberg Complex, the upper reaches of the Driehoeks River form an important wetland stretching southeast from Uitkyk Pass down to Perdekloof. This vlei system is the largest of its kind in the Cederberg Complex. A number of seeps and springs are located throughout the Cederberg Complex. These systems become

saturated during the rainy season and start releasing water during summer, thereby providing a constant source of moisture which feeds into various rivers throughout the year. Matjiesrivier Nature Reserve has a seasonal pan at Vaalvlei that receives water during summer rain spells.

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 Cederberg Complex World Heritage Site is needed. The threat to other wetland types in the Cederberg Complex are low.

3.8.2 Vegetation

The Cederberg Complex is located in the Greater Cape Floristic Kingdom. Due to the topographic, geological and climatic diversity, the Cederberg Complex spans two "Biodiversity Hotspots" namely the Cape Floristic Region, now referred to as the Core Cape Subregion, and the semi-arid Succulent Karoo (Mucina & Rutherford 2006; Manning & Goldblatt 2012). The Core Cape Subregion has a flora that differs sharply from the immediate surrounds (Manning & Goldblatt 2012). It is one of the world's smallest but richest floral kingdoms, encompassing a land area of approximately 90 760 km² (less than 4% of the southern African subcontinent). An estimated 9 383 species of vascular plants (ferns and other spore-bearing vascular plants, gymnosperms, and flowering plants) are known to occur here, of which just over 68% are endemic. The majority of these species are flowering plants. The Core Cape Flora of the Greater Cape Floristic Region is characterised by six endemic or near-endemic families and by the conspicuous presence of Asteraceae and Fabaceae (two largest families), and the Iridaceae, Aizoaceae, Ericaceae, Proteaceae, and Restionaceae (Manning & Goldblatt 2012).

Surrounding the Core Cape Subregion are vegetation elements that fall within the Extra Cape Subregion which includes the Tanqua, Western Mountain Karoo, Knersvlakte, Namaqualand Hardeveld, Namaqualand Sandveld, the Kamiesberg Mountains, Gariep and Southern Namib (Snijman 2013).

According to Manning (2007), fynbos is a fire-adapted vegetation type and evidence suggests that, in the absence of regular fire, all fynbos types except those adapted to drier conditions would become dominated by trees.

Fynbos regrowth is largely through the germination of seeds, either dropped from the canopy or stored in the soil. Plants with this strategy are known as re-seeders. Relatively few fynbos species are re-sprouters, which regenerate from the stump or rootstock after fires. Re-sprouters are able to grow more rapidly than re-seeders using reserves stored in their buried stems. Some re-sprouters, including several of the larger proteas, protect their trunks with a thick insulating layer of corky bark and sprout from buds buried in the trunk, thereby gaining a height advantage over plants that burned around them. The following vegetation types are found within the Cederberg Complex (Appendix 7.2, Map 5; Table 3.3).

3.8.2.1 Fynbos

Cederberg Sandstone Fynbos *Vulnerable D1*

This is the dominant vegetation type in the Cederberg Complex. The vegetation consists of closed restiolands on deeper moister sands, with low, sparse shrubs that become denser and Restionaceae are less dominant in the drier areas. Structurally it is predominantly asteraceous, restioid and proteoid fynbos. Typical species include common sugarbush (*Protea repens*), grey-leaf sugarbush (*Protea laurifolia*) and queen sugarbush (*Protea magnifica*) (Figure 3.16). North of Pakhuis Pass towards the Doring River this vegetation type grades through asteraceous fynbos to Doringrivier Quartzite Karoo (Mucina & Rutherford 2006).

There are many diverse communities in Cederberg Sandstone Fynbos. Large areas of lower altitude Cederberg Sandstone Fynbos not represented within the Cederberg Complex are being transformed for rooibos and citrus production. A total of 83.8% of the provincial target for Cederberg Sandstone Fynbos is met within the Cederberg Complex.

Figure 3.16: Queen sugarbush (*Protea magnifica*) Photo: Marius Wheeler.

Olifants Sandstone Fynbos *Least Threatened*

It is found on gentle to steep slopes towards the Cederberg scarp, as well as broad valley bottoms. This unit comprises a combination of communities tending to occur on the rocky west-facing slopes of the Cederberg where bare rock and cliffs are dominant and there is less accumulation of sand. The rock provides fire protection, resulting in the dominance of Cape thicket and asteraceous fynbos with interspersed low trees and tall shrubs forming a medium-tall shrub matrix. Proteoid fynbos is most prominent on the lowermost slopes and sandy plateaus and restioid fynbos occurs on deeper

sands and shallower soils (Mucina & Rutherford 2006). The Cederberg Complex contributes 28.7% of the Olifants Sandstone Fynbos to the provincial target.

Swartruggens Quartzite Fynbos *Least Threatened*

This vegetation type occurs on the high plateau areas from the Tra-Tra Mountains north of Wupperthal to Blinkberg in the south. The alternating ridges and plains with sandy and skeletal soils derived from the Witteberg Group quartzite support medium-dense, moderately tall, restioid and ericoid shrubland with open and emergent tall proteoid shrubs. This is a diverse fynbos mixture containing all structural fynbos types (except graminoid fynbos). In the lower dry areas, it is replaced by Karoo shrublands on sandstone. The fynbos transcends to Karoo as the restios thin out and succulent plants become more dominant. This is a sub-arid, winter-rainfall area with a mean annual precipitation of between 200-620 mm, peaking from May to August. Swartruggens Quartzite Fynbos is least threatened with a conservation target of 29%. Dominant species found here include sand olive (*Dodonaea viscosa* var. *angustifolia*), arid pincushion (*Leucospermum calligerum*) and renosterbos (*Elytropappus rhinocerotis*) (Mucina & Rutherford 2006). A total of 12.78% of the provincial target for Swartruggens Quartzite Fynbos is met within the Cederberg Complex.

Northern Inland Shale Band Vegetation *Least Threatened*

This vegetation unit occurs on narrow shale bands from Pakhuis Pass in the north to the Koue Bokkeveld in the south and is often associated with long linear plateaus in the Cederberg Mountains. This vegetation type encompasses diverse shrublands ranging from Karoo at lower levels and northerly aspects, Renosterveld at low and medium altitudes and various aspects and fynbos at higher altitudes. Heuweltjies are prominent in the northern portion of the band. The clay soils are derived from the shales of the Cederberg Formation. The area is typical winter-rainfall with an annual precipitation of between 250-1 360 mm, peaking from May to August. Northern Inland Shale Band Vegetation is least threatened with a conservation target of 29%. The majority (80%) of this vegetation type is protected within both the Cederberg and Grootwinterhoek Wilderness Areas and contains species such as black-rim sugarbush (*Protea accuminata*) and water sugarbush (*Protea punctata*). A total of 32% of the provincial target for this vegetation type is met within the Cederberg Complex.

Western Altimontane Sandstone Fynbos *Least Threatened*

This vegetation type is found on summits and ridges of mountains from about 1 800 m.a.s.l. upwards and includes patches on Jurie se Berg and Sneeukop (1 930 m.a.s.l.), Shadow Peak (1 898 m.a.s.l.) and Sneeuberg (2 027 m.a.s.l.). High altitude peaks are generally fragmented and localised. The vegetation structure is characterised by low, open to medium-dense restioid fynbos, with ericaceous and asteraceous components occurring locally. Proteoid fynbos are generally absent but include species such as the snow protea (*Protea cryophila)* (Figure 3.17). Skeletal and rocky lithosol soils are derived from Ordovician sandstones of the TMG. Rainfall is relatively high and can range from anything between 450-3 140 mm, peaking from May to August. A total of 21% of the provincial target for this vegetation type is met within the Cederberg Complex.

Figure 3.17: Snow protea (*Protea cryophila*). Photos: Rudolf Andrag and Patrick Lane.

Fynbos Riparian Vegetation *Least Threatened*

This vegetation forms narrow belts of alluvial thicket accompanied by palmiet (*Prionium serratum),* along upper stretches of rivers draining mountain fynbos. These are present at altitudes below 1 300m. Narrow flat or slightly sloping alluvial flats support a complex of reed beds dominated by tall palmiet and restios including low shrublands with moisture-loving *Berzelia, Cliffortia* and *Helichrysum.* Alluvial sandy or silty soils over quaternary sediments are largely derived from weathering of Table Mountain Sandstone and Cape supergroup shales. Streams are mainly fed by rainfall during winter and later on during summer by seeps carrying organic-rich water. Large streams carry water all year round, while some smaller streams turn into a series of disconnected pools in the upper reaches during summer. All streams are prone to seasonal flooding and riparian vegetation is well-adapted to cope with uprooting and water damage. Erosion occurs occasionally and can lead to patchy riparian vegetation. A total of 62.93% of the provincial target for this vegetation type is met within the Cederberg Complex.

Cape Lowland Freshwater Wetlands *Least Threatened*

This vegetation type consists of flats and landscape depressions with extensive tall reeds such as the common reed (*Phragmites australis*) and bulrush (*Typha capensis*), temporarily or permanently flooded restiolands, sedgelands and rush-beds as well as macrophytic vegetation embedded in permanent water bodies. It consists of substrates of fine sand, silty and clayey soils over young quaternary sediments from weathering shales, Cape granites and Table Mountain Sandstone; they fill depressions and accompany broad alluvia of lowland rivers. The major source of water is either temporary or permanent. In places, especially associated with Malmesbury shales, wetlands can acquire a brackish character (Mucina & Rutherford 2006). A total of 0.8% of the provincial target for this vegetation type is met within the Cederberg Complex.

3.8.2.2 Succulent Karoo

Swartruggens Quartzite Karoo *Least Threatened*

This vegetation type occurs from Karoopoort in the south to the Hottentotsberge in the north. The hilly landscape is dissected by valleys with steep rocky slopes housing succulent shrublands with *Euphorbia, Tylecodon,* and *Phiambolia.* Fynbos and Renosterveld elements shared with neighbouring dry sandstone fynbos units include *Willdenowia, Dodonaea* and *Elytropappus.* The quartzitic sandstone of the Witteberg Group support shallow skeletal soils. This semi-desert winter-rainfall area has a mean annual precipitation of approximately 200 mm, peaking from June to August. Swartruggens Quartzite Karoo is least threatened with a conservation target of 19% of which the majority is conserved within Matjiesrivier Nature Reserve. This vegetation type shows no signs of serious alien plant infestations and harbours the recently recognised endemic succulent genus *Phiambolia.* A total of 55.52% of the provincial target for Swartruggens Quartzite Karoo is met within the Cederberg Complex.

Agter-Sederberg Shrubland *Least Threatened*

Agter-Sederberg Shrubland (Figure 3.18) occurs on a narrow shale belt extending south from Wupperthal between the Skurweberg and Swartruggens to Zonderwater in the south. The slopes of low mountains and deeply incised valleys support tall shrublands composed of a mixture of succulent, *Crassula, Euphorbia, Ruschia* and *Tylecodon* and non-succulent, *Berkheya, Felicia* and *Pteronia* species. The geology includes dark grey siltstones and shales with intercalated mudstones and sandstones of the Devonian Ceres and Biedouw Subgroups (Bokkeveld Group) and quartzitic sandstone of the Witteberg Group and Nardouw Supergroup. This supports deep soils over shales and shallow soils over quartzitic sandstone. Heuweltjies are a prominent feature in this vegetation type. The area has a typical winter-rainfall with a mean annual precipitation of approximately 250 mm, peaking from June to August. Agter-Sederberg Shrubland is least threatened with a conservation target of 19% of which a small patch (7.62%) is statutorily conserved in Matjiesrivier Nature Reserve. This vegetation type is poorly studied. The Cederberg Complex have identified this vegetation type as a priority for additional formal protection through stewardship (section 2.6).

Figure 3.18: Agter-Sederberg Shrubland. Photo: Rika du Plessis.

***Citrusdal Vygieveld** Least Threatened*

Within the Cederberg Complex this vegetation unit is the smallest and encompasses patches situated on the broad bottom of the Olifants River valley, in the vicinity of Citrusdal and Clanwilliam. This vegetation type is found on broad, slightly sloping mountain flanks, as well as ridges of low hillocks emerging from the valley between mountain ranges. It mainly consists of succulent shrubland, medium to tall in height, often dominated by pencil milkbush (*Euphorbia mauritanica*) and mesemb vygies. This vegetation type often leads to spectacular floral displays during spring, associated with good rains. Dominated by shale and quartzite of the Cape Supergroup this area supports moderately deep sandy and sandy loamy soils. Rainfall occurs in winter with an annual mean of 316 mm. A total of 3.54% of the provincial target of this vegetation type is met within the Cederberg Complex.

The vegetation of Matjiesrivier Nature Reserve (Appendix 7.2, Map 6) was further classified into plant communities by Lechmere-Oertel (1998) using two-way indicator species analysis (TWINSPAN). This analysis classified the vegetation into eight major plant communities namely Asteraceous Fynbos Matrix, Dwarf Bedrock Shrubland, Fynbos/Succulent Karoo Transition, Restioid Sandy Fynbos, Sandy Succulent Karoo, Shale Succulent Karoo, Succulent Karoo Matrix and Succulent Karoo on Gravel Patches. According to Lechmere-Oertel (1998), these plant communities are associated with the variety of soil forms as well as the east-west rainfall gradient on Matjiesrivier Nature Reserve. Six of these plant communities are accommodated in the Swartruggens Quartzite Fynbos vegetation type as described in the section above.

Table 3.3: Summary of the vegetation types found within the Cederberg Complex.

Vegetation Type	Provincial Protection Target (ha)	Under Cederberg Management (ha)	% of Provincial Target Under Cederberg Management	CapeNature Threat Status (Jacobs *et al.* 2017)
Agter-Sederberg Shrubland	11 736.49	846.44	7.21	Least Threatened
Cape Lowland Freshwater Wetlands	7 878.97	66.34	0.84	Least Threatened
Cederberg Sandstone Fynbos	72 851.45	60 326.46	82.80	Vulnerable (D1)
Citrusdal Vygieveld	4 073.28	144.20	3.54	Least Threatened
Fynbos Riparian Vegetation	4 48.96	282.50	62.92	Least Threatened
Northern Inland Shale Band Vegetation	7 908.28	2 568.83	32.48	Least Threatened
Olifants Sandstone Fynbos	14 259.60	4 093.53	28.70	Least Threatened
Swartruggens Quartzite Fynbos	47 328.40	6 049.35	12.78	Least Threatened
Swartruggens Quartzite Karoo	5 453.98	3 028.35	55.52	Least Threatened
Western Altimontane Sandstone Fynbos	1 087.79	229.17	21.06	Least Threatened

3.8.2.3 Rare and Endangered Species

Clanwilliam Cedar Tree (Widdringtonia cedarbergensis)

The presence of the Clanwilliam cedar tree (Figure 3.19) in some ways defines the entire Cederberg Complex region. Its current distribution is almost entirely restricted to the Cederberg Complex (Appendix 7.2, Map 5). According to Peter Slingsby (private cartographer, 2016, unpublished data) approximately 13 500 adult Clanwilliam cedar trees remain. Formerly, more numerous (growing as an open woodland), this strong fragrant timber tree was extensively harvested between the early 1800s and 1967 (Taylor 1996). Fossilised pollen records indicate that this exploitation exacerbated an ongoing natural decline of this species since the last glacial period (150 000 years ago) (Sugden & Meadows 1990).

The relatively slow growth (12-40 years before achieving maturity), and the fact that the Clanwilliam cedar tree is killed by fire, unlike other members of *Widdringtonia* which resprout, has meant that a recovery of the population has never really occurred. In addition, the Clanwilliam cedar tree possesses a weak serotiny, which means that few seeds are available for post-fire recruitment (Mitrani 2017). Larger and more frequent fires as well as related reductions in the frequency and amount of precipitation (Mitrani 2017), are a contemporary feature of the Cederberg and this trend is likely to continue and worsen as climate change progresses.

CapeNature is committed to ensuring the future survival of the Clanwilliam cedar tree through a programme of maintaining and extending artificial plantations of this remarkable tree as a seed source for restoration efforts. CapeNature has identified the development of a Clanwilliam cedar tree restoration plan as a high priority (section 2.6). Additional management efforts will prioritise fire management and bolstering of the natural population. This species has a group of enthusiasts and researchers committed to its continued survival.

For a list of the range restricted and threatened species found within the Cederberg Complex refer to Tables 3.4 and 3.5. The data were obtained from the latest South African National Biodiversity Institute's (SANBI), Threatened Species Programme.

Table 3.4: List of highly restricted plant species for the Cederberg Complex (species that are found from a single population, <10 km² in extent, including species within 1 km of reserve boundaries).

Reserve Component	Species Name	National Redlist Status (SANBI 2018)
Cederberg	*Erica hanekomii*	Endangered
	Hesperantha elsiae	Critically Rare
	Psammotropha diffusa	Vulnerable
	Ixia angelae	Critically Rare
	Serruria flava	Critically Endangered
	Agathosma conferta	Endangered
	Agathosma distans	Vulnerable
	Oxalis oreophila	Critically Rare
	Geissorhiza erubescens	Rare
	Hesperantha laxifolia	Critically Rare

	Agathosma bicolor	Vulnerable
	Leucadendron concavum	Endangered
	Agathosma aemula	Rare
	Agathosma sp. nov. "viviers 1251 BOL"	Vulnerable
Hexberg	*Agathosma* sp. nov. (Viviers 1238 BOL)	Critically Rare

Figure 3.19: The Clanwilliam cedar tree (*Widdringtonia cedarbergensis*). Tafelberg in the background. Photo: Scott Ramsay.

Table 3.5: Summary of conservation categories for plant species found within the Cederberg Complex.

National Redlist Status (SANBI 2018)	Cederberg	Matjiesrivier	Hexberg
Critically Endangered	2	0	0
Endangered	13	1	1
Vulnerable	23	3	0
Critically Rare	3	0	0
Near Threatened	17	4	2
Rare	30	7	0
Data Deficient - Insufficient Information	3	2	0
Data Deficient - Taxonomically Problematic	5	3	0
Total Species of Conservation Concern	96	20	3
Total species recorded	1069	372	32

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.

The Cederberg Complex has 13 frog species recorded. One species, the Cape rain frog (*Breviceps gibbosus*) is listed as Threatened by the IUCN. It has been recorded from the western limits of the Cederberg Complex (Algeria), and further surveillance monitoring will be useful. The Cederberg Complex furthermore hosts two endemic frog species: the Cederberg ghost frog (*Heleophryne depressa),* which still needs formal taxonomic elevation as distinct from the Cape ghost frog *(H. purcelli),* and an undescribed species of mountain toadlet (*Capensibufo* sp.) that has previously been confused with Tradouw's mountain toad (*Capensibufo tradouwi*) (Table 3.6) (Tolley e*t al.* 2010; Cressey *et al.* 2015; Channing *et al.* 2017). The Cederberg Complex hosts two main types of amphibian habitat: highland seeps and streams/rivers. The seep areas are important habitats for mountain toadlets (*Capensibufo*) and the upper reaches of the streams, generally above the level where fish occur, are important for the ghost frog.

Ghost frogs require clean, running water year-round and their continued presence should be an indicator of good management of the upper catchments. There are no long-term frog monitoring projects in the Cederberg Complex at present and the conservation of frogs in this PA is reliant on ensuring good management of invasive alien woody plant species and an appropriate fire-return interval. These management actions should be sufficiently measured and monitored under the vegetation and fire indicators.

Table 3.6: Amphibian species of conservation concern that occur within the Cederberg Complex.

Species Name	Common Name	Global IUCN Category (2016)
Capensibufo sp.	unnamed mountain toad	Not evaluated
Heleophryne depressa	Cederberg ghost frog	Not evaluated

3.9.2 Reptiles

The Cederberg Complex has 52 reptile species recorded. An extensive survey by the University of Stellenbosch as part of the Survey of Cederberg Amphibians and Reptiles for Conservation & Ecotourism project in the area provided an updated species list in 2008. One of the 52 recorded species, the speckled padloper (*Chersobius signatus*), is currently listed as Vulnerable by the IUCN (IUCN Red List 2018). This species is threatened by anthropogenic land transformation and should thus be well-protected within the Cederberg Complex although it appears that much of the PA is marginal for this species. Continued surveillance for this species within the Cederberg Complex will provide an indication of the degree of protection afforded by the Cederberg Complex.

The Armadillo girdled lizard (*Ouroborus cataphractus*) (Figure 3.20a) and McLachlan's girdled lizard (*Cordylus mclachlani*) are now listed as Least Concern but vigilance is required to prevent the illegal collection (and associated habitat destruction) of these species within the complex. The latter species is endemic to the Koue Bokkeveld and Bokkeveld Mountains. A taxonomic review of the geckos in the genera *Afrogecko* and *Goggia* may reveal more species restricted to this area (Figure 3.20b).

The conservation of reptiles in the Cederberg Complex is reliant on ensuring effective management of invasive alien woody plant species and an appropriate fire-return interval. These management actions should be sufficiently measured and monitored under the vegetation and fire indicators.

Figure 3.20: (a) Armadillo girdled lizard (*Ouroborus cataphractus*) and (b) striped leaf-toed gecko (*Goggia lineata*). Photos: Rika du Plessis.

3.9.3 Fish

The Cederberg Complex forms part of the greater Olifants-Doring River System, which has the highest number of endemic fish species of any river system in South Africa (Impson *et al.* 1999). The Olifants-Doring River System is home to ten recognised

species, of which eight are endemic (Skelton 2001), and two genetically distinct taxa. Ten of the 12 taxa are endemic to the river system, and five are listed as threatened by the IUCN. Of the 12 taxa, eight described species and both genetically unique taxa occur in the Cederberg Complex, including five threatened taxa (Table 3.7). These comprise three large cyprinids, namely the Near Threatened Clanwilliam yellowfish (*Labeobarbus seeberi*), the Near Threatened Clanwilliam sawfin (*Cheilobarbus serra*) and the Endangered Clanwilliam sandfish (*Labeo seeberi*); and four smaller cyprinids, namely the Near Threatened Clanwilliam redfin (*Sedercypris calidus*), the Endangered fiery redfin (*Pseudobarbus phlegethon*) and two Critically Endangered taxa, the Twee River redfin (*Sedercypris erubescens*) and the Doring fiery redfin (*Pseudobarbus* sp. "*phlegethon Doring*").

In addition, there are two rock catfish, the Endangered spotted rock catfish (*Austroglanis barnardi*) and the Near Threatened Clanwilliam rock catfish (*Austroglanis gilli*) (Skelton 2001; Skelton *et al.* 2018; Impson *et al*. 2017) and at least two taxa of Cape galaxias (*Galaxias zebratus*) that occur in some rivers in the reserve complex, including a range restricted form found in the Twee River (Z. Brink, Twee River rehabilitation project manager, 2017, unpublished data). The only species found in the Olifants-Doring River System not recorded to date in the Cederberg Complex is the chubbyhead barb, *Enteromius anoplus* (Data Deficient). There are no fish species that are endemic to the Cederberg Complex, as the distributions of each extend outside the PA.

Table 3.7: Indigenous fish species of conservation concern that occur in the Cederberg Complex.

Species Name	Common Name	Global IUCN Category (2018)	Value of Cederberg Complex to fish species
Austroglanis barnardi	Spotted rock catfish	Endangered	There is a very strong population in the Heks River, including in the boundaries of the Cederberg Complex.
Austroglanis gilli	Clanwilliam rock-catfish	Near Threatened	Limited value, as the vast majority of distribution is outside the Cederberg Complex.
Sedercypris calidus	Clanwilliam redfin	Near Threatened	Good populations in the Rondegat and Matjies rivers, but majority of distribution falls outside the Cederberg Complex.
Cheilobarbus serra	Clanwilliam sawfin	Near Threatened	One of the strongest populations is in the Driehoeks-Matjies River.
Sedercypris erubescens	Twee River redfin	Critically Endangered	Limited value, as vast majority of distribution is outside the Cederberg Complex.
Galaxias zebratus	Cape galaxias	Data Deficient	Limited value, as vast majority of distribution is outside the Cederberg Complex.
Labeo seeberi	Clanwilliam sandfish	Endangered	Good population in the Matjies River, which may be the strongest Western Cape population. Rehabilitation of the Krom River could establish another population within the Matjiesrivier Nature Reserve.
Labeobarbus seeberi	Clanwilliam yellowfish	Near Threatened	Good populations in the Rondegat and Matjies rivers, but majority of distribution falls outside the Cederberg Complex.
Pseudobarbus phlegethon	Fiery redfin	Endangered	One of the strongest populations are in the Rondegat and Boskloof rivers, but several populations are outside of the Cederberg Complex.
Pseudobarbus sp. "phlegethon Doring"	Doring fiery redfin	Critically Endangered	Limited current value, due to severe impact of largemouth bass in Driehoeks-Matjies River system, but this could change if bass could be removed from a sizeable part of the river.

The greatest threat to indigenous fishes of the Cederberg Complex is that of invasive fishes, IAPs and surface water abstraction (section 4.3.1).

There is likely no poaching (illegal fishing) of indigenous fish species in the Cederberg Complex. There is no current use of the small species as they are too small for angling and they are not allowed to be kept in aquariums without the required permits. There are good populations of Clanwilliam yellowfish and Clanwilliam sawfin in the complex, especially in the Driehoeks-Matjies River. These fish are occasionally targeted by anglers outside the Cederberg Complex, especially for fly-fishing. These anglers generally practice catch and release on the indigenous species, and a considerable amount of awareness work has been conducted to make the anglers aware of the plight of indigenous fish species.

The fish species of special conservation concern, as identified through the planning, are those that are Critically Endangered (Twee River redfin, Doring fiery redfin), and

Endangered (Clanwilliam sandfish, spotted rock catfish and fiery redfin) (Figure 3.21a). The Twee River redfin (Figure 3.21b) was originally common throughout the Twee River system in its natural distribution range. However, poor farming practices and the introduction of several alien fish species from the 1980s have caused the species to become very rare throughout most of its range (Impson *et al*. 2007). Currently this species occurs in a small section of the Heks tributary within the Hexberg State Forest. One exception is an off-stream dam in the catchment, where the species was introduced in 2007 and is now thriving in large numbers (Jordaan *et al*. 2017).

The fish species introduced into the catchment include bluegill sunfish (*Lepomis macrochirus*), rainbow trout (*Oncorhynchus mykiss*), Cape kurper (*Sandelia capensis*) and lastly the Clanwilliam yellowfish, which was introduced by the then Cape Department of Nature and Environmental Conservation in the 1980s above natural barriers (Impson *et al*. 2007). The Doring fiery redfin was once widespread and common in the Driehoeks-Matjies River in the 1970s, until largemouth bass (*Micropterus salmoides*) became common throughout 90% of its range within this river system and caused the species to become extremely rare and restricted to the uppermost part of the river. Several landowners *e.g.* Driehoeks Farm have started projects to catch and euthanise largemouth bass in support of conservation of the Doring fiery redfin. These measures are starting to bear fruit as bass seem to have disappeared from the river above the Driehoeks camping site and redfin numbers are slowly increasing.

Figure 3.21: (a) Clanwilliam redfin (*Sedercypris calidus*) and Fiery redfin (*Pseudobarbus phlegethon*) and (b) Twee River redfin (*Sedercypris erubescens*). Photos: Dean Impson and Riaan van der Walt.

Another fish of conservation concern is the Endangered fiery redfin, which inhabits several tributaries of the Olifants River, such as the Rondegat, Boskloof and Jan Dissels rivers. One of the strongholds of this species is the Rondegat River, and the species is found from the Algeria station to an abstraction weir about 1 km above Clanwilliam Dam. This species has benefitted from the Rondegat River rehabilitation project, which has seen the integrated control of invasive trees and fish such as the smallmouth bass (*Micropterus dolomieu*) in the middle and lower reaches of the river (Impson *et al*. 2013). The Clanwilliam sandfish is another Endangered species that is present in the Matjies River within Matjiesrivier Nature Reserve. This is likely to be the last remaining viable breeding population in the Western Cape Province. The Endangered spotted rock catfish is still common in the Heks River, one of three rivers where it is found, despite the presence of smallmouth bass (Figure 3.22). The final fish

of conservation concern is the Twee River galaxias (*Galaxias* sp.) which has only been recorded from the Twee River. It is relatively abundant in the river, especially in pools with lots of aquatic vegetation.

Figure 3.22: Smallmouth bass (*Micropterus dolomieu*). Photo: Dean Impson.

3.9.4 Mammalian Fauna

The rugged mountains and deep valleys characteristic of the Cederberg Complex provide habitat for a variety of mammal species, such as the klipspringer *(Oreotragus oreotragus*), grey rhebok (*Pelea capreolus*), leopard *(Panthera pardus*), caracal (*Caracal caracal*), African wild cat (*Felis silvestris lybica*), Namib long-eared bat (*Laephotis namibensis*) and the abundant rock hyrax (*Procavia capensis*). The Namaqua rock mouse (*Micaelamys namaquensis*), Cape spiny mouse (*Acomys subspinosus*) and the spectacled dormouse (*Graphiurus ocularis*) are important pollinators of numerous fynbos plant species. The CapeNature Biodiversity Database indicates 88 terrestrial mammal species including seven historical and four introduced mammal species, for the Cederberg Complex based on historical and current accounts (Birss 2017). Of the extant species, three are IUCN Red Listed as Vulnerable and six as Near Threatened. Table 3.8 lists the Threatened, endemic and conservation dependent mammal species for the Cederberg Complex.

Table 3.8: Threatened, endemic and conservation dependent mammal species that occur within the Cederberg Complex.

Species Name	Common Name	Regional IUCN Category (2016)	Level of Endemism
Laephotis namibensis	Namib long-eared bat	Vulnerable	South Africa and Namibia
Panthera pardus	Leopard	Vulnerable	
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
Poecilogale albinucha	African striped weasel	Near Threatened	
Aonyx capensis	African clawless otter	Near Threatened	
Acomys subspinosus	Cape spiny mouse	Least Concern	
Bathyergus suillus	Cape dune molerat	Least Concern	Western Cape endemic
Gerbilliscus afra	Cape gerbil	Least Concern	Western Cape endemic
*Equus zebra zebra**	Cape mountain zebra	Least Concern; Conservation Dependent	Western Cape near-endemic
Raphicerus campestris	Steenbok	Least Concern	
Raphicerus melanotis	Cape grysbok	Least Concern; Conservation Dependent	Western Cape near-endemic
Georychus capensis	Cape molerat	Least Concern	Western Cape near-endemic
Myomyscus verreauxii	Verreaux's mouse	Least Concern	Western Cape near-endemic
Oreotragus oreotragus	Klipspringer	Least Concern	
Sylvicapra grimmia grimmia	Common duiker	Least Concern	

* Cape mountain zebra has been identified for re-introduction.

The Vulnerable Namib long-eared bat is endemic to South Africa and Namibia and roosts in narrow crevices in vertical rock faces. It is sparsely distributed throughout its range and is only known from the Cederberg in South Africa. It is an adept flyer, feeding primarily on beetles, moths and butterflies considered to be associated with wetlands and along water courses, (Jacobs *et al*. 2016). The main recommendation for this species is to collect *ad hoc* distribution data.

Leopards are another Vulnerable species, yet are widespread throughout the Cederberg Complex and surrounds but do face persecution, road collision and habitat loss threats outside protected areas. Population estimates vary considerably and are primarily based on habitat suitability models and indicate a global decline, thus

leopards are IUCN Red Listed as Vulnerable. As an apex predator, leopards impact on meso-predator behaviour and densities and fulfil an important ecosystem regulation function. Leopard conservation will benefit from PA expansion and continued research and monitoring (Swanepoel *et al*. 2016). CapeNature, in partnership with the Cape Leopard Trust, focus on mitigating conflict through education and conducting ecological monitoring and research in the Cederberg Complex.

The third Vulnerable species is the white-tailed mouse (*Mystromys albicaudatus*) which has a widespread but patchy and fragmented distribution across South Africa. Persistence of populations within the Cederberg Complex needs to be confirmed by means of *ad hoc* surveys. It appears to have a preference for microhabitats within vegetation types and transitory habitats post-fire. They are very rare and have very low trapping records. Further field surveys are needed to estimate population size and trends more accurately (Avenant *et al*. 2016).

The Near Threatened African clawless otter (*Aonyx capensis*) is widespread and occurs in all major drainage systems throughout the year. They have exhibited a reduction in abundance associated with the increase in riparian habitat transformation, pollution and disturbance (Okes *et al*. 2016). Contemporary density estimates are required from across the species' range to calculate overall population size in order to monitor the long term effects of riparian habitat degradation.

The Near Threatened African striped weasel (*Poecilogale albinucha*) can only persist in habitats with adequate resources due to a very high metabolic rate. African weasel numbers are reported to have declined in the rest of South Africa but presence data, despite inconsistent reporting frequencies, indicate an increase in numbers in the Western Cape Province. Further studies and field surveys to determine the current area of occupancy, densities and home range sizes are recommended (Child *et al*. 2016).

Generally, threats to mammals within the Cederberg Complex are low. This can mainly be ascribed to the relative remoteness of the area and low levels of human development and transformation, within and surrounding the complex. Poaching of fauna by subsistence communities along the eastern boundary of the Cederberg Wilderness has been identified as a low threat and this could have a localised negative impact on certain mammal species.

The 2016 Regional IUCN Red Listing process highlighted the lack of good quality data for monitoring the trends of many species, particularly small mammals. CapeNature identified small mammal priorities for which representative distribution data are inadequate to assess the conservation status (Birss 2017). Of the priority small mammals, the spectacled dormouse, the laminate vlei rat (*Otomys laminatus*), the Cape spiny mouse, the Cape dune molerat (*Bathyergus suillus*), the Cape gerbil (*Gerbilliscus afra*), the Cape molerat (*Georychus capensis*) and Verreaux's mouse (*Myomyscus verreauxii*) occur in the Cederberg Complex. The collection of field data for these species will require different approaches and are to be guided by ethical and responsible methods, particularly since these species are difficult to collect via trapping. CapeNature has embarked on further pursuing the collection of owl pellets from *Tyto* species and contributing to the development of a Rodent Cranio-dental Key, however, some focussed small mammal field surveys are still recommended for the Cape spiny mouse, Verreaux's mouse and the spectacled dormouse within the Cederberg Complex.

Three components of the Cederberg Complex have implemented and maintained registers aimed at monitoring population trends for game and domestic species. Population trend data are not yet available, however, the registers adequately reflect the presence and persistence of most listed species. Refer to Table 3.9 for a list of components, indicating presence and total population estimates of domestic and game species.

Small antelope species, such as Cape grysbok (*Raphicerus melanotis*), klipspringer, steenbok (*Raphicerus campestris*), common duiker (*Sylvicapra grimmia grimmia*) and grey rhebok (*Pelea capreolus*) naturally occur in the landscape and generally exhibit unimpeded dispersal. They are important indicators of the overall ecological state of the Cederberg 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 (Taylor *et al*. 2016). The maintenance of population trend data (Table 3.9) 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. This potentially provides an indicator for monitoring the state of mountain fynbos in the Cederberg Complex. Grey rhebok, 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 is 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 (caracal and black-backed jackal) are present.

Similarly, Cape grysbok, a near endemic to the CFR, is primarily associated with the Fynbos biome and primarily regarded as a browser (Palmer *et al*. 2016).

Klipspringer are associated with steep rocky and mountainous habitats and are able to move efficiently over rocky terrain due to its 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 Cederberg Complex (Birss *et al*. 2016).

Reserve Component	Cattle	Donkey	Horse	Gemsbok*	Eland*	Cape grysbok	Common duiker	Grey rhebok	Klipspringer	Steenbok
Cederberg	x	x	x	x	x	x	x	x	x	
Hexberg						x	x	x	x	
Matjiesrivier		x		x		x	x	x	x	x
Total Population Estimates	16	32	4	76	6	39	18	151	113	6

Table 3.9: Game and domestic species recorded in the Cederberg Complex.
* Gemsbok numbers are nomadic and not restricted to the Cederberg Complex. Eland numbers are due to intrusion from a neighbouring game farm.

The Cape mountain zebra (*Equus zebra zebra*) is a subspecies of mountain zebra, endemic to the fynbos, grassland and karoo habitats of the Western and Eastern Cape provinces which marginally extends into the Northern Cape Province. Major threats include a loss of genetic diversity through inbreeding and genetic drift, hybridisation with Hartmann's mountain zebra and other equids, a shortage of large areas of suitable habitat, and the absence of a metapopulation management strategy (Birss *et al.* 2018). Even though Cape mountain zebra have shown a significant improvement in conservation status due to a stable increase in population size and is now IUCN Red Listed at Least Concern it is noted as 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). As part of the Cederberg Complex, the Matjiesrivier Nature Reserve component has been identified and assessed as suitable for the reintroduction of Cape mountain zebra, conditional to the effective mitigation of threats posed by feral donkeys. Cape mountain zebra have already been introduced onto private land adjacent to the Cederberg Complex and proposals to "drop fences" with potential neighbours are being investigated, however, such plans need to address the management of the local donkey population to mitigate potential threats of hybridisation with Cape mountain zebra. The erection of an adequate boundary fence to prevent access for donkeys from surrounding areas will be critical to achieve this.

Should Cape mountain zebra be introduced within the Cederberg Complex, its management and monitoring should be in line with the recommendations of the Biodiversity Management Plan for Cape mountain zebra in South Africa.

3.9.4.1 Game

The Cederberg Complex has no formal large game species. All large game found in the Cederberg Complex will be dealt with according to the general CapeNature wildlife principles below.

- All game farms bordering the protected area that have extra-limital or historic alien animals, must be enclosed to the standards as stipulated in the CapeNature fencing policy. Reserve 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 is *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 our protected area, 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 PA.
- Regular assessment of habitat condition should inform the stocking rate of all game and other large ungulates in any protected area. If habitat degradation is observed, management must intervene to mitigate the threat of overstocking.
- 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.
- In areas where alien game (*i.e.* fallow deer) roam in the landscape, conservation managers must take immediate action when these animals are observed within the reserve and the animals must be removed in a humane manner immediately.

