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ECOLOGY & BIODIVERSITY

ZANDBERG FONTEIN SAND MINE NEAR ROBERTSON, WESTERN CAPE PROVINCE

BOTANICAL STUDY AND ASSESSMENT

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PROPOSED EXPANSION OF THE SAND MINE AREA ON PORTION4 OF THE FARM ZANDBERG FONTEIN 97, SOUTH OF ROBERTSON, WESTERN CAPE PROVINCE

Report Title: Botanical Study and Assessment

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I. DECLARATION OF CONSULTANTS INDEPENDENCE

The consultants hereby declare that they:

- act/ed as the independent specialists in this application;
- regard the information contained in this report as it relates to specialist input/study to be true and correct;
- do not, and will not, have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- do not, and will not, have any vested interest in the proceedings of the proposed activities;
- have disclosed, to the applicant, EAP, and competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan, or document required in terms of the NEMA Environmental Impact Assessment Regulations 2014, and any specific environmental management Act;
- are fully aware of and meet the responsibilities in terms of the NEMA Environmental Impact Assessment Regulations 2014 (specifically in terms of regulation 13 of GN No. R. 326) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have provided the competent authority with access to all necessary information at their disposal regarding the application, whether such information is favourable to the applicant or not; and
- are aware that a false declaration is an offense in terms of regulation 48 of GN No. R. 326.

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December 2021

II. REQUIREMENTS REGARDING A SPECIALIST ASSESSMENT

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Sections in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page I, II and Appendix 2 & 3
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page I, II
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1 (1.4, 1.5)
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2 (2.1, 2.2)
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development, and levels of acceptable change;	Section 6
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 2.3 and 2.8
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 5.1
g) an identification of any areas to be avoided, including buffers;	Section 5.1
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5.1
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.8
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Section 5 and 6
k) any mitigation measures for inclusion in the EMPr;	Section 6 and 7
l) any conditions for inclusion in the environmental authorisation;	Section 6 and 7
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 6 and 7
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and	Section 8

mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q) any other information requested by the competent authority.	N/A
2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

III. LIST OF ABBREVIATIONS:

CARA: Conservation of Agricultural Resources Act 43 of 1983
CBA: Critical Biodiversity Area
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora
CR: Critically Endangered (threat status)
DAFF: Department of Agriculture, Forestry, and Fisheries
DEA: Department of Environmental Affairs
DEADP:WC: Department of Environmental Affairs and Development Planning: Western Cape Province.
WCNCO: Western Cape Nature Conservation Ordinance (No. 19 of 1974)
WCBB: Draft Western Cape Biodiversity Bill, 2019 (No. 8094 of 2019)
DDD: Data Deficient – Insufficient Information (threat status)
DDT: Data Deficient – Taxonomically Problematic (threat status)
DEA: Department of Environmental Affairs
EA: Environmental Authorisation
ECO: Environmental Control Officer
EIA: Environmental Impact Assessment: EIA regulations promulgated under section 24(5) of NEMA and published in Government Notice R. 543 in Government Gazette 33306 of 18 June 2010
EMPr: Environmental Management Programme
EN: Endangered (threat status)
ESA: Ecological Support Area
EX: Extinct (threat status)
EW: Extinct in the Wild (threat status)
FEPA: Freshwater Ecosystem Priority Area
CIS: Conservation Important Species (species listed within IUCN and South African Red Data Lists or that are protected within relevant international, national, and provincial legislation)

IAPs: Invasive Alien Plant species
LC: Least Concern (threat status)
NE: Not Evaluated (threat status)
NEMA: National Environmental Management Act 107 of 1998
NEM:BA National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
NFA: National Forest Act 1998 (No 84 of 1998)
NFEPA: National Freshwater Ecosystem Priority Areas, identified to meet national freshwater conservation targets (CSIR, 2011)
NT: Near Threatened (threat status)
PES: Present Ecological State, referring to the current state or condition of an environmental resource in terms of its characteristics and reflecting a change from its reference condition
RE: Regionally Extinct (threat status)
SANBI: South African National Biodiversity Institute
TOPS: Threatened and Protected Species in terms of section 56 of the National Environment: Biodiversity Act (NEM:BA) of 2004 (Species list as published within Gazette No. 30568, 14 December 2007)
VU: Vulnerable (threat status)

IV. LIST OF DEFINITIONS:

Accelerated soil erosion: Soil erosion induced by human activities.

Acceptable cover: No less than 40% (in regions receiving less than 400 mm rain per annum) of an area rehabilitated and/or planted, shall be covered with grass and other species and that there shall be no bare patches of more than 500 cm in maximum dimension.

Asteraceous: Pertaining to vegetation dominated by members of the daisy family (Asteraceae); e.g., asteraceous fynbos.

Alien: A species that occurs outside its natural distribution. Often originating from another country or continent, the term is commonly used to describe plants not indigenous to South Africa and which have become problematic (e.g., spreading rapidly and threatening existing biodiversity).

Bare soil: Soil surface devoid of vegetation and unaltered by humans.

Biodiversity: The diversity (richness and abundance) of plant and animal species occurring in their natural environment (habitats). The term encompasses different ecosystems, landscapes, communities, populations, and genes, as well as the ecological and evolutionary processes that allow these elements of biodiversity to persist over time.

Biome: A broad ecological spatial unit representing major life zones of large natural areas, and defined mainly by vegetation structure, climate, and major large-scale disturbance factors (e.g., fire) (Mucina and Rutherford, 2006).

Cape Floristic Region (CFR): One of 37 global floristic regions (phytochoria) as defined by Takhtajan (1986); often referred to as the Cape Floristic Kingdom (CFK), one of six global floristic kingdoms. Note that the classification of the CFR has changed, it is now referred to as the Core Cape Subregion (CCR) and forms part of the Greater Cape Floristic Region (GCFR), which now includes parts of the succulent karroo.

Core Cape Subregion: See Cape Floristic Region.

Cupressoid: Pertaining to plants with small, awl-shaped leaves that clasp the stem and have the appearance of a cypress.

Climax: That vegetation type or plant community structure that occurs at the end of the seral cycle. The climax communities may not be the final endpoint of the succession: frequent or even rare events, such as fire, frost, harvesting, or hurricanes, may indefinitely hold the communities in a stable subclimax (Low & Rebelo, 1998).

Compacted soil surface: A soil surface that has been hardened by an outside source, causing the soil to be more compacted than that of the surrounding area.

Conservation: The safeguarding of biodiversity and its processes (often referred to as Biodiversity Conservation).

Conservation Important Plant: Any plant species that is protected within relevant international, national, and/or provincial legislation, and any species that is listed within the Red List of South African plants (http://redlist.sanbi.org/index.php).

Desirable end state: The future condition or target on which rehabilitation is designed and which will serve later as a basis for rehabilitation success evaluation. This can be based on a reference site or modelled according to available information on historic vegetation.

Ecotone: A zone in which two or more vegetation types or ecosystems merge. These areas may be rich in species from both systems or may occur as species-poor fringes.

Ecosystem Goods and Services: The goods and benefits people obtain from natural ecosystems. Various types of ecosystems provide a range of ecosystem goods and services. Aquatic ecosystems, such as rivers and wetlands, provide forage for livestock, grazing or sedges for craft production, and services such as pollutant trapping and flood attenuation. They also provide a habitat for a range of aquatic biota.

Ecological rehabilitation: The process of assisting the recovery of a degraded or damaged ecosystem in a trajectory that aims to render the ecosystem fully functional, stable, and able to develop further, but not necessarily returning to the original historic state.

Ecological restoration: The process of assisting the recovery of an ecosystem that has been degraded damaged or destroyed, in a trajectory that ultimately returns the ecosystem to its natural successional stage.

Ecosystem: The combination of biota within a given area, together with a suitable environment that sustains the biota and the interactions between biota. It can have a spatial unit of any size, but shows some degree homogeneity as far as structure, function, and species composition is concerned. Small-scale ecosystems typically link

up to larger-scale ecosystems and all contribute to the ecosystem function and services at the landscape-scale.

Endemic: Refers to a plant, animal species, or a specific vegetation type that is naturally restricted to a particular, usually small, region (not to be confused with indigenous). A species of animal may, for example, be endemic to South Africa in which case it occurs naturally anywhere in the country, or endemic only to a specific geographical area within the country, and is then restricted to only to that area.

Ephemeral: Referring to the life-form of an annual plant that makes occasional appearances in favourable seasons.

Establishment of grass: All procedures necessary to produce an acceptable cover of grass on an area.

Floristic Classification: Referring to the use of plant species composition (flora) as a criterion for characterising or classifying vegetation.

Forb: A plant without secondary thickening (i.e., non-woody or herbaceous), usually living for only one or two seasons.

Function/functioning/functional: Used here to describe natural systems working or operating in a healthy way, as opposed to dysfunctional and working poorly or in an unhealthy way.

Fynbos: The word Fynbos is derived from the Dutch 'fijn-bosch' and roughly translates to 'fine bush'. It is a vegetation type that is characterised by small-leaved, evergreen shrubs whose regeneration is intimately linked to fire. The fynbos biome takes its name from the dominant fynbos vegetation of the region, and is characterised by the presence of one, or a combination of, the following three elements; a restoid-, ericoid- (or heath), or proteoid component.

Geophyte/-ic: Pertaining to a plant with underground storage organs such as bulbs, corms, tubers, or rhizomes, and which resprouts during the growing season while completely dying back aboveground during the dormant season.

Geoxylic Suffrutex: A plant with annual or short-lived woody above-ground shoots sprouting from a massive or extensive, perennial, underground stem.

Graminoid: Pertaining to a herbaceous growth form characterised by a 'grass-like' appearance (e.g., tufted growth, usually long and narrow leaves, secondary root system). Example are grasses, restios, sedges, and rushes.

Habitat: The general features of an area, inhabited by animals and/or plants, which are essential to their survival (i.e., the natural "home" of a plant or animal species).

Indigenous: Refers to a species that occurs naturally within a specific area.

Invasive plant: A plant which has been declared as invasive under NEM:BA, and includes all propagules of the plant (seeds and any vegetative parts capable of reproducing asexually).

Intact: Used here to describe a natural environment that is not seriously damaged, and which functions properly.

Landscape: Consists of a mosaic of two or more ecosystems that exchange organisms, energy, water, and nutrients.

Land Type: Map unit denoting land, mappable at 1:250 000 scale, over which a marked uniformity of climate, terrain form, and soil pattern exists.

Mitigate/Mitigation: Mitigating impacts refers to reactive practical actions that minimize or reduce *in situ* impacts. Examples of mitigation include "changes to the scale, design, location, siting, process, sequencing, phasing, and management and/or monitoring of the proposed activity, as well as restoration or rehabilitation of sites". Mitigation actions can take place anywhere, as long as it reduces site effects where a change in ecological character is likely, or the values of the site are affected by those changes (Ramsar Convention, 2012).

Period of Maintaining: The Period of Maintaining is defined as the period directly after the Establishment Period until the end of the Period of Maintenance for the whole Contract as defined in the General Conditions of Contract, unless otherwise specified.

Regic Soils: Pertaining to a blanket of soil, usually sand, which has been deposited over another soil or rock, and which has not yet had enough time to develop profiles or layers.

Proteoid: Vegetation-structural term used to designate fynbos shrublands dominated by the members of the family Proteaceae (such as the genera *Protea, Leucadendron*, and *Leucospermum*).

Revegetation: The process of establishing a vegetative cover on exposed soils, regardless of species composition or structure, as long as the species are non-invasive and their presence will not impede the gradual process of ecological rehabilitation or -restoration.

Renosterveld: Renosterveld or renosterbosveld, literally translates as 'rhinoceros vegetation'. There is confusion as to whether this refers to the historical presence of the hook-lipped rhinoceros (*Diceros bicornis*) in this veld type or, more likely, whether it is derived from 'renosterbos-veld'. Renosterbos refers to the shrub *Elytropappus rhinocerotis*, the dominant plant in the vegetation. Renosterveld is an evergreen, fire-prone shrubland or grassland dominated by small, cupressoid-leaved, evergreen asteraceous shrubs (principally renosterbos) with an understorey of grasses and a high biomass and diversity of geophytes. Renosterveld is characterised by fertile soils, in contrast to the nutrient poor soils of fynbos, which has led to its large-scale transformation as a result of agriculture.

Risk: A prediction of the likelihood and impact of an outcome; usually referring to the likelihood of a variation from the intended outcome.

Soil Erosion: A natural process whereby the ground level is lowered by wind or water action and may occur as a result of *inter alia* chemical processes and/or physical transport on the land surface**.**

Succession: A series of stages in which different plants and animals colonise an area following some kind of disturbance. The final stage of succession is called the 'climax', but various disturbances may prevent the vegetation from attaining its potential climax.

Threatened Ecosystem: In the context of this document, refers to Critically Endangered, Endangered, or Vulnerable ecosystems.

Threat Status: Threat status (of a species or community type) is a simple but highly integrated indicator of vulnerability. It contains information about past loss (of numbers and/or habitat), the number and intensity of threats, and current prospects as indicated by recent population growth or decline. Any one of these metrics could be used to measure vulnerability. One much-used example of a threat status classification system is the IUCN Red List of Threatened Species (BBOP, 2009).

Vegetation structure: The horizontal, vertical, and temporal arrangement of vegetation, e.g., layers, patches, etc.

Vegetation texture: The composition of the vegetation in terms of species, growth forms, life forms, leaf morphological types, etc.

Watercourse: A river or spring, or a natural channel in which water flows regularly or intermittently, or a wetland, lake or dam into which, or from which, water flows; any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks (National Water Act, 1998).

Wetland: Refers to land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in water saturated soil (National Water Act, 1998).

Transformation: The conversion of an ecosystem to a different ecosystem or land use type.

Topsoil: Uppermost layer of soil; in natural vegetation maximally 30 cm deep; in cultivated landscapes the total depth of cultivation, containing a layer of humus, seeds, and nutrients. Topsoils that are applied to landscapes to be rehabilitated must be free of refuse, large roots and branches, stones, alien weeds and/or any other agents that would adversely affect the topsoils suitability for re-vegetation.

Weed: A plant that grows where it is not wanted, and can, therefore, be indigenous or alien.

(Coetzee 2005, Clewell et al. 2005, SER 2004)

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Proposed expansion of the sand mine area on Portion 4 of the farm Zandberg Fontein 97 south of Robertson, Western Cape Province

BOTANICAL STUDY AND ASSESSMENT

1. INTRODUCTION

1.1 Applicant

Greenmined Environmental (Pty) Ltd. on behalf of Zandberg Sandput (Pty)

1.2 Project

The project will be known as Zandberg sand mine.

1.3 Proposed Activity

Zandberg Sandput (Pty) currently holds a Mining Right (MR) for an approved area of 17.6826 ha within Portion 4 of the Farm Zandberg Fontein No 97, south of Robertson (Langeberg Local Municipality) within the Western Cape Province (Figure 1).

The Zandberg mining method entails strip mining representative of the small-scale mining industry: sand is loaded with one front-end-loader (FEL) directly onto the trucks of clients, and is then transported from site. Little to no stockpiling is required and no washing of sand is needed. The Mining Right (MR) holder removes the topsoil of a strip of ± 1 ha within which the sand is mined in blocks of approximately 50 x 50 m. Topsoil is replaced over every mined-out strip prior to the opening of the consecutive strip.

The MR holder intends to extend the mining footprint by ± 4 ha (Figure 2) and is in the process of applying for a mining right extension in terms of Section 102 of the MPRDA, 2002. Three proposed mining alternative areas of equivalent size are discussed in this report (Figure 2, Figure 3), and the applicant is applying for the approval of only one of these areas. Should the S102 application be approved, mining will progress into the expansion area while the current mining footprint is

mined-out. The mining method will not be the same as currently implemented by the MR holder. The method that will be implemented if the extension is approved will consist of sequentially mining layers (or "steps") that are 20 m in breadth with successive bench heights of 10 m. Each layer will be rehabilitated after mining. This method was proposed by mining specialists (see the mining specialist report for more details on the methods to be used).

No new infrastructure will be established in the extension area.

The proposed mining extension area will be reached via the existing access road from the Nuwehoogte Road that leads to the existing mining area.

Note: the applicant originally applied for a larger mining area, which was not supported by the relevant stakeholders (see "Original Proposed Extension Area" in Figure 2).

1.4 Terms of reference

To conduct a botanical study for a basic assessment of the proposed target area that will be set aside for mining purposes. To provide a professional opinion on botanical issues pertaining to the target area for aiding in future decisions regarding the proposed project.

1.5 Conditions of this report

All findings, recommendations, and conclusions provided in this report are based on the authors best scientific and professional knowledge and information available at the time of compilation. No form of this report may be amended or extended without the prior written consent of the authors. Any recommendations, statements or conclusions drawn from, or based on, this report must clearly cite or make reference to this report. Whenever such recommendations, statements, or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

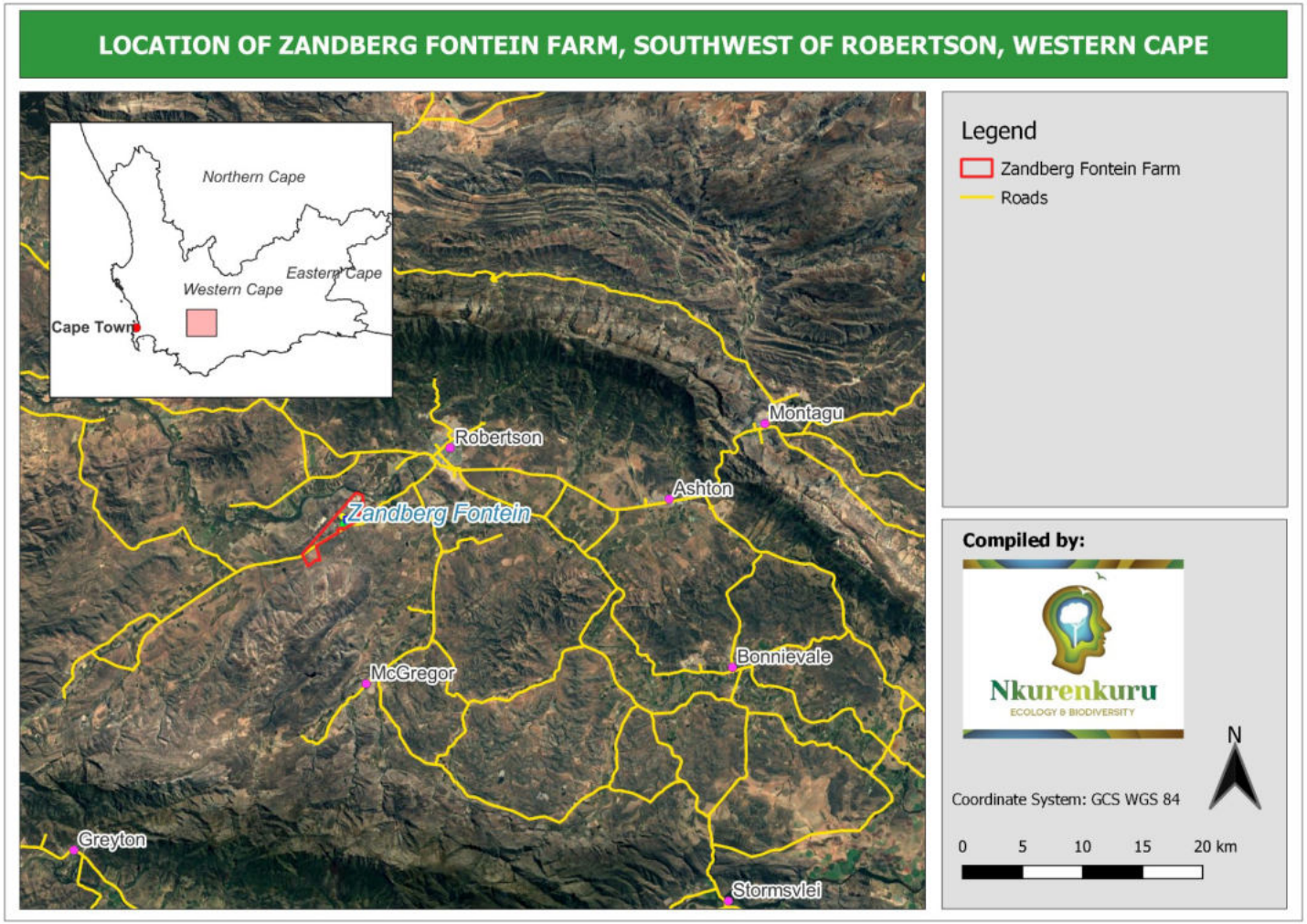

Figure 1: Locality of Zandberg Fontein farm between the towns of Roberson and McGregor in the Western Cape Province. Inset map shows the main map extent within the Western Cape.