3.9.4.2 Damage-Causing Wild Animals

Predators

All reports of predators found on protected areas 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 PA. No hunting or pursuing of predators on any PA is allowed.

Primates

All protected areas must deal with primates causing problems in line with organisational operating guidelines. A proper waste management plan must be in place. Sources of food and access to such (*i.e.* fruit trees, oak trees and rubbish bins) must be removed or secured to reduce attraction for primates. No feeding of any wild animals/primates is allowed within any PA.

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 (*i.e.* 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.

General

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

3.9.5 Avifauna

The area covered by the Cederberg Complex is substantial and consists almost entirely of fynbos vegetation with a small portion of succulent karoo in the east. There are a number of rivers flowing through the complex, but these are upper catchment systems and provide habitat for those bird species that prefer narrow fast flowing rivers and riverine vegetation. The Clanwilliam Dam, however lies along the western edge of the complex, and species associated with slow moving shallow waters may be recorded over the complex. In general, the bird species recorded in the Cederberg Complex is characteristic of the Fynbos and Karoo biomes. To date 180 bird species have been recorded within the Cederberg Complex (SABAP2 2017; BIRP 2017).

The Cederberg Complex forms part of the 75 4290 Ha Cederberg-Kouebokkeveld Complex Important Bird Area (Marnewick *et.al.* 2015). The area was recognised as an Important Bird Area as it contains globally threatened species such as the Martial Eagle *(Polemaetus bellicosus)*, Black Harrier *(Circus maurus)*, Hottentot Buttonquail *(Turnix hottentotus)* and Ludwig's Bustard (*Neotis ludwigii*), as well as range and biome restricted species namely the Cape Sugarbird *(Promerops cafer)*, Cape Siskin *(Crithagra totta)* and Victorin's Warbler *(Cryptillas victorini)*.

The Cederberg Complex is important for the seven species of birds endemic to the Fynbos biome. The habitat preference of these endemic species vary indicating the importance of maintaining a mosaic of different vegetation age and types within the complex. Cape Sugarbird and Orange-breasted Sunbird *(Anthobaphes violacea)* prefer mature mountain fynbos (Siegfried & Crowe 1983), while Hottentot Buttonquail generally occur in young fynbos, two to five years old, with very little preference for recently burnt and senescent fynbos (Lee *et al.* 2017). Cape Siskin is associated with restio-dominated fynbos (Fraser 1997a), and the Cape Rock-jumper *(Chaetops frenatus)* occurs in high mountain areas with open rocky habitats (Hockey *et al*. 2005). Victorin's Warbler is found predominantly in mesic mountain fynbos (Fraser 1997b), while the Protea Seedeater *(Crithagra leucopterus)* prefers open arid fynbos with tall Protea plants (Milewski 1976).

The major threats to biodiversity identified within the Cederberg Complex that would have an impact on the avifauna within the PA are too frequent fires and climate change. Both these threats have an impact on the vegetation and therefore impact indirectly on the endemic birds. Reporting rates from the second South African Bird Atlas Project (SABAP2) for surveys carried out within the Cederberg Complex suggest that the populations of Cape Sugarbird, Orange-breasted Sunbird, and Cape Siskin are still relatively healthy (SABAP2 2017). However, comparative analysis of data between the first and second atlas projects over the entire distribution range indicate that the Cape Sugarbird, Orange-breasted Sunbird, Cape Rock-jumper, Cape Siskin and the Protea Seedeater have all undergone substantial (>15%) range contractions as well as range fragmentation (Lee & Barnard 2012). The Cape Rock-jumper and

Protea Seedeater have low reporting rates for the Cederberg Complex (SABAP2 2017) supporting Lee & Barnard's (2012) findings. Reporting rates for Victorin's Warbler within the PA is the lowest of all the endemic species and this species was only recorded in four of the nine pentads used to create the bird list for the PA (SABAP2 2017). It is probable that the amount of suitable habitat available for this species is limited considering the arid nature of the area and the few rivers that occur in the complex.

The Hottentot Buttonquail, although a fynbos endemic species, has to date not been recorded in the complex, despite numerous atlas surveys. It is probable that the secretive nature of the species may play a role in the visibility of this species. Lee *et al.* (2017), however carried out flush transect surveys targeting suitable habitat on both the Cederberg Wilderness and Matjiesrivier Nature Reserve. The species was, however, only found outside the Cederberg Complex.

Lee & Barnard (2016) suggest that at least three of the endemic species, the Cape Rock-jumper, the Protea Seedeater and Victorin's Warbler, are directly impacted by climate change. This impact is related to temperature increases rather than the predicted changes in precipitation.

Table 3.10 indicates threatened species (regional and global) that have been recorded within the Cederberg Complex. Those species marked with an asterisk are more common in the habitats adjacent to the complex. Furthermore, the Martial Eagle and the Southern Black Korhaan *(Afrotis afra)* occur at low densities as evidenced by the reporting rates of the second bird atlas project. These species only occur sporadically within the boundaries of the Cederberg Complex and any management strategies implemented will not have a significant impact on the species as a whole. The Cape Rock-jumper (Figure 3.23a) and the Black Harrier although recorded over a large portion of the complex, have low reporting rates indicating very small populations (SABAP2 2017).

The Verreaux's Eagle *(Aquila verreauxii)* (Figure 3.23b) was recorded across the entire Cederberg Complex at high reporting rates with an average of over 50% for the entire PA (SABAP2 2017). Murgatroyd *et al.* (2016) data corroborate this with breeding densities of 3.0 pairs per 100 km² within the Cederberg as opposed to 1.2 pairs per 100 km² in the adjacent agricultural areas. The importance of the Cederberg Complex for the conservation of this species should not be underestimated and the existing monitoring programmes need to be maintained. Within the Western Cape, the Verreaux's Eagle is subject to threats that not only occur outside the reserve complex, but across the entire distribution range and should be dealt with at a national scale (Taylor *et al.* 2015).

Figure 3.23: (a) Cape Rock-jumper (*Chaetops frenatus*) and (b) Verreaux's Eagle (*Aquila verreauxii*). Photos: Patrick Lane.

The endemic bird species are reliant on the natural vegetation and there is a real threat that the fire frequencies currently experienced within the Cederberg Complex will have a negative impact on these species. Increased fire frequency which was identified as a threat to the PA values needs to be addressed in order to conserve these endemic bird species. Climate change, however, will require national and international strategies to reduce this threat and its impact on the endemic and threatened species within the complex.

Table 3.10: Threatened bird species found within the Cederberg Complex.

Species Name	Common Name	Regional Conservation Status (Taylor *et al.* 2015)	Global IUCN Category (2018)
Circus maurus	Black Harrier	Endangered	Vulnerable
Neotis ludwigii	Ludwig's Bustard*	Endangered	Endangered
Polemaetus bellicosus	Martial Eagle	Endangered	Vulnerable
Afrotis afra	Southern Black Korhaan	Vulnerable	Vulnerable
Aquila verreauxii	Verreaux's Eagle	Vulnerable	Least Concern
Falco biarmicus	Lanner Falcon	Vulnerable	Least Concern
Anthropoides paradiseus	Blue Crane*	Near Threatened	Vulnerable
Chaetops frenatus	Cape Rock-jumper	Near Threatened	Least Concern

*Species are more common outside the Cederberg Complex.

3.9.6 Invertebrates

Invertebrates are a vital component of terrestrial and aquatic ecosystems and constitute more than 80% of all animal diversity, yet they are grossly under-represented in studies of African diversity (Veldtman *et al.* 2017). Site biodiversity estimates that do not consider invertebrates not only omit the greatest components of what they are attempting to measure, but ignore groups that are very significant contributors to processes in terrestrial and aquatic ecosystems.

The southwestern Cape represents a distinct zoogeographic zone, characterised by the phylogenetic antiquity of much of its invertebrate fauna. Invertebrates play vital roles in ecosystems (McGeoch 2002; Samways *et al.* 2010a, 2012). They are essential

for nutrient recycling via leaf-litter and wood degradation, carrion and dung disposal and soil turnover. Moreover, they play integral roles in plant pollination, especially in the CFR where the flora is dependent on specialised pollination guilds. In addition, this group maintains plant community structure via phytophagy (including seed feeding), and supports insectivorous animals, such as many birds, mammals, reptiles and fish.

The importance of ants for ecosystem functioning in both fynbos and succulent karoo systems has been documented by several studies such as Johnson (1992), Le Maitre & Midgley (1992), Milton *et al*. (1992) and Midgley & Bond (1995). Myrmecochory (seed dispersal by ants) is another important ecological process in the Fynbos biome (Le Maitre & Midgley 1992). In South Africa, plants that depend on myrmecochory 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 (Bond & Slingsby 1983, Table 1).

Myrmecochorous ants belong to four subfamilies: Dolichoderinae, Formicinae, Myrmicinae and Ponerinae (Gómez & Espadaler 1998). In the CFR, the dominant myrmecochorous ants are brown house ant (*Pheidole capensis)*, large pugnacious ant (*Anoplolepis custodiens)*, small pugnacious ant (*Anoplolepis steingroeveri*), garden fierce ant (*Tetramorium sericeiventre*), and hairy sugar ant (*Camponotus niveosetosus*) (Bond & Slingsby 1983; 1984), all of which are abundant in the Cederberg Complex (Botes 2006; Botes *et al.* 2006). Botes (2006) and colleagues collected a total of 135 ant species belonging to 19 families and 29 genera in the Cederberg Complex. They showed that, across an elevational gradient within the Cederberg, temperature explained significant proportions of the variation in ant species density and abundance. In addition, at least five new species were described for this area during their study, all within the genus *Nesomyrmex* (the lonely ants), namely *Nesomyrmex antoinetteae*, *N. cederbergensis*, *N. entabeni*, *N. njengelanga*, *N. ruani* (Mbanyana & Robertson 2008).

A total of 49 ground-dwelling beetle species were collected in the Cederberg Complex of which 33 belonged to the family Tenebrionidae and 16 to Carabidae (Botes 2006; Botes *et al.* 2007). Several of these species showed habitat specificity and clear distinctions existed between the vegetation types within the Cederberg Complex. The Cederberg Complex constitutes the southern end of a southwest African centre of tenebrionid endemism and diversity (Scholtz & Holm 1985; Penrith 1986; Penrith & Endrödy-Younga 1994). In addition, three species of the South-African endemic dung beetle genus *Macroderes* have species ranges from west to southeast lowlands across the Cederberg Complex. These beetles are flightless with small ranges in the winter rainfall areas of South Africa. One of these, *Macroderes minutus* occurs specifically in Cederberg Sandstone Fynbos (C. Deschodt, University of Pretoria, 2018, pers. comm.). Two species are still undescribed. The poor state of these species' taxonomic, distributional and ecological knowledge results in their current conservation status as being Data Deficient. However, given that they are flightless with restricted ranges, they might qualify for a higher conservation status (C. Deschodt, University of Pretoria, 2018, pers. comm.).

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). In the Western Cape, eight butterfly species are classified as Critically Endangered, seven species as Endangered and five species as Vulnerable

(Mecenero *et al.* 2013, Table 2). All species that are Red Listed are threatened by habitat destruction due to development, habitat degradation due to IAPs and too frequent fires (Mecenero *et al.* 2013). There are 38 species of Lepidoptera that are endemic to the Western Cape. None of the butterflies with a threatened conservation status or those that are endemic occur in the Cederberg Complex (Veldtman *et al.* 2017).

However, species that are classified as Least Concern may still perform unique ecological functions. One such example is the Table Mountain beauty (*Aeropetes tulbaghia)*, 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 and not currently threatened. 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 3.11 gives the classification of the five Western Cape species that are likely to occur in the Cederberg Complex that are classified as Least Concern with local rarity.

Table 3.11: Conservation status of butterfly species that are likely to occur in the Cederberg Complex that were classified as Least Concern during Red Listing but have local rarity (Mecenero *et al*. 2013).

Species Name	Common Name	Distribution
Rare – Habitat specialists (restricted to micro-habitat)		
Lycaenidae		
Chrysoritis uranus schoemani	Uranus opal	Cederberg to Gifberg Mountains; Rocky ridges near the summits of high mountains in Bokkeveld Sandstone Fynbos.
Rare - Restricted range (range less than 500 km²)		
Lycaenidae		
Aloeides monticola	Cederberg copper	In the Cederberg at high altitudes in Cederberg Sandstone Fynbos.
Rare - Habitat specialists and Restricted range		
Hesperidae		
Kedestes sarahae	Cederberg ranger	Known only from its type locality in the Cederberg Wilderness in montane fynbos, in patches of *Merxmuellera* grass at altitudes around 950 m.

Another ecologically important invertebrate group is the Arachnida. The South African National Survey of Arachnida 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 to document and unify information on arachnids in South Africa. The project 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). A total of 178

species in 44 families and 100 genera were collected in the Cederberg Complex (Foord & Dippenaar-Schoeman 2016).

The dominant spider species in the Cederberg Complex include a new undescribed species of Aelurillinae (jumping spider), three Ammoxenidae (sand diving spider) species (*Ammoxenus aculeus*, *A. pedifer* and *A. kalaharicus*) and one in the family Gnaphosidae (ground spiders) *Asemesthes ceresicola*, representing 57% of all the spiders caught (Foord & Dippenaar-Schoeman 2016). The most species rich areas of the Cederberg Complex are the eastern arid slopes, where spider diversity is dominated by the family Ammoxenidae. The local availability of prey, more specifically termites, explains this pattern. Ammoxenid abundance is correlated with termite abundance (van den Berg & Dippenaar-Schoeman 1991) and one species in particular, *Ammoxenus amphalodes* has been shown to be a specialist termite eating spider, specialising on the northern harvester termite (*Hodotermes mossambicus*) (Petráková *et al*. 2015). Termitaria contain a diverse set of invertebrates within and on their surfaces, acting as nodes of invertebrate interactions and diversity (De Visser *et al*. 2008). In addition to spider species that specialise on termites, more than 90% of spiders feed on other termitophagous invertebrates (De Visser *et al*. 2008).

Levels of spider endemicity mirror that of the plants in the region. Sixty-five percent of the spider species in the Cederberg Complex are endemic to South Africa and 57 species are still undescribed. In contrast to other ecological regions in South Africa, where the most abundant taxa are widely distributed throughout the Southern African region (Dippenaar-Schoeman *et al*. 2015), four of the five most abundant species were endemic to the Western Cape.

In addition, several scorpion species have been collected for the Cederberg Complex. These include *Hadogenes minor*, *Parabuthus capensis*, *Uroplectes marlothi* and an unknown *Opisthocanthus* species. Four species of the genus *Opistophthalmus* have been collected to date, namely *O. pattisoni*, *O. leipoldti*, *O. capensis* and *O. pallipes*.

Invertebrates play an integral role in maintaining ecosystems such as the fynbos mosaic in the Cederberg Complex (Veldtman *et al.* 2017). Nonetheless, there is no comprehensive invertebrate species list available for the Cederberg Complex. Such lists are essential as inventories of what occurs within the complex, especially in terms of Red Data listings 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 (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 Cederberg Complex is updated through *ad hoc* baseline data collection. Notably, a new species of katydid has recently been discovered in the Cederberg, Duplessis' agile katydid (*Griffiniana duplessisae*) (Veldtman 2012). This species was named after, Rika du Plessis, the Conservation Manager of the Cederberg Complex who discovered it. Given the complexity of the CFR, and by extension the Cederberg Complex, it is likely that it harbours many more invertebrate species that are simply not known yet. Additional information on the insects of the CFR can be obtained from the Iziko Museums of South Africa (www.iziko.org.za).

3.9.6.1 Freshwater Macro-invertebrates

Mountainous and upland catchment areas are considered important not only for the provision of good quality water, but because of the substantial contributions they make to biodiversity (Furse 2000; Dallas & Day 2007). Additionally, they often serve as refuge areas for vertebrate and invertebrate species and in some cases serve as habitat for species that are confined to these upland freshwater ecosystems (Palmer *et al*. 1994; Dallas & Day 2007). This is especially prevalent in the more naturally acidic and low nutrient headwaters of rivers in the CFR, which are underlain by the TMG quartzitic sandstones. These are some of the conditions that have resulted in high aquatic species richness and endemism in the CFR as a whole (De Moor & Day 2013; Gouws & Gordon 2017).

Furthermore, there is 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 (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 indicators of river health (Dickens & Graham 2002). Subsequently, biomonitoring of headwater streams, such as those found within the boundaries of the Cederberg 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.

There are three species of dragonfly of conservation concern in the Western Cape (Table 3.12) which are likely to occur in the Cederberg Complex. The Endangered elusive skimmer (*Orthetrum rubens)*, is a highly threatened and range restricted species that is only known from the mountains of the Western Cape. Another species, the Endangered Ceres streamjack (*Spesbona angusta)* 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 eastern base of Franschhoek Pass. It is one of South Africa's rarest damselflies, having only been recorded from two localities in the Western Cape at an elevation of approximately 400 m above sea level (Samways & Simaika 2016). This species displays an unusual, globally unique phenomenon, of rapid reversible colour change in both sexes, linked to reproductive enhancement, competitive advantage and thermoregulation (Deacon & Samways 2016a; 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.

The third species of conservation concern is the Endangered mauve bluet (*Proischnura polychromatica)*. 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. The Vulnerable gilded presba (*Syncordulia legator*) is a localized Western Cape endemic with a few scattered records from Clanwilliam, Du Toits Kloof, the Palmiet River, Jonkershoek and Franschhoek. Deacon & Samways

(in press) argued that the conservation plan developed for the Ceres streamjack will serve as an umbrella plan for the mauve bluet and gilded presba.

Other dragonfly species which may occur in the Cederberg Complex and listed as Vulnerable are the yellow presba (*Syncordulia gracilis),* mahogany presba (*Syncordulia venator)* and rustic presba (*Syncordulia serendipator).* They are all threatened by invasive alien trees like most of the Western Cape freshwater biota. The mahogany presba is a Western Cape endemic that is only found at 300-1 300 m elevation. The rustic presba only have a few scattered records from the Western Cape, including Riebeeck Kasteel, Bainskloof and Jonkershoek and only occur above 350 m elevation. Within the Cederberg Complex increased surveillance is needed to determine the presence of these endangered invertebrate species.

Table 3.12: Dragonfly species of conservation concern likely to occur in the Cederberg Complex. (Samways & Simaika 2016).

Species Name	Common Name	National Red List Category	National Red List Criteria
Platycnemididae (Featherlegs and Threadtails)			
Spesbona angusta	Ceres streamjack	Endangered	A2c; B1ab(i,ii,iii)+2ab(i,ii,iii)
Coenagrionidae (Pond damsels)			
Proischnura polychromatica	mauve bluet	Endangered	B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv)
Corduliidae (Emeralds)			
Syncordulia legator	gilded presba	Vulnerable	B2ab(i,ii,iii), D2
Syncordulia gracilis	yellow presba	Vulnerable	B2ab(i,ii,iii), D2
Syncordulia venator	mahogany presba	Vulnerable	B2ab(i,ii,iii), D2
Syncordulia serendipator	rustic presba	Vulnerable	B2ab(i,ii,iii), D2
Libellulidae (Skimmers)			
Orthetrum rubens	elusive skimmer	Endangered	B2ab(i,ii,iii), D2

3.10 Socio Economic Context

CapeNature endeavours to build and sustain support among communities for natural resource management, cultural heritage and environmental awareness and education through promoting biodiversity management.

Protected area management planning is limited in the absence of due consideration for the influence of the protected area on its neighbours, i.e. communities and / or private landowners, and the influence of neighbours on the protected area. As such, planning and management of the Cederberg Complex must consider the role of neighbours in the formulation and implementation of the management plan.

The majority of PAs are located in rural areas, predominantly characterised by inadequacies in infrastructure and basic services, and low levels of education and high unemployment rates. CapeNature is often viewed as a catalyst for development. It is therefore expected by stakeholders that, as CapeNature discharges its mandate, it takes into account these realities and engages in people-centred outcomes and structured programmes, contributing towards sustainable development and poverty alleviation in these communities.

CapeNature's People and Conservation Programme (hereafter referred to as the Programme) is responsible for leading engagement with communities for the benefit of all concerned. The purpose of the Programme is to enable people to meaningfully participate, support and engage with biodiversity management and the natural and cultural historic heritage conservation effort and activities undertaken by CapeNature. The Programme facilitates engagement on social, economic and environmental aspects 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 Programme Strategic Plan addresses four focus areas that are aligned and linked to other relevant organisational, provincial and national imperatives Figure 3.24 (CapeNature 2015a).

Figure 3.24: CapeNature's People and Conservation Programme's strategic 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 (EPWP) and developed Small, Medium and Micro Enterprises (SMME) development programmes

to stimulate local economic development activities. These efforts contributed directly and indirectly towards eradicating and/or alleviating poverty in many communities living adjacent to protected areas. The implementation of a suite of job creation programmes like EPWPs Full Time Equivalent (FTEs), Natural Resources Management programmes such as alien vegetation management, working for wetlands *etc.* 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 of 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 including youth, woman and people with disabilities.

EPWP classified projects as per the National Department of Public Works - Projects List, are recorded in the EPWP reporting system annually, at the beginning of the financial year. The job opportunities created are also reported in the provincial Management Information System (MIS) on a monthly basis. Jobs in CapeNature emanate from Expanded Public Works Programme and Small Business Opportunities created for local entrepreneurs.

The Cederberg Complex contributes to job creation initiatives, thereby increasing the number of available employment opportunities in the Cederberg Municipal area. Firstly, the EPWP, which involves part time employees being employed for 12 months on a contractual basis. These FTEs also receive task specific and soft skill training to assist with human capacity building. The second initiative is the Integrated Catchment Management (ICM) programme which is internally funded, focussing on the employment and training of contractors that are required for various tasks which may include firebreak maintenance, alien plant clearing and hiking trail maintenance *etc.* The Cederberg Complex has received funding approval for the Environmental Protection & Infrastructure Programme during November 2018, which will be implemented from 2019 onwards.

3.10.1.2 Enterprise Development – Small, Medium and Micro Enterprises

CapeNature furthermore provides local communities with business opportunities in line with approved annual operational plans, budgets, aligned to organisational set objectives, goals and targets. A focused Enterprise Development Programme and localised support becomes key in growing the small businesses. CapeNature partners with business support institutions such as the Small Enterprise Development Agency (SEDA), South African Revenue Service (SARS), national Department of Labour, commercial 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 sharing stories of success.

Local economic development is stimulated through the facilitation of SMME opportunities within both the eco-tourism as well as ICM services in CapeNature. Within the Cederberg Complex, SMMEs are contracted on a one to three-year basis to perform essential tourism services such as house-keeping, laundry services, security services *etc.* CapeNature provides the funding for these contracts.

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 Schools programme.

The Cederberg Complex contributes to the Youth Environmental Schools programme as well as hosting regular students from tertiary institutions that are undergoing their Work Integrated Learning (WIL) internships.

As part of social development, a Women Empowerment Plan has been implemented across the organisation and includes focused interventions that address societal challenges that women face such as financial, educational, health and fitness challenges. This plan provides a wide range of activities aimed at advancing women in the workplace and society.

3.10.2 Cultural Heritage Management

Cultural heritage management contributes towards the promotion of culture and heritage through identifying and increasing accessibility opportunities of these resources with significant value for exposure and enjoyment by reserve visitors and neighbouring communities.

Within the Cederberg Complex a number of initiatives are run to promote the unique culture and heritage of the area. Annually the Cederberg Complex actively promotes free access, especially for neighbouring communities, during heritage week. The Truitjieskraal interpretation trail, focusses on the history of the Khoe-San who historically lived in the area. It also includes aspects of the archaeology, geology, fauna and flora of the area. Furthermore, the Cederberg Complex also supports community-based cultural tourism initiatives such as the Heuningvlei Heritage Route.

The Cederberg Complex is rich in cultural and historical heritage and provides a unique environment for cultural and historical based environmental education initiatives, *e.g.* the Landscape Education program.

3.10.3 Community Conservation and Resource Utilisation

In South Africa, it is entrenched practice to involve communities in the management of PAs. This practice provides opportunity to engage and agree on a shared Vision, making communities equal partners in the engagement process, rather than just beneficiaries. Transparency is a fundamental value to overcome the distrust and tendency to resolve conflict through confrontation that was fostered by the oppressive, inhuman practices and social fabric destruction associated with the Apartheid era. The approach to participatory protected area management requires a sound foundational architecture complemented by enabling mechanisms (discussed below) aligned to

conservation action objectives and achievable deliverables. The promotion of cooperative governance and establishment of partnerships with role players who see an opportunity to contribute to conservation objectives is critical.

3.10.3.1 Protected Area Advisory Committees and Forums

Participatory protected area management is enabled through Protected Area Advisory Committees (PAAC) that are institutionalised structures within CapeNature, as referred to in Section 1.6.

In a conflict situation at any platform, the different organisations need to be guided by an agreed upon conflict and dispute resolution mechanisms. This process requires swift activation so that the issues can be addressed, resolved and normalisation of relations be restored. In CapeNature this process is driven through the PAAC and further captured in the People and Conservation Programme and Natural Resource User Groups approved Code of Conduct. The PAAC's key role is to hold the conservation authority to account for the effective and sound management of the PAs in their vicinity for the benefit of the society.

The functionality of the PAAC is reported and measured through regional People and Conservation reporting structures and general regional management reports (related to stakeholder engagement). It serves as an indicator for management effectiveness, measured through the METT-SA.

The Cederberg Complex PAAC was established in 2011. To date, the biggest challenge for effective stakeholder engagement in the Cederberg Complex is the geographic extent of neighbouring communities. The lack of public transport, especially for poorer and remote neighbours makes it difficult for them to attend PAAC meetings regularly. As a result, a decision was taken to utilise other forums to share information and get input from role-players. The main forum used is the GCBC forum which takes place in Citrusdal, three times a year.

Other forums utilised for stakeholder engagement include the Cederberg Conservancy, Cederberg Heritage Route, Clanwilliam Tourism and GCFPA. The Cederberg Complex has highlighted the need for more effective engagement with smaller communities, and affected role players, along its eastern border and has set out to achieve this through the establishment of a Wupperthal Stakeholder Forum (section 2.6).

3.10.3.2 Natural Resource 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, 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 Parks action plans drive and guide the implementation of the NRUG component within the Cederberg Complex and surrounding landscape. Provincial People and Parks steering committee meetings are also utilised as platforms to facilitate implementation. Furthermore, People and Parks related matters are dealt with in quarterly local area meetings while regionally elected members address matters that cannot be addressed at locally. Capacity building

interventions are presented to members at regional meetings and discussion points may relate to bioprospecting, public participation processes and relevant legislation pertaining to the regulation and management of natural resources.

Within the Cederberg Complex, conflict arises around illegal access of livestock, poaching of animals, firewood collection, veld fires and illegal harvesting of plant species such as buchu and rooibos. In response to the challenges identified, the Cederberg Complex have identified the revision of the NRUG policy and associated permitting process to facilitate legal and sustainable access for cultural, medicinal, and spiritual usage categories (section 2.6). Regular meetings with NRUGs serve as the communication structure with these role-players.

The Cederberg Complex also provides ample opportunity for non-consumptive natural resource use. Stadsaal Cave is a popular filming location for international production companies. Furthermore, various recreational events, such as wilderness running and mountain bike events are held annually. These types of productions and events all contribute to opportunities for surrounding communities to benefit (*e.g.* accommodation, permitting fees, catering, guiding, etc.).

The Cederberg Complex is a popular tourist destination (34 530 visitors in 2017/18 financial year) in the Western Cape Province, resulting in various tourism-related economic development opportunities in and around the Cederberg Complex. CapeNature supports community- based tourism initiatives like the Cederberg Heritage Route and Heuningvlei Donkey Cart Route. Rocklands and Truitjieskraal are world-renowned bouldering and climbing sites and many climbers visit these areas during the climbing season each year. Furthermore, the Cederberg Wilderness is renowned as a hiking destination with popular hiking routes that include the Maltese Cross and Wolfberg Arch.

The Cederberg Complex offers campsite and chalet accommodation to tourists. Visitor access to the Cederberg Complex is managed through the use of permits. Partnerships with neighbours to issue permits on behalf of CapeNature makes the area more accessible for tourists and create opportunities for profit sharing through tourism contract agreements with tourism facilities in the Cederberg Conservancy.

3.10.4 Environmental Education, Awareness and Youth Development

CapeNature provides an enabling environment for environmental education, awareness and youth development which are 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 and participation in environmental and conservation issues. Main themes for the organisation include fire, species conservation, culture and heritage, healthy living, as well as 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 annual Clanwilliam cedar tree plantings), holiday programmes, educational talks and overnight camps.

Detailed plans for each protected area are captured in the regional People and Conservation Programme work plans which are also embedded in targets in the

CapeNature Annual Performance Plan which feed into the People and Conservation Programme - Strategic Action Plan.

The Cederberg Complex is committed to promote and establish sustainable education programmes and create awareness with all stakeholders focusing on the focal values of the PA (section 2.6). These values include ecological and human well-being aspects, Clanwilliam cedar tree, heritage, fire, respect and care for the environment and to promote responsible natural resource utilisation in and around the Cederberg Complex. Current environmental awareness activities include annual Clanwilliam cedar tree planting events, Arbor week talks at surrounding schools such as Algeria and Elizabethsfontein and fire awareness.

Youth development aims to create an enabling learning environment and to build the capacity of the youth within the Western Cape. Various private groups and schools use the Cederberg Complex as an outdoor classroom to bring children into the area to conduct their own environmental education programmes and activities. Examples include the SA scouts, Cape Leopard Trust, as well as various schools in the province.

Volunteer partnerships are critical and allow the Cederberg Complex to do important conservation work. These groups are an important source of capacity and expertise. The Eastern Cederberg Rock Art Group is a self-managed volunteer group that assists the reserve with the collection and capture of heritage information, focusing on archaeological information. Another examples include the annual Clanwilliam cedar tree planting days where community members from Heuningvlei and external partners such as Just Trees and Bushmanskloof Wilderness assist the Cederberg Complex with the rearing and planting of seedlings.

There are also numerous researchers that use the Cederberg Complex as a place to conduct research on a number of ecological and social topics. The landscape, position and size of the Cederberg Complex World Heritage Site offers unique research opportunities. Examples include landscape scale studies, benchmarking climate change, predator conflict mitigation and a host of special species not found anywhere else on earth.

3.11 Organisational context

3.11.1 Finance and Asset Management

In line with the legal requirement, the strategies identified for implementation within the protected area, to achieve the desired state, have been costed below.

The PA will adhere to the guiding principles listed below:

- Responsibly manage the allocation of budget, revenue raising activities and expenditure;
- Ensure solid financial management supporting the achievement of the objectives of this plan; and
- Compliance to the Public Finance Management Act (Act No. 1 of 1999) 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 (MTEF) allocation, other government grants and generated from own revenue sources derived from commercial activities. Any surplus revenue generated is used to fund shortfalls in management costs across the organisation.

CapeNature has overhead costs relating to support services such as human resources, marketing and eco-tourism, finance, biodiversity support, conservation services, people and conservation, legal services *etc.* which is not allocated to individual protected area complexes and must also be funded through grant funding or own revenue generated.

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

Total income projected for 2019/20 is budgeted at R 15 725 238, increasing at an estimated annual rate of 10% from previous years. A summary is presented in Table 3.13.

Table 3.13: A summary of the total projected income for the Cederberg Complex management plan.

Allocation	2017/2018 R'000	2018/2019 (Current Year) R'000	2019/2020 (Projection) R'000
Total Income	14, 215	13, 400	15, 725
Medium Term Expenditure Framework Allocation	5, 692	6, 424	7, 798
Own Funding	6, 547	4, 891	5, 494
External Funding	1, 977	2, 086	2, 434

3.11.1.2 Expenditure

Recurring Costs

The annual directly-allocated cost (includes staff, transport and travel, stores and equipment) is estimated at R 6 270 106 for 2019/2020. These ongoing costs are split according to strategies as illustrated in Figure 3.25.

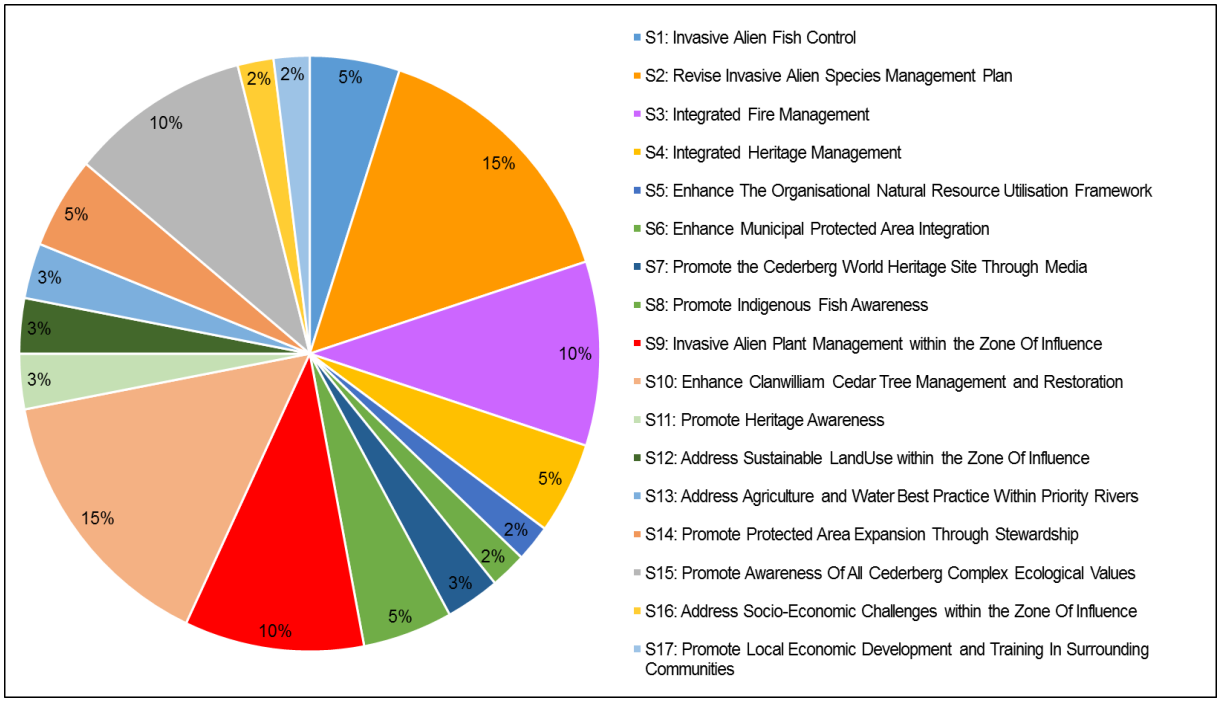


Figure 3.25: The estimated proportion of annual operational costs for the Cederberg Complex for year 2019/2020 aligned with the identified and prioritised strategies.

Once-off Costs

In addition to the recurring costs there might be once-off replacement costs of assets, *e.g.* tractor, firefighting equipment, field equipment, *etc.* that are aligned with the life span of the relevant assets being replaced.

Maintenance

The provincial Department of Transport and Public Works is responsible for and carries out maintenance on buildings in CapeNature managed PAs as captured in the User Asset Management Plans (U-AMP), governed by the Government Immovable Asset Management Act (Act No.19 of 2007).

An annual earmarked allocation is provided for the development of new, and upgrades and maintenance of tourism infrastructure. Tourism projects are prioritised across all CapeNature facilities and maintenance is scheduled accordingly.

3.11.1.3 Summary

It is estimated that the Cederberg Complex will require an annual operating budget of R 10 218 187 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 capital equipment could lead to potential shortfalls and will have a negative impact on strategies throughout.

3.11.2 Operational Staff

The Cederberg Complex has three main operational centres, namely Algeria, Kliphuis and Matjiesrivier. In total, 17 permanent staff members are shared across the three centres. The permanent staff component of the Cederberg Complex consists of a Conservation Manager that manages the entire PA from the Algeria office. Two Nature

Conservators, one based at Algeria office and another at Matjiesrivier, one Tourism Officer, one Finance and Administration Officer and five Field Rangers report to the Conservation Manager. One Field Ranger and six FTEs report to the Nature Conservator based at Matjiesrivier. Six Conservation Assistants and 13 FTEs report to the Tourism Officer based at Algeria. One Administration Assistant reports to the Finance and Administration Officer at Algeria. The remaining 18 FTEs report to the Nature Conservator based at Algeria. Two Field Rangers and six FTEs are based at Kliphuis and are managed from Algeria by the Conservation Manager and Tourism Officer respectively. In addition to the permanent staff, 37 FTE contract employees are funded by EPWP. This allocation can fluctuate depending on funding availability. Figure 3.26 indicates allocated posts.

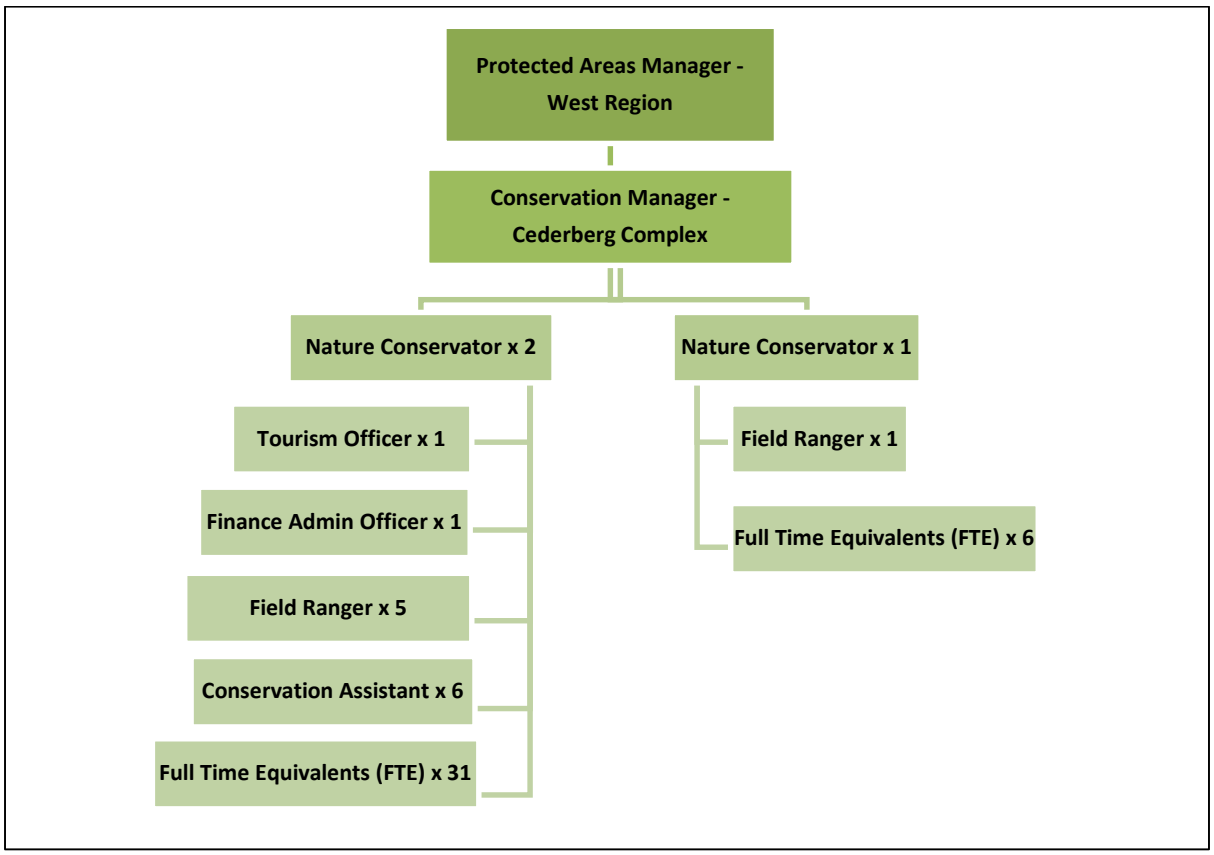


Figure 3.26: Cederberg Complex organogram.

The Conservation Manager of the Cederberg Complex report to the Protected Areas Manager of the Western Region, based at Kluitjieskraal. Regional support is provided by the Regional Manager based in Vanrhynsdorp.

Although no support staff are allocated to the Cederberg Complex specifically, the PA is supported by other internal components which include staff from Conservation Services, Community Conservation, Finance and Administration and Scientific Services. Furthermore, the Cederberg Complex has access to all internal services such as the Legal Department, Human Resources and Information and Communication Technology *etc.*

The Cederberg Complex employs SMME contractors on an annual basis, dependent on the availability of internal and/or external funding. Such contractors are primarily

used to support tourism, fire management and Natural Resource Management activities within the complex.

For the Cederberg Complex to effectively fulfil its conservation mandate, reserve management have identified the need for additional human capacity; in particular FTEs. Additional capacity would assist it to effectively conserve the identified ecological values through various management actions (section 2.6). Furthermore, by employing more contract staff, either FTEs or SMMEs, the PA can contribute towards creating additional tourism-based livelihoods.

3.12 Environmental Management

In terms of NEM: PAA Norms and Standards for the Management of Protected Areas in South Africa (Government 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 out in all relevant legislation including the terms of NEMA 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 Cederberg Complex.

The management authority shall suitably capacitate staff or appoint external partners to monitor business ventures, events and activities within the Cederberg 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 and/or Understanding (MOU) with the management authority. Such activities are only allowed in pre-approved locations within the Cederberg Complex and under strict conditions. An Environmental Management Plan is 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.

CapeNature has a standard Environmental Management Plan template for the following:

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

The use of a qualified and experienced Environmental Control Officer 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 are in place.

The issuing of contracts for alien clearing, ICM or other environmental projects may be subject to an Environmental Management Plan. Contractors will be required to undergo induction training, sign the Environmental Management Plan and adhere to specified site conditions.

3.13 Infrastructure Management

There are three main infrastructure nodes within the Cederberg Complex. The main centre is at Algeria. Infrastructure here is mainly related to management and tourism. Algeria office serves as the main centre from which the whole PA is managed. In the north, Kliphuis offers a small management hub with associated tourism infrastructure. Towards the south the Matjiesrivier office mainly contains management-related infrastructure. All infrastructure in the Cederberg Complex is assigned unique identification numbers and is recorded on the Cederberg Complex infrastructure register and undergoes periodic assessment and maintenance as part of annual planning process. See maps 7, 7a and 7b (Appendix 7.2).

3.13.1 Roads and Jeep Tracks

The provincial tar road (R364) from Clanwilliam enters the Cederberg Complex near Leipoldt's Grave and exits the PA on the eastern side of Pakhuis Pass. The public gravel road from Clanwilliam (DR 02182) joins up with the public gravel road (DR 01487) from the N7, which enters the Cederberg Complex at the top of Nieuwoudts pass in the west and runs past Algeria towards Matjiesrivier. At Matjiesrivier the road splits and runs north to Wupperthal and south to Ceres. An alternative public road passes through the Truitjieskraal area which is used when the low water bridge at the Matjies/Krom River confluence is flooded. These gravel roads are maintained by the WCDM (Appendix 7.2, Map 7).

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 Cederberg Complex is not allowed. The Heuningvlei jeep track runs from the top of Pakhuis Pass to Heuningvlei. Through a long-standing agreement with the Heuningvlei community, the gate is kept locked and the community only uses the road

for emergency purposes, hence the local name “Nood Pad”. The other two jeep tracks in the Cederberg Wilderness lead from Eikeboom to the Sneeuberg hut, and from Sanddrif to the Sneeukop hut respectively. These jeep tracks are used as hiking trails by visitors and are maintained for management access into the area to do firefighting, infrastructure maintenance, research and rescue operations.

The jeep track from the Matjiesrivier office, running into the eastern section of the reserve, including neighbouring properties, is primarily maintained by the reserve. A road maintenance agreement between affected landowners needs to be agreed upon to formalise maintenance responsibilities. The aim is to de-proclaim this road in future. Neighbouring properties have a servitude right along this route. Access is restricted and only by four-wheel drive vehicle. The access roads to the Stadsaal Cave and Truitjieskraal areas are maintained for tourists, and access is restricted to permit holders only.

Many of the jeep tracts in the Cederberg Complex require extensive capital investment to upgrade them to a better state. The reserve is currently in a process of upgrading some of them.

Visitor parking areas are available at most tourist sites such as Stadsaal Cave, Truitjieskraal, Leipoldt’s Grave, including the start of most popular hiking trails of which examples include Pakhuisberg, Welbedacht, Uitkyk, Eikeboom, Maltese Cross and Algeria. A number of hiking trails start on private land where parking is also available. Most parking areas are demarcated to restrict vehicles to the parking areas. Following a wildfire during 2004 the access road leading to the Stadsaal Cave and Elephant paintings was demarcated with bluegum poles to restrict visitors to the road surface.

3.13.2 Hiking Trails

There are approximately 500 km of hiking trails used by visitors for hiking through the Cederberg Wilderness and to a lesser extent Matjiesrivier Nature Reserve. Visitors can explore various scenic sites, rock formations, caves, bouldering sites, heritage sites and waterfalls as day hikes. More adventurous visitors can do multi-day overnight hikes and sleep at a selection of hiking huts within the Cederberg Wilderness. The trails at Matjiesrivier Nature Reserve (Stadsaal Cave and Truitjieskraal) provide access to these sites for day visitors. No hiking trails are located within Hexberg State Forest.

3.13.3 Buildings

Buildings in the Cederberg Complex are utilised for operational and tourism purposes exclusively. Regular assessments of buildings are conducted and maintenance requirements are reported to the provincial Department of Transport and Public Works that is responsible for the construction, maintenance and repair of all buildings. A schedule of infrastructural needs is submitted to the department on an annual basis for integration into the provincial infrastructure schedule. The Concept Development Plan and zonation scheme identifies existing development footprints and focus areas for management.

All buildings (Appendix 7.2, Map 7a) on Matjiesrivier Nature Reserve date back to colonial times and are classified as historical structures. These include Harding house, Wagener house, Rupert house, Du Preez house and Suurberg. The teacher’s house and school was renovated in 2016. The teacher’s house is utilised as an accommodation facility for staff and researchers whilst the school serves as a meeting

and training venue. The old stables and shed are utilised as storage facilities. Careful maintenance of these historical buildings is critical to preserve their heritage value.

The oldest buildings at Algeria (Appendix 7.2, Map 7b) are the original farm house (Garskraal) constructed in 1910 and Rietdak (1941). Both these buildings have been altered over the years and are currently being used for tourist accommodation. The ablution block in Algeria camp was built in 1980 to service the 48 campsites. Two staff houses were built in 1960 and another one in 1970. During extensive tourism upgrades in 2015 a new office, ablution block and six chalets were constructed. During 2018, a swimming pool with a small single unit ablution facility was constructed on the footprint of the previous office building that was destroyed during a wildfire in 2009. Store facilities at Algeria remain a challenge and management is in the process of securing more storage space at the Algeria office.

The five tourist chalets known as “Die Bosherberge” are located four kilometres east of Algeria. Uitkyk was a farmhouse built around 1920. Waenhuis, close by, was built in the 1930s as a stable but has subsequently been converted to tourist accommodation. Prik se Werf, Sas se Werf and Peerboom were built in 1993. Currently all these buildings are utilised as self-catering tourist accommodation.

At Kliphuis, three houses built in 1950 for staff accommodation, have subsequently been converted into tourist accommodation. A campsite with an ablution facility, built the same year, is open to visitors year round. During recent tourism upgrades, three new staff houses were built together with a small gate house facility to welcome visitors to the campsite.

A number of rustic overnight hiking huts are situated in the Cederberg Wilderness and are available for use during hikes.

3.13.4 Fences

The boundaries of the Cederberg Wilderness are mostly unfenced. Some sections with private landowners and communities are fenced off. The boundary from Pakhuisberg past Heuningvlei, along the eastern boundary of the Cederberg Wilderness to Eselbank is partially fenced. All fences are in a state of disrepair and this contributes to the problems experienced with livestock entering and grazing inside the Cederberg Wilderness.

The borders between Matjiesrivier Nature Reserve and private livestock and game farms are fenced. The remainder of the boundaries are unfenced. At entrance points such as Stadsaal Cave and Truitjieskraal, sections of fence are used to control access to these areas. A steel barrier has been put in place at the Elephant rock art site to prevent unauthorised access to the archaeological site.

Adequate fencing is a critical consideration for the re-introduction of Cape mountain zebra to Matjiesrivier Nature Reserve. Many of the fences in the Cederberg Complex require extensive capital investment to upgrade them to a better state.

3.13.5 High Sites

The Cederberg Complex is highly dependent on a well-functioning radio communication system due to large parts of the reserve not being covered by cellular coverage. Protea Peak above Algeria is registered as a high site and a two-way radio repeater is situated here to enable radio communication across the Cederberg Wilderness. A temporary mobile repeater is placed at Grashoog on Matjiesrivier

Nature Reserve. This repeater allows for radio communication coverage across most of the Matjiesrivier Nature Reserve as well as the eastern part of the Cederberg Wilderness. These two repeaters should be configured to link with each other to optimise radio coverage within the Cederberg Complex and surrounding areas.

3.13.6 Signage

There are signboards at entrances to the Cederberg Complex along all major public roads. Signboards are placed at the start of all hiking trails, however no further signage is placed within the Cederberg Wilderness. Hikers must at all times have a hiking map with them when hiking in the Cederberg Wilderness. In addition, interpretative boards are located at all popular visitor sites. In 2016 an interpretation trail was opened at Truitjieskraal, focussing on the history of the Khoe-San who historically lived in the area. It also includes aspects of the archaeology, geology, fauna and flora of the area. General visitor signage and awareness signboards are located at all tourist sites and facilities within the Cederberg Complex.

3.13.7 Utilities

3.13.7.1 Water Provision

Drinking water for staff and tourists at Algeria is piped from the Helskloof River via tanks and reservoirs. Water for the Bosherberge is piped out of the Duiwelsgat River into tanks. Water at Kliphuis is piped from a spring into a reservoir utilised by staff and tourists. At Matjiesrivier Nature Reserve, water for household and garden use is extracted from the Matjies River and stored in supply tanks from where it feeds the office and staff accommodation areas. The Cederberg Complex is entirely dependent on water from its own natural surface water sources and no municipal water serves any part of the complex.

3.13.7.2 Electricity Supply

The power supply for the Algeria office is via an Eskom distribution line across Nieuwoudts' pass from Citrusdal. The line crosses over the Rondegat River below Garskraal to the distribution point. From here underground power cables supply various distribution points in Algeria. Electricity supply to the Matjiesrivier office is supplied by a distribution line coming from the south of the reserve (Op-die-Berg). This line follows the main public road (DR 01487) leading to the reserve centre. This line branches off towards Kromrivier farm with the line running across the reserve along the Truitjieskraal public road. The Kliphuis centre is currently dependant on solar power for all its electricity needs. Management is currently assessing the feasibility of providing Kliphuis with electricity from the grid.

3.13.7.3 Communication Systems

Due to the remoteness of the three offices in the Cederberg Complex, communication via cellular coverage is impossible. During 2018, CapeNature has undergone a process to upgrade all communication systems, allowing longlivety and organisational linkages.

3.13.7.4 Waste Management

Matjiesrivier Nature Reserve forms part of the waste management and recycling project implemented in the Cederberg Conservancy. All household waste is collected

and sorted. Tins and bottles are recycled. At the moment paper and plastics are taken to the municipal landfill site in Clanwilliam.

At Algeria and Kliphuis centres, all refuse is collected and taken to the municipal landfill site in Clanwilliam. The implementation of a robust recycling project across the Cederberg Complex is seen as a priority for implementation. This will however depend on the availability of such a recycling service being available within the Cederberg municipal area.

3.13.7.5 Sewage Treatment

During extensive tourism upgrades undertaken at Algeria during 2015, a new waste water facility was constructed just downstream from Algeria. All tourism facilities at Algeria are connected to the new system. The staff houses currently still have soak-away drains; these are to be connected to the new waste water treatment plant in future. The cottages at the Bosherberge have closed sewage systems; when full, the grey water is pumped out and transported by tanker-truck to the waste water treatment plant at Algeria. Facilities at Matjiesrivier Nature Reserve and Kliphuis all have septic tanks and soakaways.

Self-composting toilets have been installed at sites with high visitor numbers. These include Stadsaal Cave, Truitjieskraal, Leipoldt's Grave as well as Rocklands and Maltese Cross parking areas. Similar units have been installed at the seven hiking huts throughout the Cederberg Wilderness. These units offer an environmentally friendly and cost effective solution to mitigate the impact of human waste at frequented overnight spots along some of the hiking trails.

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 Cederberg Complex. Values that are in good condition or healthy, provide the ecosystem services that support human welfare. Human well-being values, or aspects of human welfare that are within the scope of PA management, were 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 suite 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 maintain 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, assessed the current status of the value, and established 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 key attributes defining the 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 (KEAs) 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. 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).

Table 4.1: Descriptions for viability ratings used in the Open Standards as part of the Cederberg Complex planning process.

Very Good *Optimal integrity*	The factor is functioning at a desirable status and requires little human intervention.
Good *Minimum integrity*	The factor is functioning within its acceptable range of variation; it may require some human intervention.
Fair *Vulnerable*	The factor 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 factor to remain in this condition for an extended period will make restoration or preventing extirpation practically impossible.
Not Rated	There is insufficient information to determine a trend.

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 focal values and KEAs were identified for the Cederberg Complex:

4.2.1 Rivers and Riparian Zones

4.2.1.1 Value Description

Rivers and riparian zones include the river channel and associated buffer that supports riparian fauna and flora assemblages. Included are seasonal tributaries, sponges, seeps, wetlands and springs. Nested values of note: Indigenous fish, freshwater invertebrates, riparian vegetation, riparian fauna *e.g.* Namib Long-eared bat and African clawless otter.

The Cederberg Complex contributes significantly to freshwater security in the region by supporting and promoting human livelihoods and agriculture. The area also contributes to groundwater recharge and may represent several groundwater dependent ecosystems as far away as the Sandveld region. The water that the Cederberg Complex supply downstream is of a good quality. Table 4.2 provides the NFEPA status and estimated health condition of the rivers in the Cederberg Complex and its ZOI.

Table 4.2: National Freshwater Ecosystem Priority Areas status of rivers in and around the Cederberg Complex. Health scores are defined as follows; natural (A), good-natural (AB), good (B), fair (C), degraded (D).

Reserve Component	River	Condition*	National Freshwater Ecosystem Priority Areas Status	River Reach/Type*
Cederberg	Kliphuis	AB	Fish sanctuary	Mountain stream - foothills
	Jan Dissels	C (B)	Rehab National Freshwater Ecosystem Priority Areas	Mountain stream - foothills
	Dassieboskloof	AB	Fish sanctuary	Mountain stream - foothills
	Rondegat	AB**	Fish sanctuary	Mountain stream - foothills
	Heks	AB**	Fish sanctuary	Mountain stream
	Driehoeks/Matjies	B	Fish sanctuary	Mountain stream - foothills
Matjiesrivier	Matjies	B	Fish sanctuary	Lower reaches
	Doring	AB	Fish corridor	Middle reaches
	Krom	C	Unknown	Lower foothills
Hexberg	Heks Tributary	Unknown		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 (see River Health Programme 2006).*

4.2.1.2 Key Ecological Attributes

Indigenous invertebrate species composition

The South African Scoring System 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 (South African Scoring System Score) observed and the number of different taxa, from where an Average Score per Taxon (ASPT) is calculated. Both the South African Scoring System 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). The scores are plotted against each other and each point falls into an ecological category, ranging from natural to critically modified (Table 4.3). In the rivers of the Cederberg Complex, an ASPT score of eight or more would be considered to indicate a good to natural ecosystem condition. There is likely to be some variation in scores seasonally, 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 indicates the South African Scoring System rating for the Cederberg Complex.

Table 4.3: Ecological categories for interpreting South African Scoring System data (Dallas 2007).

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

Indigenous freshwater fish species composition

Various indigenous, threatened and highly endemic fish species are associated with the Olifants-Doring River System and the Cederberg Complex. Regular monitoring of each fish Critical Biodiversity Area in the Cederberg Complex is a key action, especially seeing that several species are highly threatened by invasive fishes and habitat degradation and that the indigenous fish species of the Olifants-Doring River System are regarded as particularly vulnerable to the likely effects of climate change (Shelton *et al.* 2017). Rivers in the Cederberg Complex network that have Critically Endangered species should be monitored every 1-2 years, and those with Endangered or Vulnerable species at least every four years.

Currently fish index scores of rivers in the Cederberg Complex are on average Good, but there is considerable variation between rivers because of the presence of invasive fishes in several rivers culminating in species loss from invaded areas as well as poor recruitment. These range from poor (Krom), to fair (middle Jan Dissels, middle Heks, Doring) to good/very good (Rondegat, Boskloof, upper Heks, upper Jan Dissels, Matjies). CapeNature, with the support of stakeholders, aims to rehabilitate some of these rivers during the next decade, including the Krom and Driehoeks rivers, which should elevate the fish index to an improved score. The viability assessment for the rivers and riparian zones value with associated KEAs and status ratings are displayed in Table 4.4.

Indigenous vegetation species composition

Riparian zones play a critical role in the ecological functioning of a river, and can serve as effective fire breaks where rivers are ecologically healthy (near natural flows and not invaded). This is because the vegetation stays moist and is more fire resistant. Most rivers in the Cederberg Complex have healthy riparian zones (good condition) with negligible levels of invasion by alien plants. The riparian zones of very few rivers are lightly invaded (*e.g.* Doring) and the focus should be on ensuring that riparian zones stay in a good condition. This will require regular surveillance monitoring and IAP clearing and maintenance. Table 4.4 indicates the indigenous vegetation rating for the Cederberg Complex.

Table 4.4: Viability assessment for rivers and riparian zones in the Cederberg Complex.

Rivers and Riparian Zones Viability Assessment								
Category	**Key Ecological Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**	**Current Rating**	**Desired Rating**
Condition	Indigenous invertebrate species composition	Average instream macro-invertebrate composition	ASPT <5	ASPT = 6-7	ASPT = 7-8	ASPT >8	Very Good in upper zone; fair in middle reaches	Good to very good
Condition	Indigenous freshwater fish species composition	% Indigenous fish species composition and age class	Indigenous fish species absent	50% or less of expected indigenous fish species present, only 1 age class present. Some invasive alien fish species present	>50% of expected indigenous fish species present, 1-2 age classes present. Some invasive alien fish species present	100% of expected indigenous fish species present and all 3 age classes present. No invasive alien fish species present	1 Boskloof = Very Good 2 Heks = Fair 3 Rondegat = Very Good 4 Jan Dissels = Fair 5 Driehoeks = Good 6 Matjies = Good 7 Krom = Poor 8 Heks Tributary = Very Good 9 Doring = Fair	1 Boskloof = Very Good 2 Heks = Fair 3 Rondegat = Very Good 4 Jan Dissels = Fair 5 Driehoeks = Very Good 6 Matjies = Good 7 Krom = Good 8 Heks Tributary = Very Good 9 Doring = Fair
Condition	Indigenous vegetation species composition	% Indigenous riparian vegetation	0-75%	76-89%	90-99%	100%	Good	Good

4.2.2 Indigenous Fish

4.2.2.1 Value Description

Various indigenous, threatened and highly endemic fish species associated with the Olifants-Doring River System that occur within the Cederberg Complex. Nested values of note: All other indigenous fish, for example Clanwilliam yellowfish, not specifically identified as focal values as well as associated freshwater invertebrates.

The indigenous fishes of the Olifants-Doring River System and Cederberg Complex are not only vital indicators of the health of aquatic ecosystems but also highlight the unique aquatic biodiversity of the region. Currently the Olifants-Doring River System has the highest endemicity of any river system in South Africa, yet many species are threatened, primarily because of predation and competition with invasive fish species as well as over-allocation and abstraction of water from both the main stem and tributaries of the Olifants-Doring River System. The attributes are thus the endemic species themselves, especially those that are highly threatened *i.e.* Endangered or Critically Endangered.

4.2.2.2 Key Ecological Attributes

There are several species or taxa listed as Critically Endangered (Doring fiery redfin, Twee River redfin) or Endangered (fiery redfin, spotted rock catfish, Clanwilliam sandfish) and the indicators that determine the ecological condition of such species in the Cederberg Complex are the composition of species community at each sampling site and the current distribution of the species related to historical distribution. The viability ratings of each species listed in Table 4.5 is as follows:

Viable recruiting population and distribution range of the Doring fiery redfin

The Critically Endangered Doring fiery redfin was assessed as being in a currently poor condition in terms of its distribution range and as a recruiting population because the taxon is extremely rare in the Driehoeks-Matjies River, where historically it used to be common and more widespread. It is now found in the uppermost reaches of the Driehoeks River above where largemouth bass occur. This is the biggest threat to the taxon. The aim is to improve its viability to fair through targeted bass control operations in the Driehoeks River in collaboration with local land-owners who support its conservation.

Viable recruiting population and distribution range of the fiery redfin

The Endangered fiery redfin was assessed as being in a poor to very good condition in the Cederberg Complex, depending on which river was focused on. Some rivers have bass invasions which have had a major negative effect on the small redfin in both its occurrence and distribution within its historical range. These include the Jan Dissels and Heks, where this species is found in the uppermost part of its range in these rivers but not in the large sections of river where bass occur. However, in other rivers its condition is very good for both indicators *e.g.* Rondegat and Boskloof. The Heks River is an attractive option for bass control using a piscicide, but this must address the spotted rock catfish population which co-occur with the smallmouth bass.

Viable recruiting population and distribution range of the Twee River redfin

The Critically Endangered Twee River redfin was assessed as being in a very good condition in the Heks River, a tributary of the Middeldeur River, which is part of the Twee River System. Only a tiny percentage of its distribution range is in the Cederberg Complex, and here the population is unaffected by any threat. The aim is to keep it this way for the next decade and further. There are projects to improve the conservation status of this fish in the Twee River, but they are outside the Cederberg Complex.

Viable recruiting population and distribution range of the Clanwilliam sandfish

The Endangered Clanwilliam sandfish was assessed as being in a fair condition for both indicators. This is because the species is doing well in the Matjies River, but not in the Doring River where bass and bluegill are dominant. The aim is to rehabilitate the Krom River and do a conservation translocation of sandfish from the nearby Matjies River in the next three years. If this is successful (*i.e.* sizeable recruiting population), then the viability of sandfish within the Cederberg Complex can be improved. In addition, water use in the Krom/Matjies/Driehoeks systems must be closely monitored to ensure compliance with resource quality objectives.

Viable recruiting population and distribution range of the spotted rock catfish

This species was assessed as being in a very good condition in the Cederberg Complex. This is because one of the three rivers where it occurs (Heks) is within the Cederberg Complex, and the species is common, widely distributed and recruiting, despite the presence of smallmouth bass. The aim is to maintain this status, but investigate whether bass can be controlled through the use of rotenone in the next decade. This will require a risk assessment.

Table 4.5: Viability assessment for indigenous fish in the Cederberg Complex.

Indigenous Fish Viability Assessment								
Category	**Key Ecological Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**	**Current Rating**	**Desired Rating**
Size	Viable recruiting population of the Doring fiery redfin (Driehoeks River System)	% distribution of age classes (Juvenile, sub adult and Adult)	All size classes present in 0-30% of sampling efforts.	All size classes present in 31-50% of sampling efforts.	All size classes present in 51-79% of sampling efforts.	All size classes present in 80-100% of sampling efforts.	Poor	Fair
Landscape	Distribution range of the Doring fiery redfin (Driehoeks River System)	% occurrence in suitable river habitat	0-10%	11-50%	51-80%	81-100%	Poor; less than 5% of Driehoeks River System	Fair
Size	Viable recruiting population of the fiery redfin (Jan Dissels, Rondegat, Boskloof and Heks River System)	% distribution of age classes (Juvenile, sub adult and Adult)	All size classes present in 0-30% of sampling efforts.	All size classes present in 31-50% of sampling efforts.	All size classes present in 51-79% of sampling efforts.	All size classes present in 80-100% of sampling efforts.	1 Boskloof = Very Good 2 Heks = Fair 3 Rondegat = Very Good 4 Jan Dissels = Fair	1 Boskloof = Very Good 2 Heks = Good 3 Rondegat = Very Good 4 Jan Dissels = Fair
Landscape	Distribution range of the fiery redfin (Jan Dissels, Rondegat, Boskloof and Heks River System)	% occurrence in suitable river habitat	0-10%	11-50%	51-80%	81-100%	1 Boskloof = Very Good 2 Heks = Poor 3 Rondegat = Very Good 4 Jan Dissels = Fair	1 Boskloof = Very Good 2 Heks = Poor 3 Rondegat = Very Good 4 Jan Dissels = Fair
Size	Viable recruiting population of the Twee River redfin (Heks Tributary)	% distribution of age classes (Juvenile, sub adult and Adult)	All size classes present in 0-30% of sampling efforts.	All size classes present in 31-50% of sampling efforts.	All size classes present in 51-79% of sampling efforts.	All size classes present in 80-100% of sampling efforts.	Very Good (for the two pools that was sampled)	Very Good

Indigenous Fish Viability Assessment								
Category	**Key Ecological Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**	**Current Rating**	**Desired Rating**
Landscape	Distribution range of the Twee River redfin (Heks Tributary)	% occurrence in suitable river habitat	0-10%	11-50%	51-80%	81-100%	Very Good	Very Good
Size	Viable recruiting population of the Clanwilliam sandfish (Matjies River System)	% distribution of age classes (Juvenile, sub adult and Adult)	At least two size classes present in 0-30% of sampling efforts.	At least two size classes present in 31-50% of sampling efforts.	At least two size classes present in 51-79% of sampling efforts.	At least two size classes present in 80-100% of sampling efforts.	Fair	Good
Landscape	Distribution range of the Clanwilliam sandfish (Matjies River System)	% occurrence in suitable river habitat	0-10%	11-50%	51-80%	81-100%	Fair	Good
Size	Viable recruiting population of the spotted rock catfish (Heks River System)	% distribution of age classes (Juvenile, sub adult and Adult)	At least two size classes present in 0-30% of sampling efforts.	At least two size classes present in 31-50% of sampling efforts.	At least two size classes present in 51-79% of sampling efforts.	At least two size classes present in 80-100% of sampling efforts.	Very Good	Very Good
Landscape	Distribution range of the spotted rock catfish (Heks River System)	% occurrence in suitable habitat in the river system	0-10%	11-50%	51-80%	81-100%	Very Good	Very Good

4.2.3 Clanwilliam Cedar Tree

4.2.3.1 Value Description

A highly endemic, Critically Endangered conifer species that is facing numerous environmental and anthropogenic challenges. Nested values of note: Possible species specific invertebrate and mammal associations.

The presence of the Clanwilliam cedar tree in some ways defines the entire Cederberg Complex region. Its current distribution is almost entirely restricted to the PA (Appendix 7.2, Map 5). Formerly, more numerous, this strong fragrant timber tree was extensively harvested between the early 1800s and 1967 (Taylor 1996). This species has showed significant decline, particularly in the past 30 years, mainly driven by higher fire frequency and temperatures (White *et al.* 2016). Climate change will exacerbate the latter contributing factors and also reduce water availability for this species in particular.

CapeNature is committed to ensuring the future survival of the Clanwilliam cedar tree through a programme of bolstering artificial and natural populations by planting seedlings and increased protection from fire. Seedlings planted out in artificial plantations should be protected from fire at all costs. Furthermore, sites chosen for natural planting should be chosen to provide maximum chance of seedling survival. The viability assessment for the Clanwilliam cedar tree with associated KEAs and status ratings are displayed in Table 4.6.

4.2.3.2 Key Ecological Attributes

Clanwilliam cedar recruitment

Since 1805, sowing of Clanwilliam cedar seeds and planting of seedlings has been implemented. During the 1980s, concerted efforts were made to propagate and plant out Clanwilliam cedar trees from nurseries established in the Cederberg Complex. Various levels of success were achieved. Partnerships have been established to assist CapeNature with the propagation of Clanwilliam cedar seedlings annually. Current augmented seedling survival rates are fair (1–10%) and the aim is to increase this rate to good (11–59%). To achieve this target a Clanwilliam cedar tree restoration plan will be compiled that will include seedling survival monitoring.

Clanwilliam cedar population size

In 2016, a desktop exercise conducted by Peter Slingsby was completed by plotting visible individual Clanwilliam cedar trees, onto CorelDraw, using high-res Google Earth images. The plotted trees were then counted and amounted to approximately 13 500 adult Clanwilliam cedar trees. This number is seen as a conservative estimate since the method cannot easily identify seedlings or young trees. This estimate is a first attempt at calculating overall adult tree population size and the results needs field vetting to determine the functionality of this monitoring.

In order to increase the viability for this species over the next ten years, the focus will be to augment the cedar population through the planting of seedlings, both into suitable areas in the wilderness, as well as into the existing artificial cedar plantations. Protecting the latter plantations against fire by means of fire breaks will be crucial.

Table 4.6: Viability assessment for Clanwilliam cedar trees within the Cederberg Complex.

Clanwilliam Cedar Tree Viability Assessment								
Category	**Key Ecological Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**	**Current Rating**	**Desired Rating**
Condition	Clanwilliam cedar recruitment	% seedling survival after 3 years (wilderness)	0%	1-10%	11-59%	60-100%	Fair (5% estimate)	Good
Condition	Clanwilliam cedar recruitment	% seedling survival after 3 years (plantations)	0%	1-10%	11-59%	60-100%	Fair (5% estimate)	Good
Size	Clanwilliam cedar population size	Number of adult trees	<10 000	10 000 – 15 000	15 000 – 20 000	>20 000	Fair (at least 13 400 mapped)	Good

4.2.4 Fynbos Mosaic

4.2.4.1 Value Description

A healthy fynbos mosaic and vegetation structure supports numerous fauna and flora species. Supported by intact connectivity it promotes ecological functioning and resilience. The fynbos vegetation mosaic in the Cederberg Complex includes seven vegetation types that include among other shale, quartzite, sandstone, altimontane, riparian and freshwater types. Nested values of note: Various eco-typical faunal species *e.g.* grey rhebok, rare/endangered/endemic plants, six associated vegetation types, leopard and Verreaux's Eagle. A healthy fynbos mosaic has many ecological and human benefits as it forms the basis of the entire ecosystem.

Fire Regime

Fynbos is a fire-adapted vegetation and is dependent on regular fires for its survival (Figure 4.1). Fires are common in fynbos because of the extreme flammability of the vegetation, especially with a high fuel load, and it is rare to find a stand of fynbos more than 20 years old. When fire runs through a mature fynbos stand it removes the choking canopy and allows light to reach the soil surface (Manning 2007). Furthermore, the infertility of most fynbos soils means that the recycling of soil nutrients is essential for fynbos survival.

Fire drives this cycle, and at appropriate intervals it stimulates re-sprouting and seedling recruitment which leads to better species diversity (Holmes *et al.* 2016). A healthy fire regime (fire frequency, seasonality, size and fire intensity) all contribute to fynbos health, however, in an increasingly fragmented, transformed and risk-averse landscape, natural fire cycles are becoming rare (Holmes *et al.* 2016). Research indicates that globally and within the CFR, many areas have experienced increases in fire frequency and size (Kraaij & van Wilgen 2014).

Van Wilgen and Forsyth (2008) divided the Western Cape into five fire eco-zones based on the fire potential as defined by climate. The Cederberg Complex falls within the western inland zone, which is characterised by strong seasonal variation in fire potential and a high mean fire potential in summer. Winter fires rarely occur, but are possible under exceptional and rare circumstances (van Wilgen & Forsyth 2008) *e.g.* hot, dry berg winds.

A healthy fire regime is especially important for the Cederberg Complex's ecosystem values. It directly affects the viability of the fynbos mosaic, as well as that of the Clanwilliam cedar tree. A healthy fynbos mosaic promotes overall ecological health by providing a balanced and diverse vegetation structure; which in turn benefits all the species that depend directly and indirectly on healthy fynbos stands.

Fire frequency is of particular importance for the regeneration of Clanwilliam cedar populations. This non-sprouting species only produces their first cones after approximately 12 years, while full reproductive maturity is only reached after 40 years (Manders 1986). Clanwilliam cedar trees need a fire interval longer than 20 years, with shorter interval fires causing greater mortality among seedlings and saplings and more intense wildfires leading to increased mortality among adult trees (Manders 1987). More than 80% of the cedar population was killed in wildfires in 1989 (Bond & van Wilgen 1996).

Furthermore, a healthy fynbos mosaic within the Cederberg Complex has multiple human well-being benefits, not only within the PA but extending into the adjacent Zone of Influence and ultimately far beyond its boundaries. Examples of such benefits include security from natural disasters, improved health and sanitation as a result of the production of good quantities of clean water, economic development, supporting tourism-based livelihoods and promoting access to natural resources for neighbouring communities.

Figure 4.1: Fire in the Cederberg Complex is an important driver of fynbos ecology, but increased fire negatively effects fynbos species diversity and structure. Photo: Marius Wheeler.

4.2.4.2 Key Ecological Attributes

Fire Frequency/Interval

Slow-maturing, serotinous Proteaceae species are used as indicator species to determine acceptable fire return intervals (van Wilgen *et al.* 1992). These species have 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 1979; Kruger 1983; Le Maitre & Midgley 1992). On the rare occasion when fire return intervals become too long, populations of serotinous Proteaceae will reach senescence, which result in declines in seed production. When fire frequency is either 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).

Short fire return intervals that occur before sufficient numbers of serotinous Proteaceae have reached maturity and set seed, can lead to population declines, local extinctions and structural changes in these plant communities (van Wilgen 1982; van Wilgen & Forsyth 2008). Kraaij & van Wilgen (2014) suggest that a fire return interval of less than seven years is likely to reduce or eliminate obligate re-seeding proteoids. Furthermore, it has been shown that increased fire frequency can benefit sprouting species; which in turn lead to an overall decrease in plant diversity (Vlok & Yeaton 1999).

According to Holmes *et al.* (2016), the latest research suggest that fire return intervals could vary anything from 8-20 years. According to Southey (2009) the expected average fire return interval calculated for Cederberg, using linear modelling, was 13.8 years during 1970 which has reduced to seven years in 2000. Van Wilgen & Forsyth (2008) attribute shorter fire intervals with an increase in human populations and associated ignitions.

In the Cederberg Complex large parts of the mountain fynbos are typically dry and slow-maturing and as a result re-seeding species take longer to reach reproductive maturity. Preliminary evidence suggest that a minimum fire return interval of 20 years should be considered for most parts of the Cederberg Complex.

The Cederberg Complex's pre-fire Proteaceae (flowering) data are collected on an annual basis and the data set is currently being built up. Preliminary results for two permanent protea plots indicate that within relatively dry Cederberg Sandstone Fynbos of nine years old, only 35% of plants have flowered more than three times. In slightly moister 10-year old Cederberg Sandstone Fynbos, only 45% of plants have flowered more than three times (Table 4.7). None of these plots have reached the minimum fire return interval. This indicator has been included into the viability assessment (Table 4.12).

Table 4.7: Percentage flowering Proteaceae that have flowered more than 3 times within the Cederberg Complex.