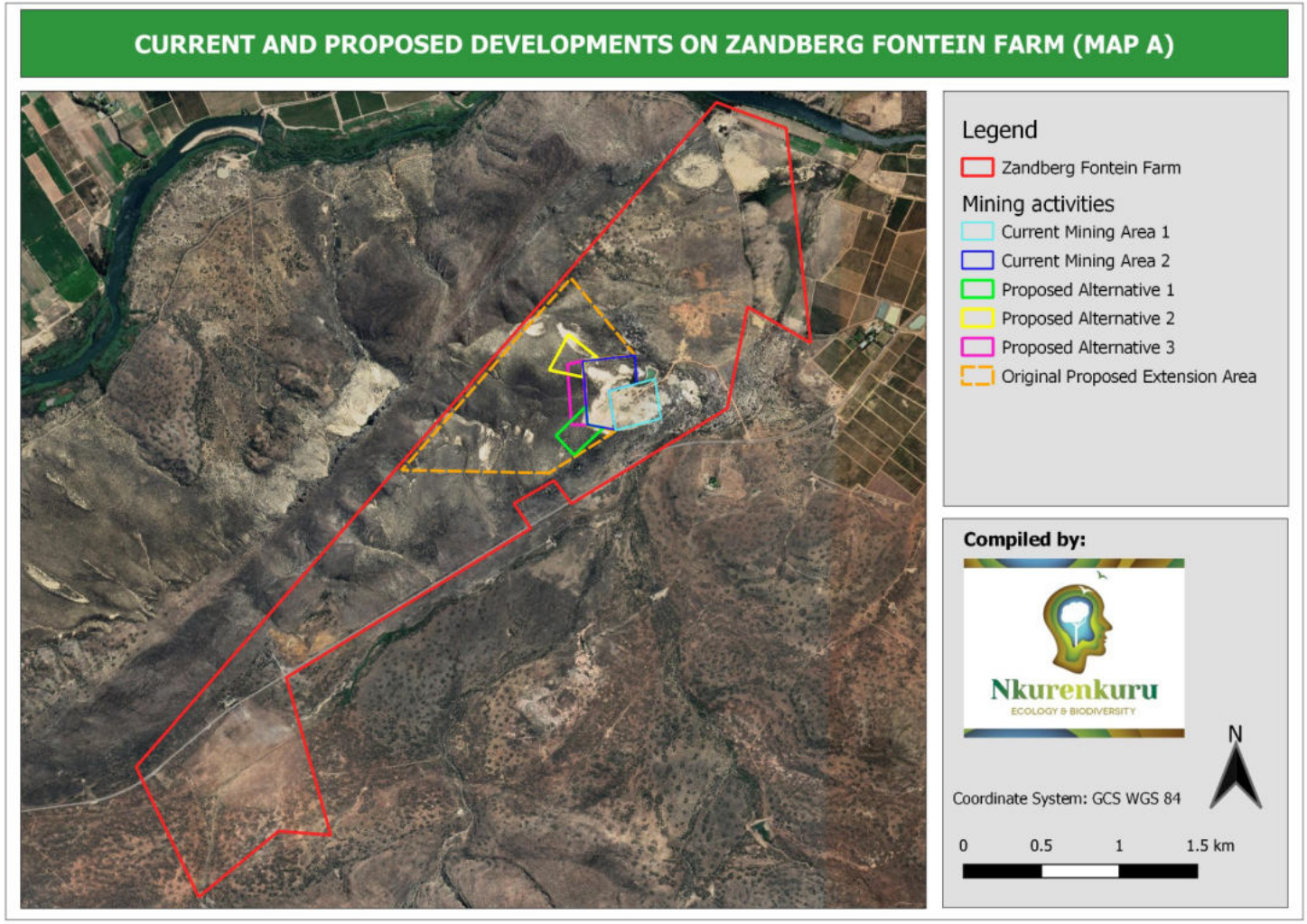

Figure 2: Details of the current and proposed developments on Zandberg Fontein farm (map A).

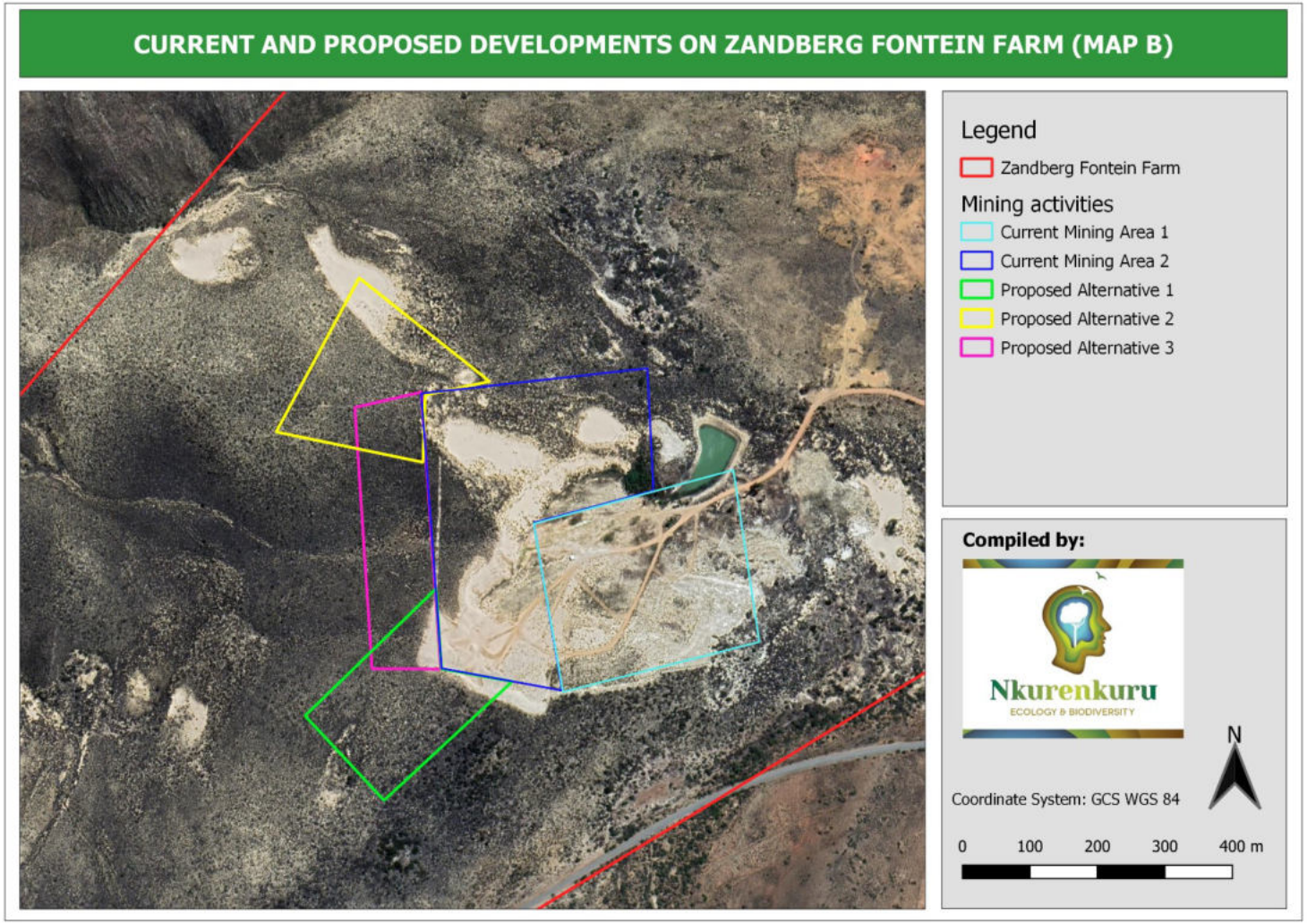

Figure 3: Details of the current and proposed developments on Zandberg Fontein farm (map B).

1.6 Relevant legislation

The following legislation was taken into account whilst compiling this report:

Provincial

» Western Cape Nature Conservation Ordinance (No. 19 of 1974) and Western Cape Nature Conservation Laws Amendment Act (No. 3 of 2000), with special reference to:
  - Schedule 1: Endangered Wild Animals
  - Schedule 2: Protected Wild Animals
  - Schedule 3: Endangered Flora
  - Schedule 4: Protected Flora

The above-mentioned Nature Conservation Ordinance accompanied by all amendments is regarded by the Department of Environmental Affairs and Development Planning — Western Cape Province (DEADP), as the legally binding provincial documents, providing regulations, guidelines, and procedures with the aim of protecting game and fish, the conservation of flora and fauna, and the destruction of problematic (vermin and invasive) species.

National

» National Environmental Management Act / NEMA (Act No 107 of 1998), and all amendments and supplementary listings and/or regulations
» Environment Conservation Act (ECA) (No 73 of 1989) and amendments
» National Environmental Management Act: Biodiversity Act / NEMA:BA (Act No. 10 of 2004) and amendments
» National Forest Act 1998 / NFA (No 84 of 1998)
» National Veld and Forest Fire Act (Act No. 101 of 1998)
» Conservation of Agricultural Resources Act / CARA (Act No. 43 of 1983) and amendments

International

» Convention on International Trade in Endangered Species of Fauna and Flora (CITES)
» The Convention on Biological Diversity
» The Convention on the Conservation of Migratory Species of Wild Animals

2. METHODOLOGY

2.1 Assessment Approach and Philosophy

The assessment was conducted according to the 2014 EIA Regulations, as amended 7 April 2017, as well as within the best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers et al. (2005).

This includes adherence to the following broad principles:

» That a precautionary and risk-averse approach be adopted towards projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e., Critical Biodiversity Areas (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.

» Demonstrate how the proponent intends on complying with the principles contained in section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA), which, amongst other things, indicates that environmental management should, in order of priority aim to:

- Avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity;
- Avoid degradation of the environment;
- Avoid jeopardising ecosystem integrity;
- Pursue the best practicable environmental option by means of integrated environmental management;
- Protect the environment as the people's common heritage;
- Control and minimise environmental damage; and
- Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic, or stressed ecosystems.

These principles serve as guidelines for all decision-making concerning matters that may affect the environment. As such, it is incumbent upon the proponent to show how proposed activities would comply with these principles and thereby contribute towards the achievement of sustainable development as defined by NEMA.

In order to adhere to the above principles and best-practice guidelines, the following forms the basis for the study approach and assessment philosophy:

The study included data searches, desktop studies, site walkovers/field surveys of the property, and baseline data collection, describing:

» The broad botanical characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

In terms of pattern, the following was identified or described:

Community and ecosystem level

» The main vegetation type, its aerial extent, and interaction with neighbouring types, soils or topography;
» Threatened or vulnerable ecosystems (cf. new SA vegetation map/National Spatial Biodiversity Assessment1, fine-scale systematic conservation plans, etc).

Species-level

» Red Data Book (RDB) species (giving location if possible, using GPS)
» The viability of an estimated population size of the RDB species that are present (including the degree of confidence in prediction based on availability of information and specialist knowledge, i.e., High=70-100% confident, Medium 40-70% confident, Low 0-40% confident). The likelihood of other RDB species, or species of conservation concern, occurring in the vicinity (include degree of confidence).

Other pattern issues

» Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, sandstone outcroppings, steep southern aspects, drainage lines etc. in the vicinity.
» The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than an infestation of undisturbed sites).
» The condition of the site in terms of current or previous land uses.

In terms of process, the following was identified or described:

» The key ecological "drivers" of ecosystems on the site and in the vicinity.
» Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e., corridors such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and

vegetation boundaries such as edaphic interfaces, upland-lowland interfaces, or biome boundaries)

» Any possible changes in key processes e.g., increased fire frequency or drainage/artificial recharge of aquatic systems.
» Furthermore, any further studies that may be required during or after the EIA process will be outlined.
» All relevant legislation, permits, and standards that would apply to the development will be identified.
» The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image, or map delineated at an appropriate level of spatial accuracy.

2.2 Data scouring and review

Data sources from the literature and GIS spatial information was consulted and used where necessary in the study and include the following (also refer to Table 1):

Vegetation:

» Vegetation types and their conservation statuses were extracted from the South African National Vegetation Map (Mucina and Rutherford 2006 and 2012, together with the beta version 2018; see also Dayaram et al., 2018) as well as the National List of Threatened Ecosystems (2011), where relevant.
» The IUCN conservation status of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (Version 2017.1).

Ecosystem:

» Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011). This includes rivers, wetlands, and catchments defined under the study.
» Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).
» Critical Biodiversity Areas were extracted from the Western Cape Biodiversity Spatial Plan (Cape Nature, 2017), available from the SANBI BGIS web portal.

Table 1: Information and data coverages used to inform the ecological assessment.

	Data/Coverage Type	Relevance	Source
Biophysical Context	**Colour Aerial Photography**	Desktop mapping of habitat/ecological features	National Geo-Spatial Information (NGI)
	Latest Google Earth™ imagery	To supplement available aerial photography	Google Earth™ On-line
	1:50 000 River Line (GIS Coverage)	Highlight potential on-site and local rivers and wetlands and map local drainage network.	CSIR (2011)
	National Land-Cover	Shows the land-use and disturbances/transformations within and around the impacted zone.	DEA (2015)
	South African Vegetation Map (GIS Coverage)	Classify vegetation types and determination of reference primary vegetation	Mucina & Rutherford (2012; 2018); Dayaram et al., 2018
	NFEPA: river and wetland inventories (GIS Coverage)	Highlight potential on-site and local rivers and wetlands	CSIR (2011)
Conservation and Distribution Context	**National Biodiversity Assessment – Threatened Ecosystems** (GIS Coverage)	Determination of national threat status of local vegetation types	SANBI (2011)
	Western Cape Biodiversity Spatial Plan (GIS Coverage)	Determination of provincial terrestrial/freshwater conservation priorities and biodiversity buffers	SANBI (2017)
	SANBI's PRECIS (National Herbarium Pretoria Computerized Information System) electronic database	Determination of plant species composition within the region as well as potential conservation important plants.	http://posa.sanbi.org 2020-01-20_181608464-BRAHMSOnlineData
	Red Data Books (Red Data Lists of Plants)	Determination of endangered and threatened plants,	Red List of South African Plants (2011)

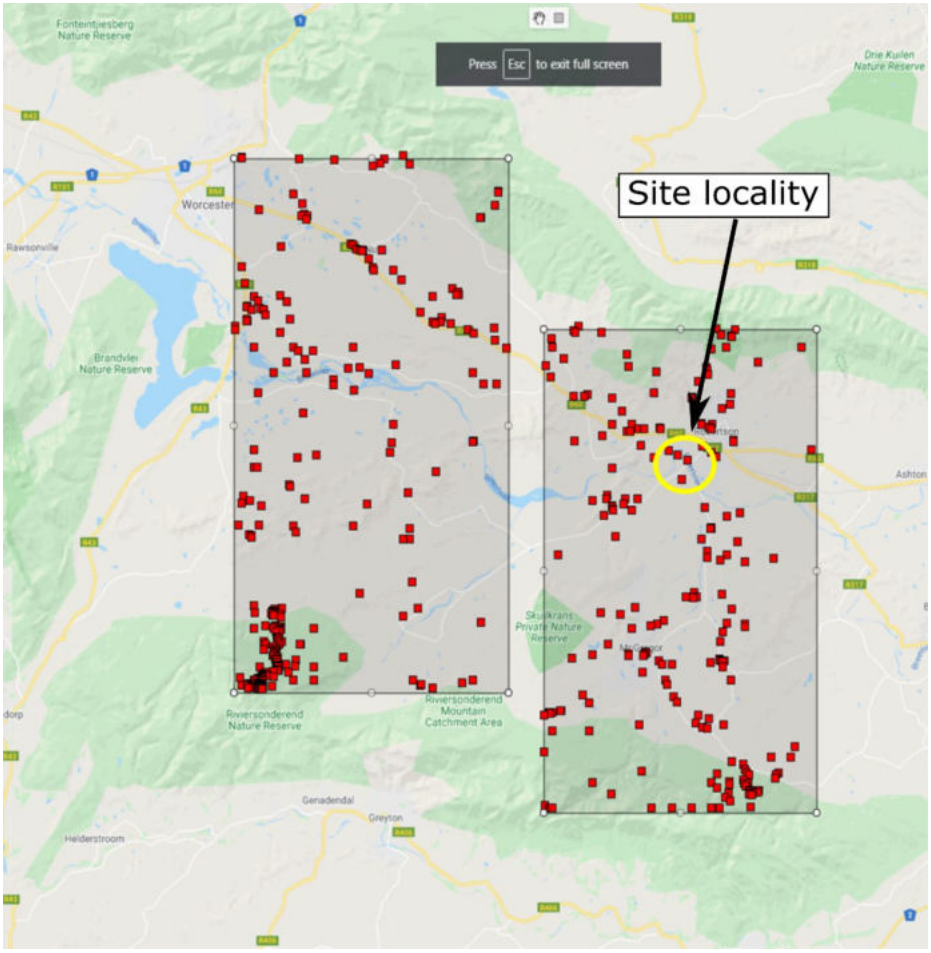

Figure 4: Site locality and areas (rectangles) indicating the extent of data extraction from POSA (red squares represent individual records). Extracted data was used to compile a list of plant species that may potentially occur within the project site and provide an indication of potential species of conservation concern that may be found within the area.

2.3 BOTANY: Methods to be followed during Field Sampling and Assessment

As part of the BA process, two detailed field surveys of the vegetation of the proposed mining footprint was undertaken (on 31 January 2020 and on 25 August 2021) with the main purpose of:

» Inspecting the various habitat, vegetation, and landscape units that are present at the mining site, and to correlate such observations with the results of the desktop study.
» Identifying all observed species recorded within the development footprint.
» Providing a list of protected and redlist species.
» Noting the presence of sensitive habitats, for example drainage lines and unique edaphic environments.

These features were mapped onto satellite imagery of the site.

Aspects of biodiversity that were used to guide the interpretation and assessment of the study area are summarized below (Table 2).

Table 2: Summary of the different aspects of biodiversity considered in the assessment of the study site.

Intrinsic / Ecological Values
Species-level aspects of biodiversity
» Protected species of flora; » Threatened Species (Red Data List); » Keystone species performing a key ecological role; » Large or congregatory species populations; » Endemic species or species with restricted ranges; » Previously unknown species.
Community & ecosystem-level aspects of biodiversity
» Distinct or diverse communities or ecosystems; » Unique ecosystems; » Locally adapted communities or assemblages; » Species-rich or diverse ecosystems; » Communities with a high proportion of endemic species or species with restricted ranges; » Communities with a high proportion of threatened and/or declining species; » The main uses and users of the area and its ecosystem goods and services: important ecosystem services, valued ecosystem goods, valued cultural areas.
Community & ecosystem-level aspects of biodiversity
» Key ecological processes (e.g., seed dispersal, pollination, primary production, carbon sequestration); » Areas with large congregations or species and/or breeding grounds; » Migration routes/corridors; » Importance as a link or corridor to other fragments of the same habitat, to protected or threatened or valued biodiversity areas; » Importance and role in the landscape with regards to arrangement of spatial components of ecological processes, comprising processes tied to fixed physical features (e.g. soil or vegetation interfaces, river or sand movement corridors, upland-lowland interfaces) and flexible processes (e.g. upland-lowland gradients and macro-climatic gradients), as well as important movement or migration corridor for species.

2.4 Assessing species of conservation concern:

Species of Conservation Concern (SoCC) are taxa (plants or animals) that have a significant conservation importance in terms of preserving South Africa's high biological diversity. They include threatened species — i.e., Red List species — that have been classified as 'at high risk of extinction in the wild' (i.e., Critically Endangered [CR], Endangered [EN], Vulnerable [VU]), as well as those classified in the categories Near Threatened (NT), Critically Rare, Rare, Declining, and Data Deficient. SoCC also include protected species listed in international conventions,

national acts, and provincial ordinances that regulate activities such as the hunting, collecting, and trading of such species. A population of an SoCC occurring on a proposed development site serves to indicate that proposed site development activities could result in significant loss of biodiversity, knowing that the loss of such subpopulations will either increase the species' extinction risk, or may even contribute to its extinction.