Permanent Protea plot	Aspect	Elevation (m)	Veld age (years)	%	Meeting threshold
Bosherberge	East	644	9	35	No
Perdekloof	Flat	903	10	45	No

CapeNature uses seven veld age categories (1-2 years, 3-4 years, 5-6 years, 7-10 years, 11-15 years, 16-25 years and >25year) and the desired state is an even distribution of area in the different veld age classes. The proportion of area in each veld age category should be greater than 5% but less than 20% (van Wilgen & Forsyth 2008). See viability assessment (Table 4.12). This should provide sufficient habitat for a full range of species requiring access to vegetation of different ages.

The Cederberg Complex has only one of its veld age classes meeting the required threshold categories (Appendix 7.2, Map 8; Table 4.8). The Swartruggens Quartzite Karoo vegetation type (3 074 ha) covering the eastern parts of the Matjiesrivier Nature Reserve has been excluded from calculations due to it being unlikely to burn.

Table 4.8: Cederberg Complex veld age categories.

Veld age categories (years)	Area burnt (ha)	%	Meeting threshold
1-2	3 470.4	4.5	No
3-4	23 919.4	31.2	No
5-6	20 238.1	26.4	No
7-10	12 317.1	16.1	Yes
11-15	2 812.9	3.7	No
16-25	3 022.0	3.9	No
>25	2 493.9	3.3	No
Unknown	8 340.2	10.9	N/A
Total	**76 614.0**	**100.0**	

Fire Season

Fynbos is generally adapted to a fire regime involving fires in the dry summer and autumn. Maximum flowering activity occurs in late winter and spring (van Wilgen *et al.* 1992), thus optimal seedling regeneration of serotinous Proteaceae is achieved after fires that occur between December and early April (Bond *et al.* 1984). Helme *et al.* (2016) indicates that winter and spring fires generally lead to an increase in grasses at the expense of fynbos plants.

Furthermore, research has shown that even the fynbos animal species are adapted to fires during this period (Viviers 1983) with their breeding habits generally synchronised with the non-fire season. For example, fynbos birds (*e.g.* sugar birds & sunbirds) generally breed in winter (May to November), so any winter fires could 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, beneath boulders and rock slabs, or in the ground, or in deep plant litter. Most of these species lay eggs in summer that hatch in early autumn, or are ovo-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.

Within the Cederberg Complex, the proportion of area that burns in summer, as defined from December to April, should ideally be above 80% (van Wilgen & Forsyth 2008). See viability assessment (Table 4.12). Fire data analysed since 1980 indicate that 75% of fires in the Cederberg Complex occur during summer and 25% during winter (May to November) (Table 4.9). The high number of winter fires were as a result of prescribed burning activities from 1970-1989, however such burn practices have stopped in recent years with very few fires having burnt in winter recently.

Table 4.9: Cederberg Complex fire season categories (1980-2018).

Fire season	Area burnt (ha)	%	Meeting threshold
Summer	151 227	75	No
Winter	50 568	25	No
Total	**201 795.3**	**100**	

Fire Size

A few large fires, or a large number of small fires can 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). On the contrary, a few large fires will upset the desired goal of maintaining an even distribution of veld ages (van Wilgen & Forsyth 2008). Fire size is furthermore 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 patches becomes too large. For this reason, it is important to have a size mosaic of young and old veld (De Klerk *et al.* 2009; Holmes *et al.* 2016). Large fire size and a lack of mosaics furthermore create difficulties for seed dispersal into the burnt area and may leave large areas vulnerable to seed production collapse (De Klerk *et al.* 2009).

According to Kraaij & van Wilgen (2014), large fires typically dominate the fynbos fire regime with large fires becoming increasing common in recent times. Although fire size is relative to the size of a particular protected area, for the purposes of assessment within the Cederberg Complex, 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 in excess of 5 000 ha; see viability assessment (Table 4.12).

According to van Wilgen & Forsyth (2008) the proportion of area that burned in the Cederberg in the period from 1945-2006 was mainly dominated by a few very large fires. Furthermore, very large fires increased over the same period at the expense of medium and large fires. Since 1980, 13 fires have been larger than 5 000 ha (Table 4.10) of which six have been larger than 10 000 ha. Three of the latter six fires occurred in 2002, 2013 and 2016 respectively. The largest fire in the Cederberg Complex was a lightning fire in December 1988 that burnt 23 751 ha (30%) of the reserve.

Table 4.10: Cederberg Complex fire size categories.

Size category (ha)	No fires	Area burnt (ha)	% area burnt	Meeting threshold
Small (0-100)	46	641	0.3	No
Medium (100-2 000)	50	32 319	16.2	No
Large (2 000-5 000)	8	23 590	11.6	No
Very Large (>5 000)	13	145 270	71.9	No
Total	**117**	**201 820**	**100**	

Fire Cause

Fire ignition sources for the Cederberg Complex have been divided into four main categories. Natural fires include those started by lightning and rock falls. Any fire caused by human activity, be it arson, an accident, negligence or equipment failure have been lumped under unnatural sources. Historically, prescribed burns took place within the Cederberg Complex from 1970-1989 and for this purpose these fire ignitions have been separated as management fires. (Table 4.11).

It is important to note that many fires that burn into the Cederberg Complex have not necessarily started inside the reserve. Often the ignition points are outside, be they natural or unnatural (Appendix 7.2, Map 8).

Table 4.11: Cederberg Complex fire ignition categories (1980-2018).

Ignition Source	No fires	Area burnt (ha)	% area burnt
Natural	51	101 120	50.1
Unnatural	26	34 109	16.9
Management Historical	27	13 828	6.9
Unknown	13	52 763	26.1
Total	**117**	**201 820**	**100**

Post-fire Recruitment

The way in which species regenerate after fire, determines the composition of fynbos vegetation after a fire. Post-fire regeneration success of fynbos species can vary a lot and is dependent on a number of factors which can include fire intensity, seed viability, water availability, *etc.* In order to improve and refine the fire control measures and management techniques for each nature reserve, data collection on post-fire recruitment of re-seeding Proteaceae is important. The recruitment success of serotinous Proteaceae species which do not re-sprout after fire is used as the indicator of post-fire regeneration success of fynbos vegetation. Only non-sprouting *Protea* and *Leucadendron* species are used in these surveys.

The ratio of seedlings to re-seeding parent plants measured 12 – 18 months after a fire should be more than 1:5 (van Wilgen & Forsyth 2008). The Cederberg Complex's post-fire (seedling) data are collected on an annual basis and will be analysed when sufficient data are available. This indicator has been included into the viability assessment (Table 4.12).

Given the current fire regime of the Cederberg Complex, fire management over the next 10 years will be focussed on actively managing fires to promote a wider range of veld age classes, most notably the Cederberg Complex is in need of older veld age classes and to keep fire return intervals at approximately 20 years. Furthermore, the extent of very large fires (>5 000 ha) is a concern and fire management will focus, where possible, in keeping fires to below this threshold and promoting small and medium fires.

Indigenous Vegetation Species Composition

The fynbos areas of the Cederberg Complex are relatively free of IAPs and these species have been indicated as an overall low threat, even though it affects a number of ecological values (section 4.3). The percentage indigenous fynbos vegetation within the Cederberg Complex is between 90-99% (Good) and the goal for the next 10 years is to maintain or improve this status where possible. This indicator has been included into the viability assessment (Table 4.12).

Connectivity (Cederberg core corridor)

Most important to the functioning, management and consolidation of conservation gains for the Cederberg Complex is the long-term security and management of the natural veld connecting the Cederberg Wilderness and Matjiesrivier Nature Reserve. This can be achieved through the signing of in-perpetuity stewardship agreements with private landowners situated between the fynbos and succulent karoo mosaic as highlighted through the Conservation Action Priorities (CAP) map process. Two identified contract nature reserve sites will be upgraded to in-perpetuity agreements

and two other newly-identified sites signed as biodiversity agreements or a higher category. This indicator has been included into the viability assessment (Table 4.12).

Table 4.12: Viability assessment for the fynbos mosaic within the Cederberg Complex.

Fynbos Mosaic Viability Assessment								
Category	**Key Ecological Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**	**Current Rating**	**Desired Rating**
Condition	Fire frequency/interval	% veld in different age classes	One or less veld age class fall between 5-20% of the protected area.	Two veld age classes fall between 5-20% of the protected area.	Three veld age classes fall between 5-20% of the protected area.	Four or more veld age classes fall between 5-20% of the protected area.	Poor	Fair
Condition	Fire frequency/interval	% of serotinous Proteaceae that have flowered before a fire	50% of plants have flowered 1 time.	50% of plants have flowered 2 times.	50% of plants have flowered 3 times.	50% of plants have flowered more than 3 times.	Fair (estimate)	Good
Landscape	Fire season	% of area burnt in summer	>60% of the protected area burnt between December-April	>70% of the protected area burnt between December-April	>80% of the protected area burnt between December-April	>90% of the protected area burnt between December-April	Fair	Good
Condition	Fire Size	% of fire size categories burnt within the protected area	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%	Poor	Fair
Landscape	Post-fire recruitment	Ratio of serotinous Proteaceae that have recruited after a fire	No seedlings	Parent to seedling ratio is <1:5	Parent to seedling ratio is 1:5	Parent to seedling ratio is >1:5	TBD	TBD

Fynbos Mosaic Viability Assessment								
Category	**Key Ecological Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**	**Current Rating**	**Desired Rating**
Condition	Indigenous vegetation species composition	% indigenous fynbos vegetation	0-75%	76-89%	90-99%	100%	Good	Good
Landscape	Connectivity (Cederberg core corridor)	Number of properties in core corridor secured in stewardship	No form of stewardship	2 properties are voluntary stewardship sites or contract nature reserves	2 properties are voluntary stewardship sites or contract nature reserves signed into perpetuity	2 properties are perpetuity stewardship sites and 2 others as biodiversity agreements or higher	Fair	Very Good

4.2.5 Succulent Karoo Mosaic

4.2.5.1 Value Description

A healthy succulent karoo mosaic and vegetation structure supports numerous fauna and flora species. Supported by intact connectivity it promotes ecological functioning and resilience. The succulent karoo vegetation mosaic includes three vegetation types that include quartzite, scrubland and vygieveld elements. Nested values of note: Various eco-typical faunal species, rare/endangered/endemic plants, three associated vegetation types, leopard and Verreaux's Eagle. The viability assessment and status ratings are displayed in Table 4.13.

4.2.5.2 Key Ecological Attributes

Indigenous vegetation species composition

The succulent karoo areas of the Cederberg Complex is relatively free of IAPs and have been indicated as an overall low threat, even though it affects a number of ecological values (section 4.3). The percentage indigenous succulent karoo vegetation within the Cederberg Complex is between 90-99% (Good) and the goal is to maintain this status over the next 10 years.

Connectivity (Cederberg core corridor)

The most poorly-protected vegetation type within the succulent karoo mosaic ecosystem found in and around Matjiesrivier Nature Reserve is Agter-Sederberg Shrubland. Currently only 21% (~2 463 ha) of this vegetation type is protected within the Matjiesrivier Nature Reserve and adjacent stewardship sites and additional protection of this vegetation type has been identified as a priority. The current Western Cape provincial biodiversity target is 11 736 ha of Agter-Sederberg Shrubland under formal protection and the shortfall is 9 386 ha. Two private properties identified through the Conservation Action Priority map process will be engaged towards upgrading their current stewardship agreements to in-perpetuity agreements. An additional two will be approached for signing of a biodiversity agreement or higher category.

Table 4.13: Viability assessment for the succulent karoo mosaic within the Cederberg Complex.

Succulent Karoo Mosaic Viability Assessment								
Category	**Key Ecological Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**	**Current Rating**	**Desired Rating**
Condition	Indigenous vegetation species composition	% indigenous succulent karoo vegetation	0-75%	76-89%	90-99%	100%	Good	Good
Landscape	Connectivity (Cederberg core corridor)	Number of properties in Agter-Sederberg Shrubland secured in stewardship	No form of stewardship	2 properties are voluntary stewardship sites or contract nature reserves	2 properties are voluntary stewardship sites or contract nature reserves signed into perpetuity	2 properties are perpetuity stewardship sites and 2 others as biodiversity agreements or higher category.	Fair	Good

4.2.6 Palaeontological Heritage

4.2.6.1 Value Description

Intact fossil deposits and glacier floor remains provide a glimpse into geological time and offers a timeline into the past. Nested values of note: Fossilised fauna and flora and geological history. The National Heritage Resources Act (Act No. 25 of 1999) protects heritage resources as defined under the National Estate, which include among others, paleontological resources.

According to Penn-Clarke (2016) the fossils found at Matjiesrivier Nature Reserve are overwhelmingly abundant within the rocks of the Bokkeveld Group which lie along the eastern part of the reserve. The fossils present within these rocks are well-documented and belong to a unique biogeographic fauna known as the Malvinokaffric Realm. Although the fossils associated with the Malvinokaffric Realm mentioned are abundant within the rocks of the Bokkeveld Group, Matjiesrivier Nature Reserve is the only place in South Africa where these occur along with the other identified sites worldwide (Penn-Clarke 2016). Viability ratings and KEAs are indicated in Table 4.14.

4.2.6.2 Key Ecological Attributes

Heritage condition (the conservation state of these fossils)

The fossil deposit and glacial floors in the Cederberg Complex are in a fair to good condition. The *in situ* protection provided by the natural location of these values is the most desired level of conservation and protection and the goal is to maintain the current condition of the value over the next 10 years.

4.2.7 Pre-colonial Heritage

4.2.7.1 Value Description

The National Heritage Resources Act (Act No. 25 of 1999) protects heritage resources as defined under the National Estate, which include among others, prehistoric and historic material and human remains.

The original inhabitants of the region were hunter-gatherers who lived more than half a million years ago during the Earlier Stone Age. People of our own species, *Homo sapiens sapiens*, made Middle Stone Age artefacts in the Cederberg at least a 100 000 years ago, and Later Stone Age people, ancestors of the San (Bushmen), occupied many rock shelters in the Cederberg Complex during the last 10 000 years (Deacon & Deacon 1999; Parkington & Dlamini 2015).

Intact rock art and artefacts provide a glimpse of human presence and activities within the area over the last 500 000 years up until the arrival of European settlers. Nested values of note: Stone Age history and human interaction. 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. Viability ratings and KEAs are indicated in Table 4.14.

4.2.7.2 Key Ecological Attributes

Heritage condition (the conservation state of the rock art, archaeological artefacts and deposits)

The rock art, archaeological artefacts and deposits found in the Cederberg Complex are well-protected. Unnatural alteration and disturbances are limited resulting in an overall good condition rating for this value. The goal is to maintain the current rating of this value over the next ten years.

4.2.8 Historical Structures

4.2.8.1 Value Description

The National Heritage Resources Act (Act No. 25 of 1999) protects heritage resources as defined under the National Estate, which include among others, prehistoric and historic material, human remains, historical structures and ruins.

Historical structures reflect the history of colonial occupation and activities within the area since the early 1800s. Nested values of note: Colonial history and human interaction. Structures in the Cederberg Complex include a number of historic buildings, stone kraals and cages, shelters and graveyards. Restoration and maintenance work done on these structures should be done in such a way as to preserve the historical value; in accordance with NEM: PAA. Viability ratings and KEAs are indicated in Table 4.14.

4.2.8.2 Key Ecological Attributes

Heritage condition (structures older than 70 years)

The arrival of European settler in the Cederberg Complex marked the beginning of permanent structures being built. Since construction, some of the structures have been abandoned and has fallen in disrepair due to lack of maintenance and environmental factors. In some cases, the continued use and modernisation of buildings have resulted in irreversible alteration. The overall condition of historical structures in the Cederberg Complex are poor to good (depending on the structure) and the goal for the next 10 years is to maintain and prevent further deterioration, through a partnership with Heritage Western Cape, the provincial Department of Transport and Public Works and other role players.

Table 4.14: Viability assessment for heritage values associated with the Cederberg Complex.

Heritage Values Viability Assessment								
Category	**Key Ecological Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**	**Current Rating**	**Desired Rating**
Condition	Heritage condition (the conservation state of these fossils & glacier floors)	State of alteration	Any state of un-natural alteration or disturbance	Any state of natural alteration or disturbance	No natural alteration, or disturbance above ground	No alteration or disturbance (fossils, in geological formations know to contain fossils, still underground and not exposed to any weathering)	Fair to very good	Maintain current condition
Condition	Heritage condition (the conservation state of the rock art, archaeological artefacts and deposits)	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	Good	Maintain current condition
Condition	Heritage condition (structures 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)	Poor to good	Maintain current condition

4.2.9 Tourism-based Livelihoods, Social Development, and Economic Development

4.2.9.1 Value Description

CapeNature aims to build and sustain support among communities in terms of natural resource management, education and cultural heritage activities through promoting biodiversity management. The Cederberg Complex supports sustainable tourism-based livelihoods and in partnership with role players contribute to local economic and social upliftment. Nested values: Intact ecosystems, water, plants, non-consumptive resources and wilderness. Associated human benefits: Green jobs, capacity and skills development, training opportunities and existing tourism infrastructure.

4.2.9.2 Key Ecological Attributes

Tourism-based job opportunities

Currently the Cederberg Complex provide 30-39 FTE job opportunities and one SMME contract. If more job opportunities can be created it can improve the viability rating to fair (Table 4.15). If additional funding can be secured the Cederberg Complex aims to increase job opportunities within the Cederberg Complex to more than 50 and provide contracts for up to four SMMEs.

Skills development opportunities

Opportunities for skills development in communities within the Cederberg Complex ZOI are limited. Currently CapeNature only provide training to contracted employees. To improve skill sets and capacitate communities around the Cederberg Complex an assertive effort needs to be made over the next 10 years to provide and expand current skills development opportunities.

4.2.10 Responsible Utilisation of Natural Resources

4.2.10.1 Value Description

CapeNature sustains relationships with surrounding communities and Natural Resource User Groups (NRUGs). Within the Cederberg Complex, conflict often arises around illegal access of livestock, poaching of animals, firewood collection, veld fires and illegal harvesting of plant species, such as buchu and rooibos. In response to the challenges identified, the Cederberg Complex has identified the revision of the NRUG policy and associated permitting process to facilitate legal and sustainable access for cultural, medicinal, and spiritual usage categories (section 2.6). The Cederberg Complex also provides ample opportunity for non-consumptive natural resource use *e.g.* filming and various recreational events, such as wilderness running and mountain bike events.

Providing sustainable access for the use of consumptive and non-consumptive natural resources within the Cederberg Complex is important. Nested values: Water, plants, non-consumptive resources and wilderness. Associated human benefits: For recreational, economic, traditional, cultural, medicinal and spiritual use.

4.2.10.2 Key Ecological Attributes

Natural resource utilisation permits

Policies and procedures currently do not accommodate all aspects of consumptive and non-consumptive resource utilisation. The goal is to improve the current viability

rating from poor to good over the next 10 years by implementing approved consumptive resource utilisation policies and procedures and assessing and issuing resource use permits where appropriate (Table 4.15).

4.2.11 Respect and Care for the Natural Environment

4.2.11.1 Value Description

CapeNature provides an enabling environment for environmental education, awareness and youth development which are aligned to the curriculum (where relevant), environmental calendar days and species conservation.

The Cederberg Complex is committed to promote and establish sustainable education programmes and create awareness with all stakeholders focusing on the focal values of the PA (section 2.6). These include ecological and human well-being aspects, Clanwilliam cedar tree, heritage, fire and to promote responsible natural resource utilisation in and around the Cederberg Complex. Through such initiatives the aim is to nurture respect and care for the natural environment, including the focal values of the Cederberg Complex. Nested values: Intact ecosystems, advocacy, education and awareness. Associated human benefits: Knowledge and respect and care for the natural values of the Cederberg Complex.

4.2.11.2 Key Ecological Attributes

Environmental Education and Awareness

The current Cederberg Complex environmental education, awareness and interpretation programme only includes two of the identified focal values of the Cederberg Complex. The goal is to include all identified values into the programme over the next 10 years, increasing the current viability rating from fair to very good (Table 4.15).

Table 4.15: Viability assessment for human well-being values associated with the Cederberg Complex.

Human Well-being Values Viability Assessment								
Category	**Key Ecological Attribute**	**Indicator**	**POOR**	**FAIR**	**GOOD**	**VERY GOOD**	**Current Rating**	**Desired Rating**
Social upliftment	Tourism-based job opportunities	Number of Full Time Equivalent jobs per annum	<30 FTE job opportunities	30-39 FTE job opportunities	40-49 FTE job opportunities	>50 FTE job opportunities	Fair	Very Good
Social upliftment	Tourism-based job opportunities	Number of Small, Medium and Micro Enterprises contracts per annum	No SMME contracts	1-2 SMME contracts	3-4 SMME contracts	>4 SMME contracts	Fair	Good
Knowledge expansion	Skills development opportunities	Number of community members attending capacity & skills development interventions per annum (per intervention)	None	32	(75) (5 communities x 15 people x 1 intervention)	(150) (5 communities x 15 people x 2 interventions)	Poor	Good
Access and compliance	Natural resource utilisation permits	Number of Natural Resource User Group permits issued per annum	No permit applications received	Applications received; none viable and permits not issued	Applications received; some are viable and permits are issued	All applications received are viable and permits are issued	Poor	Good
Knowledge expansion	Environmental education and awareness	Number of values included into the Cederberg Complex environmental education, awareness and interpretation programme	No values included	1-2 of the values included	3-4 of the values included	All values included	Fair	Very Good

4.3 Threat Assessment

The viability assessment was followed by a threat 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 (CMP 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 rankings 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 screened for consideration where necessary. 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.

Climate change can have significant environmental, social, cultural and economic consequences for vulnerable natural and social systems. Although the effects of climate change are speculative, it is likely to have major impacts such as an increase in the frequency of extreme weather events (for example droughts, floods and storm surges), habitat shifting and alteration and a hotter and drier climate. The effects of climate change are far reaching and affect almost every single one of the Cederberg Complex focal values. For the Cederberg Complex, a drier and hotter climate drives higher fire frequencies and reduces the availability of water for numerous plant and animal species, including humans. Climate change impacts and threats are primarily mitigated by building more resilient habitats so that the species, and associated focal values, are given the best possible change to adapt.

The threat assessment shown in Table 4.18 identifies all threats to natural and cultural values, the abatement of which will enable the achievement of objectives towards the desired state of the Cederberg Complex. The critical threats to the Cederberg Complex's focal values are listed below.

4.3.1 Invasive Alien Fish

The greatest threat to the indigenous fish of the Olifants-Doring River System and the Cederberg Complex are invasive alien fish species (Tweddle *et al*. 2009; Impson *et al*. 2017), through predation and competition, with at least 10 species recorded in the Olifants-Doring River System. Where invasive fish species occur, indigenous fish are either absent or present in very low numbers with the exception of the rock catfish. The partial or complete loss of indigenous fishes, not surprisingly, has knock on effects on the aquatic food web (Lowe *et al*. 2014). Invasive fish species known to occur in the Cederberg Complex are shown in Table 4.16. The black bass (*Micropterus* spp.) have had the greatest impact (van der Walt *et al.* 2016), as they thrive in the rivers and dams of the system and decimate the smaller species (excluding the rock catlets) and juveniles of the larger species through predation. The partial or complete loss of indigenous fish assemblages has a major effect on the ecological health of rivers, and

several indigenous fish species in the Cederberg Complex are highly threatened because of invasive fishes.

The value-threat rating of invasive fish was assessed as having a medium impact on both the rivers and riparian zones value, and the indigenous fish value, within the Cederberg Complex (Table 4.18). The scope of the impact (medium rating) includes rivers that are moderately to severely invaded (*e.g.* Jan Dissels, Heks, Krom, Driehoek) and rivers only lightly invaded or not invaded at all in the Cederberg Complex (*e.g.* Rondegat, Heks, Boskloof, Matjies). The severity of impact by invasive alien fish on the indigenous fish of the Cederberg Complex is high, whilst the severity of impact by invasive fish on the rivers and riparian zones is very high. The impact of the threat is, however, reversible in some rivers, providing that sufficient resources (budget, trained people) are available to address the problem in the priority river areas. The overall threat rating, across all values, is medium.

Table 4.16: Invasive alien fish species that occur in the Cederberg Complex.

Species Name	Common Name	Impact (low, medium, high)
Lepomis macrochirus	Bluegill sunfish	Medium (predator, competitor)
Micropterus dolomieu	Smallmouth bass	High (predator)
Micropterus punctulatus	Spotted bass	High (predator)
Micropterus salmoides	Largemouth bass	Medium (predator)
Oncorhynchus mykiss	Rainbow trout	Medium (predator)

4.3.2 Surface Water Abstraction

Surface water abstraction usually takes place on rivers and alters flow regimes of rivers, especially during the dry season. This can cause rivers to have much less flow and become shallower and warmer. This compromises habitat quality (presence of rapids, riffles, pools and backwaters) and quantity (amount of each present, and depth of each).

Habitat quality and quantity are crucial considerations for a river and its instream and riparian zone to be ecologically healthy. The instream zone includes fish, amphibians and aquatic invertebrates and the health of these communities is dependent on ecologically healthy rivers *i.e.* those with near natural to natural flow.

Surface water abstraction was regarded as a medium level threat (summary threat rating across all values) in the Cederberg Complex (Table 4.18). In terms of scope (low) and severity (medium), most rivers that flow through the Cederberg Complex arise in the PA and there is no significant abstraction on these rivers at present. These rivers, especially those that are un-impacted by IAPs in their catchments and riparian zones, are benchmarks of what natural flow regimes should be in the mountain stream and foothill river zone. They should stay abstraction-free to serve as benchmarks and to provide their vital ecological services to users downstream.

Surface water abstraction is, however, a problem for the Matjiesrivier Nature Reserve, as two important rivers that flow through the reserve (Krom and Matjies) have been negatively impacted by surface water abstraction upstream of the reserve. Abstraction of water from rivers during the dry season is regarded as one of the prime threats to fish species in the Olifants-Doring River System. In many cases, the abstraction is so severe at the offtake point on streams that there is no flow downstream, leading to

ecosystem collapse. Fish breed and recruit during the dry season (October to March) so it is essential that perennial rivers retain sufficient flow to provide enough suitable habitat for fish to survive the hot dry summers.

Both rivers have weirs and pumps on them that abstract water and this has a severe effect on dry season flow, particularly in the Krom River. These abstractions are likely a much greater problem for the fish than the riparian zone, hence the difference in impact. This is because the fish get restricted to pools during the dry season for extended periods, which worsens predation by invasive fish. Riparian zones need to be dry for several months before plants die, and this has not been observed on the Krom River yet. Despite increased levels of abstraction, the Matjies River remains perennial, although habitat quality and quantity for fish deteriorates. Such abstractions are usually irreversible as land-owners become dependent on such abstractions for economic reasons. They can only be reversed if the land-owner is willing to stop dry season abstraction.

The over-abstraction of surface water, over-allocation of water resources combined with a drying climate could be argued as among the most consequential threats to human well-being and economic value in the Cederberg. Once surface water resources are depleted, groundwater will – and already is, being targeted following the extended drought of 2015-2017. This will impact both deep and surface aquifers with likely far-reaching effects on terrestrial ecosystems and vegetation communities (B. Paxton, Freshwater Research Centre, 2018, pers. comm.).

4.3.3 High Veld Fire Frequency

Fire frequency is the number of times that fires occur within a defined area over a defined period. The frequency of fires in the Cederberg Complex has been rated and evaluated as a threat mainly for the Clanwilliam cedar tree and fynbos mosaic. The threat of short fire intervals negatively affects the recruitment of serotinous Proteaceae, as well as the recruitment and survival of the Clanwilliam cedar tree.

The scope of this threat on the Clanwilliam cedar tree value is very high with a high severity and very high irreversibility rating, resulting in a summary value-threat rating of very high (Table 4.18). This is due to the ecological character of the Clanwilliam cedar tree.

The threat scope on the succulent karoo is low because this is not a fire-driven ecosystem, however, the severity of fire impact is high, with a medium irreversibility rating. The result is that fire has a low value-threat rating on the succulent karoo mosaic.

The Fynbos biome is a fire-driven ecosystem and fires have to occur in this system, but the frequency at which fires occur in an area during a specific period is what creates the identified threat. The scope of this threat is rated very high, with a high severity and irreversibility resulting in a high value-threat rating.

Due to the high and very high scope, severity and irreversibility ratings, the overall threat rating of fire frequency across all Cederberg Complex values are high.

4.3.4 Fire Damage to Heritage Values

The Cederberg Complex is mostly located in the Fynbos biome, a fire-driven ecosystem. Although many natural fires occur, some fires are illegally started by humans (*e.g.* hikers in the Cederberg Complex or neighbours).

The palaeontological heritage values are only threatened by fire where fossil sites are above ground and exposed to fire. Rocks are heated up by fire and when temperatures are too high they crack and cause damage to the fossils embedded. This is however part of a natural process that has been going on for millennia.

The archaeological heritage is part of a living landscape for at least the past 3 000 years and has mostly survived. Some rock art had been damaged as a result of veld fires due to management neglect, while illegal fires by hikers at overnight sites in the Cederberg Wilderness cause smoke damage to rock art. This must be addressed through awareness that highlight the heritage values of the Cederberg Complex. Fire can cause serious damage to rock art, not only to the paint but to the rock surface bearing the art as well. The inclusion of archaeological sites in fire management plans as eco-sensitive areas mitigate the risk of damage to rock art sites.

Historical heritage structures at risk of fire damage are mostly those that are still intact and have wood and thatch used in construction. Fire protection mitigation for buildings have been put in place at high risk areas. Most of these structures are situated at Matjiesrivier Nature Reserve where fires occur less frequent.

The damage caused by fire to heritage values (pre-colonial heritage and historical structures) has a medium scope rating with a very high severity and irreversibility rating, resulting in an overall high value-threat rating for both values, and a high summary threat rating across all values (Table 4.18).

4.3.5 Inappropriate Agricultural Development (Corridor Connectivity)

Inappropriate agricultural development is a serious problem in the fynbos region. In the Cederberg Complex this threat expands into the succulent karoo where fertile shale soils are accessible for agricultural practices. This threat could have severe impacts such as biodiversity loss, reduced ecological functioning and resilience and a loss of corridor connectivity; providing natural pathways for species to move in the landscape. In the face of climate change the latter is particularly important.

Inappropriate development can take many forms in agricultural areas that are in the ZOI of the Cederberg Complex. Examples include illegal clearing of virgin land, over-use of chemicals (*e.g.* pesticides) and fertilizers, developing orchards and vineyards in the flood zones of rivers and inappropriate road construction.

Inappropriate agricultural development was assessed as having a low overall score (Table 4.18). The scope of impact on the succulent karoo and fynbos mosaics in the Cederberg Complex is rated as low, whilst the severity of the impact is low and high respectively. This is because many farms are relatively undeveloped because of one or more factors that include topography, poor soils and lack of water for irrigation. The irreversibility of the impacts is high where virgin veld and flood zones have been ploughed for crops and orchards, the impact is generally irreversible because of the length of time for ploughed soils to recover to natural veld. This has a major impact in terms of the loss of plant species with very limited ranges.

4.3.6 Invasive Alien Plants

IAPs are mainly a problem for biodiversity, ecosystem processes and infrastructure in the Cederberg Complex. This is because they outcompete indigenous plants, degrade soils and rivers (especially riparian zones), wetlands and they exacerbate the risk of fire and associated damage caused by fires. Fortunately, the Cederberg Complex is

relatively free of invasive alien vegetation and they have been indicated as an overall low threat, across all values, even though it affects a number of the values (Table 4.18). IAPs growing along rivers are regarded as a low threat in the Cederberg Complex, although they pose a serious threat to indigenous fish in other parts of the Olifants-Doring River System, because they outcompete indigenous riparian plants leading to river bed and bank alteration and degradation and reductions in river flow, especially during the dry season.

The spread of most invasive plants is negatively affected by fire, which in turn influences clearing activities and prioritisation thereof. Clearing and controlling IAP species is costly and given the limited funding available, prioritisation of areas to be cleared must be undertaken to maximise benefit. Van Wilgen & Forsyth (2008) argue that the use of fire is, however, a vital component of IAP control and that clearing systems should make maximum use of fire events to control IAPs.

All CapeNature reserves are divided into a mini-compartment system. Each of these compartments is assigned a unique compartment number through the national Water Information Management System. Each mini-compartment records the density, age class, clearing method and clearing stage for the five dominant invasive IAP species that occur in it. Afterwards each mini-compartment undergoes a prioritisation process. The densities and priority areas for invasive plant clearing within the Cederberg Complex is indicated in Appendix 7.2, Map 9. Priorities for clearing are incorporated into the annual plan of operations for the Cederberg Complex on an annual basis.

Invasive plants can be effectively controlled and their effects are to a large extent reversible when they are reduced to very light infestations that require low cost maintenance. The CapeNature Biological Control Strategy (CapeNature 2017b) requires that reserve management intensify the application of biocontrol as a clearing method. Biological control agents are present on several plant species in the Cederberg Complex (*e.g.* blackwattle, long-leaved wattle, sesbania, prickly pear cactus) and this management tool is hailed as a cost-effective and successful method of control when used as part of an integrated alien plant clearing plan (van Wilgen *et al*. 2013).

The goal of the Cederberg Complex is that by 2029 the fynbos and succulent karoo vegetation mosaics consist of, and are maintained at, at least 99% indigenous species. A number of strategies has been identified to assist the Cederberg Complex in achieving this goal.

IAP clearing within the Cederberg Complex is mainly funded through CapeNature directly, through ICM funding or through EPWP. Given the limited funding available for invasive alien clearing (R70 000 in the 2018/19 financial year) and the inaccessibility of many of these invaded sites, alternative ways of dealing with invaded sites must be found. The Working on Fire High Altitude Team has been active in the Cederberg Complex and do clearing of priority mini-compartments that are not accessible by normal ground teams.

Table 4.17 lists the priority IAP species for control in terms of compartments and hectares invaded and their risk of invasion. The top priorities (ranking of 1) are Mediterranean cluster pine (*Pinus pinaster*), Monterey pine (*Pinus radiata*), grey poplar (*Populus canescens*), mesquite (*Prosopis glandulosa*), rigid fiddleneck (*Amsinckia retrorsa)*, blackwood (*Acacia melanoxylon*), black wattle (*Acacia mearnsii*) and long-leaved wattle (*Acacia longfolia*). Interestingly, English oak has invaded the

most compartments (23) whilst the rigid fiddleneck has the highest average hectares invaded (23 ha).

Table 4.17: Priority invasive alien plant species that occur in the Cederberg Complex.

Species Name	Common Name	Invasive Alien Species Category	Number of Compartments Infested	Average Density (%)	Risk of Invasion
Acacia longifolia	Long-leaved Wattle	1b	1	1.00	High
Acacia mearnsii	Black Wattle	2	9	4.06	High
Acacia melanoxylon	Blackwood	2	1	5.00	High
Amsinckia retrorsa	Rigid fiddleneck		19	23.34	High
Pinus pinaster	Mediterranean cluster pine	1b	6	1.92	High
Pinus radiata	Monterey pine	1b	2	0.51	High
Populus canescens	Grey Poplar	2	11	24.68	High
Prosopis glandulosa	Mesquite	1b	4	0.50	High
Sesbania punicea	Red Sesbania	1b	2	15.00	High
Acacia saligna	Port Jackson Willow	1b	22	0.88	High
Eucalyptus grandis	Saligna Gum	1b	42	0.73	High
Opuntia ficus-indica	Sweet Prickly Pear	1b	6	0.01	High
Rubus fruticosus	European blackberry	2	17	0.61	High

4.3.7 Overgrazing

Overgrazing by domestic animals or by naturally-occurring grazing animals happen when carrying capacity for the particular vegetation type is exceeded for a period of time. This is usually associated with too many animals being kept within the reserve or animals entering the reserve illegally.

Generally overgrazing is not a problem within the Cederberg Complex as densities of indigenous grazers are below carrying capacity thresholds. However, problems have arisen because fences that separate the Cederberg Complex from neighbouring properties are either non-existent or in a state of disrepair due to a combination of factors. This has allowed domestic stock, such as cattle and donkeys mainly, to enter especially along the reserve's eastern border. On Matjiesrivier Nature Reserve, a roaming population of gemsbok does occur but they are not confined to the reserve. Table 4.18 list the overgrazing threat as low. The effects of current overgrazing associated with illegal livestock access is reversible with improved management through fences, engagement with relevant partners and taking legal action where appropriate.

4.3.8 Copying and Defacing of Rock Art

The National Heritage Resources Act (Act No. 25 of 1999) clearly state that archaeological sites may not be destroyed, damaged, altered, defaced or in any form be disturbed. The trade in and selling of archaeological material or objects requires the necessary permits from the responsible heritage resources authority. The occurrence of graffiti is to date not a major threat but as more and more tourists visit the Cederberg Complex this may change. Disturbance caused by humans falls under the fire threat. The risk can be mitigated through awareness raising and interpretation signage.

The copying of rock art for the purpose of selling for personal gain does occur but it is difficult to track and regulate. The scope of impact is medium and the severity of the threat is very high and in most instances irreversible, resulting in a medium value-threat rating. The overall threat rating (across all values) of copying and defacing rock art is rated as a low risk (Table 4.18).

4.3.9 Alteration of Fossil Beds

Fossils are protected *in situ* where they naturally occur. Fossil beds are altered and destroyed when natural geological layers are destroyed and altered for the mining of gravel for the use of road construction. This activity occurs in a few isolated locations in the Cederberg Complex. The severity of mining for gravel is low and historical practices have resulted in irreversible damage, resulting in a medium value-threat rating. Based on the scope of impact, the threat has an overall low threat rating across all values (Table 4.18). The occurrence of future mining can be mitigated through EMPs and engagement with role players.

4.3.10 Illegal Removal of Fossils and Artefacts

The illegal removal of fossils and artefacts relates to the lack of knowledge and awareness by people regarding these heritage values. Moving or removing any fossil or artefact from it's natural *in situ* position takes it out of context and greatly reduces the value of the fossil or artefact. The threat can be mitigated through increased awareness and interpretation. The scope and severity of this threat to both the palaeontological heritage and pre-colonial heritage values is low with a very high irreversible impact resulting in an overall medium threat rating across all values (Table 4.18).

4.3.11 Illegal Alteration of Historical Structures

The illegal alteration made to historical structures is directly linked to a lack of knowledge about the value of the particular heritage feature, and the special maintenance requirements needed to keep the value intact. Illegal alteration occurs when maintenance and infrastructure improvements are implemented that ultimately reduce the heritage value of such structures. The scope of impact of illegal alteration of heritage structures is high and the severity and irreversibility is very high, resulting in an overall high threat rating across all values (Table 4.18).

4.3.12 Natural Damage to Heritage Features

Historical structures not used for operational purposes are left unattended in the landscape and are exposed to the natural elements (rain, wind and animals) causing damage. The scope and severity of natural damage to pre-colonial heritage values are medium with a high irreversibility. The scope, severity and irreversibility of the natural

damage to historical structures are very high. This results in an overall high threat rating for natural damage across all values within the Cederberg Complex (Table 4.18).

4.3.13 Lack of Awareness of Values

The lack of awareness has been identified as a threat to the following values of the Cederberg Complex: indigenous fish, Clanwilliam cedar tree, fynbos mosaic heritage responsible resource utilisation and respect and care for the natural environment. The values have all been rated separately. The overall threat rating across all values indicates that this threat has a high risk (Table 4.18). The threat can be mitigated through enhancing the existing environmental education, awareness and interpretation programme of the Cederberg Complex to focus on all the identified focal values of the Cederberg Complex.

Table 4.18: Summarised threat assessment for the Cederberg Complex.

Threats\Values	Palae-ontological Heritage	Pre-colonial Heritage	Historical Structures	Rivers and Riparian Zones	Indigenous Fish	Clanwilliam Cedar Tree	Fynbos Mosaic	Succulent Karoo Mosaic	Summary Threat Rating
Alteration of Fossil Beds	Medium								Low
Alteration of Riparian Zones and Beds				Low	Low				Low
Climate Change						High	Medium	Medium	Medium
Copying and Defacing of Rock Art		Medium							Low
Diversion of Flow				Low	Low				Low
Fire Damage to Heritage Values		High	High						High
Gravel Pits (Continued Use)								Medium	Low
High Veld Fire Frequency (Too Many Fires)						Very high	High	Low	High
Illegal Alteration of Historical Structures			Very high						High
Illegal Removal of Fossils and Artefacts	Medium	Medium							Medium
Inappropriate Agricultural Development (Corridor Connectivity)							Medium	Low	Low
Inappropriate Infrastructure Development (Corridor Connectivity)							Low		Low
Invasive Alien Fish				Medium	Medium				Medium
Invasive Alien Plants				Low	Low		Low	Low	Low

Threats\Values	Palae-ontological Heritage	Pre-colonial Heritage	Historical Structures	Rivers and Riparian Zones	Indigenous Fish	Clanwilliam Cedar Tree	Fynbos Mosaic	Succulent Karoo Mosaic	Summary Threat Rating
Lack of Awareness of Values	Medium	Medium	Low		Low	High	High		High
Natural Damage to Heritage Features		Medium	Very high						High
Overgrazing							Medium	Low	Low
Poaching							Low		Low
Pollution				Low	Low		Low		Low
Recreation				Low	Low		Low		Low
Surface Water Abstraction				Low	High				Medium
Weirs (Barriers)				Low	Low				Low
Summary Value Ratings:	Medium	Medium	Very high	Medium	Medium	High	High	Medium	**Overall Project Rating (Very High)**

4.4 Sensitivity Analysis

Sensitivity mapping of reserve biodiversity, heritage and physical environments forms the basis of spatial planning and decision-making in protected areas. The sensitivity analysis 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 where 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 a significant environmental risk to infrastructure.

The method ensures that the location, nature and required mitigation for access, activities, and infrastructure development within PAs 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 (Figure 4.2). 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 investigation, but allow 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.

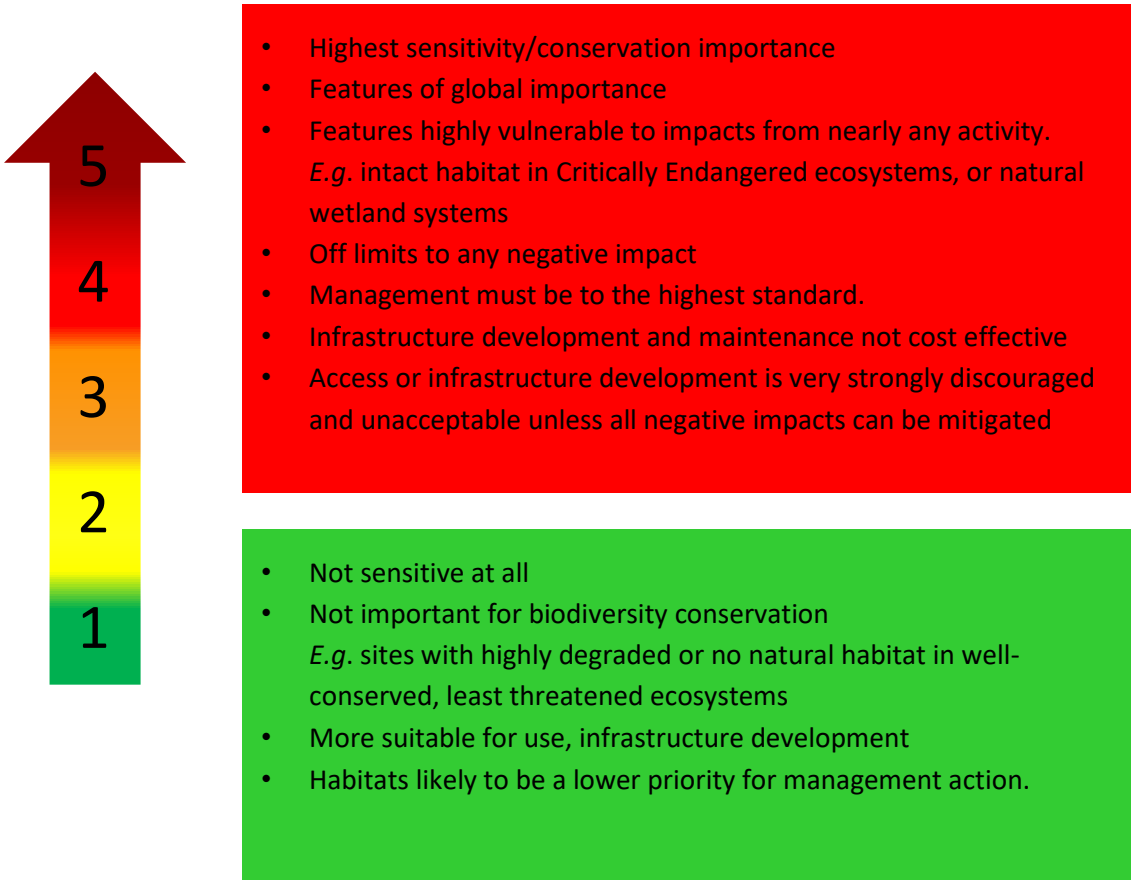


Figure 4.2: CapeNature method for sensitivity scoring and synthesis.

Physical and biodiversity sensitivities were included in the analysis as per Table 4.19 below.

Table 4.19: Physical and biodiversity categories included in the sensitivity analysis for the Cederberg Complex.

Category		Dataset	Criteria	Sensitivity Score	
Physical	Slope (degrees)	Slope calculated from 20 m resolution digital elevation model	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 >30°	5
			Strongly avoid for infrastructure development, cut and fill or other difficult and expensive construction method	High sensitivity 20°-30°	4

Category		Dataset	Criteria	Sensitivity Score	
			required. Appropriate engineering mitigation essential to prevent erosion and slope instability. Highest initial and on-going cost due to slope stabilisation and erosion management required.		
			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 10°-20°	3
			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 5°-10°	2
			Preferred areas for any built infrastructure, lowest risk of erosion or instability, lowest construction and on-going maintenance costs.	Lowest sensitivity 0°-5°	1
	Soil erodibility/ Geology	1:250 000 Geological series maps, clipped for Cederberg (2004)	Only included the geological formation known for palaeontological deposits (fossils), such as Boplaas, Cedarberg, Gamka, Gydo, Heks River, Osberg, Tra-tra, Voorstehoek, Waboomberg and Wupperthal.	Highest sensitivity	5
			Formations normally prone to erosion should have been included, but the mapped areas were not sufficiently fine-scale to only highlight those areas. On closer inspection, most areas are covered by other highly sensitive landscape features.		
Biodiversity	Rivers	1:50 000 National Geo-Spatial Information Rivers	Within 200 m of perennial river.	Highest sensitivity	5
			For Cederberg the non-perennial river buffers was not included due to some inaccuracies in the data and an “over estimation” of sensitivity.		
	Wetlands	NFEPA wetlands (Nel & Driver 2012)	Wetland.	Highest sensitivity	5
			Within 200 m of wetlands.	High sensitivity	4
	Special plant communities	Special plant communities at Matjiesrivier Nature Reserve (Lechmere-Oertel 1998)	Special plant communities’ sensitive due to species composition, such as Succulent Karoo on Gravel Patch, Restioid Sandy Fynbos and Asteraceous Fynbos Matrix. The latter two communities are sensitive to fires.	Highest sensitivity	5

Category		Dataset	Criteria	Sensitivity Score	
			Special plant communities due to unique species composition as well as signs of the presence of underground water.	High sensitivity	4
	Vegetation status	South African Vegetation Map (Mucina & Rutherford 2006) with 2014 CapeNature Ecosystem status	Critically Endangered - The fynbos riparian vegetation, even though not rated as part of the South African Vegetation Map, are rated 5 as all riparian habitats are rated.	Highest sensitivity	5
			Vulnerable - Olifants Alluvium Fynbos. Agter-Sederberg Shrubland (even though listed as Least Threatened) was given a higher sensitivity rating, due to the small portion protected within Matjiesrivier Nature Reserve and nowhere else.	Moderate sensitivity	3
			Least threatened - Cederberg Sandstone Fynbos, Northern Inland Shale Band Vegetation, Olifants Sandstone Fynbos, Swartruggens Quartzite Fynbos, and Western Altimontane Sandstone Fynbos.	Lowest sensitivity	1
	Rare and endangered plant species	Clanwilliam cedar tree localities (Slingsby 2016); Rare and endangered plant species extracted from CapeNature State of Biodiversity database; All threatened species, SANBI 2015.	All plant species rated as Critically Endangered, Critically Rare, Endangered, Near Threatened, Rare or Vulnerable. This included all Clanwilliam cedar trees (*Widdringtonia cedarbergensis*). Point localities buffered by 5 m.	Highest sensitivity	5
Heritage	Archaeological and cultural sites	South African Heritage Resource Agency Information System	Heritage sites as extracted from the national heritage resources database. Files were received in csv format, converted to shapefile format and then buffered by 100 m.	Highest sensitivity	5

4.4.1 Results of Sensitivity Analysis

The sensitivity of the Cederberg Complex was dominated by slope and perennial rivers (Appendix 7.2, Map 10; Table 4.19). These two factors contributed 91% towards the overall 35 958 ha identified as having the highest sensitivity rating (Table 4.20). Other factors with high sensitivity scores included special plant communities, vegetation status, rare and endangered plants as well as geological and heritage features (Table 4.19).

Table 4.20: Sensitivity scores for the Cederberg Complex.

Sensitivity Score	Area (ha)	Area (% of total)
1	5 136.3	6.3
2	9 232.0	11.4
3	16 484.7	20.3
4	14 391.2	17.7
5	35 958.3	44.3

4.5 Zonation

PA 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 PA objectives and sensitivity analyses.

Ideally, zonation development should be conducted 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; for alternatives for every component.

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 Stakeholder Participation Process.

CapeNature's zonation categories (Table 4.21) 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 South African National Parks and Ezemvelo KZN 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 4.21: Guide to CapeNature zonation categories applicable to the Cederberg Complex.

Protected Area Zones	Description of Zones
Wilderness / Wilderness (declared)	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.

The zonation of PAs provides formal guidelines for the management of the area for conservation, access to the area and what uses are allowed for each particular area/zone. Determining the zones is guided by existing infrastructure and their use, future developments and access, and the impact, construction and operating costs. The Cederberg Complex zones were developed from input provided by all relevant stakeholders.

Underlying decision-making rules used 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 protected area.
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 without 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.

According to the National Environmental Management: Biodiversity Act's National List of Ecosystems, most vegetation types represented in the cluster are Least Threatened, however still poorly or moderately well protected (Mucina & Rutherford 2006). Cederberg Sandstone Fynbos makes up the largest area of Cederberg Wilderness, and is considered a vulnerable ecosystem, because although largely untransformed, it does include a high number of regionally threatened plant species (*i.e.* criterion D1). Agter-Sederberg Shrubland is poorly protected and is in need of additional conservation measures.

The Cederberg Wilderness is close to the N7 West Coast tourism route, and is a very popular tourism destination; therefore, high requirement for access must be balanced against protecting one of the province's largest true wilderness areas. The Cederberg Wilderness is a large reserve, with a wide range of access and activity requirements. It contains extensive areas without human infrastructure, which provide a true wilderness experience.

Matjiesrivier Nature Reserve is relatively remote with most of the eastern part of the reserve regarded as a wilderness zone. Popular day visitor sites and public roads are restricted to the western part of the reserve. The reserve has not been identified as a priority for tourism development.

Hexberg State Forest has no road access and tourism access or development is not proposed. Despite its remote location, large areas of Hexberg State Forest look onto nearby farmlands, and the property does not include any extensive area that can be considered wilderness. The Cederberg Complex was zoned as follows using the following categories (Appendix 7.2, Map 11):

Wilderness Zone: The Cederberg Wilderness includes extensive areas with entirely natural and wild viewsheds with no built infrastructure, roads or vehicular access. Large parts of the area were zoned as "wilderness zone", except for the 1 km strip along the boundary, which was zoned as "primitive zone". In addition, a 1 km buffer around all main public roads within the protected area was zoned as "primitive zone", except for the areas zoned for "nature access" and/or "development".

The eastern part of Matjiesrivier Nature Reserve on the Nieuwe Gift plateau was zoned as "wilderness zone". This section of the protected area has entirely natural areas with minimal built infrastructure, roads or vehicular access.

Primitive: Primitive zones were determined largely by viewshed analysis, and reflect extensive areas that look onto nearby farmlands, roads or other human infrastructure,

and as a result do not qualify as true wilderness. For Cederberg Wilderness, a 1 km buffer along the inside of the protected area boundary is zoned as “primitive”. A 1 km buffer along all main public roads was zoned “primitive”, except for the areas zoned for “nature access” and/or “development”. The entire Hexberg State Forest was zoned as “primitive”.

The western part of Matjiesrivier Nature Reserve, down from the Nieuwe Gift plateau is zoned as “primitive” except for the areas zoned for “development” and “nature access”.

Nature Access: Nature access zones allow for access and appropriate management of most popular day visitor sites, in particular the bouldering (rock climbing) area of Rocklands. An extensive “nature access” zone is provided to allow access and buffer the “high intensity development” zone around Algeria. This zone is appropriately located to take advantage of a day trail route to the Helsekloof waterfall, including existing disturbed habitat, roads and trails left by previous forestry operations. The popular day hikes within the Cederberg Complex, including a 25 m buffer, are zoned as “nature access”. This includes the popular Stadsaal Cave and Truitjieskraal bolting route in Matjiesrivier Nature Reserve.

Development - Low Intensity: Three “low intensity development” zones allowing for road-accessed camping and self-catering facilities are identified. These include the cottages at the Bosherberge near Algeria, and the Kliphuis campsite and cottages. The Populierbos area at Matjiesrivier Nature Reserve is also zoned as “low intensity development”. This area provides for limited environmental education and day visitor interpretation access.

Development - High Intensity: This zone encompasses the existing footprint of the popular Algeria campsite and associated facilities and chalets. High intensity development zoning reflects both the high numbers of overnight visitors that the site can appropriately accommodate, and allows for facilities associated with a busy tourism node. The node is appropriately located on the periphery of the reserve, on a major access route, and within the original historical Algeria development footprint.

Development - Management Zones: Management footprints are provided at Algeria that are close to, but appropriately separated from, tourism areas. A small satellite management centre is located at Kliphuis to allow cost-effective and convenient management of the campsite and northern section of Cederberg Wilderness. This would otherwise incur high on-going travel and time costs. At Matjiesrivier Nature Reserve, the management zone provides for staff accommodation, stores and administration facilities. This location is highly visible and serves as a reception facility for day visitors.

4.6 Access

The main management and/or tourism centres of the Cederberg Complex are located at Algeria, Matjiesrivier and Kliphuis. Controlled access points should be easily accessible to relevant user groups. Most of the hiking trails in the Cederberg Wilderness start on private land and landowners assist in controlling public access onto these trails. Uncontrolled access to most of the area can easily be obtained from any of the public roads traversing the Cederberg Complex and/or properties along its boundaries. MOUs have been signed with tourism offices in the Cederberg Conservancy who assist the Cederberg Complex by selling permits for day access to

Stadsaal Cave, Truitjieskraal, Maltese Cross and Wolfberg Arch. Access to these sites is controlled by gates and coded locks. Access to Rocklands is controlled through permits and MOUs with partners, who then assist in selling permits to access the area. All permits issued specify the conditions of use for a particular area accessed.

Uncontrolled and remote access to the Cederberg Wilderness and Hexberg State Forest poses particular management and safety risks. This problem is addressed in the Integrated Compliance Plan for the Cederberg Complex; mainly through conducting patrols and permit inspections.

Controlled public access points to the Cederberg Complex are listed in Table 4.22 and indicated on Appendix 7.2, Map 12.

Table 4.22: Controlled public access points to the Cederberg Complex.

Locality	Name	Type of Access	Activity
Algeria	Algeria Office	Controlled	Camping, cottages, hiking, interpretation, enquiries
Kliphuis	Kliphuis Office	Controlled	Camping, cottages, hiking, interpretation, enquiries, bouldering
Matjiesrivier Nature Reserve	Matjiesrivier Office	Controlled	Interpretation, enquiries
Matjiesrivier Nature Reserve	Stadsaal Cave	Controlled	Hiking, interpretation
Matjiesrivier Nature Reserve	Truitjieskraal	Controlled	Hiking, interpretation, sports climbing
Bokveldskloof	Maltese Cross	Controlled	Hiking
Sanddrif	Wolfberg Arch	Controlled	Hiking

Access for researchers wanting to conduct studies within the Cederberg Complex is managed through the issuing of research permits.

Currently one designated helicopter landing site is located within the Cederberg Complex at Algeria (S 32° 22’ 22.85’’ E 19° 03’ 18.44’’). According to NEM: PAA a legal no fly-zone restriction of 2 500 feet (762 m) exists above all special Nature Reserves, National Parks and World Heritage Sites.

Access to the Heuningvlei jeep track between Pakhuis Pass and Heuningvlei is for community tourism and emergency use only. Access for legal harvesting of natural resources on the Cederberg Complex is evaluated and considered on an *ad hoc* basis as required and by permit only.

Five servitude agreements are applicable to the Cederberg Complex where the respective entities are provided access across land, or managed as part of the complex. Current servitudes are listed in Table 4.23 and indicated in Appendix 7.2, Map 12.

Table 4.23: Servitudes and management agreements applicable to the Cederberg Complex.

Date of Agreement	Type of Agreement	Partner	Duration (years)	Area Affected	Conditions of Use
03/10/2013	Servitude	Tony Kings (Zuurfontein)	In perpetuity	Matjesrivier 324; Vyfhoek 313; Nieuwe Gift 312;	Access along servitude road to property
03/10/2013	Servitude	Johan van der Westhuyzen (Bakkrans & Mooiberg)	In perpetuity	Nieuwe Gift 312	Access along servitude road to property
03/10/2013	Servitude	CapeNature	In perpetuity	Nieuwe Gift 312; Wildehondskloof 311	Access along servitude road to property
Not Specified	Access	Telkom	In perpetuity	Truitjeskraal 326	Access to Telkom infrastructure
Unknown	Right of Way	WCDM	In perpetuity	Driehoek 331/1; Driehoek 331/2; Driehoek 331/3; Annex Welbedacht 333	Access along servitude road to property
Unknown	Right of Way	WCDM	In perpetuity	Driehoek 331/2; Annex Welbedacht 333	Access along servitude road to property
Unknown	Right of Way	Telkom	In perpetuity	Farm 286	Access to Telkom infrastructure
Unknown	Right of Way	Neighbouring Landowners	In perpetuity	Hexberg 58; Hexberg 59	Access along servitude road to property

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 4.3) 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 are 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 (Act No. 1 of 1999) such as concessions or public private partnerships.

Figure 4.3: 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 Cederberg Complex is a popular tourist destination in the province. A total of 34 530 visitors accessed the PA during the 2017/18 financial year. This contributed to various tourism economic development opportunities in and around the Cederberg Complex. CapeNature supports community-based tourism initiatives like the Cederberg Heritage Route.

Current tourist activities in the Cederberg Complex are low impact activities and examples include back-packing, rock climbing (sport, traditional and bouldering), photography, bird watching and swimming in the rivers. A number of rustic overnight hiking huts are situated in the Cederberg Wilderness and are available for use during hikes. The Cederberg Wilderness is zoned to control visitors in order to maintain the unspoilt atmosphere and limit visitor impact; within the wilderness and primitive zones, groups are limited to a maximum of 12 persons per day.

Rocklands and Truitjieskraal are world-renowned bouldering and climbing sites and many climbers visit these areas during the climbing season each year. At Rocklands a contractual agreement with five neighbouring landowners allows them to sell access permits as part of the unified permit system, facilitating access to bouldering sites for visitors. At Truitjieskraal a number of climbing routes was already established prior to the proclamation of the reserve. In 2006, CapeNature and the Mountain Club of South Africa compiled a management plan to manage the climbing and bolting activities at Truitjieskraal.

The Cederberg Wilderness is also renowned as a hiking destination with popular hiking routes that include the Maltese Cross and Wolfberg Arch (Figures 4.4 a & b), some routes are also used annually for wilderness trail running events.

Figure 4.4: (a) The Maltese Cross and the (b) Wolfberg Arch. Photos: Scott Ramsay.

Algeria has 48 campsites situated along the banks of the Rondegat River as well as 13 self-catering chalets, eight at Algeria and five at the Bosherberge. Kliphuis campsite is located at the base of Pakhuis Pass. It has 10 campsite sites situated along the Kliphuis River as well as three self-catering chalets equipped with solar and gas appliances. This route is popular with people on-route to the Biedouw valley, especially during flowering season.

The Stadsaal Cave, Elephant rock art and Truitjieskraal sites are well-known and are good examples of the geological and archaeological heritage of the area. Accessibility to these sites is relatively easy and permits can be obtained from all tourism facilities in the Cederberg Conservancy. No tourism accommodation is available on Matjiesrivier Nature Reserve.

Integrated tourism management and marketing exists between CapeNature and the Cederberg Conservancy. A tourism committee meets quarterly and websites of both institutions are linked. Marketing material and brochures give exposure to both institutions. Visitor access to the Cederberg Complex is managed through the use of permits. Partnerships with neighbours who issue permits on behalf of CapeNature makes the area more accessible to tourists and creates opportunities for profit sharing.

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

At Matjiesrivier there is a possibility of using existing infrastructure for the development of a small interpretation centre. Furthermore, the reserve lends itself to the development of a wilderness hiking trail through the wilderness zone. Both these tourism products will have a heritage theme to promote the unique heritage aspects of the area.

At Algeria, there is a possibility to expand the number of chalets in an existing and approved development footprint directly below the newly built chalets (Appendix 7.2, Map 7b), which forms part of the current high intensity development zone. The development of a mountain bike trail on the old plantation jeep tracks above Algeria office is also being considered. At Kliphuis additional accommodation through chalets or campsites may be considered. No tourism development is intended for Hexberg State Forest due to its remote locality.

Tourism interpretation and signage have been identified as a need for the Cederberg Complex. A specific focus of this will be to highlight the unique values of the Cederberg Complex (section 2.6).

4.8 Protected Area Expansion

The expansion of protected areas in South Africa is informed by the National Protected Area Expansion Strategy (SANBI & DEAT 2010). This strategy provides a broad national framework for PA 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 National Protected Area Expansion Strategy which calls on provinces to develop implementation plans in support of the national strategy; including support for provincial conservation efforts and priorities, CapeNature has produced a Western Cape Protected Area Expansion Strategy (WCPAES) and

Implementation Plan 2015-2020 (CapeNature 2015b). This CapeNature strategy addresses the formal declaration of priority natural terrestrial, freshwater and estuarine 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 national strategy, the provincial strategy is informed by immediately available resources and therefore highlights some different spatial priorities.

The Cederberg Complex's expansion will be achieved in line with the WCPAES. These sites have been identified through systematic conservation planning that culminated in the WCBSP and include sites that contain Critical Biodiversity Areas (CapeNature 2017a). The Conservation Action Priority map, a spatial representation of the WCPAES, which includes a subset of Critical Biodiversity Areas, is used to guide expansion initiatives.

The expansion of the Cederberg Complex has been achieved through implementation of the CapeNature Stewardship Programme and the GCBC landscape initiative (Appendix 7.2, Map 13). This is in accordance with the Cape Action for People and the Environment project objectives to enhance connectivity in this strategic landscape by working with local communities, landowners and agro-industries to secure natural corridors through the landscape.

Most important to the functioning, management and consolidation of conservation gains for the Cederberg Complex is the long-term security and management of the natural veld connecting the Cederberg Wilderness and Matjiesrivier Nature Reserve. Greater security and increased connectivity can be achieved through the signing of in-perpetuity stewardship agreements with private landowners situated between the Fynbos and Succulent Karoo biomes as highlighted through the Conservation Action Priority map process. Two identified Contract Nature Reserve sites will be upgraded to in-perpetuity agreements and two other sites as Biodiversity Agreements or a higher conservation status.

Agter-Sederberg Shrubland is a poorly protected vegetation type within the succulent karoo, found in and around Matjiesrivier Nature Reserve (Appendix 7.2, Map 5). Currently only 21% (~2 463 ha) of this vegetation type is protected within the reserve and adjacent stewardship sites. A second objective for the Cederberg Complex is to increase the area of formal protection for this vegetation type. The current Western Cape provincial biodiversity target is 11 736 ha; a shortfall of 9 386 ha. Two private properties identified through the Conservation Action Priority map process will be engaged towards upgrading their existing stewardship agreements to in-perpetuity. An additional two properties containing Agter-Sederberg Shrubland will be approached for signing of a Biodiversity Agreement or higher category.

Achieving the two objectives will contribute to the Cederberg Complex management plan targets, as well as the Cape Action for People and the Environment's vision of a greater Cederberg landscape, benefiting people and the environment, WCPAES objectives, and to the national goal of achieving cost-effective PA expansion for improved ecosystem representation, ecological sustainability and resilience to climate change.

4.9 Zone of Influence: Protected Area Integration and Mainstreaming

The Norms and Standards attached to NEM: PAA require that a ZOI must be identified for a protected area, that a programme is encouraged to develop and maintain good

relations with neighbours, that there is a formal programme of regular interaction between protected area management and neighbours, protected area staff regularly collaborate with partners, local communities and other organisations, and that neighbouring communities have relevant input into decisions relating to the PAs management. The purpose of the ZOI is to ensure that the PA is integrated into the landscape so that land and water use planning take due consideration of the protected area's objectives. The ZOI 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.

The sensitivity analysis, KEAs and threats of the Cederberg Complex are primary informants for the establishment of the ZOI. Feature data were limited to 10 km from the proclaimed boundary around the Cederberg 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 ZOI calculation are rated on a standard scale of 1 to 4: with Low (1), Medium (2), High (3), and Very high (4) (Table 4.24). These ratings were assigned to each input feature within the ZOI. Higher scores represent areas where many features overlap and influence on the PA would be higher.

The dominant factor affecting the Cederberg Complex through its Zone of Influence is a high vegetation flammability index, affecting 172 752 ha (65%) of the surrounding zone. This holds a significant biodiversity and infrastructure risk due to the likelihood of fires starting outside of the PA and moving into the Cederberg Complex with associated negative impacts (Table 4.24). Illegal resource collection was an additional important factor, affecting 27 868 ha (10.5%) of the ZOI. This includes unregulated overgrazing by livestock and illegal activities such as poaching of rooibos, buchu and other flora as well as poaching of wildlife.

Another factor with a very high rating but having a low influence were species of special concern. Point localities were buffered by 5 m. A small area, 9.5 ha of the total 265 973.1 ha, was identified as being affected by this criterion.

The remaining features had a negligible effect on the Cederberg Complex, due to a combination of factors of which their low rating was the most important factor. The Cederberg Complex ZOI map is depicted in Map 14 (Appendix 7.2).

Table 4.24: Criteria used for defining the Zone of Influence around the Cederberg Complex.

Feature	Criteria	Rating	Zone Area (ha)	% of Zone
Species of special concern	Known locations of fauna and flora species of special concern occurring outside the protected area.	Very high (4)	9.5	0.00
Fire hazards (high fire frequency)	Flammability of the vegetation.	High (3)	172 752.7	64.95
Over abstraction of water (surface	Surface and groundwater abstraction points, buffered by 100m.	High (3)	59.9	0.02

and groundwater)				
Illegal resource use	Illegal resource use, which includes unregulated overgrazing by livestock and game.	High (3)	27 868.0	10.48
Use of dams and water management	Rivers and water courses selected for Invasive Alien Species strategies (both Invasive Alien Plant and Invasive Alien Fish) that are upstream from the protected area.	Medium (2)	794.4	0.30
	Fish barriers and upper limit of indigenous fish including a 100m buffer.	Medium (2)	1 225.1	0.46
Viewshed analyses ("sense of place" for a wilderness)	Identified current or future land use activities that will be incompatible with "sense of place".	Low (1)	27 270.8	10.25
Invasive Alien Plants	Stands of Invasive Alien Plants or plantations within a radius of the protected area is a source of re-infestation.	Low (1)	547.3	0.21
Game farming	The threat of game farming adjacent to reserves, *e.g.* introduction of extra-limited game species, or fencing that limits the movement of natural wild species.	Low (1)	13 531.4	5.09
Mountain Catchment Areas	Included all adjacent Mountain Catchment Areas into the Zone of Influence.	Low (1)	81 536.5	30.66
Stewardship sites	Stewardship sites that have direct land and/or water management responsibilities and that contribute to protected area values and appropriate PA design (connectivity and extent).	Low (1)	35 962.1	13.52
Areas identified in Protected Area Expansion Strategy (Conservation Action Priority map)	Include areas identified for the Conservation Action Priority map.	Low (1)	84 369.3	31.72
Special projects (Northern Cape)	Areas mapped through expert workshop such as mammal corridors, fish, plants, birds, *etc.*	Low (1)	35 151.9	13.22

5 STRATEGIC IMPLEMENTATION FRAMEWORK

For the Cederberg Complex, an analysis of the conservation situation was undertaken to enable a common understanding of the context of the Cederberg 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 protected area.

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 Cederberg Complex focal ecological and service areas, goals and associated strategies is provided in Table 5.1. The Strategic Implementation Framework is provided in Table 5.2.

CapeNature will lead the implementation of the management plan, although achieving the vision requires a coordinated effort. The reserve is indebted to a multitude of stakeholders and volunteers assisting it on an annual basis. The following stakeholders are some of our key partners in achieving the management plan deliverables:

- All our neighbours, surrounding stewardship properties, including the Cederberg Conservancy
- All volunteers and groups working in the Cederberg Complex
- Cederberg Municipality
- Greater Cederberg Fire Protection Association
- Greater Wupperthal Community
- Heritage Western Cape
- Moravian Mission of South Africa
- National Department of Agriculture, Forestry and Fisheries
- National Department of Environmental Affairs
- National Department of Water and Sanitation
- South African Environmental Observation Network
- Various academic institutions
- Western Cape Department of Agriculture
- Western Cape Department of Environmental Affairs and Development Planning
- West Coast District Municipality

Table 5.1: Focal values and service areas, goals and associated strategies identified for the Cederberg Complex.

Focal Values	Goals	Strategies
Rivers & Riparian Zone	By 2029, all riparian zones within the Cederberg Complex are maintained at 90-99% indigenous vegetation cover, have an instream macro-invertebrate South African Scoring System score above 8, and viable* indigenous fish communities are present in all 9 priority rivers identified for fish conservation. *1 Boskloof = Very Good; *2 Heks = Fair; *3 Rondegat = Very Good; *4 Jan Dissels = Fair; *5 Driehoeks = Very Good; *6 Matjies = Good; *7 Krom = Good; *8 Heks Tributary = Very Good; *9 Doring = Fair.	**S1** **S2** **S8** **S9** **S13**
Indigenous Fish	By 2029, the Cederberg Complex supports viable* recruiting populations and distribution ranges of all 5 priority indigenous fish species. *1 Doring Fiery Redfin = Fair; *2 Fiery Redfin = See desired rating per river; *3 Twee River Redfin = Very Good; *4 Clanwilliam Sandfish = Good; *5 Spotted Rock Catfish = Very Good.	**S1** **S2** **S8** **S9** **S13** **S15**
Clanwilliam Cedar Tree	By 2029, the augmented Clanwilliam cedar tree recruitment rate is between 11-59% and the total number of adult* trees has increased to 20 000 individuals. *Adult = those that can be reliably identified on aerial imagery.	**S3** **S10** **S11** **S15**
Fynbos Mosaic	By 2029, the fire regime of the Cederberg Complex* supports viable fynbos veld age and size categories. *Excluding Swartruggens Quartzite Karoo areas	**S2** **S3** **S9** **S12**
	By 2029, both the fynbos and succulent karoo vegetation mosaics within the Cederberg Complex will be comprised of 90-99% indigenous vegetation.	**S2** **S9**
	By 2029, two priority properties will have signed in perpetuity stewardship agreements and another two as biodiversity agreements or higher, in both the fynbos and succulent karoo vegetation mosaics.	**S14**
Succulent Karoo Mosaic	By 2029, both the fynbos and succulent karoo vegetation mosaics within the Cederberg Complex will be comprised of 90-99% indigenous vegetation.	**S2** **S9**
	By 2029, two priority properties will have signed in perpetuity stewardship agreements and another two as biodiversity agreements or higher, in both the fynbos and succulent karoo vegetation mosaics.	**S14**

Palaeontological Heritage **Pre-colonial Heritage** **Historical Structures**	By 2029, all human disturbance to heritage features within the Cederberg Complex is limited, to maintain, or where feasible, improve condition.	**S3** **S4** **S11** **S15**
Focal Service Areas	**Goals**	**Strategies**
Tourism-based Livelihoods; Economic Development; Social Development	By 2029, the Cederberg Complex will support sustainable tourism-based livelihoods and in partnership with role players contribute to economic and social upliftment in and around the complex.	**S16** **S17**
Responsible Utilisation of Natural Resources	By 2029, access to and utilisation of natural resources within the Cederberg Complex are in accordance with CapeNature policy and procedures.	**S5** **S6** **S12** **S13**
Respect and Care for the Natural Environment	By 2029, the Cederberg Complex environmental education, awareness and interpretation programme will promote all* ecological and human well-being values. *Indigenous Fish; *Clanwilliam Cedar Tree; *Fynbos Mosaic; *Heritage; *Responsible Resource Utilisation; *Respect and Care for the Natural Environment.	**S8** **S11** **S15**

Table 5.2: Strategic Implementation Framework for the Cederberg Complex.