A description of the different SANBI Red List categories (http://redlist.sanbi.org/) of is provided in Table 3 and Figure 5, below.

Table 3: South African Red List Categories for species of conservation significance (adapted from SANBI, on-line at http://redlist.sanbi.org/redcat.php).

Present State			
Species of Conservation Concern (SoCC)		Extinct (EX)	A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only after exhaustive surveys throughout the species' known range have failed to record an individual.
		Extinct in the Wild (EW)	A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside is natural and historical range.
		Regionally Extinct (RE)	A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
	Threatened Species	Critically Endangered, Possibly Extinct (CR PE)	Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but exhaustive surveys required for classifying the species as Extinct have not yet been completed. A small chance remains that such species may still be rediscovered.
		Critically Endangered (CR)	A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
		Endangered (EN)	A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.
		Vulnerable (VU)	A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
		Near Threatened (NT)	A species is Near Threatened when available evidence indicates that it almost meets any one of the IUCN criteria for Vulnerable, and is, therefore, likely to become at risk of extinction in the near future.
		Critically Rare [non-IUCN]	A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
		Rare [non-IUCN]	A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria.
		Declining	A species is Declining when it does not meet or almost meet any one of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.

		Data Deficient – Insufficient Information (DDD)	A species is DDD when there is inadequate information to make an assessment of its extinction risk, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate.
Other		Data Deficient – Taxonomically Problematic (DDT)	A species is DDT when taxonomic problems hinder its distribution range and habitat from being well defined so that an assessment of risk of extinction is not possible.
		Least Concern (LC)	A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
		Not Evaluated (NE)	A species is Not Evaluated when it has not been evaluated against the criteria. The national Red List of South African plants is a comprehensive assessment of all South African indigenous plants, and therefore all species are assessed and given a national Red List status. However, some species included in Plants of southern Africa: an online checklist are species that do not qualify for national listing because they are naturalized exotics, hybrids (natural or cultivated), or synonyms. These species are given the status Not Evaluated and the reasons why they have not been assessed are included in the assessment justification.

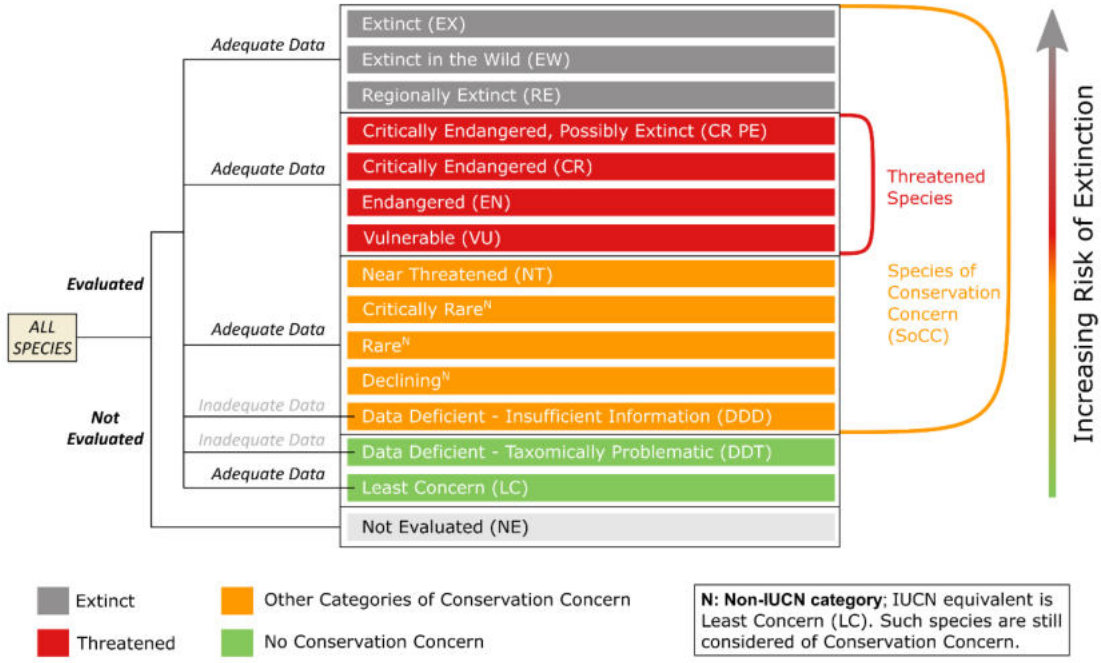

Figure 5: Red List categories used in this report, delineated according to SANBI's Red List of South African Plants (version 2020; http://redlist.sanbi.org/redcat.php).

As mentioned, flora of conservation concern (including threatened, protected, and rare species) likely to occur in the various habitats of the study area were assessed at a desktop level using the outputs of SANBI's PRECIS (National Herbarium Pretoria Computerized Information System) electronic database. This information was used to identify potential habitats in the project area that could support these

species. Special attention was given to the identification of any Red Data species as well as the identification of suitable habitat for Red Data species observed during field investigations.

2.5 Ecological Mapping

Mapping was done by comparing georeferenced ground survey data to available Google-Earth Satellite Imagery, thus extrapolating survey reference points to the entire study area. Due to the intricate mosaics and often gradual mergers of vegetation units, generalisations were made and delineations are therefore approximate. Mapped units thus indicate dominant vegetation, but smaller vegetation types invariably exist within dominant units, and could not be mapped separately. The latter would require a supervised classification of georeferenced raw SPOT or similar satellite imagery (with full reflectance data), which was not available for this project due to a limited budget. Maps were created with QGIS (version 3.20).

2.6 Sensitivity Analysis and Criteria

The determination of specific ecosystem services and the sensitivity of ecosystem components, both biotic and abiotic, is complex and no single overarching criterion applies to all habitats studied. The main aspects of an ecosystem that require incorporation into a sensitivity analysis, however, include the following (see Kremen 2005):

» Describing the nature and number of species present, taking into consideration their conservation value, as well as the probability of such species to survive or re-establish following disturbances (of various magnitudes), and alterations to their specific habitats.
» Identifying the species or habitat features that are 'key ecosystem providers' and characterising their functional relationships.
» Determining the aspects of community structure that influence function, especially aspects influencing stability or rapid decline of communities.
» Assessing key environmental factors that influence the provision of services.
» Gaining knowledge about the spatial-temporal scales over which these aspects operate.

This implies that, in a sensitivity analysis, aspects that currently prevail in the project area should be taken into consideration. The possibility of fully restoring the original environment and its biota, or at least rehabilitating ecosystem services,

after significant disturbance, as close as possible to the original state, should also be considered.

According to the above, sensitivity classes are summarised as follows:

» **Very High Sensitivity:** Areas that contain critical and/or unique habitats have a very high sensitivity; such areas usually serve as habitats for rare/endangered species or perform critical and irreplaceable ecological roles. Very high sensitivity areas are *no-go* areas and developments in such areas should be avoided at all costs.
» **High Sensitivity:** Areas that usually have a high biodiversity value or important ecological roles, and impacts on such areas will likely be high; these areas include natural or transformed land. It might be difficult to mitigate all impacts appropriately in high sensitivity areas, and thus developments within these areas are undesirable and should proceed with caution.
» **Medium Sensitivity:** The impacts on medium sensitivity areas are likely to be localized, with the risk of secondary impacts (e.g., erosion) being low; these areas include natural or previously transformed land. On the condition that appropriate mitigation measures are implemented, developments within medium sensitivity areas will have relatively little ecological impact.
» **Low Sensitivity:** The impact on ecological processes and plant diversity in a low sensitivity area is likely to be negligible. Areas of low sensitivity are those areas where natural vegetation has already been transformed, for example due to intensive agricultural practices such as crop production. The majority of developments would have little ecological impact in low sensitivity areas.

2.7 Impact Assessment Methodology

The impact assessment methodology is in accordance with the recently revised 2014 EIA regulations. The significance of environmental impacts is a function of: the present environmental aspects that are to be impacted on, the probability of an impact occurring, and the consequence of such an impact occurring before and after implementation of proposed mitigation measures.

The significance of environmental impacts is to be assessed by means of the criteria of nature (descriptive), extent (scale), duration, magnitude (severity), probability (certainty), and direction (negative, neutral, or positive) (Figure 6).

» **Nature:** description of what causes the effect, what will be affected, and how it will be affected.

» **Extent:** whether the impact will be site specific (limited to the immediate area or site of development), local, or regional/provincial; a value between 1 and 5 is assigned as appropriate (with 1 being low and 5 being high).
» **Duration:**
  - the lifetime of the impact will be of a very short duration (0 – 1 year) — assigned a score of 1;
  - the lifetime of the impact will be of short duration (1 – 5 years) — assigned a score of 2;
  - medium-term (5 – 15 years) — assigned a score of 3;
  - long term (15 – 30 years) — assigned a score of 4; or
  - permanent (> 30 years) — assigned a score of 5.
» **Magnitude:** quantified on a scale from 0 – 10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high and processes are altered to the extent that they temporarily cease, and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
» **Probability (of occurrence):** the likelihood of the impact actually occurring. Probability is estimated on a scale of 1 – 5, where 1 is highly improbable (will likely not happen), 2 is improbable (possible, but likelihood still low), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will definitely occur regardless of any prevention measures).
» **Significance:** determined through a synthesis of the characteristics described above and can be assessed as **LOW**, **MEDIUM** or **HIGH**; and
» **Direction:** either positive, negative or neutral;

Also included are:

» the degree to which the impact can be reversed;
» the degree to which the impact may cause irreplaceable loss of resources; and
» the degree to which the impact can be mitigated.

The significance is calculated by combining the criteria as follows:

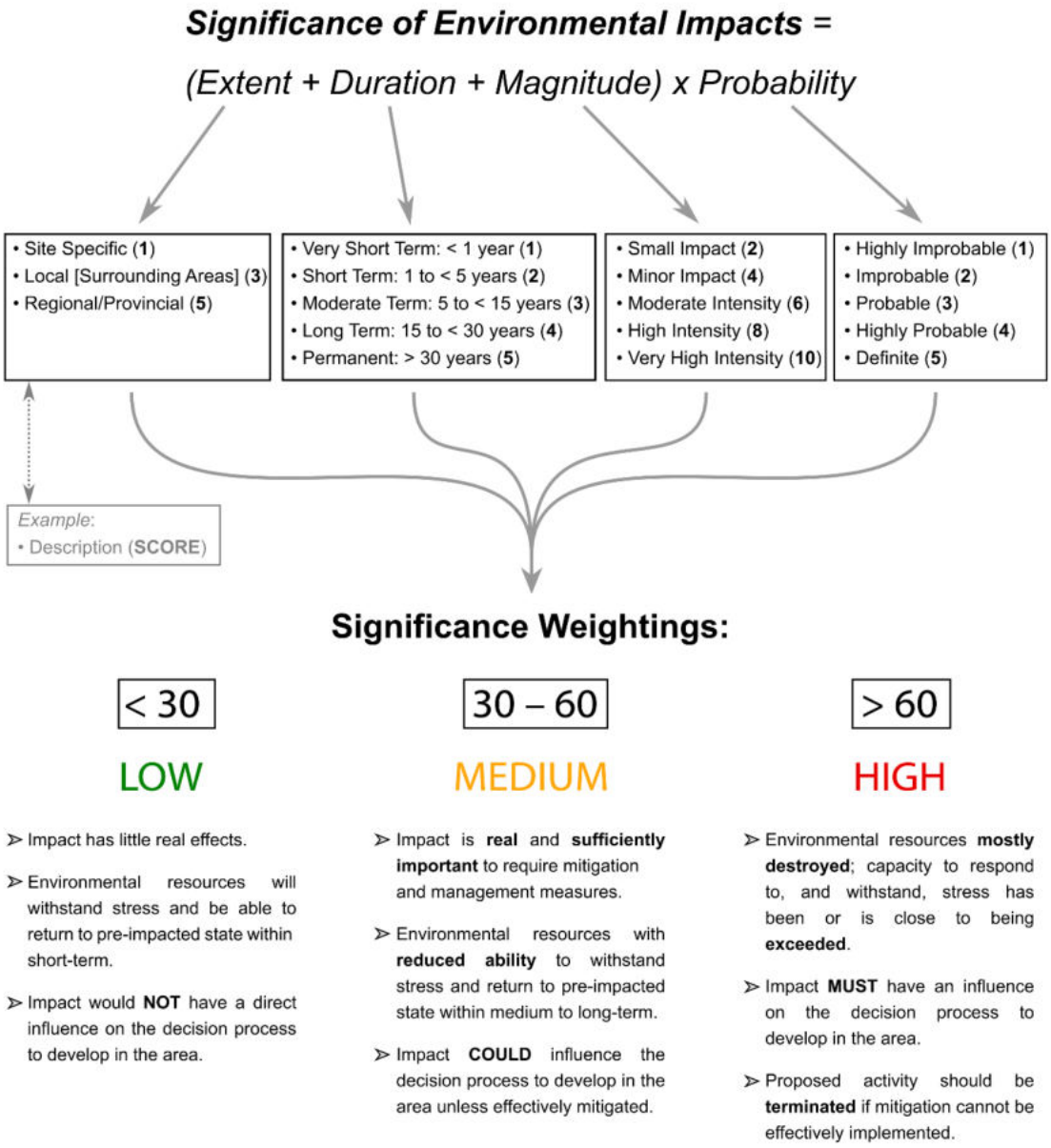

Figure 6: Calculation, description, and summary of Significance Weightings.

2.8 Assumptions and Limitations

This report deals exclusively with a defined area and the impacts upon flora biodiversity and natural ecosystems in that area.

» All relevant project information provided by the applicant and engineering design team to the ecological specialist was correct and valid at the time that it was provided.

» Probably the most significant potential limitation associated with such a sampling approach is the narrow temporal window of sampling.

Temporal variation plays an important role in the structure and patterns of plant biodiversity, -communities, and species occurrences. Two site visits might, therefore, not fully catalogue plant species diversity in an area (for example, due to seasonal variation of vegetation). The site was surveyed both in a dry period, out of flowering season (31 January 2020) as well as an optimal flowering season following good rains (25 August 2021). Thus, the vegetation of the area has most likely been documented well.

Nevertheless, some annual, short-lived, ephemeral (plants surviving unfavourable conditions as seeds), geophytic (species with underground storage organs), or other cryptic species might not have been observed/detected. For example, some plant species of the families Amaryllidaceae, Colchicaceae, Eriospermaceae, Hyacinthaceae, Hypoxidaceae, Iridaceae, and Orchidaceae, are known to completely die back during certain times of the year, depending on respective life strategies. Thus, such species remain unobservable/undetectable and survive only as dormant bulbs, corms, tubers, or rhizomes below the soil surface. Moreover, rare and threatened plant species are generally uncommon and/or localised, and can easily be overlooked. Even multiple site visits might therefore fail to locate such species.

Furthermore, flowers and fruits are crucial for the complete and accurate identification of plant species, and any absence of such flowers and fruits might prevent the complete and accurate identification of such plant species. Flowering and fruiting times are species specific and there would invariably have been some plant species that were not flowering and/or fruiting when the site surveys were conducted.

In principle, it is impossible to survey any site to its full extent, both physically and temporally. The total number of plant species thus recorded on site is therefore certainly an underestimate of the potential number of species that could occur on site, although most plant species have likely been documented.

In light of all of the aforementioned, the authors declare a gap in knowledge as to the potential presence of plant species that might not have been observable/detectable on site as a result of their potential annual, short-lived, dormant, or ephemeral nature during the time of the surveys, their rare and localised distributions on site, and also the incomplete and inaccurate identification of plant species which lacked flowers and/or fruits and/or other characteristic features during the time of the surveys. A list of protected and/or endangered species known to occur in the area (as per SANBI online databases) was used to supplement the list of species recorded during the site visit. This final combined list

is likely to be sufficiently conservative and cautious to account for the aforementioned study limitations.

3. THE IMPORTANCE OF BIODIVERSITY AND CONSERVATION

The term "Biodiversity" is used to describe the wide variety (richness and abundance) of plant and animal species occurring in their natural environment or "habitat". Biodiversity not only encompasses all living things but also the series of interactions that sustain them, which are termed "ecological processes".

South Africa's biodiversity provides an important basis for economic growth and development; keeping biodiversity intact is vital for ensuring the on-going provision of ecosystem services, for example the production of clean water through comprehensive catchment management practices. The role of biodiversity in combating climate change is also well recognised and further emphasises the key role that biodiversity management plays on a global scale (Driver et al., 2012). Typical pressures that natural ecosystems face from human activities include the loss and degradation of natural habitat, invasive alien species, pollution and waste, and climate change (Driver et al., 2012).

High levels of infrastructural and agricultural development typically restrict the connectivity of natural ecosystems, and maintaining connectivity is considered critical for the long-term persistence of both ecosystems and species, in the face of human development and global climate change. Biodiversity loss places aspects of South Africa's economy and quality of life at risk, and reduces socioeconomic options for future generations. In essence, then, sustainable development is not possible without a healthy biodiversity.

4. DESCRIPTION OF THE AFFECTED ENVIRONMENT - BASELINE

4.1 Broad-Scale Vegetation Patterns

The majority of the site is mapped as Breede Sand Fynbos (FFd 8), with a smaller section of North Sonderend Sandstone Fynbos (FFs 13) towards the western- and south-western boundary, as well as Robertson Karoo (SKv7) to the extreme southwest and Muscadel Riviere (AZi8) to the northeast (Mucina & Rutherford, 2006 and 2018) (Figure 7). Only Breede Sand Fynbos and North Sonderend Sandstone

Fynbos are described below, since only they will either be directly impacted by (in the former) or are close to (in the latter) the proposed mining areas.

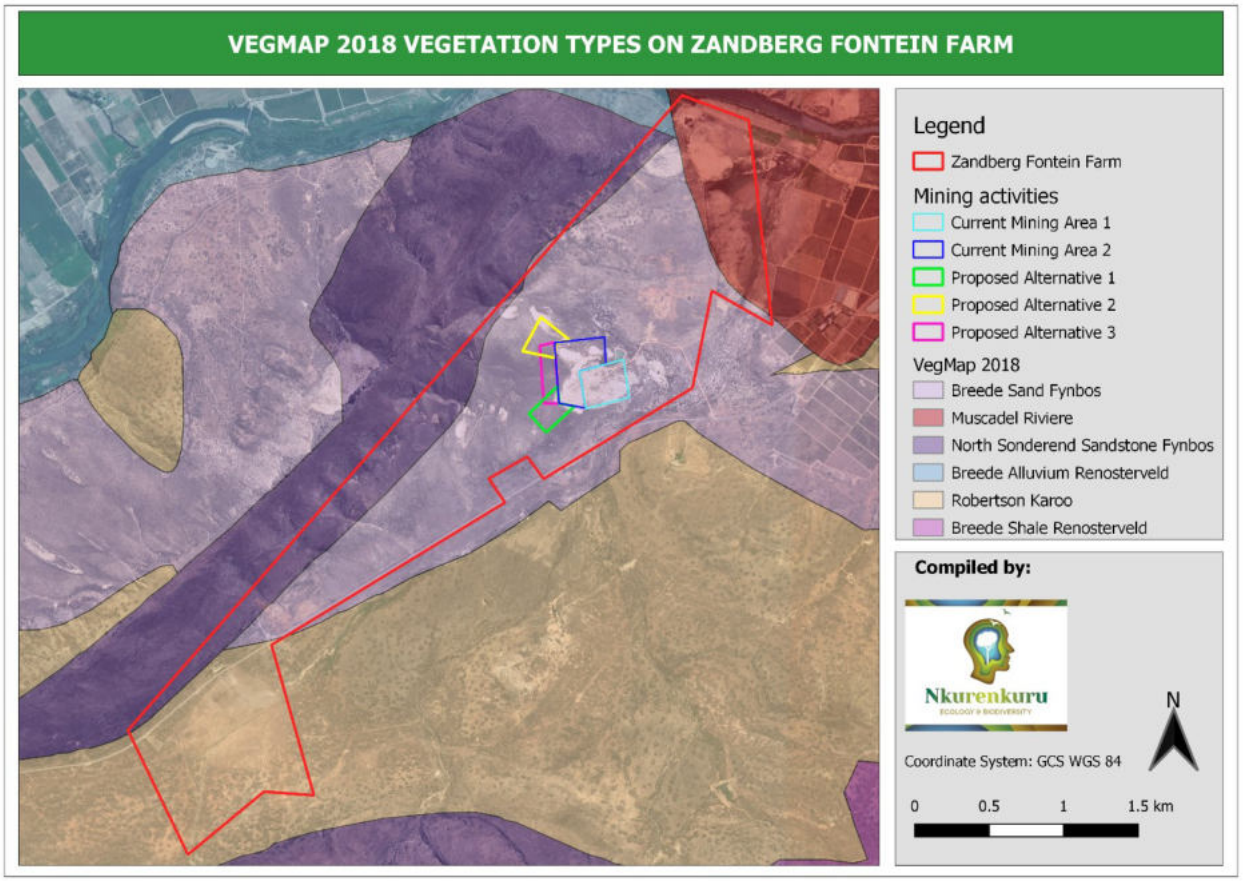

Figure 7: Map illustrating the different vegetation types, according to VegMap 2018, found on Zandberg Fontein farm and in the general region. Also shown are the three proposed alternative mining areas (Alternative 1, 2, and 3).