STRATEGIES:	**Strategy 1: Address invasive alien fish control on priority rivers within the Cederberg Complex and its ZOI.**				
GOALS:	• **By 2029, all riparian zones within the Cederberg Complex are maintained at 90-99% indigenous vegetation cover, have an instream macro-invertebrate South African Scoring System score above 8, and viable* indigenous fish communities are present in all 9 priority rivers identified for fish conservation.** • **By 2029, the Cederberg Complex supports viable* recruiting populations and distribution ranges of all 5 priority indigenous fish species.**				
THREATS:	• **Invasive Alien Fish.**				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 1.1: By 2021, CapeNature have prioritised rivers within the Western Cape Province for invasive alien fish control.	Assist with the implementation of control plans for priority rivers identified within the Cederberg Complex and its ZOI.	**Lead:** Freshwater Scientist **Enablers:** Ecological Coordinator; Conservation Manager	Year 3	Priority rivers list; Final project clearing report	Integrated Work Plan

STRATEGIES:	Strategy 2: Address IAS control through the development of an IAS control plan for the Cederberg Complex.				
GOALS:	• By 2029, all riparian zones within the Cederberg Complex are maintained at 90-99% indigenous vegetation cover, have an instream macro-invertebrate South African Scoring System score above 8, and viable* indigenous fish communities are present in all 9 priority rivers identified for fish conservation. • By 2029, the Cederberg Complex supports viable* recruiting populations and distribution ranges of all 5 priority indigenous fish species. • By 2029 the fire regime of the Cederberg Complex* will support viable fynbos veld age and size categories. • By 2029, both the fynbos and succulent karoo vegetation mosaics within the Cederberg Complex will be comprised of 90-99% indigenous vegetation.				
THREATS:	• Invasive Alien Plants.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 2.1: By 2022, CapeNature have revised and implemented the Cederberg Complex IAS control plan.	Revise and implement the approved plan.	**Lead:** Conservation Manager **Enablers:** Regional Ecologist; Ecological Coordinator; Catchment Manager; Protected Areas Manager	Year 3	Proportion of IAP hectares cleared or maintained	Integrated Work Plan

STRATEGIES:	**Strategy 3: Through partnership, enhance the management and protection of the fynbos, Clanwilliam cedar tree and heritage values of the Cederberg Complex.**				
GOALS:	• **By 2029, the augmented Clanwilliam cedar tree recruitment rate is between 11-59% and the total number of adult* trees has increased to 20 000 individuals.** • **By 2029, the fire regime of the Cederberg Complex* will support viable fynbos veld age and size categories.** • **By 2029, all human disturbance to heritage features within the Cederberg Complex is limited, to maintain, or where feasible, improve condition.**				
THREATS:	• **High veld fire frequency.** • **Fire damage to heritage values.**				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 3.1: By 2020, CapeNature have obtained commitment from partners to audit and implement all Fire Management Unit Plans within ZOI of the Cederberg Complex.	Utilise GCFPA and WCDM work group meetings to obtain support for auditing and implementation.	**Lead:** Conservation Manager **Enablers:** Catchment Manager; Community Conservation Manager; Protected Areas Manager	Year 1	Minutes of meetings and email correspondence; Partner audit reports	
Objective 3.2: By 2022, CapeNature have revised and implemented the Cederberg Complex environmental education, awareness and interpretation programme to include a fire awareness theme.	Revise and implement the approved plan.	**Lead:** Conservation Manager **Enablers:** Community Conservation Manager; Protected Areas Manager	Year 3	Number of awareness events	Environmental education, awareness and interpretation programme; Integrated Work Plan

STRATEGIES:	**Strategy 4: Through partnership, share, evaluate and enhance the management and protection of the Cederberg Complex heritage values both internally and externally.**
GOALS:	• **By 2029, all human disturbance to heritage features within the Cederberg Complex is limited, to maintain, or where feasible, improve condition.**
THREATS:	• **Fire damage to heritage values.** • **Natural damage to heritage features.** • **Illegal alteration of historical structures.** • **Illegal removal of fossils and artefacts.** • **Alteration of fossil beds.** • **Copying and defacing of rock art.**

Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 4.1: By 2022, CapeNature have revised and implemented the heritage management SOG.	Revise and implement the approved SOG.	**Lead:** Conservation Manager **Enablers:** Regional Ecologist; Ecological Coordinator; Protected Areas Manager	Year 3	Approved heritage management SOG; Updated heritage Inventory for the Cederberg Complex; Heritage information logged on national heritage resources database	Cultural heritage survey guidelines and assessment tools for protected areas in South Africa; Draft heritage SOG; Draft heritage management SOG
Objective 4.2: By 2025, CapeNature have a revised and approved heritage management plan for the Cederberg Wilderness.	In partnership with Heritage Western Cape, revise and implement the approved heritage management plan for the Cederberg Wilderness.	**Lead:** Conservation Manager **Enablers:** Regional Ecologist; Ecological Coordinator; Protected Areas Manager	Year 6	Approved Cederberg Wilderness heritage management plan; Number of monitoring or management interventions	Heritage management guidelines; Ecological Matrix; Integrated Work Plan
Objective 4.3: By 2026, CapeNature have an organisational heritage agreement with Heritage Western Cape.	Finalise an organisational heritage agreement.	**Lead:** Conservation Manager **Enablers:** Protected Areas Manager	Year 7	Signed MOU	National Heritage Resources Act
Objective 4.4: By 2026, CapeNature in partnership with relevant role players, have developed and implemented a training programme to enhance heritage management within the organisation.	Develop and implement an approved heritage training programme for relevant CapeNature staff.	**Lead:** Conservation Manager **Enablers:** Protected Areas Manager; Human Resource Manager	Year 7	Approved heritage training programme; Number of training events	CapeNature Skills Development Programme

STRATEGIES:	**Strategy 5: The CapeNature Natural Resource Utilisation policy and Permit System must provide usage categories and guidelines for Cultural, Medicinal and Spiritual use.**				
GOALS:	• **By 2029, access to and utilisation of natural resources within the Cederberg Complex are in accordance with CapeNature policy and procedures.**				
THREATS:	• **Lack of knowledge and understanding within the ZOI on the sustainable use of natural resources.**				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 5.1: By 2023, CapeNature have revised and implemented the Natural Resource Utilisation policy and Permitting System.	Revise and implement the approved Natural Resource Utilisation policy and Permitting System.	**Lead:** Conservation Manager **Enablers:** Protected Areas Manager; Biodiversity Support; Law Administration; Community Conservation Manager	Year 4	Approved policy; Amended Permit System; Cederberg Complex NRUG permits issued	Draft policy; Current permit system

STRATEGIES:	Strategy 6: Incorporate protected area priorities and ZOI into municipal IDPs and SDFs.				
GOALS:	• By 2029, access to and utilisation of natural resources within the Cederberg Complex are in accordance with CapeNature policy and procedures.				
THREATS:	• Lack of knowledge and understanding within the ZOI on the sustainable use of natural resources.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 6.1: By 2020, CapeNature have formalised a process of incorporating protected area priorities and ZOI into municipal IDPs and SDFs.	Finalise and implement the approved procedure for the next IDP and SDF revision round.	**Lead:** Conservation Manager **Enablers:** Protected Areas Manager; Biodiversity Support; People and Conservation; Conservation Planning	Year 1	Minutes of meetings and email correspondence; Municipal IDPs and SDFs	

STRATEGIES:	Strategy 7: Promote the Cederberg Complex as a World Heritage Site and unique Wilderness destination for Spiritual Health.				
GOALS:	• Not applicable				
THREATS:	• General lack of understanding and appreciation of the World Heritage Site status and values.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 7.1: By 2022, CapeNature have developed and implemented a media & marketing campaign to promote the wilderness and spiritual values of the Cederberg Complex World Heritage Site.	Develop and initiate implementation of the media & marketing campaign.	**Lead:** Conservation Manager **Enablers:** Protected Areas Manager; Communication Services Manager	Year 3	CapeNature media valuation reports	

STRATEGIES:	**Strategy 8: Inspire all stakeholders about the significance of indigenous fish species within the Cederberg Complex and its ZOI.**				
GOALS:	• **By 2029, all riparian zones within the Cederberg Complex are maintained at 90-99% indigenous vegetation cover, have an instream macro-invertebrate South African Scoring System score above 8, and viable* indigenous fish communities are present in all 9 priority rivers identified for fish conservation.** • **By 2029, the Cederberg Complex supports viable* recruiting populations and distribution ranges of all 5 priority indigenous fish species.** • **By 2029, the Cederberg Complex environmental education, awareness and interpretation programme will promote all* ecological and human well-being values.**				
THREATS:	• **Invasive Alien Fish.**				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 8.1: By 2022, CapeNature have revised and implemented the Cederberg Complex environmental education, awareness and interpretation programme to include a fish theme.	Revise and implement the approved plan.	**Lead:** Conservation Manager **Enablers:** Protected Areas Manager; Community Conservation Manager; Freshwater Scientist	Year 3	Number of awareness events	Environmental education, awareness and interpretation programme; Integrated Work Plan

STRATEGIES:	Strategy 9: Through partnership, address IAP clearing and compliance within the ZOI of the Cederberg Complex.				
GOALS:	• **By 2029, all riparian zones within the Cederberg Complex are maintained at 90-99% indigenous vegetation cover, have an instream macro-invertebrate South African Scoring System score above 8, and viable* indigenous fish communities are present in all 9 priority rivers identified for fish conservation.** • **By 2029, the Cederberg Complex supports viable* recruiting populations and distribution ranges of all 5 priority indigenous fish species.** • **By 2029 the fire regime of the Cederberg Complex* will support viable fynbos veld age and size categories.** • **By 2029, both the fynbos and succulent karoo vegetation mosaics within the Cederberg Complex will be comprised of 90-99% indigenous vegetation.**				
THREATS:	• **Invasive Alien Plants.**				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 9.1: By 2021, CapeNature have prioritised neighbouring properties within the ZOI of the Cederberg Complex for IAP clearing and/or compliance action.	Prioritise neighbouring properties for IAP clearing and/or compliance action.	**Lead:** Conservation Manager **Enablers:** Catchment Manager; Protected Areas Manager	Year 2	List of priority properties	
Objective 9.2: By 2022, CapeNature have obtained commitment from partners to assist with IAP clearing and compliance within the ZOI of the Cederberg Complex.	Obtain commitment and action from relevant partners.	**Lead:** Conservation Manager **Enablers:** Catchment Manager; Protected Areas Manager	Year 3	Minutes of meetings and email correspondence; Partner funding committed; Partner directives issued	IAS legislation

STRATEGIES:	Strategy 10: Enhance the management and restoration of the Clanwilliam cedar tree within the Cederberg Complex.				
GOALS:	• By 2029, the augmented Clanwilliam cedar tree recruitment rate is between 11-59% and the total number of adult* trees has increased to 20 000 individuals.				
THREATS:	• Not applicable, this strategy directly promotes the restoration of the value.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 10.1: By 2023, CapeNature have developed and implemented a Clanwilliam cedar tree restoration plan.	In partnership with the University of Cape Town and South African Environmental Observation Network, develop and implement the approved Clanwilliam cedar tree restoration plan.	**Lead:** Conservation Manager **Enablers:** Ecological coordinator; Regional Ecologist; Protected Areas Manager	Year 4	Number of seedlings planted	Integrated Work Plan

STRATEGIES:	Strategy 11: Inspire all stakeholders about the significance of all heritage values within the Cederberg Complex.				
GOALS:	• **By 2029, the augmented Clanwilliam cedar tree recruitment rate is between 11-59% and the total number of adult* trees has increased to 20 000 individuals.** • **By 2029 all human disturbance to heritage features within the Cederberg Complex is limited, to maintain, or where feasible, improve condition.** • **By 2029, the Cederberg Complex environmental education, awareness and interpretation programme will promote all* ecological and human well-being values.**				
THREATS:	• **Fire damage to heritage values.** • **Illegal removal of fossils and artefacts.** • **Alteration of fossil beds.** • **Copying and defacing of rock art.** • **General lack of cultural knowledge and understanding amongst neighbours, communities, tourists, and CapeNature staff.**				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 11.1: By 2022, CapeNature have revised and implemented the Cederberg Complex environmental education, awareness and interpretation programme to include a heritage theme.	Revise and implement the approved plan.	**Lead:** Conservation Manager **Enablers:** Community Conservation Manager; Protected Areas Manager	Year 3	Number of awareness events	Environmental education, awareness and interpretation programme; Integrated Work Plan

STRATEGIES:	**Strategy 12: Through partnership, address illegal and un-sustainable resource utilisation practices which includes domestic animals, extra-limital game, poaching, overgrazing and land degradation within the Cederberg Complex and its ZOI.**
GOALS:	• **By 2029, the fire regime of the Cederberg Complex* will support viable fynbos veld age and size categories.** • **By 2029, access to and utilisation of natural resources within the Cederberg Complex are in accordance with CapeNature policy and procedures.**
THREATS:	• **Overgrazing.** • **Lack of knowledge and understanding within the ZOI on the sustainable use of natural resources.**

Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 12.1: By 2020, CapeNature have ensured that all game farmers within the ZOI of the Cederberg Complex are compliant with the GTUP.	Ensure adjacent game farmers comply to GTUP.	**Lead:** Conservation Services Manager **Enablers:** Protected Areas Manager; Conservation Manager	Year 1	Valid property certificate	GTUP
Objective 12.2: By 2023, CapeNature have obtained commitment from partners and landowners to address un-sustainable resource utilisation practices within the Cederberg Complex and its ZOI.	Obtain commitment from relevant partners.	**Lead:** Conservation Manager **Enabler:** Conservation Services Manager; Protected Areas Manager	Year 4	Minutes of meetings and email correspondence; Partner action	NEM: PAA; Conservation Ordinance, National Animal Pounds Bill; Municipal Bylaws, Agricultural stocking and tagging guidelines

STRATEGIES:	Strategy 13: Through partnership, address agricultural water use best practice and compliance with landowners within the Krom/Matjies/Driehoeks River systems.
GOALS:	• By 2029, all riparian zones within the Cederberg Complex are maintained at 90-99% indigenous vegetation cover, have an instream macro-invertebrate South African Scoring System score above 8, and viable* indigenous fish communities are present in all 9 priority rivers identified for fish conservation. • By 2029, the Cederberg Complex supports viable* recruiting populations and distribution ranges of all 5 priority indigenous fish species. • By 2029, access to and utilisation of natural resources within the Cederberg Complex are in accordance with CapeNature policy and procedures.
THREATS:	• Surface water abstraction.

Objectives	Actions	Responsibility	Time-frame	Measurable Indicators	Existing Procedures
Objective 13.1: By 2022, CapeNature have supported the establishment of a Matjies/Krom/Driehoeks River water user's forum with relevant partners.	Establish or use an appropriate forum to engage relevant partners and landowners.	**Lead:** Conservation Manager **Enablers:** Catchment Manager; Protected Areas Manager	Year 3	Minutes of meetings and email correspondence; Forum established	
Objective 13.2: By 2023, CapeNature have obtained commitment from partners and landowners to address agricultural water use best practice and compliance within the Krom/Matjies/Driehoeks River systems.	Obtain commitment from relevant partners.	**Lead:** Conservation Manager **Enablers:** Catchment Manager; Conservation Services Manager	Year 4	Minutes of meetings and email correspondence; Partner funding committed; Partner directives issued	Agriculture best practice guidelines; Water legislation

STRATEGIES:	**Strategy 14: Enhance the protection and ecological functioning of the Cederberg core corridor through protected area consolidation and stewardship.**				
GOALS:	• **By 2029, two priority properties will have signed in perpetuity stewardship agreements and another two as biodiversity agreements or higher, in both the fynbos and succulent karoo vegetation mosaics.**				
THREATS:	• **Inappropriate agricultural development affecting corridor connectivity.**				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 14.1: By 2020, CapeNature have incorporated priority properties for stewardship into the revised Conservation Action Priority map.	Incorporate priority properties for stewardship into the Conservation Action Priority map.	**Lead:** Conservation Services Manager **Enablers:** Protected Area Expansion & Stewardship Manager; Conservation Planner; Conservation Manager; Protected Areas Manager	Year 1	Revised Conservation Action Priority map	Current WCPAES & Conservation Action Priority map
Objective 14.2: By 2028, CapeNature have secured stewardship agreements with eight or more priority properties and all properties of the Cederberg Complex have been declared under NEM: PAA.	Extend four stewardship nature reserves into perpetuity.	**Lead:** Conservation Services Manager **Enablers:** Protected Area Expansion & Stewardship Manager; Conservation Manager; Legal Services Manager; Protected Areas Manager	Year 9	Submission to the Minister	Stewardship operational procedures manual
	Secure four properties as stewardship sites.	**Lead:** Conservation Services Manager **Enablers:** Protected Area Expansion & Stewardship Manager; Conservation Manager; Legal Services Manager; Protected Areas Manager	Year 9	Submission to the Minister	Stewardship operational procedures manual
	Declare Cederberg Wilderness and Hexberg State Forest under NEM: PAA.	**Lead:** Legal Services Manager **Enablers:** Protected Areas Manager; Conservation Manager	Year 9	Submission to the Minister	Government Gazette Proclamation

STRATEGIES:	Strategy 15: Enhance and raise awareness of all ecological values within the Cederberg Complex and where appropriate its ZOI.				
GOALS:	• By 2029, the Cederberg Complex supports viable* recruiting populations and distribution ranges of all 5 priority indigenous fish species. • By 2029, the augmented Clanwilliam cedar tree recruitment rate is between 11-59% and the total number of adult* trees has increased to 20 000 individuals. • By 2029 all human disturbance to heritage features within the Cederberg Complex is limited, to maintain, or where feasible, improve condition. • By 2029, the Cederberg Complex environmental education, awareness and interpretation programme will promote all* ecological and human well-being values.				
THREATS:	• Lack of awareness of values.				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 15.1: By 2026, CapeNature have developed and implemented an interpretation (signage) plan to raise awareness of all ecological values within the Cederberg Complex, and where applicable in the Zone of Influence.	In conjunction with Communications Services Department, develop and implement an interpretation plan for the Cederberg Complex.	**Lead:** Conservation Manager **Enablers:** Community Conservation Manager; Communication Services Manager; Protected Areas Manager	Year 7	Interpretation plan for the Cederberg Complex; Signage captured into infrastructure register	CapeNature signage guideline and order form

STRATEGIES:	**Strategy 16: Through partnership, address socio-economic challenges of surrounding communities within the ZOI of the Cederberg Complex.**				
GOALS:	• **By 2029, the Cederberg Complex will support sustainable tourism-based livelihoods and in partnership with role players contribute to economic and social upliftment in and around the complex.**				
THREATS:	• **Lack of basic infrastructure to enable economic and social development within the greater Wupperthal community.** • **Lack of training opportunities for the surrounding communities.** • **Lack of ability among the youth to utilise available opportunities for social and personal growth.**				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 16.1: By 2022, CapeNature have facilitated the establishment, and have become an active member, of the Wupperthal Stakeholder Forum.	Initiate and become an active member of the Wupperthal Stakeholder Forum.	**Lead:** Community Conservation Manager **Enablers:** People and Conservation Senior Manager; Conservation Manager; Protected Areas Manager	Year 3	Minutes of meetings and email correspondence; Forum established	
Objective 16.2: By 2024, CapeNature have engaged with partners to identify and promote opportunities for economic development within the ZOI of the Cederberg Complex.	Facilitate meetings with relevant role players to promote opportunities for economic development within the ZOI of the Cederberg Complex.	**Lead:** Community Conservation Manager **Enablers:** People and Conservation Senior Manager; Protected Areas Manager	Year 5	Minutes of meetings and email correspondence; Partner action	Municipal IDP; People and Conservation Strategic Plan

STRATEGIES:	**Strategy 17: Support economic development through skills & capacity building and identifying sustainable work opportunities for surrounding communities within the Cederberg Complex and its ZOI.**				
GOALS:	• **By 2029, the Cederberg Complex will support sustainable tourism-based livelihoods and in partnership with role players contribute to economic and social upliftment in and around the complex.**				
THREATS:	• **Lack of training opportunities for the surrounding communities.** • **Lack of ability among the youth to utilise available opportunities for social and personal growth.**				
Objectives	**Actions**	**Responsibility**	**Time-frame**	**Measurable Indicators**	**Existing Procedures**
Objective 17.1: By 2021, CapeNature have collated recommendations from existing reports that support tourism livelihoods and economic development in the ZOI of the Cederberg Complex.	Source, collate and feed through recommendations from existing reports to partners and communities.	**Lead:** Community Conservation Manager **Enablers:** Conservation Manager; Protected Areas Manager	Year 2	Summary report	
Objective 17.2: By 2023, CapeNature have developed and implemented a policy to guide capacity building and contractor development within communities located in the ZOI of protected areas.	Develop and implement the approved policy.	**Lead:** People and Conservation Senior Manager **Enablers:** Conservation Manager; Protected Areas Manager	Year 3	Approved policy or guidelines	People and Conservation Strategic Plan
	Develop and implement a skills development plan for communities within the ZOI of the Cederberg Complex.	**Lead:** Community Conservation Manager **Enablers:** Conservation Manager; Protected Areas Manager	Year 4	Number of training events	People and Conservation Strategic Plan
Objective 17.3: By 2023, CapeNature have identified and prioritised viable economic development projects for implementation within the Cederberg Complex and its ZOI.	Implement existing and additional economic development opportunities as funding becomes available.	**Lead:** Community Conservation Manager **Enablers:** Marketing and Ecotourism Manager; Conservation Manager; Protected Areas Manager	Year 4	SMME register; MIS report	People and Conservation Strategic Plan

6 REFERENCES

Aldridge R.J., Theron J.N. & Gabbott S.E. 1994. The Soom Shale: a unique Ordovician fossil horizon in South Africa. *Geology Today* 10:218-221.

Andrag R.H. 1977. Studies in die Sederberge oor (i) Die status van die Clanwilliam seder (*Widdringtonia cedarbergensis*), (ii) Buitelugontspanning. Unpublished M.Sc Thesis. University of Stellenbosch, Stellenbosch.

Avenant N.L., Wilson B., Power R.J., Palmer G. & Child M.F. 2016. A conservation assessment of *Mystromys albicaudatus*. In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T, editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Bands D.P. 1978. Policy memorandum, Cederberg Catchment Area No. 1. Management Plan for the period 1979/80-1983/84. Unpublished. Department of Forestry, Stellenbosch.

Barnard B. 1996. Geologiese opnames-Matjiesrivier. Unpublished manuscript. University of Stellenbosch, Stellenbosch.

Barnard W.S. & Greeff R. 1993. Grys en grillig: 'n Verkenning van denudasievorme in die Sedeberge, K.P. SA Geograaf.

Birds in Reserve Project (BIRP). 2017. Birds in Reserves Project: a citizen science project of the Animal Demography Unit. URL: http://birp.adu.org.za/site_list.php?prov=WC. Accessed on 2017/10/09.

Birss C., Peel M., Power R.J. & Relton R. 2016. A conservation assessment of *Oreotragus oreotragus*. In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T, editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Birss C. 2017. Mammals. In: Turner A.A, editor. Western Cape Province State of Biodiversity Report 2017. CapeNature Scientific Services, Stellenbosch. ISBN: 978-0-621-45962-3.

Birss C., Cowell C., Hayward N., Peinke D., Hrabar H.H. & Kotze A. 2018. Biodiversity Management Plan for the Cape mountain zebra in South Africa. Jointly developed by CapeNature, South African National Parks, Eastern Cape Parks and Tourism Agency, National Zoological Gardens, Department of Environmental Affairs, Northern Cape Department of Environment and Nature Conservation, Eastern Cape Department of Economic Development, Environmental Affairs and Tourism and Free State Department of Economic, Small business, Tourism and Environmental Affairs. Version 1.0. Government Gazette No. 41498, Notice 31 of 2018. URL: http://www.gpwonline.co.za/.

Bond W.J. & Slingsby P. 1983. Seed dispersal by ants in shrublands of the Cape Province and its evolutionary implications. *South African Journal of Science* 79: 231-233.

Bond W.J. & Slingsby P. 1984. Collapse of an ant-plant mutualism: The Argentine ant (*Iridomyrmex humilis*) and myrmecochorous Proteaceae. *Ecology* 65: 1031-1037.

Bond W.J., Vlok J.H.J. & Viviers M. 1984. Variation in seedling recruitment of Cape Proteaceae after fire. *Journal of Ecology* 72: 209-221.

Bond W.J. & van Wilgen B.W. 1996. Fire and plants : Population and Community Biology Series 14. *Biological Conservation* 83: 231–232. DOI: 10.1016/S0006-3207(97)87174-1.

Botes A. 2006. Insect macroecological patterns along an altitudinal gradient: The Greater Cederberg Biodiversity Corridor. Unpublished PhD Thesis. University of Stellenbosch, Stellenbosch.

Botes A., McGeoch M.A., Robertson H.G., Van Niekerk A., Davids H.P. & Chown S.L. 2006. Ants, altitude and change in the northern Cape Floristic Region. *Journal of Biogeography* 33: 71-90.

Botes A., McGeoch M.A. & Chown S.L. 2007. Ground-dwelling beetle assemblages in the northern Cape Floristic Region: patterns, correlates, and implications. *Austral Ecology* 32: 210-224.

Bradshaw P. & Holness S. 2013. Fynbos World Heritage Site Assessments. Internal report compiled for comparative analysis of sites appropriate for the Extension Nomination of the Cape Floral Region. Unpublished. Timmins, Cape Town.

Branch B. 1998. Field guide to snakes and other reptiles of Southern Africa. Struik Publishers, Cape Town.

Broadley D.G. 1983. Fitzsimons' Snakes of Southern Africa. Delta books, Johannesburg.

CapeNature. 2015a. People and Conservation Strategic Plan, 2015-2020. Internal report. CapeNature, Cape Town.

CapeNature. 2015b. Western Cape Protected Area Expansion Strategy: 2015 – 2020. Internal report. CapeNature, Cape Town.

CapeNature. 2017a. The Western Cape Biodiversity Spatial Plan Handbook. Internal report. CapeNature, Cape Town.

CapeNature. 2017b. Biological Control Implementation Strategy. Internal report, CapeNature, Cape Town.

Cederberg Municipality. 2017. Cederberg Municipality Final Fourth Generation Integrated Development Plan (IDP) 2017-22. Cederberg Municipality, Clanwilliam. URL: http://cederbergmun.gov.za/final-4th-generation-idp-2017-2022.

Channing A., Measey G.J., De Villiers A.L., Turner A.A. & Tolley K.A. 2017. Taxonomy of the *Capensibufo rosei* group (Anura: Bufonidae) from South Africa. *Zootaxa* 47: 282-292.

Child M.F., Rowe-Rowe D., Birss C., Wilson B., Palmer G., Stuart C., Stuart M., West S. & Do Linh San E. 2016. A conservation assessment of *Poecilogale albinucha*.

In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T, editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Clayton C.H. 1954. Memorandum on the Cederberg Forest Reserve. Unpublished report. Department of Forestry, Cape Town.

Cleaver G., Brown L.R., Bredenkamp G.J., Smart M.C. & Rautenbach C.J. 2003. Assessment of environmental impacts of groundwater abstraction from Table Mountain Group (TMG) aquifers on ecosystems in the Kammanassie Nature Reserve and environs. Report number: 1115/1/03. Water Research Commission, South Africa. ISBN: 1-77005-034-5.

Colvin C., Riehmann K., Brown C., Le Maitre D., Mlisa A., Blake D., Aston T., Maherry A., Engelbrecht J., Pemberton C., Magoba R., Soltau L. & Prinsloo E. 2009. Ecological and environmental impacts of large-scale groundwater development in the Table Mountain Group (TMG) aquifer system. Report number 1327/1/08. Water Research Commission, South Africa. ISBN: 978-1-77005-796-8.

Conservation Coaches Network (CCNet). 2012. Harmonized Open Standards Presentations. URL: http://cmp-openstandards.org/guidance/basic-open-standards-presentations-ccnet-2012/. Accessed on 2018/05/12.

Conservation Measures Partnership (CMP). 2013. Open Standards for the Practice of Conservation. Version 3.0. URL: http://cmp-openstandards.org/wp-content/uploads/2014/03/CMP-OS-V3-0-Final.pdf. Accessed on 2018/05/12.

Cowan G.I. & Mpongoma N. 2011. Guidelines for the development of a management plan for a protected area in terms of the National Environmental Management: Protected Areas Act, 2003. Unpublished. Department of Environment Affairs, Pretoria.

Cowling R.M., Pressey R.L., Lombard A.T., Desmet P.G. & Ellis A.G. 1999. From representation to persistence: requirements for a sustainable reserve system in the species-rich Mediterranean-climate deserts of southern Africa. *Diversity and Distributions* 5: 51-71.

Cressey E.R., Measey G.J. & Tolley K.A. 2015. Fading out of view: the enigmatic decline of Rose's mountain toad *Capensibufo rosei*. *Oryx* 49: 521-528.

Dallas H.F. 2004. Seasonal variability of macroinvertebrate assemblages in two regions of South Africa: Implication for Aquatic Bioassessment. *African Journal of Aquatic Science* 29: 173-184.

Dallas H.F. 2007. River Health Programme: South African Scoring System (SASS) Data Interpretation guidelines. Institute of Natural Resources and Department of Water Affairs and Forestry, Pretoria.

Dallas H.F. & Day J.A. 2007. Natural variation in macroinvertebrate assemblages and the development of a biological banding system for interpreting bioassessment data – a preliminary evaluation using data from upland sites in the south-western Cape, South Africa. *Hydrobiologia* 575: 231-244.

De Beer C.H. (1998) Cederberg 4X4 Trail – Geological Description. Council for Geoscience, Cape Town.

De Moor F.C. & Day J.A. 2013. Aquatic biodiversity in the Mediterranean region of South Africa. *Hydrobiologia* 719: 237-268. DOI: 10.1007/s10750-013-1488-7.

De Visser S.N., Freymann B.P. & Schnyder H. 2008. Trophic interactions among invertebrates in termitaria in the African savanna: A stable isotope approach. *Ecological Entomology* 33: 758-764.

Deacon J. 1998. Some views on Rock paintings in the Cederberg. National Monuments Council, Cape Town. ISBN: 1-875012-25-7.

Deacon H.J. & Deacon J. 1999. Human Beginnings in South Africa. Uncovering the Secrets of the Stone Age. Rowman Altamira Publishers, United States of America.

Deacon C. & Samways M.J. (in press). Conservation planning for the extraordinary and Endangered Spesbona damselfly. *Journal of Insect Conservation*.

Deacon C. & Samways M.J. 2016a. Conservation of a phenomenon: rapid, reversible colour change in both sexes of one of the world's most threatened damselflies. *Journal of Insect Conservation* 20: 497-504.

Deacon C. & Samways M.J. 2016b. Larva of one of the world's rarest and most threatened damselflies: *Spesbona angusta* (Odonata: Platycnemididae). *Odonatologica* 45: 225-234.

Deacon J. 1993. Management Guidelines for rock art sites in two wilderness areas in the Western Cape. University of Stellenbosch, Stellenbosch.

Deacon J., Du Plessis R., Wiltshire N., Gates E, Mashek C & Bluff K. 2016. Matjiesrivier Nature Reserve: Cultural Heritage Management Plan 2018-2023. Eastern Cederberg Rock Art Group, Cape Town.

Department of Environmental Affairs and Tourism (DEAT). 2003. Nomination of the Cape Floral Region of South Africa for Inclusion on the World Heritage List. Department of Environmental Affairs and Tourism, Pretoria.

Department of Environmental Affairs and Tourism (DEAT). 2015. Nomination of the Extension of the Cape Floral Region Protected Areas: World Heritage Site. Department of Environmental Affairs and Tourism, Pretoria.

Department of Water Affairs and Forestry (DWAF). 2000. Hydrogeological Map Series of the Republic of South Africa: Cape Town 3317. Department of Water Affairs and Forestry, Pretoria.

Dickens C.W.S. & Graham P.M. 2002. The South African Scoring System (SASS) Version 5 rapid bioassessment method for rivers. *African Journal of Aquatic Science* 27: 1-10.

Dippenaar-Schoeman A.S., van den Berg A.M., Haddad C.R. & Lyle R. 2013. Spiders in South African agroecosystems: A review (Arachnida, Araneae). *Transactions of the Royal Society of South Africa* 68: 57-74.

Dippenaar-Schoeman A.S., Haddad C.R., Foord S.H., Lyle R., Lotz L.N. & Marais P. 2015. South African National Survey of Arachnida (SANSA): Review of current knowledge, constraints and future needs for documenting spider diversity (Arachnida: Araneae). *Transactions of the Royal Society of South Africa* 70: 245-275.

Foord S. & Dippenaar-Schoeman A.S. 2016. The effect of elevation and time on mountain spider diversity: A view of two aspects in the Cederberg mountains of South Africa. *Journal of Biogeography* 43: 2354-2365.

Frame J. & Killick M. 2004. Integrated water resource planning in the City of Cape Town. *Water SA* 30: 100-104.

Fraser M. 1997a. Cape Siskin. In: Harrison J.A., Allan D.G., Underhill L.G., Herremans M., Tree A.J., Parker V. & Brown C.J, editors. The atlas of Southern African birds Volume 2: Passerines. BirdLife South Africa, Johannesburg.

Fraser M. 1997b. Victorin's Warbler. In: Harrison J.A., Allan D.G., Underhill L.G., Herremans M., Tree A.J., Parker V. & Brown C.J, editors. The atlas of Southern African birds Volume 2: Passerines. BirdLife South Africa, Johannesburg.

Furse M.T. 2000. The application of RIVPACS procedures in headwater streams – an extensive and important natural resource. In: Wright J.F., Sutcluffe D.W. & Furse M.T, editors. Assessing the biological quality of fresh waters: RIVPACS and other techniques. Freshwater Biological Association, United Kingdom.

Gabbott S.E., Browning C., Theron J.N. & Whittle R.J. 2016. The late Ordovician Soom Shale Lagerstätte: an extraordinary post-glacial fossil and sedimentary record. *Journal of the Geological Society* 174: 1-9.

Goldblatt P. & Manning J. 2000. Cape Plants: A conspectus of the Cape flora of South Africa – Strelitzia 9. National Botanical Institute, Pretoria.

Gómez C. & Espadaler X. 1998. Myrmecochorous dispersal distances: A world survey. *Journal of Biogeography* 25: 573-580.

Gouws E.J., Malan D., Job N., Nieuwoudt H., Nel J., Dallas H. & Bellingan T. 2012. Freshwater Ecosystems. In: Turner A.A, editor. Western Cape State of Biodiversity Report 2012. CapeNature Scientific Services, Stellenbosch. ISBN: 978-0-621-41407-3.

Gouws E.J. & Gordon A. 2017. Freshwater Ecosystems. In: Turner A.A, editor. Western Cape Province State of Biodiversity Report 2017. CapeNature Scientific Services, Stellenbosch. ISBN: 978-0-621-45962-3.

Hanekom P. 2012. Diep Spore. SilverSedge Books, Gauteng.

Helme N., Holmes P. & Rebelo T. 2016. Chapter 5: Ecosystem Guidelines: Midland and Mountain Fynbos Ecosystems. In: Cadman M, editor. Ecosystems Guidelines for Environmental Assessment in the Western Cape - Edition 2. Fynbos Forum, Cape Town.

Hockey P.A.R., Dean W.R.J. & Ryan P.G, editors. 2005. Roberts' Birds of Southern Africa – Edition 7. John Voelcker Bird Book Fund, Cape Town.

Hockings M., Leverington F. & Cook C. 2015. Protected area management effectiveness. In: Worboys G.L., Lockwood M., Kothari A., Feary S. & Pulsford I, editors. Protected Area Governance and Management. ANU Press, Canberra.

Holmes P., Dorse C., Rebelo T., Helme N., Wood J., Palmer G. & Harrison J. 2016. Chapter 4: Planning for and managing risk, restoration, *ex situ* conservation and animals. In: Cadman M, editor. Ecosystems Guidelines for Environmental Assessment in the Western Cape - Edition 2. Fynbos Forum, Cape Town.

Hrabar H., Birss C., Peinke D., King S., Novellie P., Kerley G.I.H. & Child M.F. 2016. A conservation assessment of *Equus zebra zebra*. In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T, editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Hubbard C.S. 1937. Observations on the distribution and rate of growth of Clanwilliam cedar *Widdringtonia juniperoides* Endl. *South African Journal of Science* 33: 572-86.

Impson N.D., Bills I.R., Cambray J.A. & Le Roux A. 1999. The primary freshwater fishes of the Cape Floristic Region: conservation needs for a unique and highly threatened fauna. Internal scientific report. Western Cape Nature Conservation Board, Stellenbosch.

Impson N.D., Marriott M.R., Bills I.R. & Skelton P.H. 2007. Conservation biology and management of a critically endangered cyprinid, the Twee River redfin, *Barbus erubescens* (Teleostei: Cyprinidae), of the Cape Floristic Region, South Africa. *African Journal of Aquatic Science* 32: 27-33.

Impson N.D., van Wilgen B. & Weyl O.L.F. 2013. Coordinated approaches to rehabilitating a river ecosystem invaded by alien plants and fish. *South African Journal of Science* 109: 3-6.

Impson N.D., van der Walt R. & Jordaan M.S. 2017. Freshwater Fishes. In: Turner A.A, editor. Western Cape Province State of Biodiversity Report 2017. CapeNature Scientific Services, Stellenbosch. ISBN: 978-0-621-45962-3.

International Union for Conservation of Nature (IUCN). 2018. The IUCN Red List of Threatened species. URL: http://www.iucnredlist.org/details/10241/0.

Jacobs D., Cohen L., MacEwan K., Monadjem A., Richards L.R., Schoeman C., Sethusa T. & Taylor P.J. 2016. A conservation assessment of *Laephotis namibensis*. In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T, editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Jacobs L.E.O., Koopman R., Schutte-Vlok A. & Forsyth T. 2017. Plants and Vegetation. In: Turner A.A, editor. Western Cape Province State of Biodiversity Report 2017. CapeNature Scientific Services, Stellenbosch. ISBN: 978-0-621-45962-3.

Johnson S.D. 1992. Plant-animal relationships. In: Cowling R.M, editor. Fynbos Ecology: Nutrients, fire and diversity. Oxford University Press, Cape Town.

Johnson S.D. & Bond W.J. 1992. Convergent floral evolution in a guild of butterfly pollinated fynbos plants. In: Thanos C, editor. Proceedings of the 6th International Conference on Mediterranean Ecosystems. University of Athens, Athens.

Jordaan M.S., van der Walt J.A., Brink Z., Erasmus S. & Weyl O.L.F. 2017. Conservation implications of establishment success of the critically endangered Twee River redfin *Pseudobarbus erubescens* (Skelton 1974) in an artificial impoundment in South Africa. *Aquatic Conservation: Marine and Freshwater Ecosystems* 27: 886-889. DOI: 10.1002/aqc.2747.

King J.M. & Schael D.M. 2001. Assessing the ecological relevance of spatially nested geomorphological hierarchy for river management. Report number: 754/1/01. Water Research Commission, South Africa.

Kingsford R.T. & Biggs H.C. 2012. Strategic adaptive management guidelines for effective conservation of freshwater ecosystems in and around protected areas of the world. IUCN WCPA Freshwater Taskforce - Australian Wetlands and Rivers Centre, Sydney.

Kraaij T. & van Wilgen B.W. 2014. Drivers, ecology, and management of fire in fynbos. In: Allsopp N., Colville J.F. & Verboom A, editors. Fynbos: Ecology, Evolution, and Conservation of a Megadiverse Region. Oxford University Press, Cape Town.

Kruger F.J. & Lamb A.J. 1979. Conservation of the Kogelberg State Forest. Preliminary assessment of the effects of management from 1967 - 1978. Report number 79-02. Jonkershoek Forestry Research Station, Stellenbosch.

Kruger F.J. 1983. Die Hottentots Holland Natuurreservaat. Unpublished pamphlet 316. South African Forestry Research Institute, Pretoria.