Breede Sand Fynbos (FFd 8):

The unit overall is very fragmented and occurs as dune plumes and dune seas in the valley bottoms primarily south of the Breede River, and extends up the sides of adjacent hills. The vegetation characteristic of this unit consists of open, tall proteoid shrubland combined with an open to medium dense restioid herbland in undergrowth. The dominant components are proteoid and restioid fynbos. Soils are of recent aeolian sand accumulations of riverine origin (Breede River).

The unit is currently mapped to comprise about 97 km^2 of land area. However, the largest mapped fragment is currently almost entirely inundated by the Theewaterskloof dam, covering a total of 67 km^2, which leaves at most 30 km^2 remaining; this is still likely an overestimate, since other mapped fragments have also been affected by transformation.

Breede Sand Fynbos is currently classified as Vulnerable, since its conservation target is 30%, but none of the unit is conserved in statutory conservation areas, while only 2% is protected in the Hawequas and Quaggas Berg Private Nature Reserves. Furthermore, some 45% of the area has been transformed, mainly for agriculture and by building of the Brandviei and Kwaggaskloof Dams. In fact, the largest patch of this unit is now almost entirely under the water of these reservoirs. Low levels of infestation by alien *Eucalyptus*, *Acacia saligna*, and *Hakea sericea* have been recorded.

Breede Sand Fynbos is a poorly studied vegetation unit. This, together with high levels of fragmentation, the non-existence of statutory conserved areas of the unit, and the moderate level of transformation of the unit, makes it a high conservation priority.

Table 4: Key species associated with the Breede Sand Fynbos according to Mucina and Rutherford (2006).

DOMINANT SPECIES	
Growth Form	**Key Species**
Tall shrubs	*Leucospermum rodolentum (dominant), Metalasia densa, Protea laurifolia*
Low shrubs	*Afrolimon longifolium, Aspalathus heterophylla, Euchaetis pungens, Lachnospermum fasciculatum, Leucadendron brunioides var. brunioides, L. salignum, Wiborgia fusca*
Succulent shrub	*Ruschia caroli*
Herbs	*Pelargonium senecioides*
Geophytic Herb	*Romulea setifolia*
Graminoids	*Cynodon dactylon, Ehrharta villosa var. villosa, Ficinia lateralis, Willdenowia incurvata*
ENDEMIC SPECIES	
Growth Form	**Key Species**
Geophytic herb	*Ixia pumilio*

North Sonderend Sandstone Fynbos (FFs 13):

This unit is distributed from the northern slopes of the Riviersonderend Mountains from Villiersdorp to Bromberg and Luiperdsberg east of Stormsvlei, including Klipberg and Sandberg towards Robertson. Its altitudinal range is from 150 m to peaks exceeding 1 600 m (Jonaskop, Pilaarkop and an unnamed peak).

The unit consists of gentle to steep north-facing slopes, highly dissected in a few places, with a midslope sandy plateau and extensive gentle lower slopes. The vegetation is an open, tall, proteoid-leaved evergreen shrubland with a dense moderately tall, ericoid-leaved shrubland as understorey. While extensive proteoid and restioid fynbos dominate the middle slopes, the unit is mainly comprised of asteraceous fynbos on the western and lower slopes. Ericaceous fynbos is restricted to the highest peaks. The deep sandy habitat of the northern plateau is a distinctive feature associated with many endemic species. Lithosol soils in this unit are derived from Ordovician sandstones of the Table Mountain Group (Cape Supergroup).

The unit comprises only about 531 km^2 of land area and is classified as Least Threatened. The conservation target is 30%, and 21% of the unit is statutorily conserved in the Riviersonderend Nature Reserve, with an additional 51% mainly in a private conservation area of the same name. The unit thus enjoys a high level of conservation. Furthermore, about 2% has been transformed by cultivation for protea nurseries and fruit orchards, specifically occurring the deep sands of the northern plateau, which supports many threatened taxa. Alien *Pinus pinaster* and *Hakea sericea* occasionally occur over about half of the area.

The northern slopes of the Riviersonderend Mountains are a poorly explored area. Data suggest that this unit, together with South Sonderend Sandstone Fynbos (FFs 14), form the centre of specific diversity in Proteaceae, especially for the genus *Serruria*, which may also be the case for other genera and families after further exploration. The genus *Endonema* (Penaeaceae) is endemic to the Riviersonderend Mountains.

Table 5: Key species associated with the North Sonderend Sandstone Fynbos according to Mucina and Rutherford (2006).

DOMINANT SPECIES	
Growth Form	**Key Species**
Small trees	*Acacia karroo, Cunonia capensis, Metrosideros angustifolia, Protea nitida*
Tall shrubs	*Protea neriifolia, P. repens, Polygala fruticosa, Protea laurifolia, Searsia pyroides*
Low shrubs	*Agathosma leptospermoides, Athanasia oocephala, Cliffortia ruscifolia, Elytropappus glandulosus, Erica denticulata, E. globiceps subsp. zeyheri, E. jonasiana, E. lateralis, E. modesta, E. plukenetii subsp. plukenetii, E. serrata, E. taxifolia, E. vestita, Leucadendron laureolum, L. microcephalum, L. salignum, Leucospermum calligerum, Muraltia ferox, Paranomus adiantifolius, P. capitatus, Passerina burchelii, Phaenocoma prolifera, Prismatocarpus lycioides, Protea amplexicaulis,*

	P. cynaroides, P. humiflora, P lorifolia, P. scabra, P. subulifolia, Serurria gremialis, S. viridifolia, Stoebe spiralis
Succulent shrubs	*Drosanthemum leptum, Ruschia acutangula*
Herbs	*Edmondia sesamoides, Ursinia oreogena*
Geophytic herb	*Gladiolus atropictus*
Graminoids	*Ehrharta ramosa subsp. aphylla, Hypodiscus squamosus, H. striatus, Ischyrolepis capensis, I. distracta, I. gaudichaudiana, Pentaschistis eriostoma, Restio filiformis, Thamnochortus cinereus*
ENDEMIC SPECIES	
Growth Form	**Key Species**
Low shrubs	*Leucadendron burchellii, L. immoderatum, L. nervosum, Leucospermum harpagonatum, Serruria stellata, S. williamsii, Spatalla argentea*

POSA species observations

A list was obtained from the SANBI database (POSA — Plants of southern Africa; http://posa.sanbi.org/) containing all plant species that have been recorded to date from the surroundings of the study area. POSA generated species lists also contain updated Red Data information according to the Red List of South African Plants, published by SANBI in Strelitzia 25 (Raimondo *et al*. 2009; updated online version: http://redlist.sanbi.org/?). Only protected and red data species that may potentially occur in the study area have been listed within the baseline study section of this report. The field surveys confirmed which of these species actually occur within the study area, and also revealed the presence of additional species that may not yet have been recorded in official databases.

A total of 1866 species have been recorded within the broader area based on the online plant search. Due to the fact that the impacted habitat type (sand dune) occurs as relatively small, scattered geographical patches within the region, plant species from two similar locations were extracted (see Figure 4). However, it should be noted that, due the extremely high diversity of vegetation types within the two polygons used for online data gathering, this plant richness estimate (i.e., 1866 species), is highly likely to be a gross overestimate, since the great majority of these species would not occur within the site area and vicinity, since they are adapted to other vegetation types and soils.

Ground truthing of the site confirmed a combined total of 109 plant species present within the proposed alternative areas, the broader area, and the already mined area (see Figure 7), of which 56 occur in Breede Sand Fynbos. A total of 11 species were alien.

From online data, the shrub and dwarf shrub layers were well represented with a high species diversity (dwarf shrubs = 426 species; shrubs = 504 species), similarly the lower herb/forb layer was also high in diversity with 397 species recorded in the broad region. The graminoid layer was lower in species diversity and is primarily represented by restioids (it is expected that even though restioids are lower in species diversity, these species would be relatively high in cover-abundance). Geophytic and succulent growth forms are also a prominent feature within the broader areas (geophytes = 246 species recorded; succulents = 213 species recorded).

Prominent families, in terms of species diversity, recorded within the extracted areas include:

» Asteraceae: 252 species;
» Ericaceae: 162 species;
» Fabaceae: 141 species;
» Iridaceae: 111 species;
» Proteaceae: 90 species;
» Aizoaceae: 89 species;
» Scrophulariaceae: 62 species; and
» Restionaceae: 54 species

Another unique feature of these areas is the high number of South African endemics with a total of 1365 (73%) SA endemics recorded. High numbers of endemics were observed with the plant families Aizoaceae, Asphodelaceae, Asteraceae, Ericaceae, Iridaceae, Geraniaceae, Restionaceae, and Proteaceae.

Furthermore, only 39 alien plant species were recorded within the extracted areas with 19 species being invasive. Of these 19 species, 10 species are listed within NEM:BA Act No. 10 of 2004 (Alien and Invasive Species List, 2016) namely;

» *Acacia saligna* (Fabaceae): Category 1b
» *Echium plantagineum* (Borainaceae): Category 1b;
» *Eucalyptus camaldulensis* (Myrtaceae): Category 1b within fynbos;
» *Leptospermum laevigatum* (Myrtaceae): Category 1b;
» *Orobanche ramosa* (Orobanchaceae): Category 1b;
» *Ricinus communis* (Euphorbiaceae): Category 2;
» *Salsola kali* (Amaranthaceae): Category 1b
» *Schinus molle* (Anacardiaceae): Category 3;
» *Sesbania punicea* (Fabaceae): Category 1b;
» *Xanthium strumarium* (Asteraceae): Category 1b

4.2 Species of Conservation Concern

A total of 173 Species of Conservation Concern plant species are known to occur in the broad area surrounding the site, as obtained from the SANBI POSA database and Threatened Species Programme, Red List of South African Plants (2011; http://redlist.sanbi.org/?). These species are listed below in Table 6.

The majority of these species are from the families Proteaceae (protea family; 29 species) and Fabaceae (pea family; 21 species). Furthermore, it includes 104 Threatened Species (8 Critically Endangered, 31 Endangered species, 65 Vulnerable).

As mentioned, the online list includes a much broader area than the actual site, and as a result, the actual number of species of conservation concern which might occur within the site should be significantly less. However, this precautionary measure of including a larger area allows for adequate information to be extracted and evaluated.

A total of 521 species have been recorded within the extracted areas which are Protected (Schedule 4) within the Nature Conservation Ordinance No. 19 of 1974 and Western Cape Nature Conservation Laws Amendment Act (No. 3 of 2000). The high number of protected species is mainly due to the fact that all species within the families Amaryllidaceae, Bruniaceae, Ericacea, Iridaceae, Orchidaceae, Proteaceae, and Rutaceae are protected, and are families which are well represented within this region.

Only one nationally protected tree (under the National Forests Act, 1998 – Act No. 84 of 1998) has been recorded, namely *Podocarpus elongatus*.

Table 6: Red List Flora species that have been listed within the SANBI POSA database and that have been recorded within the broad region surrounding the study site.

Family	Species	IUCN	Family	Species	IUCN
Asteraceae	*Zyrphelis nervosa*	CR	Proteaceae	*Protea longifolia*	VU
Fabaceae	*Wiborgiella bowieana*	CR	Proteaceae	*Protea restionifolia*	VU
Oxalidaceae	*Oxalis pseudohirta*	CR	Proteaceae	*Serruria stellata*	VU
Proteaceae	*Leucadendron globosum*	CR	Proteaceae	*Serruria viridifolia*	VU
Proteaceae	*Leucadendron thymifolium*	CR	Rosaceae	*Cliffortia cruciata*	VU
Proteaceae	*Leucospermum harpagonatum*	CR	Rosaceae	*Cliffortia integerrima*	VU
Proteaceae	*Protea caespitosa*	CR	Ruscaceae	*Eriospermum bowieanum*	VU
Proteaceae	*Serruria aemula*	CR	Rutaceae	*Agathosma leptospermoides*	VU
Aizoaceae	*Acrodon purpureostylus*	EN	Rutaceae	*Agathosma microcarpa*	VU

Asphodelaceae	*Gasteria disticha*	EN	Rutaceae	*Agathosma pulchella*	VU
Asteraceae	*Lidbeckia pinnata*	EN	Rutaceae	*Agathosma serratifolia*	VU
Asteraceae	*Stoebe rugulosa*	EN	Rutaceae	*Agathosma trichocarpa*	VU
Bruniaceae	*Brunia esterhuyseniae*	EN	Rutaceae	*Diosma passerinoides*	VU
Campanulaceae	*Merciera brevifolia*	EN	Rutaceae	*Diosma pilosa*	VU
Ericaceae	*Erica modesta*	EN	Rutaceae	*Euchaetis pungens*	VU
Ericaceae	*Erica oakesiorum*	EN	Stilbaceae	*Stilbe serrulata*	VU
Fabaceae	*Aspalathus candicans*	EN	Thymelaeaceae	*Lachnaea grandiflora*	VU
Fabaceae	*Aspalathus wurmbeana*	EN	Aizoaceae	*Brianhuntleya intrusa*	NT
Geraniaceae	*Pelargonium violiflorum*	EN	Aizoaceae	*Drosanthemum calycinum*	NT
Hyacinthaceae	*Lachenalia physocaulos*	EN	Asphodelaceae	*Trachyandra filiformis*	NT
Hyacinthaceae	*Lachenalia stayneri*	EN	Asteraceae	*Lachnospermum neglectum*	NT
Iridaceae	*Freesia marginata*	EN	Asteraceae	*Metalasia adunca*	NT
Iridaceae	*Geissorhiza geminata*	EN	Boraginaceae	*Lobostemon gracilis*	NT
Iridaceae	*Ixia atrandra*	EN	Euphorbiaceae	*Euphorbia nesemannii*	NT
Iridaceae	*Ixia collina*	EN	Fabaceae	*Aspalathus lactea*	NT
Iridaceae	*Ixia pumilio*	EN	Fabaceae	*Cyclopia genistoides*	NT
Iridaceae	*Moraea radians*	EN	Fabaceae	*Lotononis prostrata*	NT
Orchidaceae	*Disa hallackii*	EN	Fabaceae	*Wiborgia tenuifolia*	NT
Penaeaceae	*Endonema lateriflora*	EN	Geraniaceae	*Pelargonium divisifolium*	NT
Plumbaginaceae	*Limonium purpuratum*	EN	Hyacinthaceae	*Lachenalia contaminata*	NT
Polygalaceae	*Muraltia gillettiae*	EN	Iridaceae	*Babiana fragrans*	NT
Proteaceae	*Leucospermum formosum*	EN	Iridaceae	*Babiana stricta*	NT
Proteaceae	*Mimetes argenteus*	EN	Iridaceae	*Freesia caryophyllacea*	NT
Proteaceae	*Protea lacticolor*	EN	Iridaceae	*Watsonia aletroides*	NT
Proteaceae	*Serruria incrassata*	EN	Polygalaceae	*Muraltia concava*	NT
Proteaceae	*Serruria williamsii*	EN	Polygalaceae	*Muraltia trinervia*	NT
Proteaceae	*Spatalla argentea*	EN	Proteaceae	*Aulax pallasia*	NT
Ruscaceae	*Eriospermum vermiforme*	EN	Proteaceae	*Aulax umbellata*	NT
Rutaceae	*Diosma parvula*	EN	Proteaceae	*Leucadendron burchellii*	NT
Aizoaceae	*Antimima leipoldtii*	VU	Proteaceae	*Leucadendron nervosum*	NT
Aizoaceae	*Drosanthemum giffenii*	VU	Proteaceae	*Leucadendron teretifolium*	NT
Aizoaceae	*Drosanthemum striatum*	VU	Proteaceae	*Protea coronata*	NT
Aizoaceae	*Erepsia oxysepala*	VU	Proteaceae	*Protea cryophila*	NT
Aizoaceae	*Stayneria neilii*	VU	Proteaceae	*Protea effusa*	NT
Apiaceae	*Centella thesioides*	VU	Proteaceae	*Protea scabra*	NT
Apocynaceae	*Duvalia elegans*	VU	Proteaceae	*Serruria elongata*	NT
Apocynaceae	*Stapelia paniculata*	VU	Proteaceae	*Serruria fasciflora*	NT
Apocynaceae	*Stapeliopsis breviloba*	VU	Proteaceae	*Spatalla curvifolia*	NT
Asphodelaceae	*Astroloba rubriflora*	VU	Rhamnaceae	*Phylica nigrita*	NT
Asteraceae	*Anaxeton brevipes*	VU	Rutaceae	*Agathosma foetidissima*	NT
Asteraceae	*Anaxeton hirsutum*	VU	Rutaceae	*Diosma pedicellata*	NT
Asteraceae	*Berkheya angusta*	VU	Thymelaeaceae	*Lachnaea filicaulis*	NT
Asteraceae	*Metalasia tenuis*	VU	Aizoaceae	*Antimima microphylla*	DD

Bruniaceae	*Brunia latebracteata*	VU	Aizoaceae	*Drosanthemum albiflorum*	DD
Colchicaceae	*Colchicum hughocymbion*	VU	Aizoaceae	*Drosanthemum collinum*	DD
Ericaceae	*Erica alfredii*	VU	Aizoaceae	*Drosanthemum globosum*	DD
Ericaceae	*Erica caledonica*	VU	Aizoaceae	*Drosanthemum papillatum*	DD
Ericaceae	*Erica colorans*	VU	Aizoaceae	*Lampranthus falcatus*	DD
Ericaceae	*Erica floccifera*	VU	Aizoaceae	*Lampranthus leipoldtii*	DD
Ericaceae	*Erica ignita*	VU	Aizoaceae	*Lampranthus occultans*	DD
Ericaceae	*Erica insolitanthera*	VU	Apocynaceae	*Ceropegia fimbriata*	DD
Ericaceae	*Erica pilosiflora*	VU	Apocynaceae	*Tavaresia meintjesii*	DD
Ericaceae	*Erica sicifolia*	VU	Asphodelaceae	*Haworthia herbacea*	DD
Ericaceae	*Erica viscidiflora*	VU	Asteraceae	*Curio crassulifolius*	DD
Fabaceae	*Amphithalea pageae*	VU	Asteraceae	*Senecio coleophyllus*	DD
Fabaceae	*Aspalathus acanthoclada*	VU	Asteraceae	*Senecio erysimoides*	DD
Fabaceae	*Aspalathus angustifolia*	VU	Asteraceae	*Senecio glutinarius*	DD
Fabaceae	*Aspalathus araneosa*	VU	Ericaceae	*Erica greyi*	DD
Fabaceae	*Aspalathus chrysantha*	VU	Ericaceae	*Erica haemastoma*	DD
Fabaceae	*Aspalathus excelsa*	VU	Ericaceae	*Erica involvens*	DD
Fabaceae	*Aspalathus florulenta*	VU	Ericaceae	*Erica longistyla*	DD
Fabaceae	*Aspalathus lactea*	VU	Ericaceae	*Erica ostiaria*	DD
Fabaceae	*Aspalathus macrocarpa*	VU	Ericaceae	*Erica ovina*	DD
Fabaceae	*Aspalathus pinguis*	VU	Hyacinthaceae	*Ornithogalum niveum*	DD
Fabaceae	*Aspalathus recurva*	VU	Malvaceae	*Anisodontea gracilis*	DD
Fabaceae	*Aspalathus steudeliana*	VU	Oxalidaceae	*Oxalis leptocalyx*	DD
Fabaceae	*Lotononis involucrata*	VU	Oxalidaceae	*Oxalis lindaviana*	DD
Fabaceae	*Lotononis rigida*	VU	Oxalidaceae	*Oxalis pardalis*	DD
Iridaceae	*Chasmanthe bicolor*	VU	Polygalaceae	*Muraltia schlechteri*	DD
Iridaceae	*Geissorhiza brehmii*	VU	Rhamnaceae	*Phylica lucens*	DD
Iridaceae	*Gladiolus atropictus*	VU	Rosaceae	*Cliffortia varians*	DD
Iridaceae	*Ixia dolichosiphon*	VU	Santalaceae	*Thesium brachygyne*	DD
Iridaceae	*Ixia vanzijliae*	VU	Santalaceae	*Thesium frisea*	DD
Oxalidaceae	*Oxalis meisneri*	VU	Santalaceae	*Thesium microcarpum*	DD
Penaeaceae	*Endonema retzioides*	VU	Santalaceae	*Thesium repandum*	DD
Proteaceae	*Leucadendron galpinii*	VU	Scrophulariaceae	*Pseudoselago burmannii*	DD
Proteaceae	*Protea burchellii*	VU			

4.3 Conservation Planning / Context

4.3.1 National Protected Areas Expansion Strategy

Land-based protected area expansion targets include large, intact, and unfragmented areas of high importance for biodiversity representation and ecological persistence, which are suitable for the creation or expansion of large

protected areas. Such areas were identified through a systematic biodiversity planning process undertaken as part of the development of the National Protected Area Expansion Strategy 2008 (NPAES). They present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES, and were designed with a strong emphasis on climate change resilience and requirements for protecting freshwater ecosystems. These areas should not be seen as future boundaries of protected areas, since in many cases only a portion of a particular focus area would be required to meet the protected area targets set in NPAES. They are also not a replacement for fine-scale planning, which may identify a range of different priority sites based on local requirements, constraints, and opportunities.