Le Maitre D.C. & Midgley J.J. 1992. Plant reproductive ecology. In: Cowling R.M, editor. Fynbos Ecology: Nutrients, fire and diversity. Oxford University Press, Cape Town.

Lechmere-Oertel R.G. 1998. The environmental determinants of the Fynbos/Succulent Karoo boundary in the Matjiesrivier Nature Reserve, Western Cape. Unpublished M.Sc Thesis. University of Cape Town, Cape Town.

Lee A.T.K. & Barnard P. 2012. Endemic fynbos avifauna: comparative range declines as cause for concern. *Ornithological Observation* 3: 19-28.

Lee A.T.K. & Barnard P. 2016. Endemic birds of the Fynbos biome: a conservation assessment and impacts of climate change. *Bird Conservation International* 26: 52-68. DOI: 1011017/S0959270914000537.

Lee A.T.K., Wright D.R. & Reeves B. 2017. Habitat variables associated with encounters of Hottentot Buttonquail *Turnix hottentottus* during flush surveys across the Fynbos biome. *Ostrich* 89: 13-18. DOI: 10.2989/00306525.2017.1343209.

Leverington F. & Hockings M. 2004. Evaluating the effectiveness of protected area management: The challenge of change. In: Barber C.V., Miller K.R. & Boness M, editors. Securing protected areas in the face of global change: Issues and strategies. International Union for Conservation of Nature, Gland.

Leverington F., Hockings M., Pavese H., Costa K.L. & Courrau J. 2008. Management effectiveness evaluation in protected areas - a Global Study: Overview of approaches and methodologies. Supplementary report No.1. University of Queensland, TNC, WWF, IUCN-WCPA, Australia.

Lewis-Williams J.D. 1990. Discovering Southern African Rock Art. David Philip Publishers, Cape Town.

Lombard A.T. 2000. World Heritage Site Nomination: Plant and vertebrate distributions in relation to nominated World Heritage Sites in the Cape Floristic Region, South Africa. Unpublished report. Common Ground Consulting, Cape Town.

Low A.B. & Rebelo A.G, editors. 1996. Vegetation of Southern Africa, Lesotho and Swaziland: a companion to the vegetation map of South Africa, Lesotho and Swaziland. Department of Environmental Affairs & Tourism, Pretoria.

Luckhoff H.A. 1971. The Clanwilliam Cedar: It's Past History and Present Status. *The Mountain Club of South Africa Journal* 74: 33-39.

Maingard L.F. 1931. The Lost Tribes of the Cape. *South African Journal of Science* 28: 487-504.

Manders P.T. 1986. An assessment of the current status of the Clanwilliam cedar (*Widdringtonia cedarbergensis*) and the reasons for its decline. *South African Forestry Journal* 139: 48-53.

Manders P.T. 1987. A transition matrix model of the population dynamics of the Clanwilliam cedar (*Widdringtonia cedarbergensis*) in natural stands subject to fire. *Forest Ecology and Management* 20: 171-186.

Manning J. 2007. Field Guide to Fynbos. Struik Nature Publishers, Cape Town.

Manning J. & Goldblatt P, editors. 2012. Plants of the Greater Cape Floristic Region 1: the Core Cape flora – Strelitzia 29. South African National Biodiversity Institute, Pretoria.

Marnewick M.D., Retief E.F., Theron N.T., Wright D.R. & Anderson, T.A. 2015. Important Bird and Biodiversity Areas of South Africa. BirdLife South Africa, Johannesburg.

Mbanyana N. & Robertson H.G. 2008. Review of the ant genus *Nesomyrmex* (Hymenoptera: Formicidae: Myrmicinae) in southern Africa. *African Natural History* 4: 35-55.

McGeoch M.A. 2002. Insect conservation in South Africa: an overview. *African Entomology* 10: 1-10.

Mecenero S., Ball J.B., Edge D.A., Hamer M.L., Henning G.A., Krüger M., Pringle E.L., Terblanche R.F. & Williams M.C. 2013. Conservation assessment of the butterflies of South Africa, Lesotho and Swaziland: Red List and atlas. Animal Demography Unit, University of Cape Town, Johannesburg.

Midgley J.J. & Bond W.J. 1995. Relative attractiveness of seeds of myrmecochorous Australian and South African plants to ants, and the chemical basis of this attraction. *South African Journal of Science* 61: 230-232.

Milewski A. 1976. Feeding ecology and habitat of the Protea Seedeater. Unpublished PhD Thesis. University of Cape Town, Cape Town.

Milton S.J., Dean W.R.J. & Kerley G.I.H. 1992. Tierberg Karoo Research Centre: history, physical environment, flora and fauna. *Transactions of the Royal Society of Southern Africa* 48: 15-46.

Mucina L. & Rutherford M.C, editors. 2006. The vegetation of South Africa, Lesotho and Swaziland - Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Murgatroyd M., Underhill L.G., Rodrigues L. & Amar A. 2016. The influence of agricultural transformation on the breeding performance of a top predator: Verreaux's Eagles in contrasting land use areas. *Condor* 118: 238-252.

Nel J.L., Murray K.M., Maherry A.M., Peterson C.P., Roux D.J., Driver A., Hilll L., van Deventer H., Funke N., Swartz E.R., Smith-Adao L.B., Mbona N., Downsborough L. & Nienaber S. 2011a. Technical Report for the National Freshwater Ecosystem Priority Areas Project. Report number: 1801/2/11. Water Research Commission, Pretoria.

Nel J.L., Driver A., Strydom W., Maherry A., Petersen C., Hill L., Roux D.J., Nienaber S., van Deventer H., Swartz E. & Smith-Adao L.B. 2011b. Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources. Report number: TT 500/11. Water Research Commission, Pretoria.

Nel J.L. & Driver A. 2012. National Biodiversity Assessment 2011: Technical Report. Volume 2: Freshwater Component. Report number: CSIR/NRE/ECO.IR/2012/0022/A. Council for Scientific and Industrial Research, Stellenbosch.

Nieuwoudt O. 2015. My Cederberg Story. Published by Susan de la Bat. ISBN: 978-0-620-66095-2.

Okes N., Ponsonby D.W., Rowe-Rowe D., Avenant N.L. & Somers M.J. 2016. A conservation assessment of *Aonyx capensis*. In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T, editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Ollis D.J., Snaddon C.D., Job N. & Mbona N. 2013. Classification System for wetlands and aquatic ecosystems in South Africa. User manual: Inland Systems. SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria.

Palmer C., Palmer A., O'keeffe J. & Palmer R. 1994. Macroinvertebrate community structure and altitudinal changes in the upper reaches of a warm, temperate southern African river. *Freshwater Biology* 32: 337-347.

Palmer G., Birss C., Kerley G.I.H., Feely J., Peinke D. & Castley G. 2016. A conservation assessment of *Raphicerus melanotis*. In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T, editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Parkington J. & Dlamini N. 2015. First People Ancestors of the San. Creda Communications, Cape Town.

Parsons R.P. & Conrad J.E. 1998. Explanatory notes for the Aquifer Classification Map of South Africa. Report number: KV 116/98. Water Research Commission, Pretoria.

Penn N. 2005.The Forgotten Frontier: Colonist and Khoisan on the Cape's Northern Frontier in the 18th Century. Ohio University Press: Double Storey Books, Cape Town.

Penn-Clarke C.R. 2013. Facies analysis, palaeo-environmental successions and sequence stratigraphy of the Early to Middle Devonian Ceres Subgroup (Bokkeveld Group: Cape Supergroup), Western Cape Province, South Africa. Unpublished PhD Thesis. University of the Witwatersrand, Johannesburg.

Penn-Clarke C.R. 2016. The Geological and Palaeontological Heritage of the Matjiesrivier Nature Reserve. Unpublished report.

Penn-Clarke C.R., Rubidge B.S. & Jinnah Z.A. 2018. Two hundred years of palaeontological discovery: Review of research on the Early to Middle Devonian Bokkeveld Group (Cape Supergroup) of South Africa. *Journal of African Earth Sciences* 137:157-178.

Penrith M.L. 1986. Relationships in the tribe Adesmiini (Coleoptera: Tenebrionidae) and a revision of the genus *Stenodesia* Reitter. *Annals of the Transvaal Museum* 34: 275-302.

Penrith M.L & Endrödy-Younga S. 1994. Revision of the subtribe Cryptochilina (Coleoptera: Tenebrionidae: Cryptochilini). *Transvaal Museum Monograph* 9: 1-144.

Petráková L., Líznarová E., Pekár S., Haddad C.R., Sentenská L. & Symondson W.O. 2015. Discovery of a monophagous true predator, a specialist termite-eating spider (Araneae: Ammoxenidae). *Scientific Reports* 5: 2045-2322. DOI: 10.1038/srep14013.

Procheş S. & Cowling R.M. 2006. Insect diversity in Cape fynbos and neighbouring South African vegetation. *Global Ecology and Biogeography* 15: 445-451.

Procheş S. & Cowling R.M. 2007. Do insect distributions fit our biomes? *South African Journal of Science* 103: 258-261.

Procheş S., Forest F., Veldtman R., Chown S.L., Johnson S.D., Richardson D.M. & Savolainen V. 2009. Dissecting the plant-insect diversity relationship in the Cape. *Molecular and Phylogenetic Evolution* 51: 94-99.

Reid D.L., Rogers J. & Minter W.E.L. 2000. The Geology of the Western Cape. Field Excursion. University of Cape Town, Cape Town.

River Health Programme. 2006. State of Rivers Report: Olifants/Doring and Sandveld Rivers. Department of Water Affairs and Forestry, Pretoria. ISBN: 0-620-36021-6.

Samways M.J., Bazelet C.S. & Pryke J.S. 2010a. Provision of ecosystem services by large-scale corridors and ecological networks. *Biodiversity Conservation* 19: 2949-2962.

Samways M.J., Sharratt N.J. & Simaika J.P. 2010b. Effect of alien riparian vegetation and its removal on a highly endemic river macroinvertebrate community. *Biological Invasions* 13: 1305-1324.

Samways M.J., Hamer M. and Veldtman R. 2012. Development and future of insect conservation in South Africa. In: New T.R, editor. Insect Conservation: Past, Present and Prospects. Springer Publishing, Dordrecht.

Samways M.J. & Simaika J.P. 2016. Manual of Freshwater Assessment for South Africa: Dragonfly Biotic Index. South African National Biodiversity Institute, Pretoria. ISBN: 978-1-928224-05-1.

Scholtz C. H. & Holm E. 1985. Insects of southern Africa. University of Pretoria Press, Pretoria.

Shelton J.M., Weyl O.L.F., Chakona A., Ellender B.R., Esler K.J., Impson N.D., Jordaan M.S., Marr S.M., Ngobela T., Paxton B.R., van der Walt J.A. & Dallas H.F. 2017. Vulnerability of Cape Fold Ecoregion freshwater fishes to climate change and other human impacts. *Aquatic Conservation: Marine and Freshwater Ecosystems* 28: 68-77. DOI: 10.1002/aqc.2849.

Siegfried W.R. & Crowe T.M. 1983. Distribution and species diversity of birds and plants in Fynbos vegetation of Mediterranean climate zones, South Africa. In: Kruger F.J., Mitchell D.T. & Jarvis J.U.M, editors. Mediterranean-type ecosystems: The role of nutrients. Springer-Verlag, Berlin Heidelberg New York Tokyo Publishing. ISBN: 978-3-642-78881-9.

Skelton P.H. 2001. A complete guide to the freshwater fishes of Southern Africa. Struik Publishers, Cape Town.

Skelton P.H., Swartz E.R. & Vreven E.J. 2018. The identity of *Barbus capensis* Smith, 1841 and the generic status of southern African tetraploid cyprinids (Teleostei, Cyprinidae). *European Journal of Taxonomy* 410: 1-29.

Smith C.A. 1955. Early 19th Century records of the Clanwilliam cedar (*Widdringtonia juniperoides* Endl.). *Journal of the South African Forestry Association* 25: 58-65.

Snijman D.A, editor. 2013. Plants of the Greater Cape Floristic Region 2: the extra Cape flora – Strelitzia 30. South African National Biodiversity Institute, Pretoria.

Southey D. 2009. Wildfires in the Cape Floristic Region: Exploring vegetation and weather as drivers of fire frequency. Unpublished M.Sc Thesis. University of Cape Town, Cape Town.

South African Bird Atlas Project (SABAP2). 2017. URL: http://sabap2.adu.org.za/species_list.php#menu_left. Accessed on 2017/10/09.

South African National Biodiversity Institute (SANBI). 2018. Plant Redlist Status: Red List of South African Plants version 2017.1. URL: http://redlist.sanbi.org/. Accessed on 2018/08/15.

South African National Biodiversity Institute (SANBI) & Department of Environmental Affairs & Tourism (DEAT). 2010. National Protected Area Expansion Strategy of South Africa 2008: Priorities for expanding the protected area network for ecological sustainability and climate change adaptation. South African National Biodiversity Institute and National Department of Environmental Affairs and Tourism, Pretoria.

Sugden J.M. & Meadows M.E. 1990. The History of the Clanwilliam Cedar (*Widdringtonia cedarbergensis*): Evidence from Pollen Analysis. *South African Forestry Journal* 153: 64-71.

Swanepoel L.H., Balme G., Williams S., Power R.J., Snyman A., Gaigher I., Senekal C., Martins Q. & Child M.F. 2016. A conservation assessment of *Panthera pardus*. In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T, editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Taylor H.C. 1996. Cederberg Vegetation and Flora - Strelitzia 3. South African National Biodiversity Institute, Pretoria.

Taylor M.R., Peacock F. & Wanless R.M. 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.

Taylor A., Cowell C., Drouilly M., Schulze E., Avenant N., Birss C. & Child M.F. 2016. A conservation assessment of *Pelea capreolus*. In: Child M.F., Roxburgh L., Do Linh San E., Raimondo D. & Davies-Mostert H.T, editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Tolley K.A., De Villiers A.L., Cherry M.I. & Measey G.J. 2010. Isolation and high genetic diversity in dwarf mountain toads (*Capensibufo*) from South Africa. *Biological Journal of the Linnaean Society* 00: 822-834.

Truswell J.F. 1970. An introduction to the historical geology of South Africa. Purnell, Cape Town.

Tweddle D., Bills R., Swartz E., Coetzer W., Da Costa L., Engelbrecht J., Cambray J., Marshall B., Impson D., Skelton P.H., Darwall W.R.T. & Smith K.S. 2009. The status and distribution of freshwater fishes. In: Darwall W.R.T., Smith K.G., Tweddle D. & Skelton P, editors. The status and distribution of freshwater biodiversity in Southern Africa. IUCN, Gland and South African Institute for Aquatic Biodiversity, Grahamstown.

Van den Berg A. & Dippenaar-Schoeman A. 1991. Ground-living spiders from an area where the harvester termite *Hodotermes mossambicus* occurs in South Africa. *Phytophylactica* 23: 247-253.

Van der Walt J.A, Weyl O.L.F., Woodford D.A. & Radloff F.G.T. 2016. Spatial extent and consequences of black bass (*Micropterus*) invasion in a Cape Floristic Region river basin. *Aquatic Conservation Marine and Freshwater Systems* 26: 736-748.

Van Wilgen B.W. 1982. Some effects of post-fire age on the above ground biomass of fynbos (macchia) vegetation in South Africa. *Journal of Ecology* 70: 217-225.

Van Wilgen B.W., Bond W.J. & Richardson D.M. 1992. Ecosystem management. In: Cowling R.M, editor. Fynbos Ecology: Nutrients, fire and diversity. Oxford University Press, Cape Town.

Van Wilgen B.W. & Forsyth G.G. 2008. The historical effects and future management of fire regimes in the Fynbos Protected Areas of the Western Cape Province. Report number: CSIR/NRE/ECO/ER/2008/0078/C. Council for Scientific and Industrial Research, Stellenbosch.

Van Wilgen B.W., Moran V.C. & Hoffmann J.H. 2013. Some perspectives on the risks and benefits of biological control of invasive alien plants in the management of natural ecosystems. *Environmental Management* 52: 531-540.

Veldtman A. 2012. Arthropods. In: Turner A.A, editor. Western Cape State of Biodiversity Report 2012. CapeNature Scientific Services, Stellenbosch. ISBN: 978-0-621-41407-3.

Veldtman A., Dippenaar-Schoeman A.S., Samways M.J., Veldtman R. & Du Plessis D. 2017. Arthropods. In: Turner A.A, editor. Western Cape Province State of Biodiversity Report 2017. CapeNature Scientific Services, Stellenbosch. ISBN: 978-0-621-45962-3.

Viviers M. 1983. Practical training in Mountain Catchment Conservation Research in the Western Cape (Fire Season). Unpublished report. Saasveld College, George.

Vlok J.H.J. & Yeaton R.I. 1999. The effect of overstorey proteas on plant species richness in South African mountain fynbos. *Diversity and Distributions* 6: 233-242.

Vlok J.H.J. & Yeaton R.I. 2000. Competitive interactions between overstorey proteas and sprouting understorey species in South African mountain fynbos. *Diversity and Distributions* 6: 273-281.

Wes-Kaapse Natuurbewaring (WKNB). 1997. Matjiesrivier Natuurreservaat Bestuursplan. Unpublished. Wes-Kaapse Natuurbewaring, Kaapstad.

West Coast District Municipality (WCDM). 2017. Integrated Development Plan 2017-21. West Coast District Municipality, Moorreesburg.

White J.D.M., Jack S.L., Hoffman M.T., Puttick J., Bonora D., Visser V. & February E.C. 2016. Collapse of an iconic conifer: long-term changes in the demography of *Widdringtonia cedarbergensis* using repeat photography. *BioMed Central Ecology 1*6(53): 1-11.

Winterbottom J.M. 1968. Remarks on the avifauna of the macchia of the southern Cape Province. *Revue de Zoologie et de Botanique Africaines* 77: 221-235.

World Congress. 2016. Contract Management Education, Engagement and Excellence. Orlando, Florida.

7 APPENDICES

7.1 STAKEHOLDER ENGAGEMENT REPORT FOR THE CEDERBERG COMPLEX

CEDERBERG COMPLEX AND WORLD HERITAGE SITE

Western Cape, South Africa

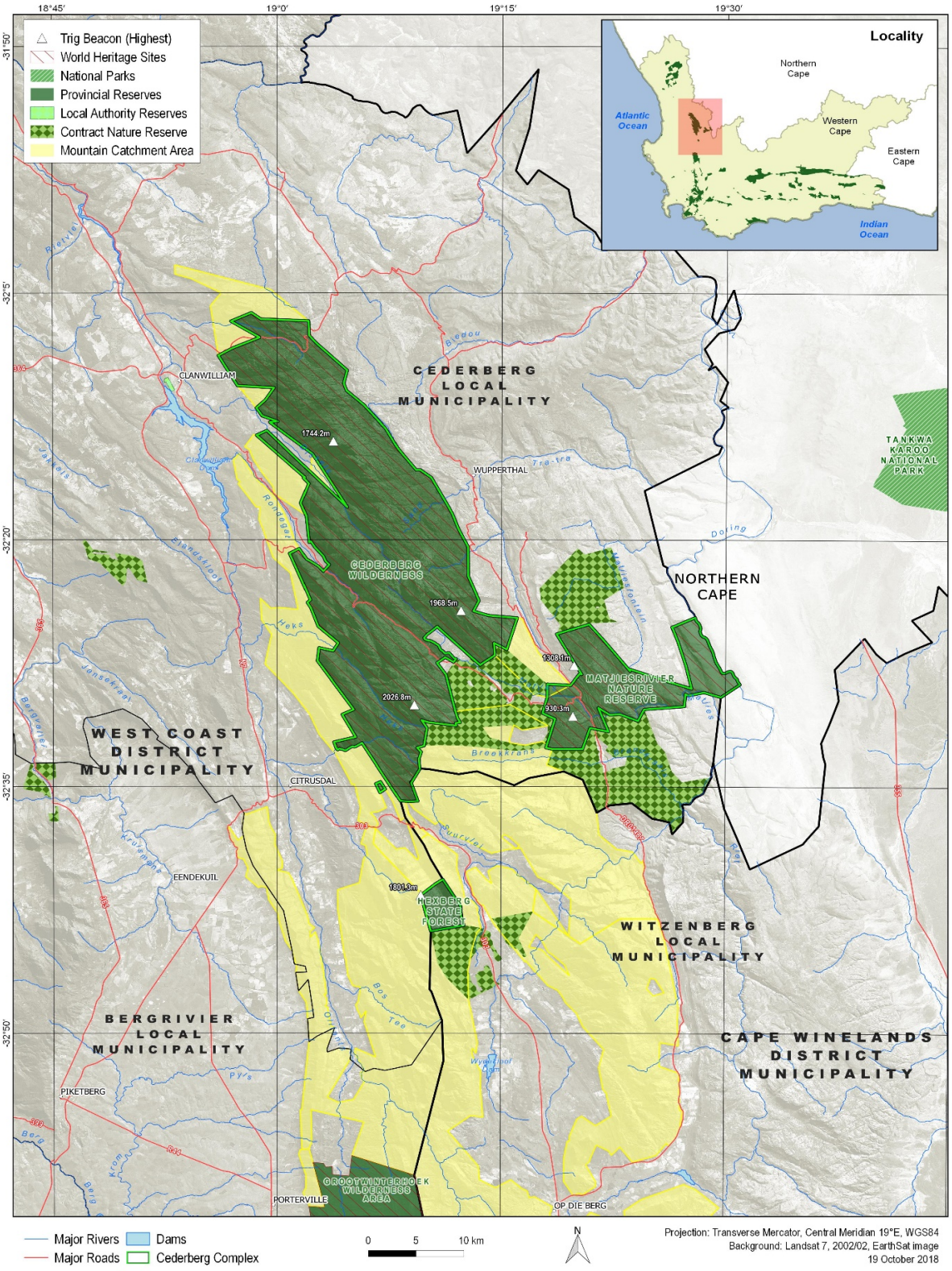
STAKEHOLDER ENGAGEMENT PROCESS REPORT

COMPILED BY FOOTPRINT ENVIRONMENTAL SERVICES

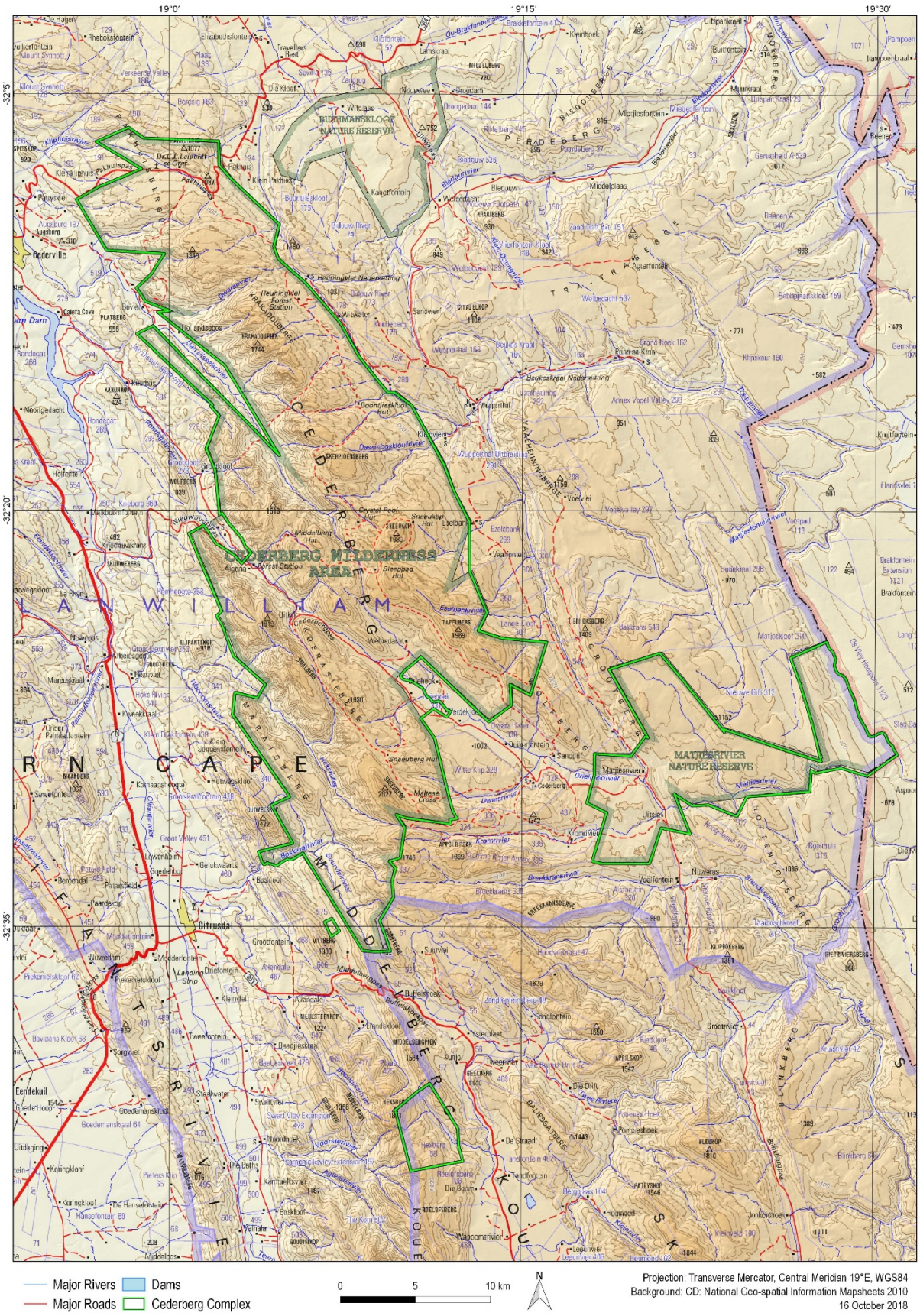
DATE: JANUARY 2019

7.2 MAPS OF THE CEDERBERG COMPLEX

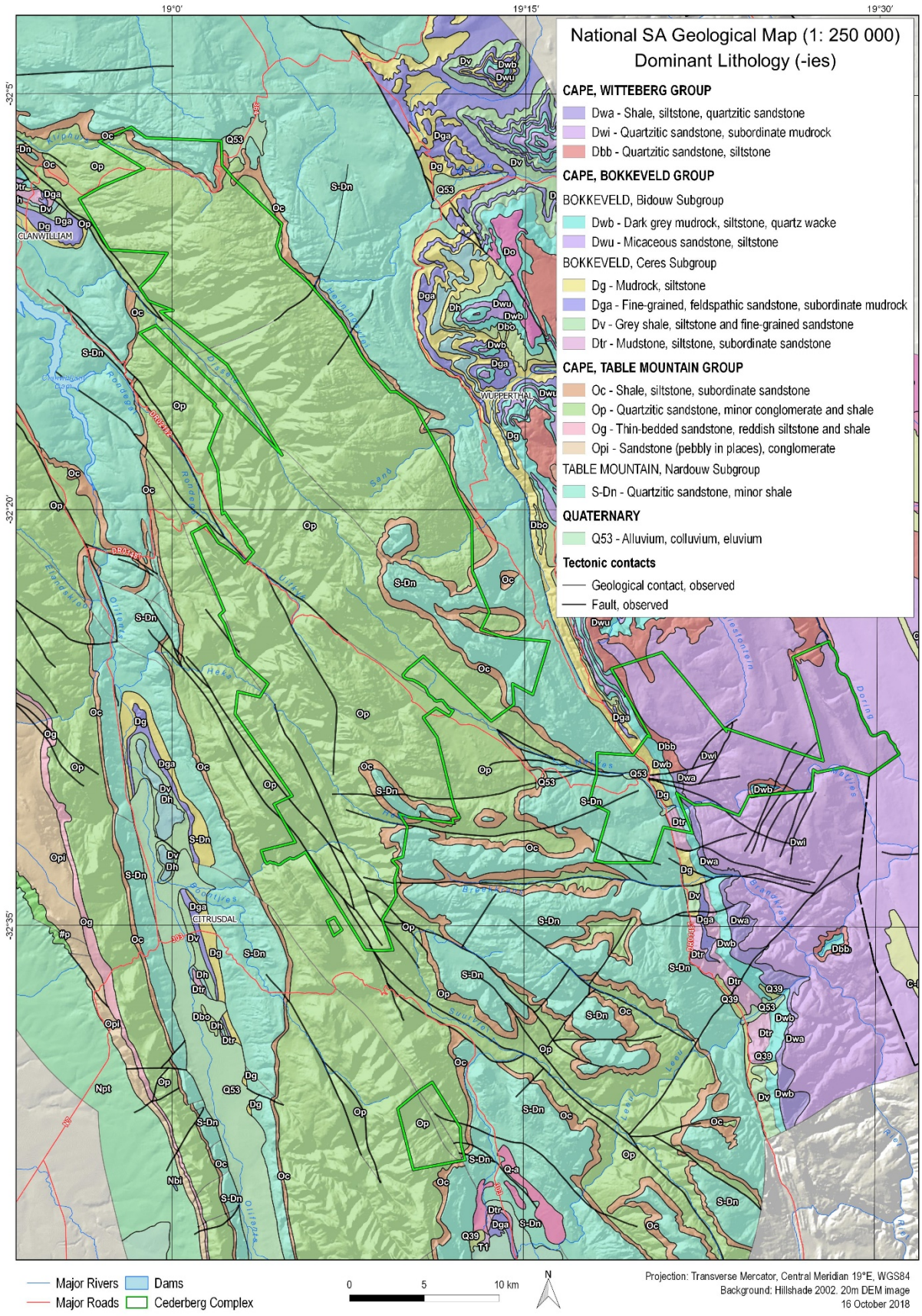
Map 1: Location and extent of Cederberg Complex.



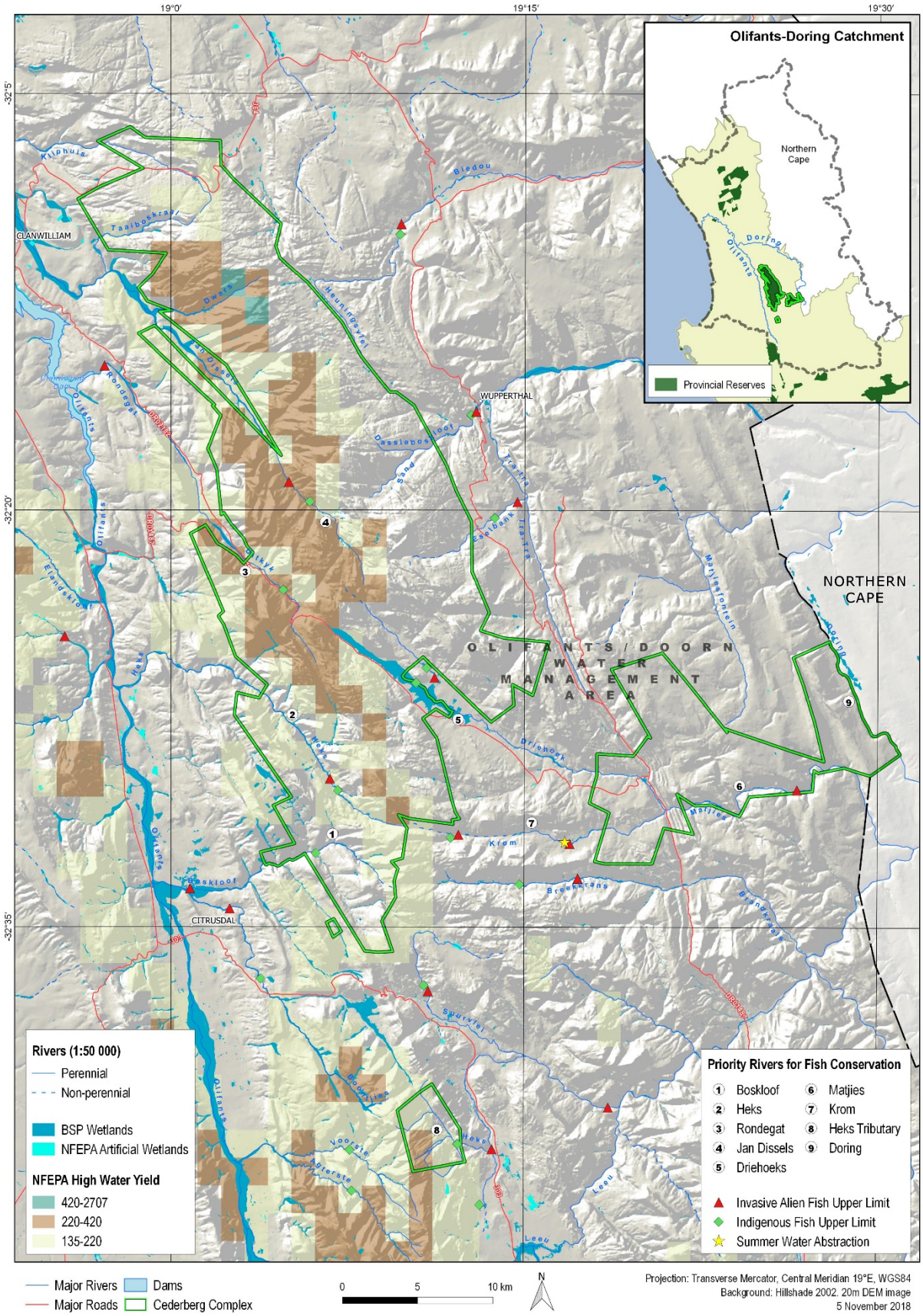
Map 2: Topography of Cederberg Complex.



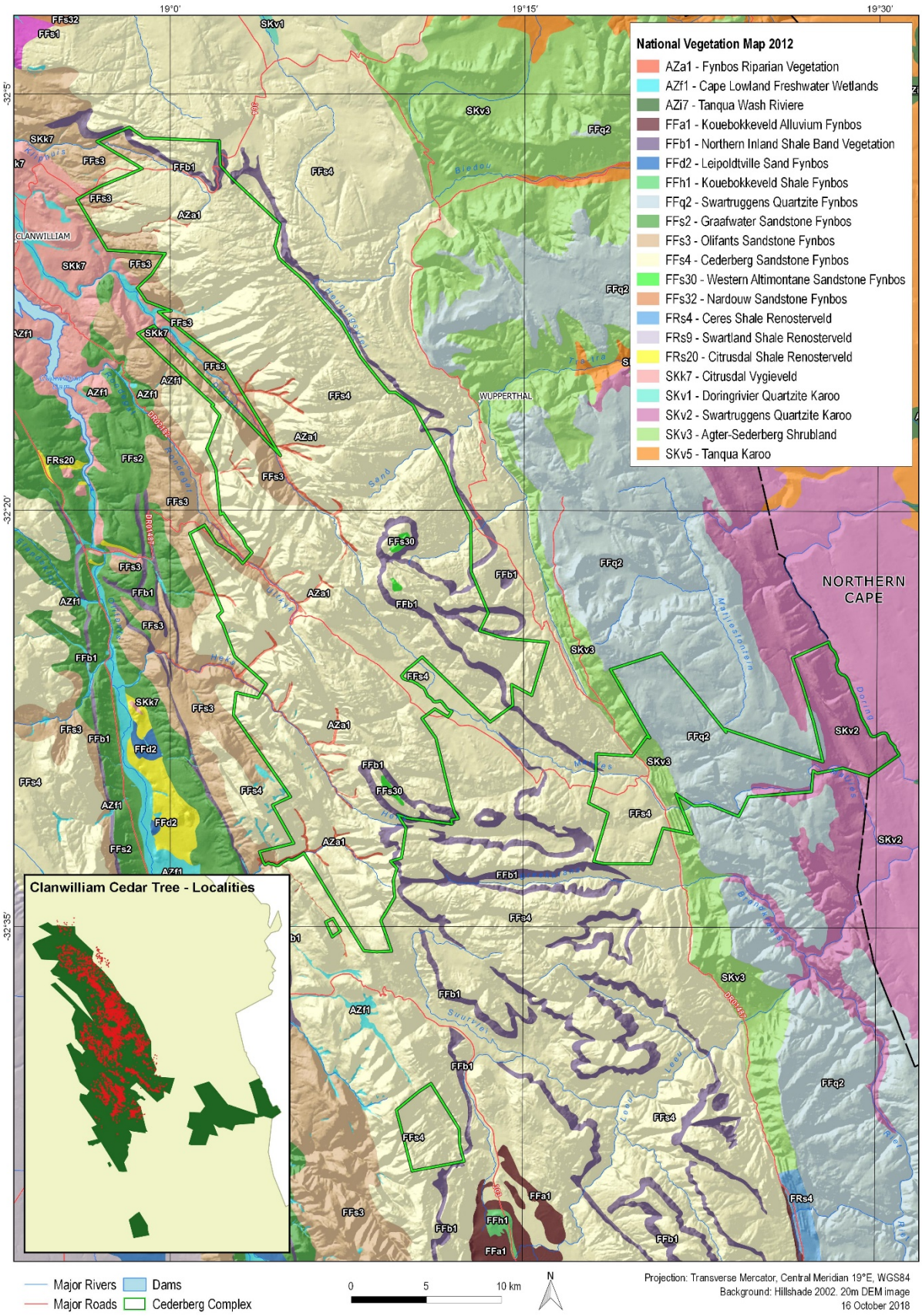
Map 3: Geology of Cederberg Complex.