The proposed alternative areas are not located within any NPAES Areas or any Formal-/Informal Protected Areas. The nearest NPAES Area is located approximately 1.03 km south-east of the site (namely, Vrolijkheid), whilst the nearest Informal Protected Area is located ± 7.8 km south-west (Skuilkrans Private Nature Reserve). The nearest Formal Protected Area, the Langeberg-Wes Mountain Catchment Area, is located 7.6 km north of the project site.

The proposed development will thus not have an impact on the national ecosystem-specific protected area targets.

4.3.2 National Level of Conservation Priorities (Threatened Ecosystems)

South Africa's vegetation types have been assigned a conservation status according to their respective degrees of transformation and rates of conservation. The conservation status of a habitat or vegetation type is based on the amount of its original area that currently remains intact relative to various thresholds. On a national scale, these thresholds are arranged from Least Threatened to Critically Endangered (Figure 8), as determined by the best available scientific approaches (Driver et al. 2005). The level at which an ecosystem becomes Critically Endangered depends on biodiversity targets, and therefore differs from one ecosystem to another, varying from 16% to 36% (Driver et al. 2005).

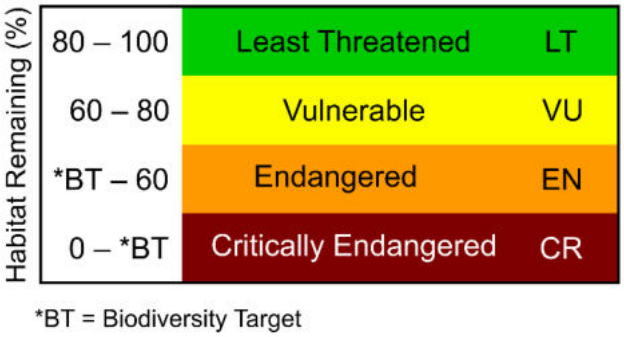

Figure 8: Ecosystem threat status categories as per Driver et al. (2005). The biodiversity target represents the minimum conservation requirement.

Nationally, threatened ecosystems that are currently under threat of being transformed by other land uses have been identified and listed. The first national list of threatened terrestrial ecosystems for South Africa was gazetted on 9 December 2011 (NEM:BA National list of ecosystems that are threatened and in need of protection, G 34809, GoN 1002, 9 December 2011). The primary purpose of listing threatened ecosystems is to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function, and composition of threatened ecosystems (SANBI, 2011). NEM:BA lists threatened or protected ecosystems in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU), or protected. There are four main implications of listing ecosystems:

» Planning related implications which are linked to the requirement in the Biodiversity Act (Act 10 of 2004) for listed ecosystems to be taken into account in municipal IDPs and SDFs;
» Environmental authorisation implications in terms of NEMA and the EIA regulations;
» Proactive management implications in terms of the National Biodiversity Act;
» Monitoring and reporting implications in terms of the Biodiversity Act.

All three proposed mining alternative areas are located within one vegetation type (Breede Sand Fynbos), and close by another (North Sonderend Sandstone Fynbos) (Mucina and Rutherford, 2006). Currently, the first type, namely Breede Sand Fynbos, is classified as Vulnerable (Figure 9), since only 2% is protected in the Hawequas and Quaggas Berg Private Nature Reserves, while none of the unit is conserved in statutory conservation areas, and some 45% of the area has been transformed, and this ecosystem is thus very fragmented. The conservation target of 30% could be attained, but will probably not be realized since only 2% is currently protected. The second type, namely North Sonderend Sandstone Fynbos, is classified as Least Threatened, since 21% of the 30% conservation target is

statutorily conserved in the Riviersonderend Nature Reserve, with an additional 51% mainly in a private conservation area of the same name, while only low levels of transformation has occurred.

Although the project site is located on a dune plume that, as currently mapped (Mucina and Rutherford 2012/2018), covers an area of approximately 597 ha, the true extent of this is likely much less (see section 5).

Due to the high impact nature of the proposed mining activities, which essentially removes all vegetation and topsoil, these activities will result in the local loss of some species, functions, and services, unless rehabilitated. However, on site observations show that if an adequate layer of sand is reintroduced after mining, then rehabilitation of the site, with retention of many Species of Conservation Concern, is a distinct possibility (see section 7).

Approximately 148 ha of pristine Breede Sand Fynbos exists on site (see section 5). About 2.7% of this will thus be transformed by the proposed mining extension. Taking into account the total combined size (max. 30 km^2, see section 4.1) of all currently mapped Breede Sand Fynbos, an area of less than 1% (0.13% of 3026 ha) of this vegetation type / ecosystem will be impacted by the proposed mining activities.

Table 7: Conservation status of the vegetation type occurring in and around the study area.

Vegetation Type	Target (%)	Transformed (%)	Conserved (Statutorily & other reserves)	Conservation Status	
				Driver *et al.*, 2005; Mucina & Rutherford, 2006	National Ecosystem List (NEMA:BA)
Breede Sand Fynbos	30%	45%	2%	Vulnerable	Vulnerable
North Sonderend Sandstone Fynbos	30%	2%	72%	Least Threatened	Not Listed

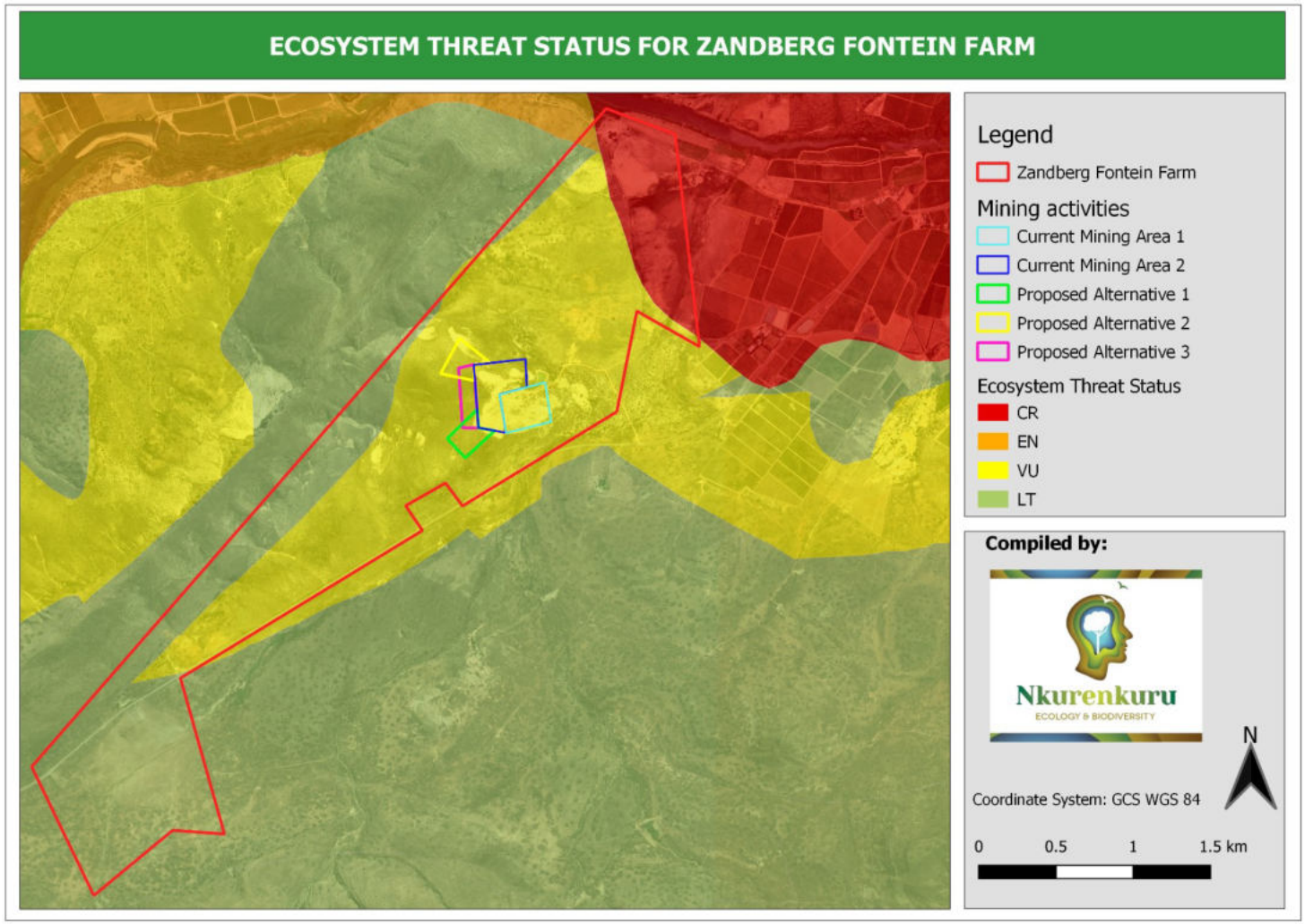

Figure 9: Threat status of ecosystems/vegetation types on Zandberg Fontein farm.

4.3.3 Critical Biodiversity Areas and Broad Scale Ecological Processes

Critical Biodiversity Areas (CBA) have been identified for all municipal areas of the Western Cape Province (CapeNature, 2017) and are published by SANBI (bgis.sanbi.org). This biodiversity assessment identifies CBAs representing biodiversity priority areas that should be maintained in a natural to near-natural state. CBA maps show the most efficient selection and classification of land portions to be safeguarded so that ecosystem functioning is maintained and national biodiversity objectives are met (see Table 8 for CBA land management objectives).

All three proposed mining alternative areas (and most of the farm) are located almost entirely within a CBA1, together with some randomly scattered pixels of, and a small unclassified portion (Figure 10). The insignificant and random nature of the CBA2 pixels are likely a side-effect of the algorithm used to generate the CBA spatial layers. Ground-truthing confirmed that both proposed mining alternative areas conform to CBA1 criteria, including a portion not originally classified. Areas classified as CBA1 are regarded as "areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure" (WCSBP 2017). Thus, CBA1 areas are in a natural condition (or nearly so), with little to zero transformation and no secondary vegetation. The desired outcome for such areas is to maintain them "in a natural or near natural state, with no further loss of habitat", and only "low-impact, biodiversity-sensitive land uses" are appropriate.

Table 8: Relationship between Critical Biodiversity Areas categories (CBAs) and land management objectives

CBA category	Land Management Objective
Protected Areas (PA) & CBA 1	***Natural landscapes:*** » Ecosystems and species are fully intact and undisturbed. » Areas with high irreplaceability or low flexibility in terms of meeting biodiversity pattern targets. If the biodiversity features targeted in these areas are lost then targets will not be met. » Landscapes that are at or past their limits of acceptable change.
CBA 2	***Near-natural landscapes:*** » Ecosystems and species largely intact and undisturbed. » Areas with intermediate irreplaceability or some flexibility in terms of the area required to meet biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising the ability to achieve targets. » Landscapes that are approaching but have not passed their limits of acceptable change.
ESA	***Functional landscapes:*** » Ecosystem moderately to significantly disturbed but still able to maintain basic functionality.

	» Individual species or other biodiversity indicators may be severely disturbed or reduced. » Areas with low irreplaceability with respect to biodiversity pattern targets only.
ONA (Other Natural Areas) and Transformed	***Production landscapes***: » Manage land to optimise sustainable utilisation of natural resources.

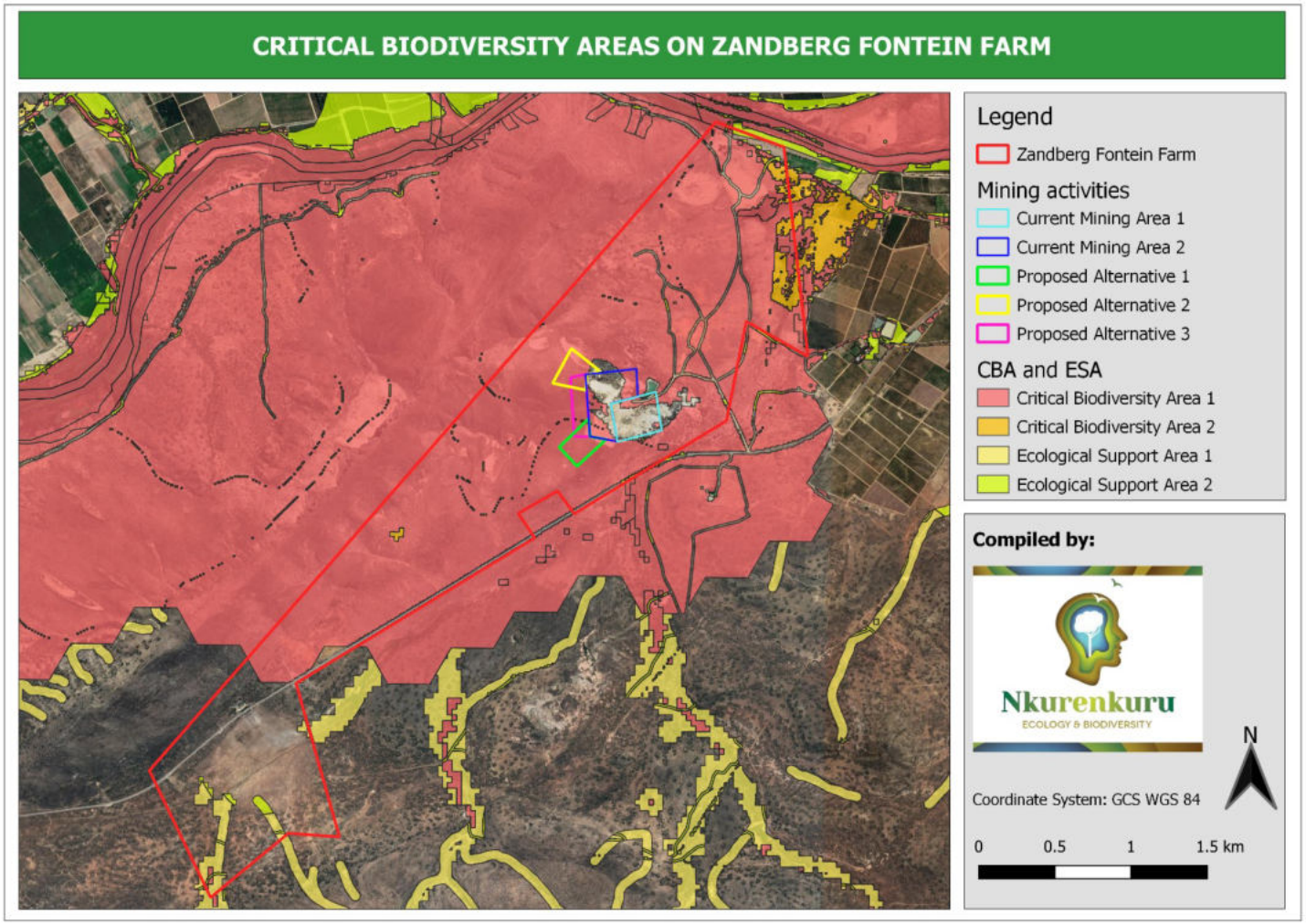

Figure 10: Critical biodiversity areas (CBA) found on Zandberg Fontein farm and in relation to the proposed alternative mining areas.

5. FINDINGS OF THE BOTANICAL ASSESSMENT

5.1 Site Specific Vegetation Description - Fine Scale Vegetation Patterns

In this section, the different habitats and vegetation patterns observed within the study site are described, but are limited to Breede Sand Fynbos (since it is the vegetation type that will directly be impacted by the proposed alternative mining areas) and North Sonderend Sandstone Fynbos (since it is the closest other vegetation type to the propose alternative areas). As these are field-based observations taken directly from the site, they are of greater reliability and pertinence than the results of the National Vegetation Map, which represents a coarse scale and does not represent the detail of the site adequately. A summary of the habitat units is given by Tables 9 – 11, and relevant photos and maps are shown by Figures 11 – 13.

The vegetation of the alternative mining areas, as well as the majority of the site in the vicinity of the alternative areas, is of pristine Breede Sand Fynbos (see Figure 11 for representative photos), together with pristine North Sonderend Sandstone Fynbos along the northern part of the farm boundary (Figure 12). Of Breede Sand Fynbos, there exists a pristine main contiguous unit (in which occur all three proposed alternative areas), together with a smaller unit in the north-eastern corner of the farm. Furthermore, two degraded (one moderate, the other heavily) Breede Sand Fynbos units on the property. The moderately degraded unit has already undergone passive restoration, and shares many elements of pristine Breede Sand Fynbos. This unit is reported to have been mined by the previous owners many years ago (personal communication Trudi Viljoen). The heavily degraded area, however, is under heavy invasive *Acacia saligna* infestation, and has been heavily overgrazed by cattle (see section 7 for detailed discussion). The extent of the Breede Sand Fynbos was less than what has been mapped according to the Vegetation Map of South Africa (Mucina & Rutherford 2012/2018).

Other vegetation types, which are not discussed in detail here, are an intermediate/transitional North Sonderend Sandstone Fynbos type that manifests where the sand layer becomes shallow, thereby exposing the underlaying sandstone, as well as a large section of Robertson Karoo.

In terms of Breede Sand Fynbos, there was some variability in habitat types, mostly related to vegetation cover. In other words, the existence of mobile, or windblown, dunes with sparse vegetation cover, are found across the site, which progresses towards semi-mobile dunes with moderate cover, to stabilised dunes with high

vegetation cover. These different habitat types do not, however, vary substantially in species composition, but only in cover. The same suite of species are found in all these types.