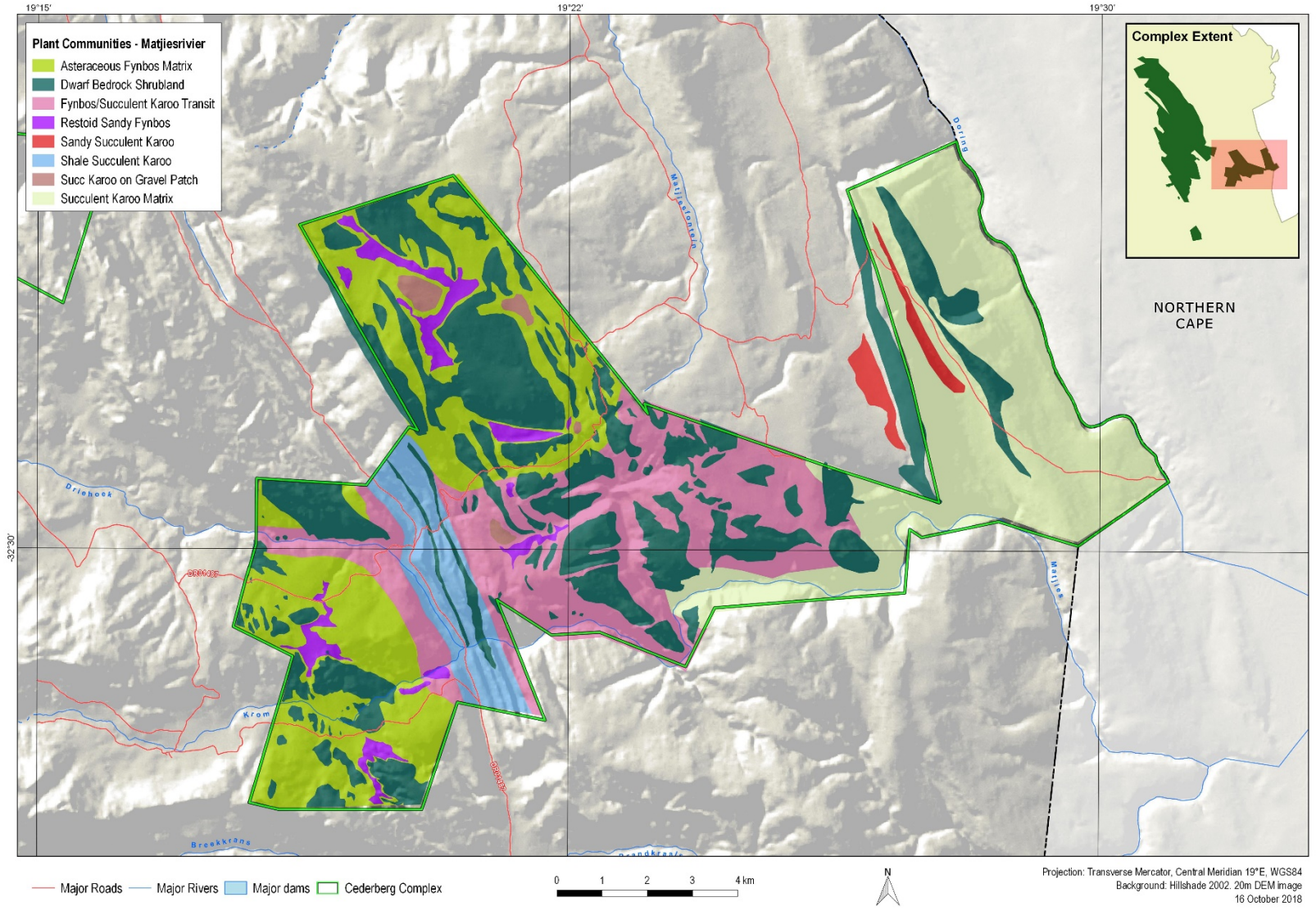
Map 4: Aquatic systems of Cederberg Complex.



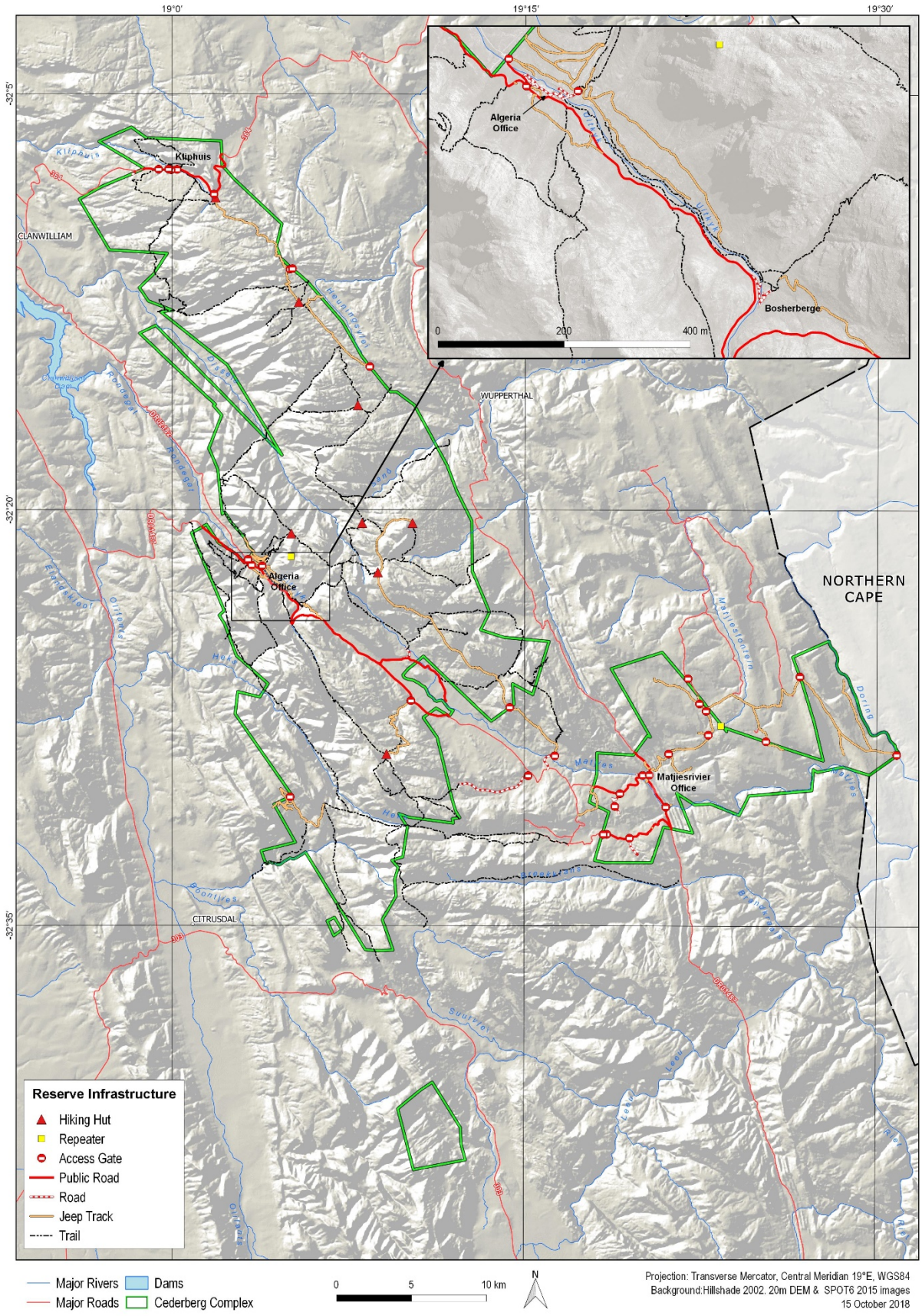
Map 5: Vegetation of Cederberg Complex.



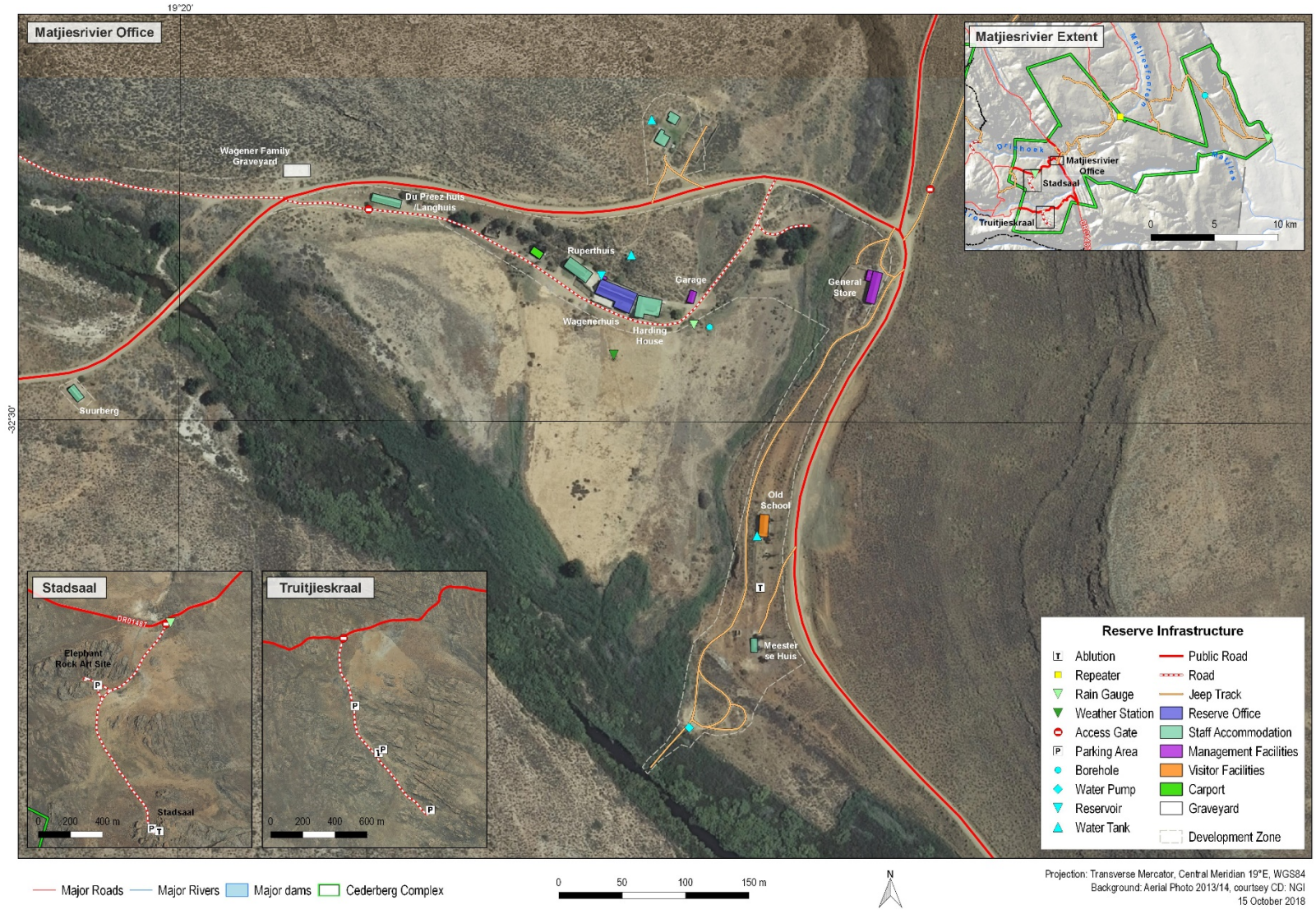
Map 6: Plant communities of Matjiesrivier Nature Reserve.



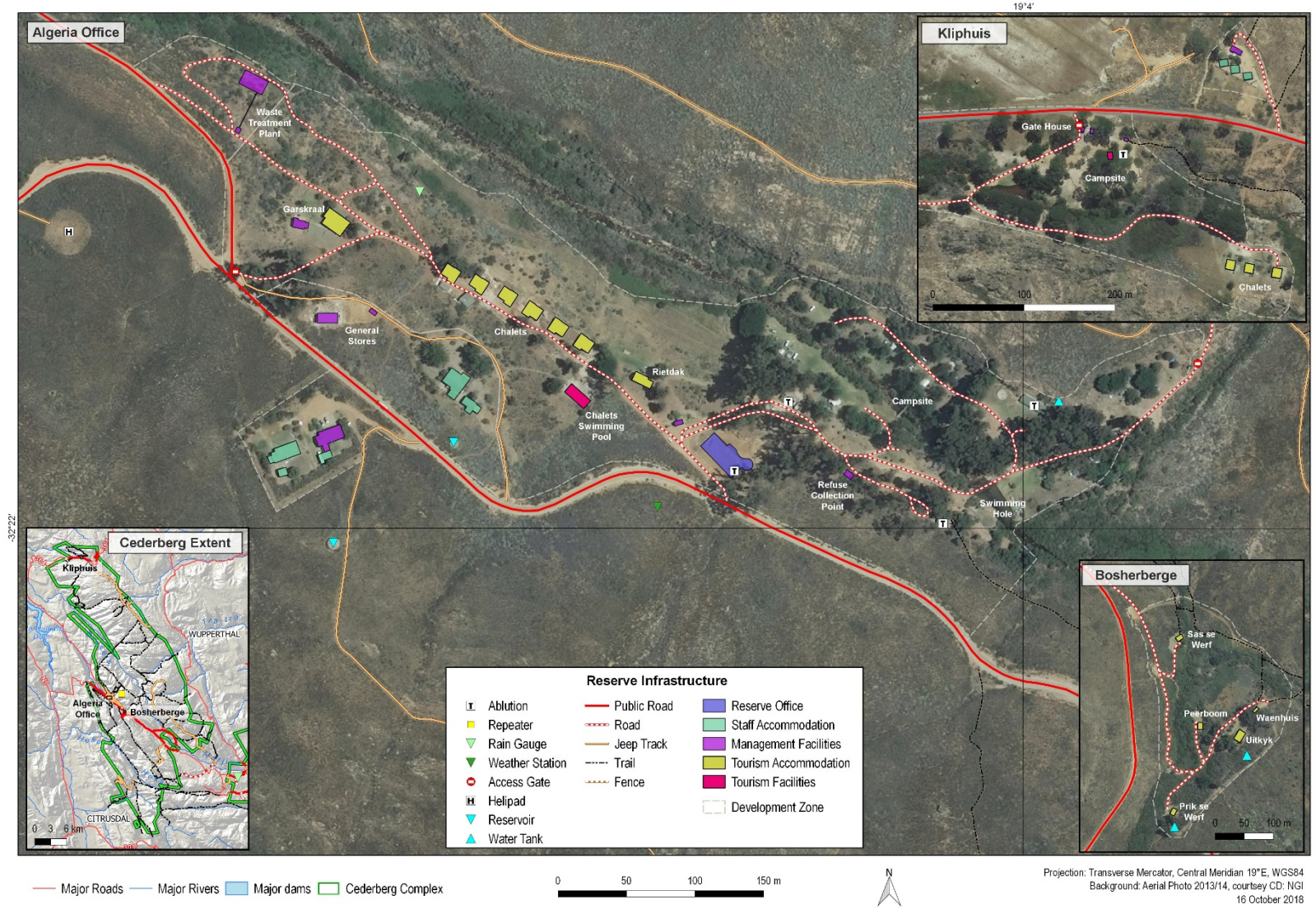
Map 7: Infrastructure on Cederberg Complex.



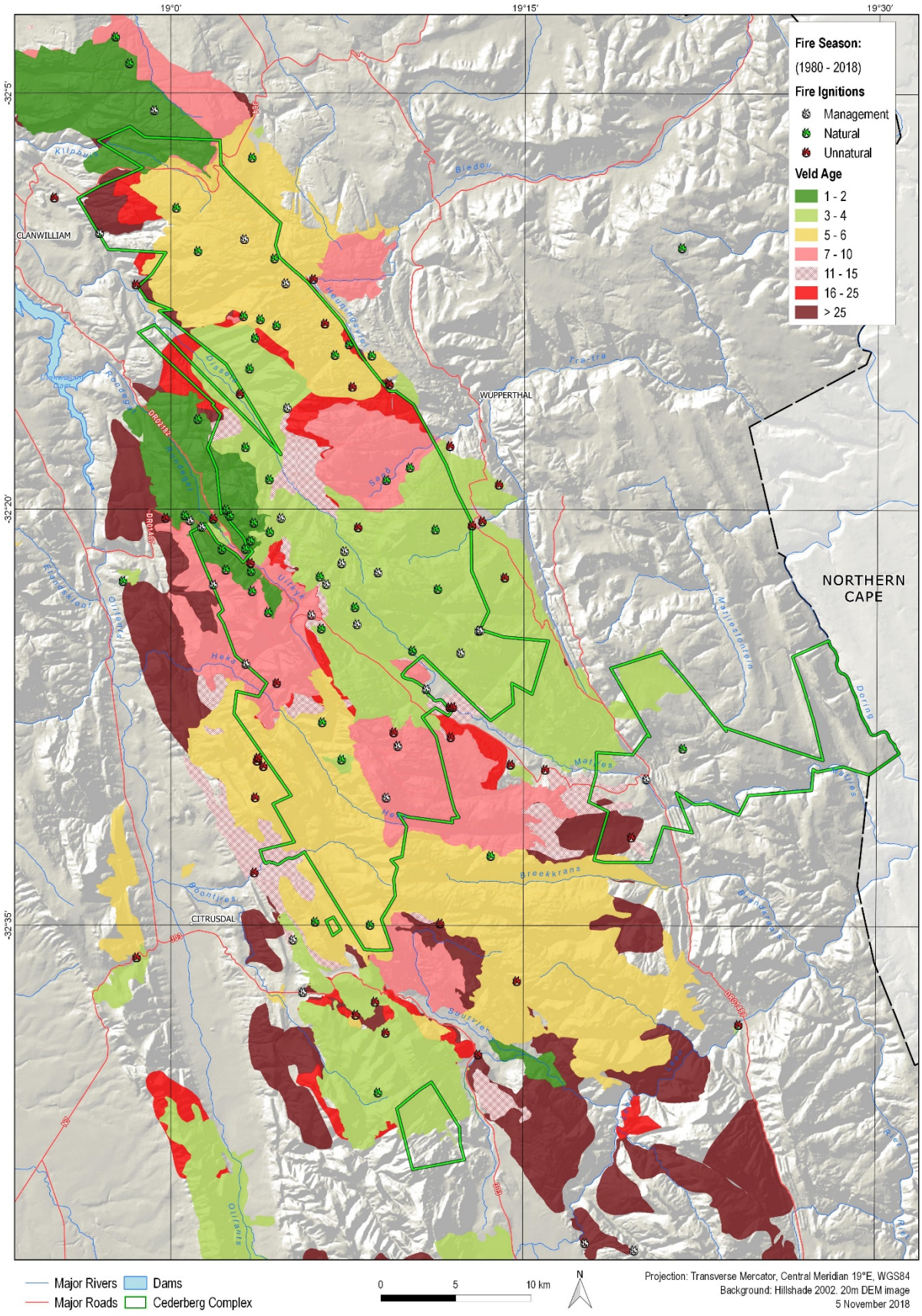
Map 7a: Infrastructure on Matjiesrivier Nature Reserve.



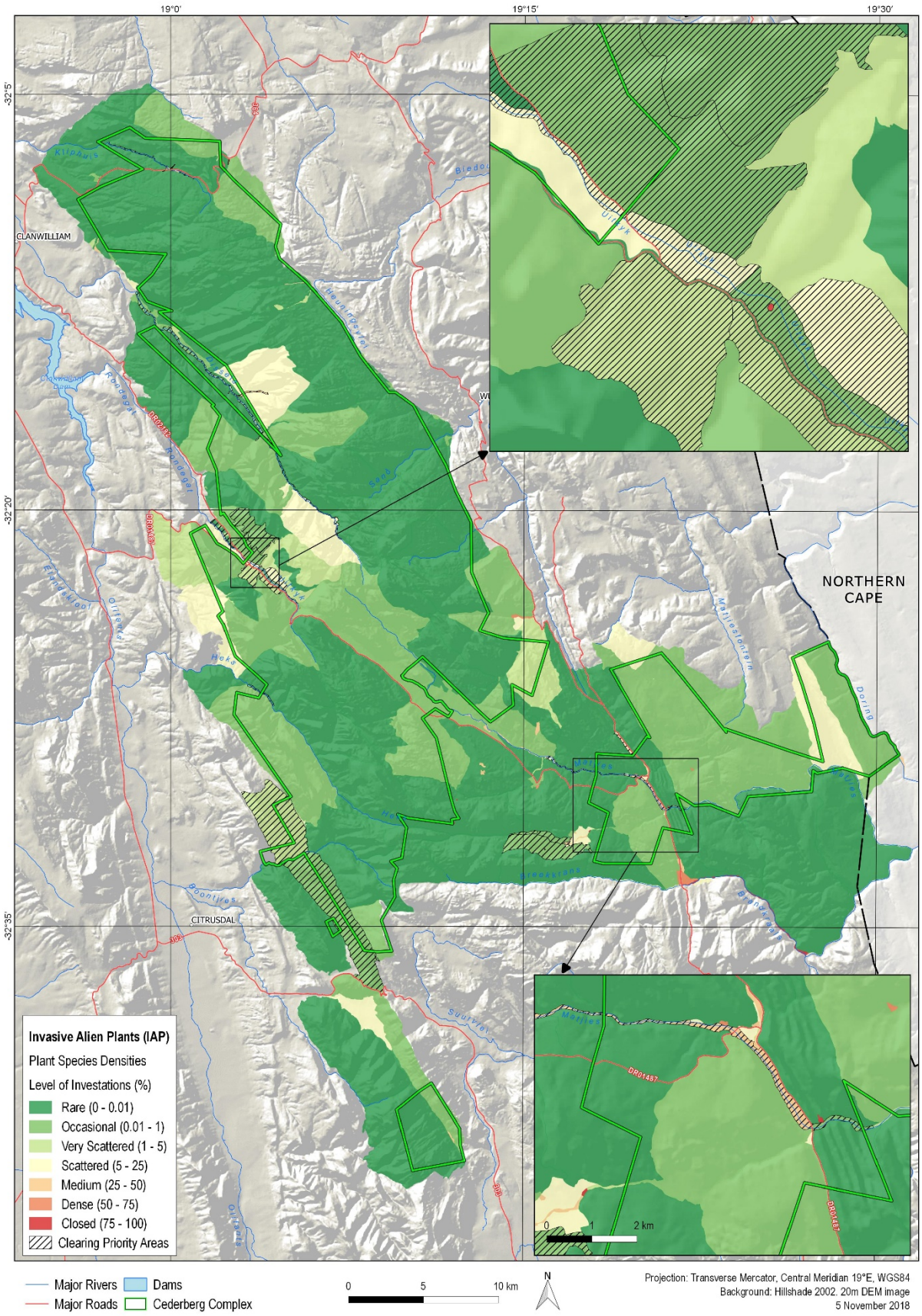
Map 7b: Infrastructure on Cederberg Wilderness.



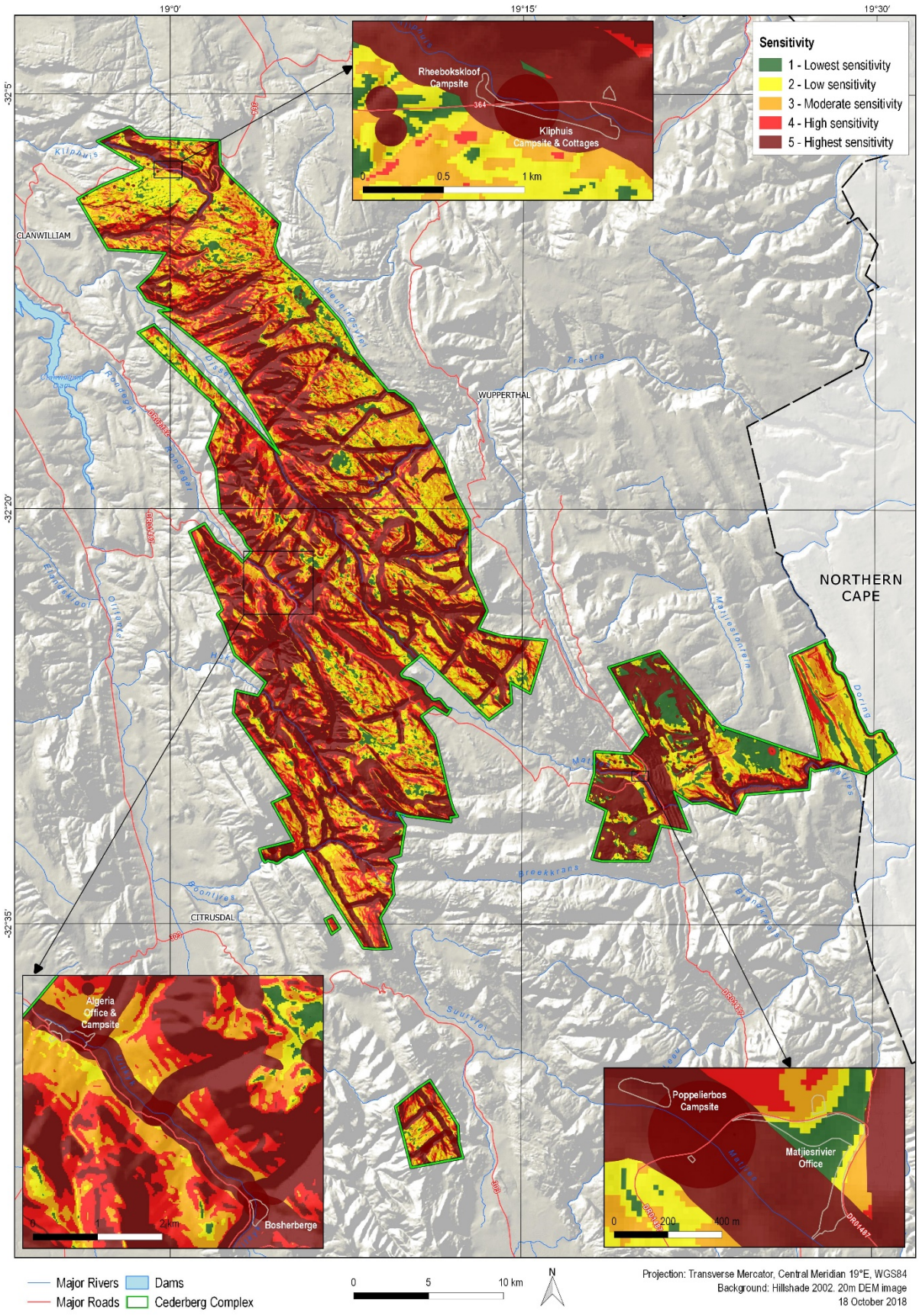
Map 8: Fire regime of Cederberg Complex.



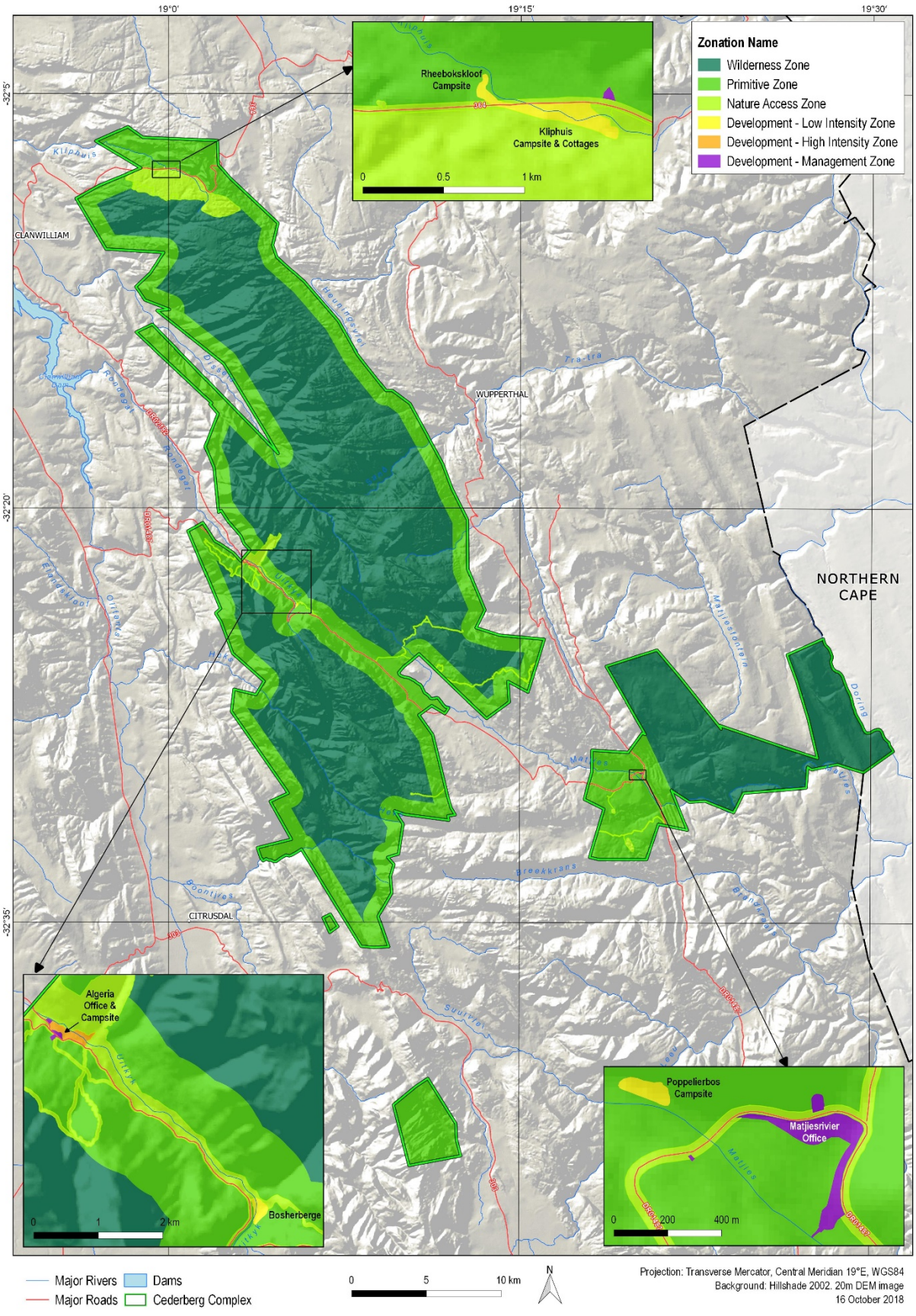
Map 9: Invasive vegetation and management compartments of Cederberg Complex.



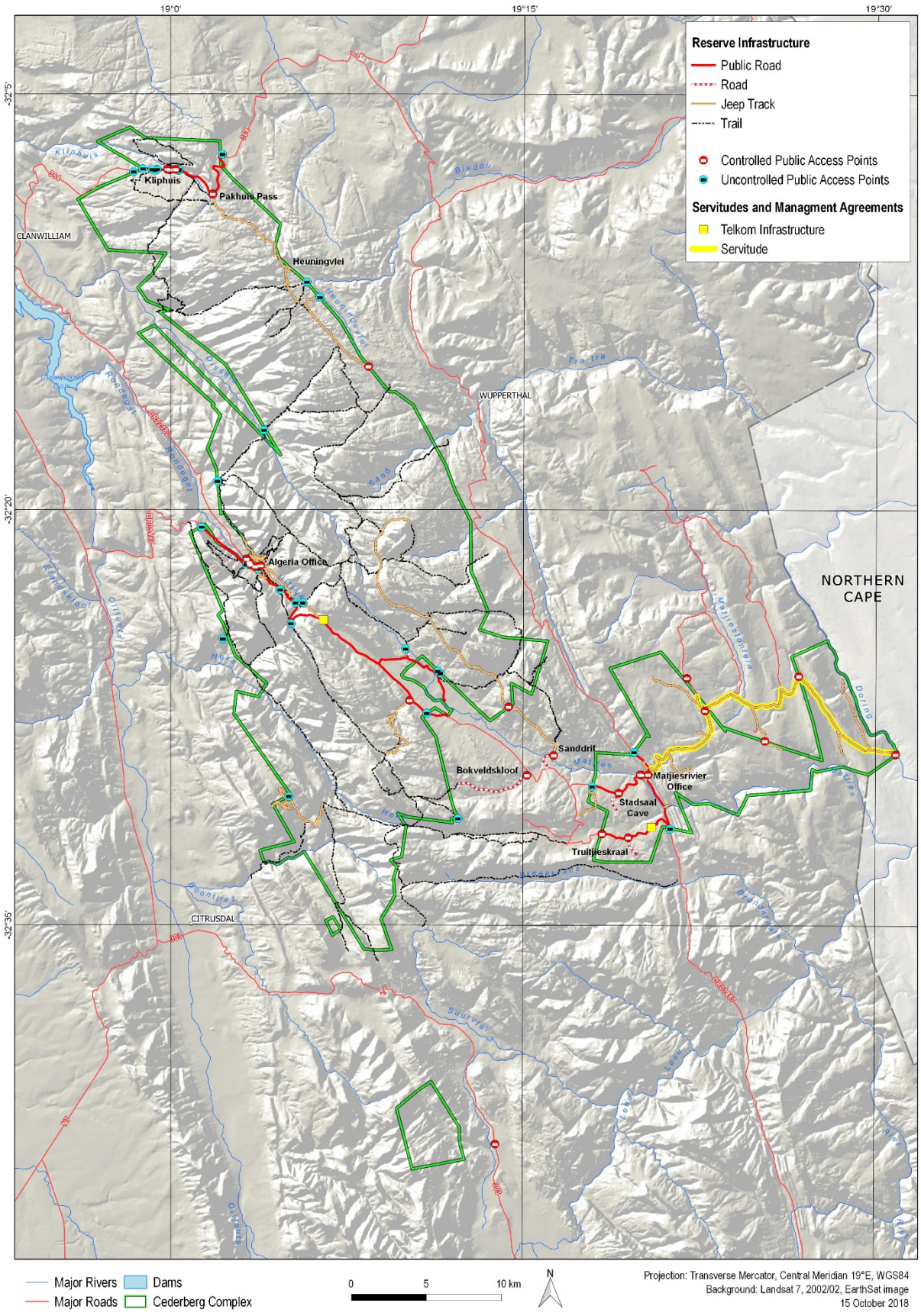
Map 10: Sensitivity of Cederberg Complex.



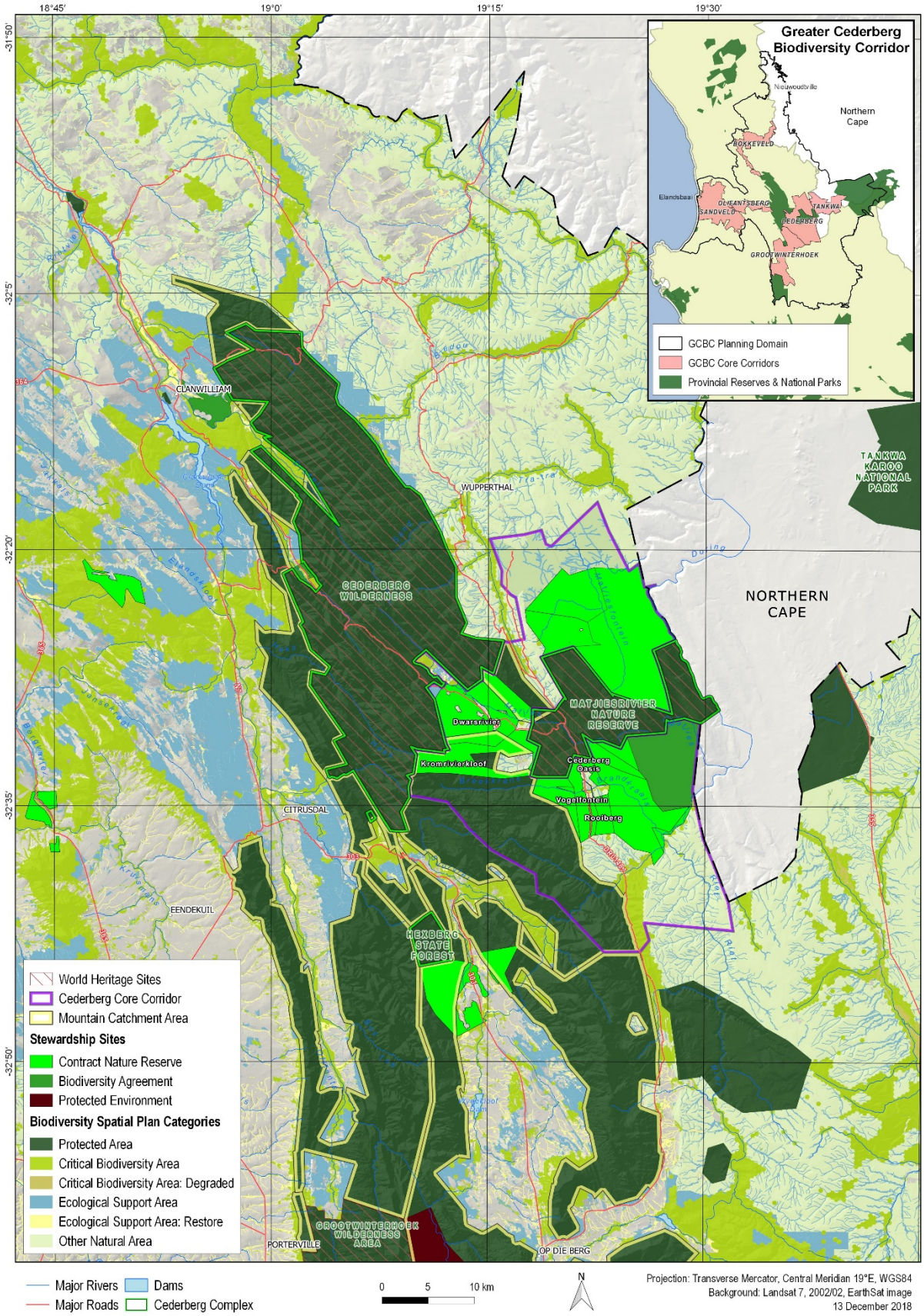
Map 11: Zonation of Cederberg Complex.



Map 12: Access and servitudes on Cederberg Complex.



Map 13: Expansion of Cederberg Complex.



Map 14: Zone of Influence around Cederberg Complex.