The majority of the vegetation was relatively uniform. The tall shrub layer had Proteaceae species alternating in dominance, such as *Protea laurifolia* (especially noticeable south of current mining area 1, and proposed alternative area 1)*, Leucospermum calligerum, and Leucadendron salignum*, together with scattered individuals of *Wiborgia obcordata.* The medium to small shrub layer was dominated by *Aspalathus lactea, A. quinquefolia*, *Erica plumosa*, *Erica serrata*, *Euchaetis pungens*, and *Metalasia adunca*. Although the site had relatively few forb species, smaller shrubs and plants that were abundant included *Aristea dichotoma, Oxalis obtusa*, *Prismatocarpus brevilobus*, *Wahlenbergia nodosa*, and *Polpoda capensis*. Finally, the graminoid layer was dominated by *Thamnochortus lucens* and *Willdenowia incurvata,* with less dominant *Pentameris pallida* and *Stipagrostis zeyheri*. The vegetation unit in its entirety was pristine, with no signs of previous transformation or secondary vegetation. Also, no invasive alien plant species were observed within the pristine Breede Sand Fynbos units.

In terms of North Sonderend Sandstone Fynbos, the extent of the vegetation unit was also less than what has been mapped according to the Vegetation Map of South Africa (Mucina & Rutherford 2012/2018). The true extent of the North Sonderend Sandstone Fynbos vegetation unit was limited to the northern border of the farm, and is characterised by increased altitude. The vegetation type is thus confined to the steep mountain slopes quite some distance from the current and proposed mining activities, and is unlikely to be affected by them. The tall shrub layer again included species from the Proteaceae, such as *Protea laurifolia*, *P. nitida*, and *Leucadendron salignum*, together with *Serruria gremialis*, and the rock-loving species *Maytenus oleoides* was observed growing in between many of the exposed sandstone crevices, with other typical species being *Cliffortia ruscifolia*, *Podalyria calyptrata*, *Stayneria neilii*, *Syncarpha canescens* subsp. *canescens*, and *Searsia dissecta*. The medium height shrub layer was dominated by *Aspalathus burchelliana* and *A. hirta*. The graminoid layer was dominated by the grass *Capeochloa cincta*.

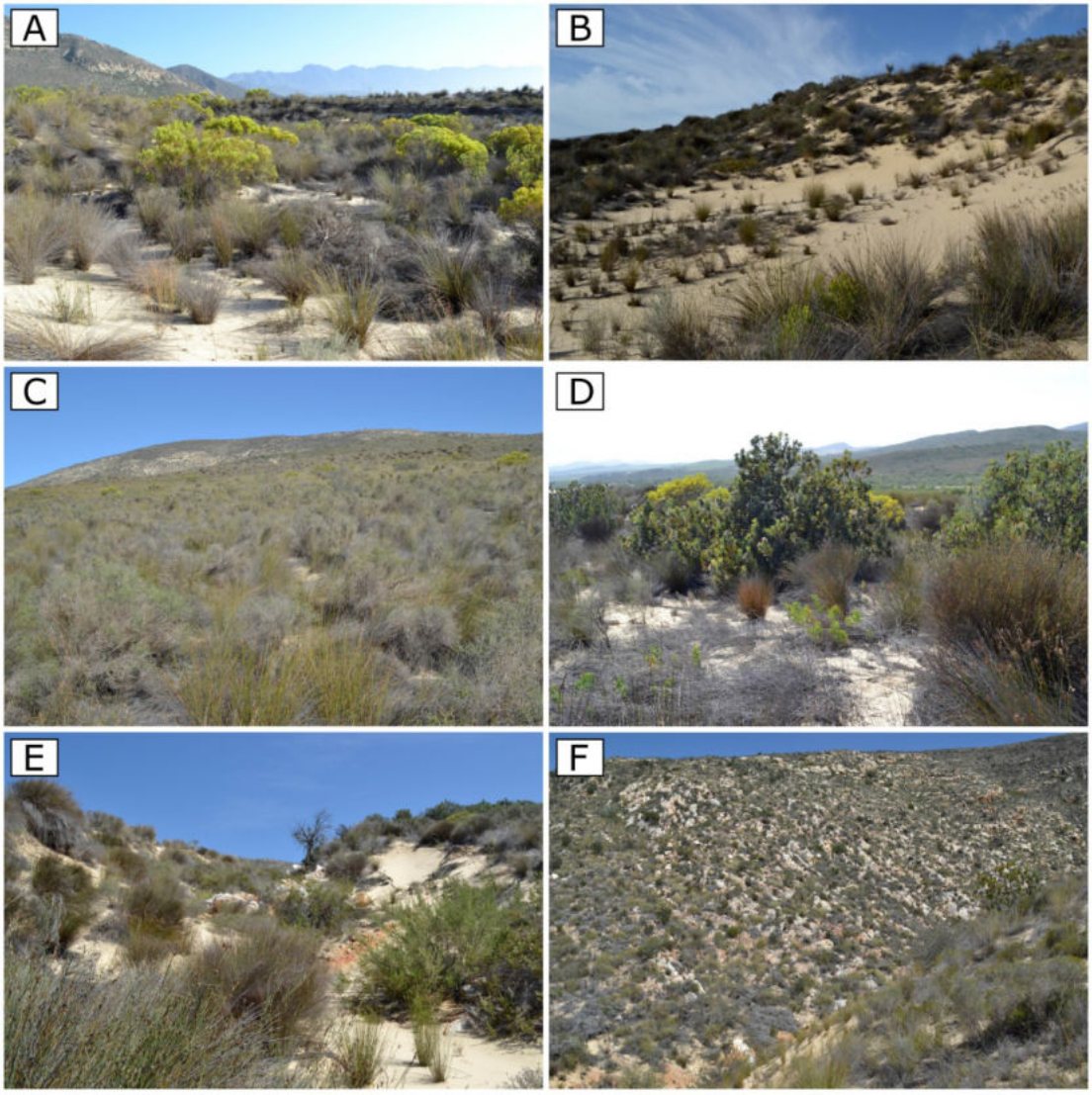

Figure 11: Representative photos of Breede Sand Fynbos and North Sonderend Sandstone Fynbos on site. A) and B) vegetation of semi-mobile dunes showing prominent *Leucadendron salignum* (light green in A), as well as moderate to sparse vegetation cover, C) dense vegetation cover of stabilised dunes with dominant *Aspalathus* and *Thamnochortus*, D) patch of *Protea laurifolia* growing together with *Leucadendron salignum* and *Willdenowia incurvata* on the lower foot slopes of the mountains, E) view upstream of a drainage line showing exposed sandstone lithology, and F) north-east facing slope of North Sonderend Sandstone Fynbos bordering a drainage line in the south-western part of the farm.

Table 9: Summary of results for the fynbos habitat occupying the stabilised dune plume.

<table>
<tr><td rowspan="3">Fynbos of the stabilised dune portions</td><td>Habitat Sensitivity</td><td>High</td><td colspan="3" rowspan="3"><u>Photographs:</u>
  </td></tr>
<tr><td>No-Go Areas</td><td>All areas outside of the proposed alternative areas.</td></tr>
<tr><td>Present Ecological Status (PES)</td><td>A: Unmodified, natural</td></tr>
<tr><td>Substrate</td><td colspan="3">» Deep aeolain sand
» Regic Sand: Recently deposited aeolain sand with very minimal evidence of pedogenesis apart from some very slight coloration of the surface due to the accumulation of organic material.
» Moderately fine textured with a loose friable consistency.
» Stabilised with a dense, well developed fynbos cover.</td></tr>
<tr><td>Species richness</td><td colspan="2">56 Indigenous Species (including mobile and semimobile dunes)</td><td>Dominant and diagnostic species:</td><td colspan="2">Aspalathus lactea, Leucadendron salignum, Thamnochortus lucens, Willdenowia incurvata</td></tr>
<tr><td>Alien Invasive Plants</td><td colspan="2">None recorded</td><td>Conservation Important Flora:</td><td colspan="2">Red Data (ICUN Listed): Aspalathus lactea subsp. breviloba, Babiana leipoldtii, Euchaetis pungens, Lachnaea uniflora, Metalasia adunca, Ruschia pungens; Provincially Protected: Aristea dichotoma, Babiana leipoldtii, Babiana ringens subsp. ringens, Brunsvigia orientalis, Carpobrotus edulis subsp. edulis, Erica imbricata, Erica plumosa, Erica serrata, Erica similis, Erica sonderiana, Euchaetis pungens, Gladiolus carinatus, Leucadendron salignum, Leucospermum calligerum, Protea</td></tr>
</table>

			laurifolia, Ruschia pungens, Ruschiella argentea, Tetragonia fruticosa
Slope & Geomorphological Setting	» Dune plumes that have settled along the south-eastern slope of the Sandberg Mountain Range (narrow mountain range running in south-west to north-east direction. » Steep slopes are associated with incised drainage valleys running parallel to the mountain range. » Moderate-steep to steep slopes.	**Naturalness:**	**High** Mostly natural and undisturbed area covered by a well-developed, dense, climax fynbos type providing stability to the dune plume.
Disturbance	» Minimal to no disturbance	**Anthropogenic importance and potential**	**Agricultural Potential: Low** » Game Farming: Some grazing potential for scarce game / wildlife such as Cape Mountain Zebra (*Equus zebra zebra*), Grey Rhebok (*Pelea capreolus*), Bontebok (*Damaliscus pygargus dorcas*) and Cape Grysbok (*Raphicerus melanotis*)
Habitat & Biotic Integrity:	**Very-High** » The majority of the mountain range and associated dune plumes are in a natural to near-natural condition with minimal disturbance. » Sand plumes can be regarded as unique, complex habitats inhabited by specialists; subsequently these habitats contribute to habitat and niche diversity within the region. » Dense fynbos vegetation helps slow down surface runoff and stabilise sand plumes. » Potential/suitable habitat for rare/conservation important faunal species such as Cape Mountain Zebra (*Equus zebra zebra*), Grey Rhebok (*Pelea capreolus*), Bontebok (*Damaliscus pygargus dorcas*), Cape Grysbok (*Raphicerus melanotis*), Cape Golden Mole (*Chrysochloris asiatica*), White-tailed Mouse (*Mystromys albicaudatus*), Cape Spiny Mouse (*Acomys subspinosus*) » A permanent vegetation cover is necessary to maintain the functionality and stability of this ecosystem	**Conservation value**	**High** » Listed as Vulnerable within the National Threatened Ecosystem List (2011) » Listed as a Vulnerable Vegetation Type (Mucina & Rutherford, 2012; BSP 2016) » Located within a CBA1 area which is vital for meeting provincial conservation targets. » Recorded Red Data flora species » Recorded Provincially Protected (Schedule 4) flora » Natural habitat. » Potential / suitable habitat for conservation important faunal species.

Conclusion and Mitigation Requirements	» This area is of a high ecological sensitivity and high conservation value. » It is recommended that if an alternative area is approved for mining, that a biodiversity offset be implemented so as to protect the remaining habitats. » Very small-scale development activities are unlikely to have a significant impact on regional ecological functionality if strict mitigation measures are implemented (e.g., biodiversity offsets), especially in terms of the establishment of a stable vegetation cover post-mining and the management and eradication of potential Invasive Alien Plants (IAPs). » Operational activities should strictly be implemented only within a proposed alternative area indicated in this study. » No Species of Conservation Concern may be re-located, disturbed, or destroyed without the necessary Permits in place (obtained from the relevant nature conservation authorities) » A vegetation rehabilitation and management plan is vital for the stabilisation of soils and the prevention of potential erosion from occurring or becoming exacerbated. » An invasive alien plant management plan should be compiled and address the mitigation and management of such species throughout the operational phase as well as post-operational phase. » Phased development / mining should occur where small strips are mined at a time, and as a strip becomes exhausted (in terms of the mined resource), immediate rehabilitation should be initiated, whilst mining of a new strip commences. » Rehabilitation progress, erosion control, and IAP monitoring can occur simultaneously post-operational phase and should occur bi-annually for a minimum of two years.

Table 10: Summary of results for the fynbos habitat occupying the semi-mobile and mobile sections of the dune plume.

<table>
<tr><td rowspan="3">Fynbos of the mobile and semi-mobile dune plumes</td><td>Habitat Sensitivity</td><td>High</td><td colspan="3" rowspan="3"><u>Photographs:</u>
  </td></tr>
<tr><td>No-Go Areas</td><td>All areas outside of the proposed alternative areas.</td></tr>
<tr><td>Present Ecological Status (PES)</td><td>A: Unmodified, natural</td></tr>
<tr><td>Substrate</td><td colspan="3">» Active portions of the dune plume with sparse to moderate vegetation cover
» Deep aeolain sand
» Regic Sand: Recently deposited aeolain sand with almost no evidence of pedogenesis.
» Fine textured with a loose friable consistency.</td></tr>
<tr><td>Species richness</td><td colspan="2">56 Indigenous Species (including mobile and semimobile dunes)</td><td>Dominant and diagnostic species:</td><td colspan="2">Aspalathus lactea, Aspalathus quinquefolia, Leucadendron salignum, Metalasia adunca, Polpoda capensis, Willdenowia incurvata, Willdenowia sulcata</td></tr>
<tr><td>Alien Invasive Plants</td><td colspan="2">None recorded</td><td>Conservation Important Flora:</td><td colspan="2">Red Data (ICUN Listed): Aspalathus lactea, Euchaetis pungens, Metalasia adunca; Provincially Protected: Aristea dichotoma, Erica similis, E. sonderiana, Euchaetis pungens, Leucadendron salignum</td></tr>
<tr><td>Slope & Geomorphological Setting</td><td colspan="2">» Typically, these mobile to semi-mobile portions of the dune plume (that have settled along the south-eastern slope of the Sandberg Mountain Range) are associated with the lower- and footslope sections of the north-facing aspect of this dune plume.</td><td>Naturalness:</td><td colspan="2">High

These are naturally active portions of the dune plume and even though vegetation cover may be sparse or even absent, the</td></tr>
</table>

	» Moderate slopes		vegetation that is present is completely natural and characteristic of such areas.
Disturbance	» No anthropogenic or artificial disturbances » This is a dynamic, active portion of the dune exposed to natural disturbances such as sand deposition and removal.	**Anthropogenic importance and potential**	**Agricultural Potential: Very Low**
Habitat & Biotic Integrity:	**Moderate-Low** » Natural to near-natural condition with minimal disturbance. » Low vegetation cover. » Unique, dynamic, and complex habitat, inhabited by habitat specialists (however diversity is expected to be low), subsequently this habitat type contributes to somewhat to habitat and niche diversity within the region. » Fynbos vegetation within semi-mobile areas provide some stabilisation to these areas, preventing the mobile areas from encroaching into the natural dense vegetated portions surrounding these areas. » Ecosystem functions and services are minimal.	**Conservation value**	**High** » Listed as Vulnerable within the National Threatened Ecosystem List (2011) » Listed as a Vulnerable Vegetation Type (Mucina & Rutherford, 2012/2018; BSP 2017) » Located within a CBA1 area which is vital for meeting provincial conservation targets. » Recorded Red Data flora species » Recorded Provincially Protected (Schedule 4) flora » Natural habitat. » Natural vegetation within semi-mobile areas provide some stabilisation to these areas and provide a valuable function / service in preventing the mobile areas from encroaching into the natural dense vegetated portions surrounding these areas which have a high conservation value.
Conclusion and Mitigation Requirements	» This area is of a high ecological sensitivity and high conservation value. » It is recommended that if an alternative area is approved for mining, that a biodiversity offset be implemented so as to protect the remaining habitats. » Very small-scale development activities are unlikely to have a significant impact on regional ecological functionality if strict mitigation measures are implemented (e.g., biodiversity offsets), especially in terms of the establishment of a stable vegetation cover post-mining and the management and eradication of potential Invasive Alien Plants (IAPs). » Operational activities should strictly be implemented only within a proposed alternative area indicated in this study. » No Species of Conservation Concern may be re-located, disturbed, or destroyed without the necessary Permits in place (obtained from the relevant nature conservation authorities) » A vegetation rehabilitation and management plan is vital for the stabilisation of soils and the prevention of potential erosion from occurring or becoming exacerbated. » An invasive alien plant management plan should be compiled and address the mitigation and management of such species throughout the operational phase as well as post-operational phase. » Phased development / mining should occur where small strips are mined at a time, and as a strip becomes exhausted (in terms of the mined resource), immediate rehabilitation should be initiated, whilst mining of a new strip commences.		

	Rehabilitation progress, erosion control, and IAP monitoring can occur simultaneously post-operational phase and should occur bi-annually for a minimum of two years.

Table 11: Summary of results for the drainage lines.

Fynbos occurring on sandstone bordering drainage lines	**Habitat Sensitivity**	**High**
	No-Go Areas	All drainage lines should be regarded as No-Go Areas, unless approved by a hydrologist/wetland specialist.
	Present Ecological Status (PES)	**A: Unmodified, natural**
Substrate	» Upper slopes: o Soils mostly absent (eroded by water runoff) o Exposed bedrock, and large boulders. » Lower slopes: o Variable soil depth. o Soils removed in some areas due to erosion exposing bedrock and boulders o Some areas containing moderately deep, fine textured, alluvial and aeolain soils (areas where surface flow have sufficiently slowed down for deposition to occur).	
Slope & Geomorphological Setting	» Moderate to steep slopes » Mostly parallel to the south-west to north-east running, narrow mountain range. » Typically, relatively short ephemeral drainage systems containing surface flow only for a short period of time following rainfall events. » Some of the drainage lines drain into a larger semi-seasonal to ephemeral watercourse that feed into the Breëde River. The other drainage lines disappear into the dune plume. » The upper portions of these drainage systems form moderately deep, narrowly incised valleys within the dune plume and mountain slopes.	

Photographs:

Species richness	**25** Indigenous Species	**Dominant and diagnostic species:**	*Aspalathus burchelliana, Aspalathus hirta, Capeochloa cincta, Cliffortia ruscifolia, Colpoon compressum, Maytenus oleoides, Podalyria rotundifolia, Serruria gremialis*
Alien Invasive Plants	**None recorded**	**Conservation Important Flora:**	**Red Data (ICUN Listed):** *Aspalathus burchelliana;* **Provincially Protected:** *Serruria gremialis*
Disturbance	» Minimal to no disturbance	**Naturalness:**	**High** Mostly natural and undisturbed area covered by a well-developed vegetation layer including larger shrubs and graminoids.
Habitat & Biotic Integrity:	**High** » Most of the drainage lines are natural and undisturbed within the surveyed area. » The prominent drainage line traversing the central portion of the project study has been intercepted by current mining activities. » This habitat is characterised by unique, complex micro-habitats which contribute to habitat and niche diversity within the region. » The shade effect created by some of the larger boulders and stones result in higher moisture retention. » Vegetation helps slow down surface runoff and moisture retention. » A permanent vegetation cover is necessary to maintain the functionality and stability of this ecosystem. » Ecosystem functions and services includes: o Absorption and reduction of occasional flash floods. o Important corridor for abiotic and biotic material transfer, as well as wildlife. o Keystone species maintain habitat and create specific microhabitats for a multitude of organisms. o Dense herbaceous vegetation helps slow down floods, 'catch' sediments, and retain nutrients. o Vegetation filters out possible pollutants to prevent their discharge into the lower lying freshwater resources.	**Anthropogenic importance and potential**	**Agricultural Potential: Low** » Due to the sporadic nature of these drainage lines, none of them contain farm dams for storing surface runoff. » Most of the surface runoff within these drainage lines simply dissipate into the sand plume, thus feeding the aquifers, an important source of water for livestock.
		Conservation value	**High** » Located within a CBA1 area which is vital for meeting provincial conservation targets. » Recorded Red Data flora species. » Recorded Provincially Protected (Schedule 4) flora. » Natural habitat. » Biotic and abiotic corridor for material and wildlife movement. » Absorption and retention of runoff and source of water input for aquifers. » Niche habitats.

Conclusion and Mitigation Requirements	» This area is of a high ecological sensitivity and high conservation value. » These habitats are regarded as No-Go Areas. » The obliteration of these upper tributaries may gradually lead to a die-off of larger trees and shrubs and other species depending on higher soil moisture levels in downstream drainage lines beyond the development due to the reduction of occasional floods as upper tributaries are obliterated. This must be avoided at all costs.

The vegetation of the area is pristine (no invasive aliens, no transformation, no secondary vegetation), numerous unique micro-habitats exist, and various important functions and services are provided by these habitats and their vegetation cover. The majority of the area is located within a CBA1, regarded as important for meeting the provincial conservation targets, which means that all three alternative areas, as well as the majority of the farm (specifically Breede Sand Fynbos), can be classified as highly sensitive. Thus, these habitats have a high ecological sensitivity and conservation value / importance. Loss of these habitats would not be acceptable unless appropriate biodiversity offset measures are implemented in order to converse the remaining vegetation, and rehabilitation is implemented after mining.

Three alternative areas are proposed for mining activities: alternative area 1, 2, and 3 (Figure 12, Figure 13). Alternative area 1 is the preferred option for mining for the following reasons: 1) Alternative area 1 is of mostly uniform vegetation and habitat, and only slightly intrudes into a semimobile dune, in contrast to alternative area 2, which dissects a large part of mobile/semi mobile dunes towards its northern and north-eastern sides. Thus, mining in alternative area 2 would have a reducing effect on overall site habitat diversity. 2) Alternative area 1 has a gentler slope (Figure 14), especially towards the south-western and south-eastern edges, which would cause less of a problem in terms of erosion and the collapse of unstable side walls once mining has commenced. It is also lower in overall height compared to the current mining level, and the resulting mining slopes would be gentler. In contrast, alternative area covers the main, and one of the highest, dune areas on site. As such, side wall collapse is bound to be a large problem, unless the walls can be stabilised with specialised mining techniques and structures (consultation with a mining technician/engineer is highly recommended). In alternative area 2, sidewall collapse would be a great concern on all sides facing the dune (i.e., northeast, northwest, and southwest). Moreover, alternative area 2 is characterised, in the northern part, by an east facing mobile dune with a very steep slope. This would also likely result in heavy erosion and collapse of the side walls after mining. The side wall collapse of these steep and high slopes of alternative area 2 could therefore threaten the integrity of a large part of the main sand dune. 3) Since these open, mobile dune portions are created primarily by wind action (Tyson 1999), it is possible that much of the usable sand has already been blown out, and that there might less usable sand in the eastern part of alternative area 2.

The southern part of alternative area 3 is similar to alternative area 1, and in fact overlaps with it. Likewise, the northern part of alternative area 3 is similar to alternative area 2, and overlaps with it. This means that levels of Species of Conservation Concern abundance are intermediate between these two areas. At its centre, the area also transects across a drainage line. In this specific part the vegetation is dominated by *Galenia africana* (LC; see Figure 15), which is not of conservation concern. Although drainage lines are considered here as no-go areas, the authors of this report would cede such a view if the input of a wetland/water specialist will be obtained. If such a specialist proposes adequate mitigation measures, then alternative area 3 can be considered as intermediate in mining preference between areas 1 and 2. One advantage of area 3 is that it minimizes edge effects: perimeter of ± 580 m vs. ± 720 m (area 2) and ± 690 m (area 1).

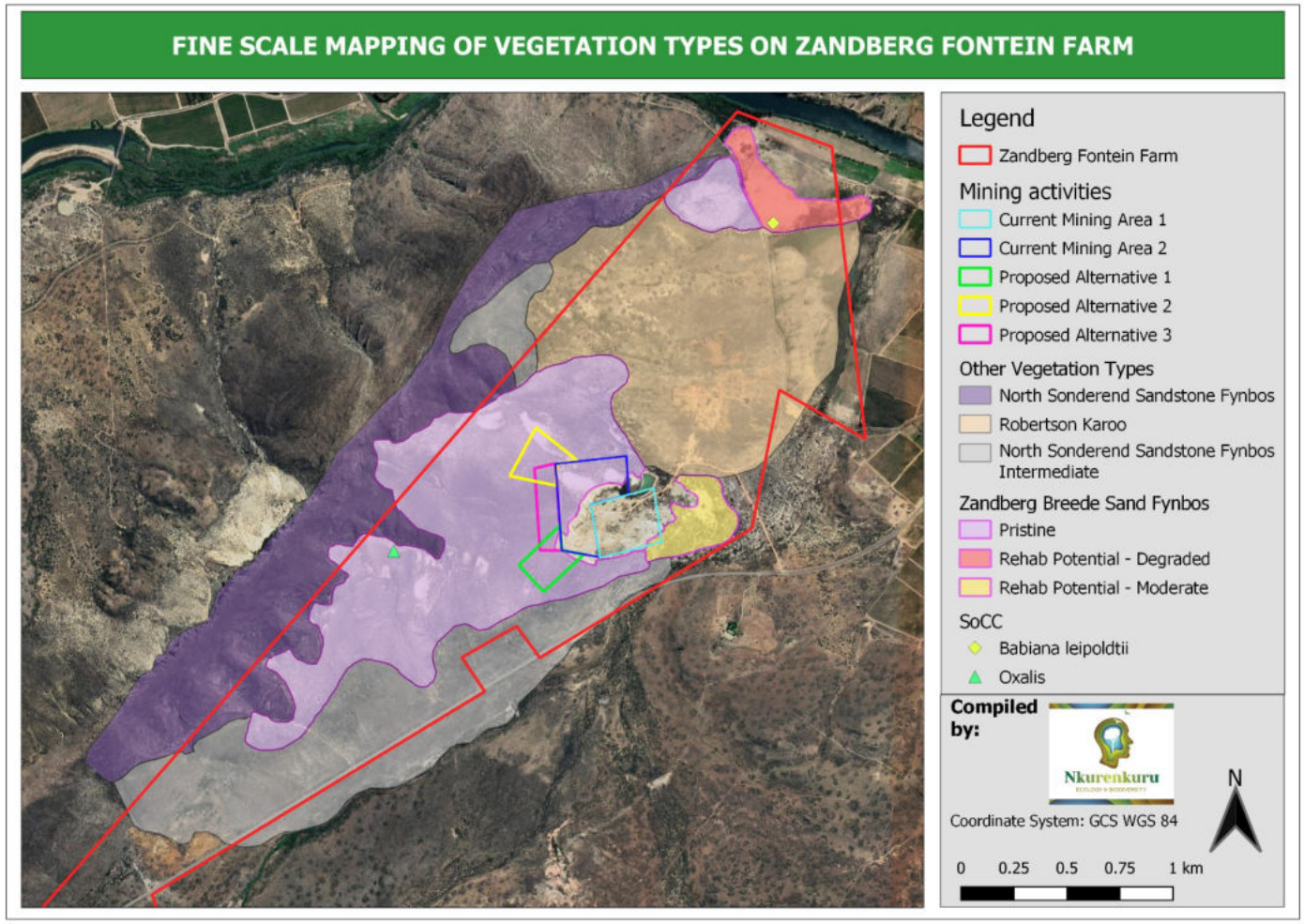

Figure 12: Fine scale mapping (ground truth/actual extent) of vegetation types on Zandberg Fontein farm. In conjunction to the main area of pristine Breede Sand Fynbos (BSF), the north eastern corner of the farm contains another area of pristine BSF, as well as a heavily degraded BSF area. A patch of previously mined BSF, which has passively restored to a state containing some elements of BSF, also occurs immediately to the east of current mining area 1.

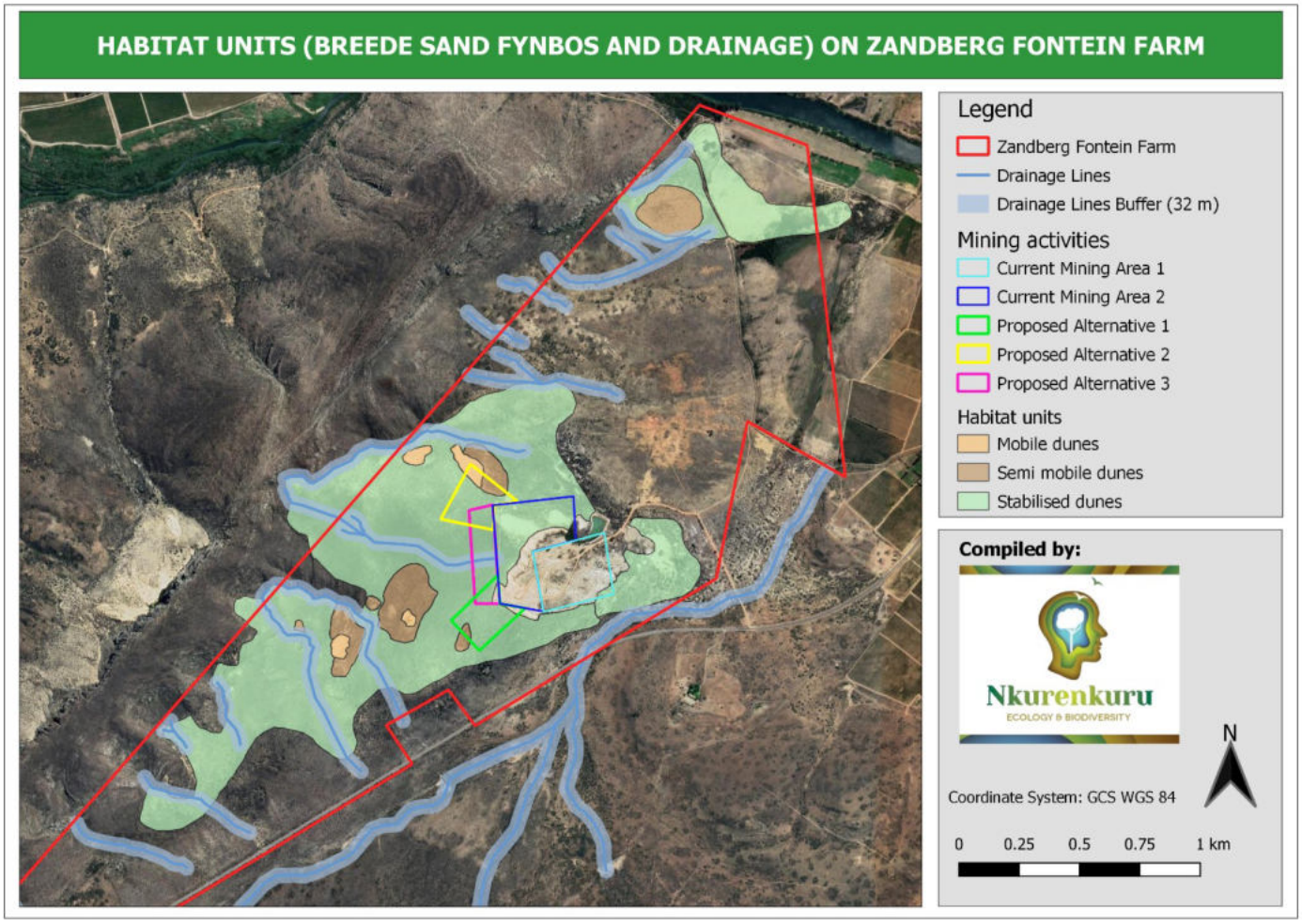

Figure 13: Habitat units (with regards to Breede Sand Fynbos and drainage lines) on Zandberg Fontein farm.

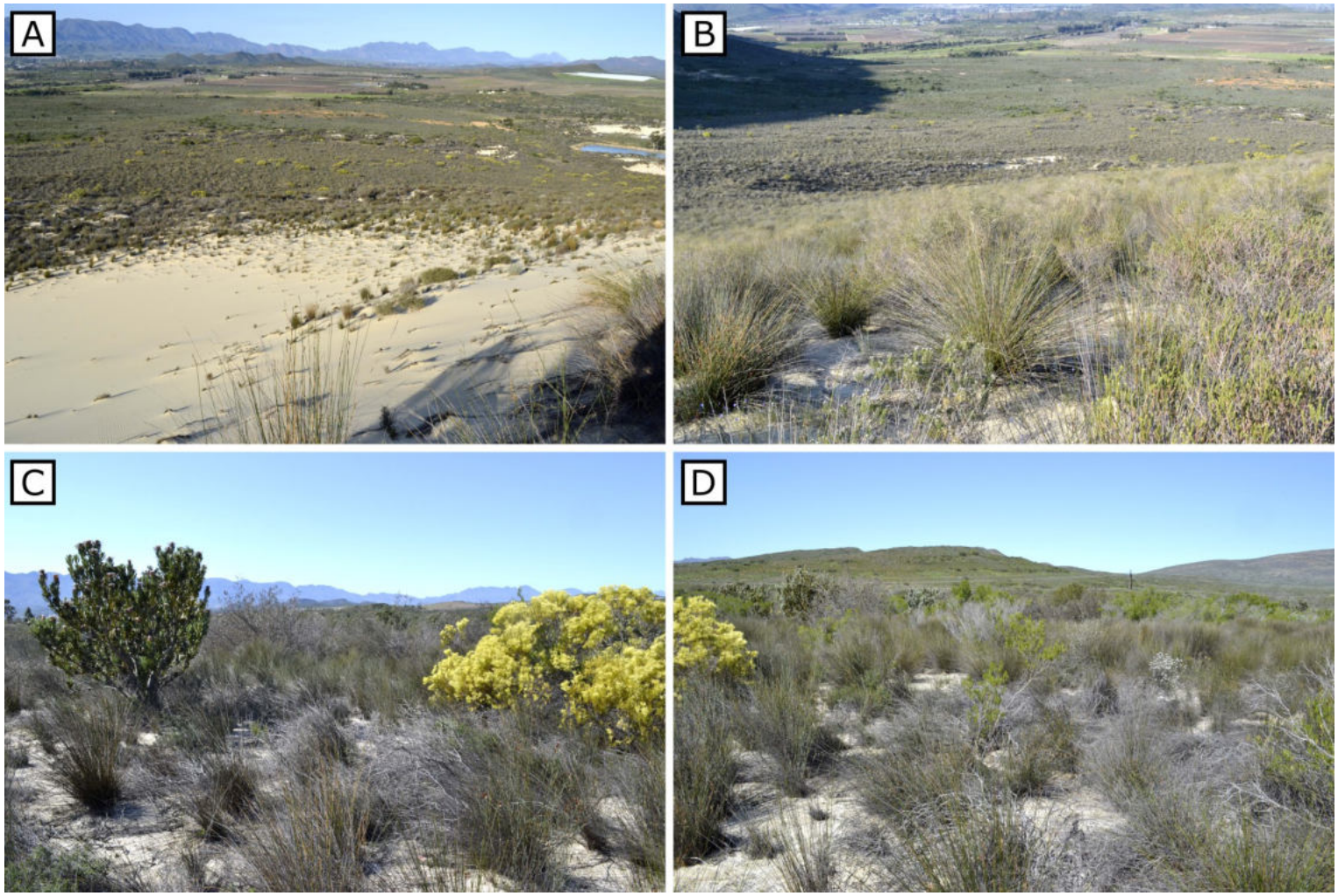

Figure 14: Representative photos of proposed alternative areas 1 (A and B) and area 2 (C and D). Alternative area 3 shares similarities with both these areas.

Figure 15: The central section of alternative area 3 forms part of a drainage line, which fans out towards its eastern border of the area. The vegetation in this part is dominated by Galenia africana (the large green shrubs at the forefront of the photo).

5.2 Species of Conservation Concern

As previously mentioned, a species list was obtained from the SANBI database (POSA) for the study area and surrounding environment. According to this list a total of about 244 plant Species of Conservation Concern are known to occur in the broad area surrounding the site: 62 Red List species (i.e., CR, EN, VU, NT and DD) and 213 provincially protected species (Schedule 4; note that this figure includes the already mentioned Red List species). It is, however, important to note that this list includes many species occurring in other vegetation types not found on the farm, and are thus highly unlikely to occur within the proposed alternative areas).

Ground truthing confirmed a total of 32 Species of Conservation Concern to be present on site in Breede Sand Fynbos and North Sonderend Sandstone Fynbos (Table 12; Figure 16): 10 Red List species (2 EN; 5 VU; 1 NT; 2 DD) and 28 provincially protected species (Schedule 4; note that this figure includes the already mentioned Red List species). Specifically, many of the Breede Sand Fynbos species occurred in large numbers across the site (for example, *Aspalathus lactea* subsp. *breviloba*: > 1000 plants; *Euchaetis pungens*: > 1000 plants; *Metalasia adunca*: > 1000 plants). The Endangered species *Babiana leipoldtii* was found in the degraded

Breede Sand Fynbos section in northern part of the farm (Figure 12). Although it was not found in or near the two proposed alternative areas, it is likely to occur in the vicinity.

Furthermore, 18 of these species were not present in the list obtained online (POSA) during the desktop phase, which proves the value of ground-truthing sites to validate such online species lists. This includes 2 Endangered species (*Aspalathus burchelliana*, *Lachnaea uniflora*), 2 Vulnerable species (*Erica pilosiflora* subsp. *pilosiflora*, *Lachnaea uniflora*), 1 Near Threatened species (*Metalasia adunca*), and 2 Data Deficient species (*Aloe perfoliata* var. *glauca*, *Ruschia pungens*). It should be noted, however, that *Aspalathus burchelliana*, *Erica pilosiflora* subsp. *pilosiflora*, and *Aloe perfoliata* var. *glauca* are species of North Sonderend Sandstone Fynbos, and would unlikely be impacted by the proposed mining activities, which are restricted to Breede Sand Fynbos and are quite some distance to the nearest start of North Sonderend Sandstone Fynbos.

Table 12: Plant Species of Conservation Concern recorded on the farm Zandberg Fontein, specifically within Breede Sand Fynbos and North Sonderend Sandstone Fynbos.

Family	Species	Conservation Status	
		IUCN Red List	WCNCO (Schedule 4)
Fabaceae	*Aspalathus burchelliana*	EN	
Iridaceae	*Babiana leipoldtii*	EN	Yes
Aizoaceae	*Stayneria neilii*	VU	Yes
Ericaceae	*Erica pilosiflora* subsp. *pilosiflora*	VU	Yes
Fabaceae	*Aspalathus lactea* subsp. *breviloba*	VU	
Rutaceae	*Euchaetis pungens*	VU	Yes
Thymelaeaceae	*Lachnaea uniflora*	VU	
Asteraceae	*Metalasia adunca*	NT	
Aizoaceae	*Ruschia pungens*	DD	Yes
Asphodelaceae	*Aloe perfoliata* var. *glauca*	DD	Yes
Aizoaceae	*Carpobrotus edulis* subsp. *edulis*	LC	Yes
Aizoaceae	*Ruschiella argentea*	LC	Yes
Aizoaceae	*Tetragonia fruticosa*	LC	Yes
Amaryllidaceae	*Brunsvigia orientalis*	LC	Yes
Apocynaceae	*Eustegia minuta*	LC	Yes
Ericaceae	*Erica imbricata*	LC	Yes
Ericaceae	*Erica plumosa*	LC	Yes
Ericaceae	*Erica serrata*	LC	Yes
Ericaceae	*Erica similis*	LC	Yes
Ericaceae	*Erica sonderiana*	LC	Yes
Fabaceae	*Podalyria calyptrata*	LC	Yes

Iridaceae	*Aristea dichotoma*	LC	Yes
Iridaceae	*Babiana ringens* subsp. *ringens*	LC	Yes
Iridaceae	*Gladiolus carinatus*	LC	Yes
Orchidaceae	*Disperis capensis*	LC	Yes
Proteaceae	*Leucadendron brunioides* var. *brunioides*	LC	Yes
Proteaceae	*Leucadendron salignum*	LC	Yes
Proteaceae	*Leucospermum calligerum*	LC	Yes
Proteaceae	*Paranomus dispersus*	LC	Yes
Proteaceae	*Protea laurifolia*	LC	Yes
Proteaceae	*Serruria gremialis*	LC	Yes
Rutaceae	*Agathosma stipitata*	LC	Yes

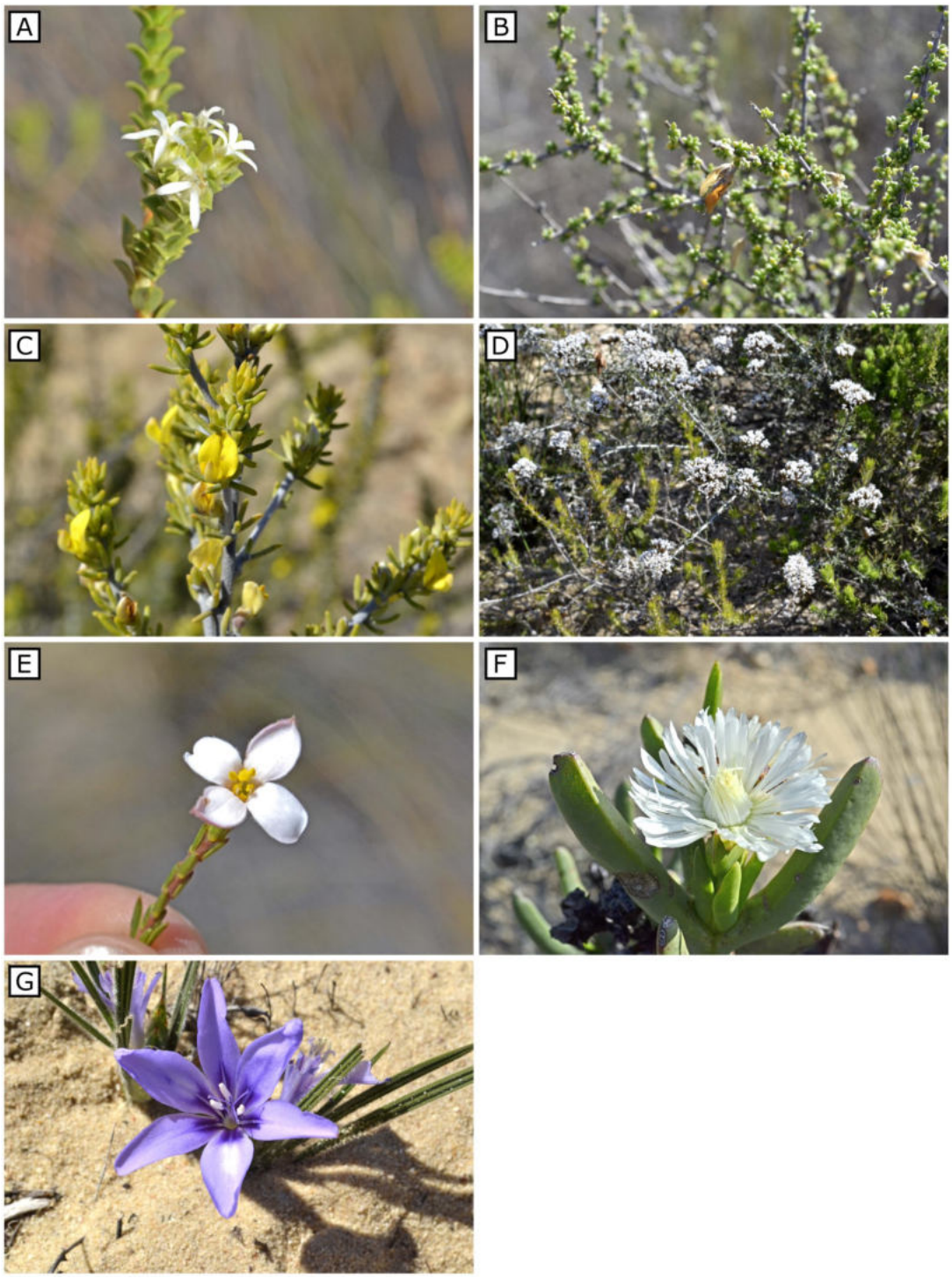

Figure 16: Representative photos of Red List species that were found on the farm Zandberg Fontein, specifically within Breede Sand Fynbos (BSF) and North Sonderend Sandstone Fynbos (NSSF). Indicated for each species is the vegetation type in which it occurs, together with its Red List status: A) *Euchaetis pungens* (BSF; VU), B) *Aspalathus lactea* subsp. *breviloba* (BSF; VU), C) *Aspalathus burchelliana* (NSSF; EN), D) *Metalasia adunca* (BSF; NT), E) *Lachnaea uniflora* (BSF; VU), F) *Stayneria neilii* (NSSF; VU), and G) *Babiana leipoldtii* (BSF; EN).

An interesting finding on site was the presence of an unknown *Oxalis* species (Figure 17). Currently, the species does not seem to have been described before (personal communication Dr. Kenneth Oberlander, *Oxalis* taxonomist); however,

this would need to be confirmed by more extensive studies. The species was found away from the proposed alternative areas, on the higher slopes of the Breede Sand Fynbos close to its border with North Sonderend Sandstone Fynbos in the north-west (see Figure 12), and would likely not be impacted by the proposed developments, since it occurred at least 600 m away from alternative area 1 (the area closest to it).

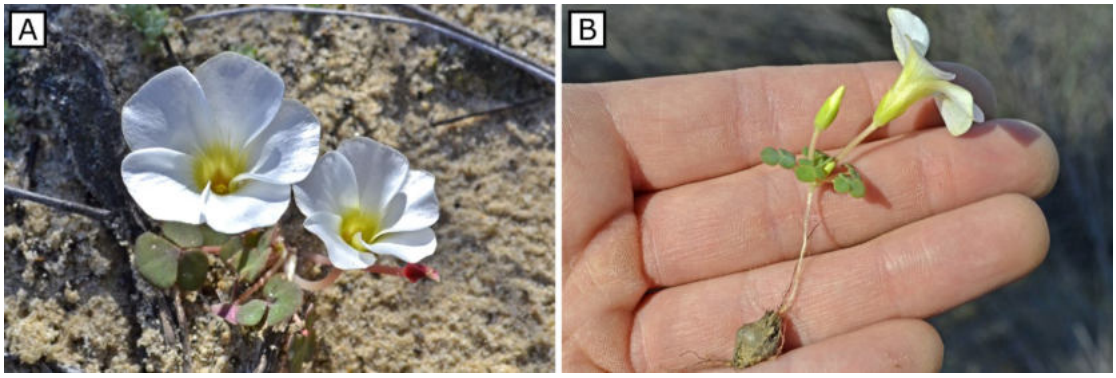

Figure 17: *Oxalis* species found that could not be identified by *Oxalis* taxonomists. Although the species currently remains unidentified, further studies could prove it not to be the case.

The three alternative areas proposed for mining activities (Figure 12, Figure 13) share a very similar suite of species, since all three areas are fully within Breede Sand Fynbos. They are thus similar in terms of the species identities of both Species of Conservation Concern and Least Threatened species. However, alternative area 1 is characterised by a higher dominance of proteoid species, specifically *Protea laurifolia*, *Leucadendron salignum*, and *Leucospermum calligerum*. Although these species are protected, they are very widespread and not threatened. Their dominance in area 1 also means that the abundances of other Red List species are less than in area 2 (even though the same species occur in both areas). Area 3 is intermediate between areas 1 and 2: the southern section has a lower abundance of Red List species, while the northern part has a higher abundance.

For these reasons, alternative area 1 would be the preferred option for mining, since it would entail destroying a lower number of plants of Red List species/Species of Conservation Concern. Area 3 is also a viable option: although a higher number of SoCC plants would be destroyed, the area has the advantage of minimizing edge effects (as previously mentioned).

5.3 Alien plant species

The pristine Breede Sand Fynbos (and North Sonderend Sandstone Fynbos) areas were free from any alien plants. However, 11 alien plants (Table 13; Figure 18 and Figure 19) were recorded in and around current mining areas 1 and 2 (see Figure 3 for locality details).

Table 13: Alien plant species recorded in and around current mining areas 1 and 2.

Family	Species	NEM:BA Category
Arecaceae	*Livistona chinensis*	-
Asparagaceae	*Yucca gloriosa*	-
Cactaceae	*Opuntia ficus-indica*	See text for details.
Casuarinaceae	*Casuarina equisetifolia*	2
Fabaceae	*Acacia cyclops*	1b
Fabaceae	*Acacia saligna*	1b
Myrtaceae	*Eucalyptus cladocalyx*	1b (also see text for details)
Pinaceae	*Pinus roxburghii*	2
Poaceae	*Pennisetum setaceum*	1b (Sterile cultivars or hybrids are not listed)
Scrophulariaceae	*Myoporum laetum*	3
Solanaceae	*Nicotiana glauca*	1b

A total of 9 of the 11 alien plants are listed as invasive species in the NEM:BA Alien & Invasive Species Regulations. *Opuntia ficus-indica* is listed as Category 1b, unless its fruits are used for human consumption, which does not appear to be the case here. Spineless cultivars and selections are not listed, but that is also not applicable here.

Eucalyptus cladocalyx has various listings under NEM:BA, but it is listed as Category 1b at its current locality for two reasons: 1) it occurs within a Listed Ecosystem (Breede Sand Fynbos; which also happens to form part of a CBA), and 2) it is listed by default as Category 1b in Fynbos, except if it qualifies for other exemption conditions that are not applicable here (i.e., occurring within cultivated land at least 50 metres away from untransformed land, occurring within 50 metres of the main house on a farm, or occurring in urban areas and having a trunk diameter of more than 400 mm at 1000 mm height).

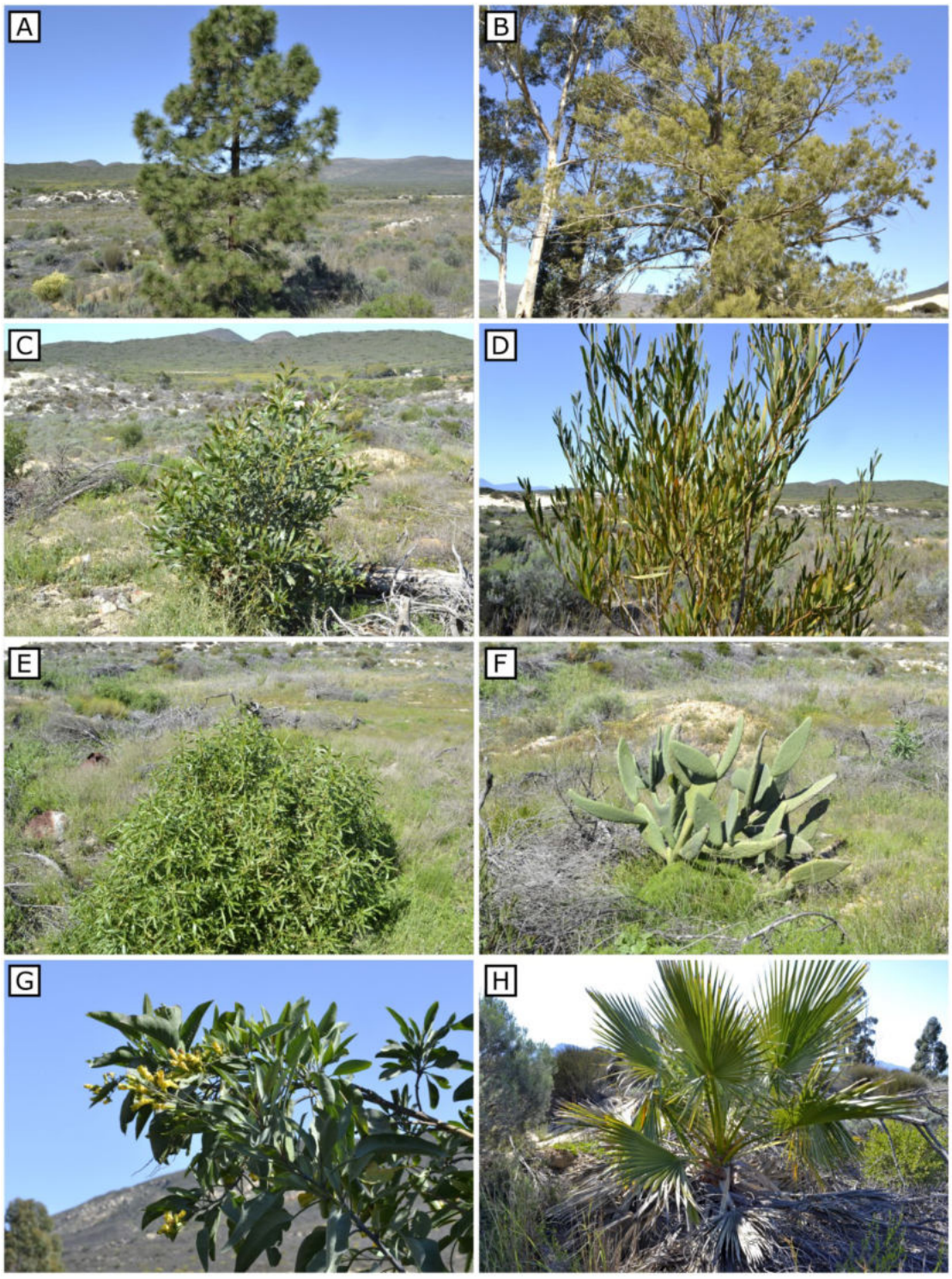

Figure 18: Alien plant species that were recorded on the farm Zandberg Fontein, predominantly in and around current mining areas 1 and 2. A) *Pinus roxburghii*, B) *Casuarina equisetifolia* (right) growing next to *Eucalyptus cladocalyx* (left), C) *Acacia saligna*, D) *Acacia cyclops*, E) *Myoporum laetum*, F) *Opuntia ficus-indica*, G) *Nicotiana glauca*, and H) *Livistona chinensis*.

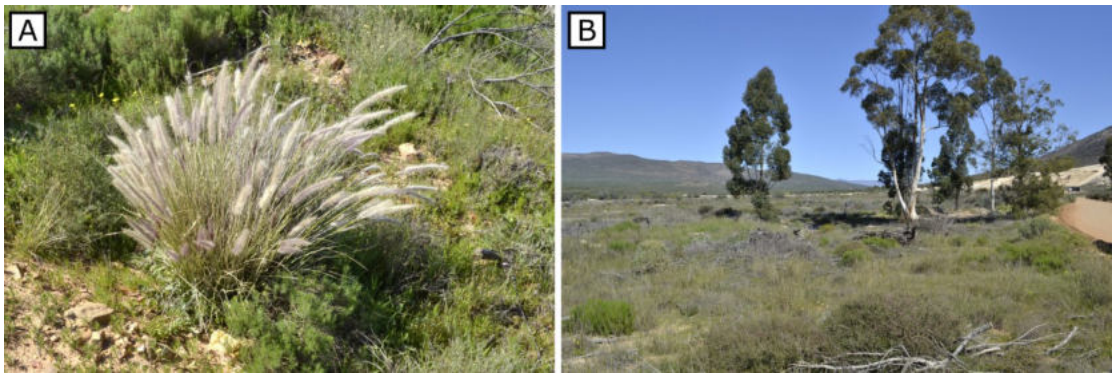

Figure 19 (continued from Figure 18): Alien plant species that were recorded on the farm Zandberg Fontein, predominantly in and around current mining areas 1 and 2. A), C) *Pennisetum setaceum*, and D) *Eucalyptus cladocalyx*.

6. ASSESSMENT OF PROPOSED IMPACTS

6.1 Assumptions

The following is assumed and/or known:

- » A thorough botanical walkthrough of all footprint areas will be conducted to detect and relocate, if possible, all plant Species of Conservation Concern by a suitably qualified botanist prior to commencement of activities.
- » Throughout the duration of the mining activities, the footprint will be routinely cleared of all alien invasive plants if detected.
- » The clearing of vegetation may occur **strictly within the approved alternative area only**.

- After decommissioning, a continuous vegetation layer will be the most important aspect of ecosystem functionality within and beyond the project site. This is addressed in detail in section 7. A weakened or absent vegetation layer not only exposes the soil surface, but also lacks binding and absorption capacity (which creates the buffering functionality of vegetation) to prevent or lessen erosion as a result of floods.

6.2 Localised vs. cumulative impacts: explanatory notes

Ecosystems consist of a mosaic of various vegetation/habitat zones or "patches". The size of natural patches affects the diversity (richness and abundance) of species they contain. At the periphery of patches, influences of neighbouring patches become apparent, known as "edge effects". Patch edges may be subjected

to increased levels of heat, dust, desiccation, disturbance, invasion of alien species, and other impacts. Edges seldom contain species that are rare, habitat specialists, or that require large tracts of undisturbed core habitat. Fragmentation due to development reduces the size of core habitats, while greatly increasing edge habitats. This causes species compositional shifts, which in turn adds extra pressure on ecosystem dynamics and functionality (Perlman & Milder 2005).

The cumulative impacts of developments on species population viability can significantly be reduced if new developments arise as close as possible to existing developed and/or transformed areas. If this is not possible, different sections of new developments should be kept as close together as possible.

Three alternative areas are proposed for mining activities (see Figure 3 and Figure 4). All are of equivalent size, namely 4 ha. Of these, area 1 is the preferred for the proposed mining activities, since it would entail destroying a lower number of plants of Species of Conservation Concern, and has gentler slopes. Alternative area 3 is also a viable option. Although mining in area 3 would lead to the loss of more SoCC individuals, it has the advantage of having the smallest perimeter of all three areas, namely ± 580 m vs. ± 720 m for area 2 and ± 690 m for area 1. The steeper slopes in the northern part of area 3 might lead to increased sidewall collapse during mining; however, this can likely be mitigated effectively with proper mining techniques.

If a proposed footprint of 4 ha is approved it is highly likely that this development will contribute to the cumulative impacts of the area by:

- Affecting the conservation of provincial targets;
- Impacting the national conservation targets set out for the vegetation type and ecosystem.
- Compromising the ecological functioning of the larger "natural" environment; and
- Disrupting the connectivity of the landscape for fauna and flora and impairing their ability to respond to environmental fluctuations.

A total of at least 0.13% (4 ha of 3026 ha; see section 4.1) of Breede Sand Fynbos will be impacted by the proposed mining activities. If an appropriate size (120 ha; 30:1 ratio, see section 7) of pristine Breede Sand Fynbos, of which about 148 ha exists on the farm Zandberg Fontein, is allocated as a biodiversity offset, then the 4 ha can be regarded as acceptable loss for the development.

It should be noted that excessive clearing of vegetation can and will influence runoff and stormwater flow patterns and dynamics, which could greatly accelerate the

erosion of plains and intermittent drainage lines, and could have detrimental effects on the lower-lying areas. Thus:

- All drainage lines are regarded as No-Go Areas, unless approved by a hydrologist/wetland specialist.
- Rehabilitation and revegetation of all surfaces disturbed or altered during the operational phase is highly desirable.

Disturbance of indigenous vegetation creates a major opportunity for the establishment of invasive species (which are present on site; section 5.3), and their uncontrolled spread into adjacent natural habitats.

» A regular monitoring and eradication protocol must be part of all the developments' long-term management plans (see section 7).

After decommissioning, a continuous vegetation layer will be the most important aspect of ecosystem functionality within and beyond the project site.

- A weakened or absent vegetation layer not only exposes the soil surface but also lacks the binding and absorption capacity that creates the buffering functionality of vegetation to prevent or lessen erosion and the destabilization of the dune plume as a result of floods and wind.

6.3 Identification of Potential Impacts and Associated Activities

Potential impacts resulting from the proposed project would stem from a variety of different activities and risk factors associated with the site-establishment and operation phases of the project, including the following:

6.3.1 Site-establishment and Operational Phase

» Human presence and uncontrolled access to the site may result in negative impacts on fauna and flora through poaching of fauna and uncontrolled collection of plants for traditional medicine or other purposes.
» Site clearing and exploration activities for site establishment.
» Vegetation clearing will impact Species of Conservation Concern. Vegetation clearing would also lead to the loss of vegetation communities and habitats for fauna, and potentially the loss of faunal species, habitats, and ecosystems. On a larger and cumulative scale (if numerous and uncontrolled developments are allowed to occur in the future), the loss of these vegetation communities and habitats may

potentially lead to a change in the conservation status of the affected vegetation type as well as the ability of this vegetation type and associated features to fulfil its ecological responsibilities (functions).

» Soil compaction and increased erosion risk would occur due to the loss of plant cover and soil disturbance created during the operational phase. This may potentially impact the downstream watercourses and aquatic habitats. These potential impacts may result in a reduction in the buffering capacities of the landscape during extreme weather events.
» Invasion by alien plants may be attributed to excessive disturbance to vegetation, creating a window of opportunity for the establishment of these species. In addition, regenerative material of invasive alien species may be introduced to the project site by machinery traversing through the mining areas.
» Presence and operation of mining vehicles and machinery on the project site. This will create a physical impact as well as generate noise, potential pollution, and other forms of disturbances at the site.
» The facility will require management and if this is not done effectively, it could impact adjacent intact areas through impacts such as erosion and the invasion of alien plant species.

6.3.2 Cumulative Impacts

» The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the country's ability to meet its conservation targets.
» Transformation of intact habitat would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna, avifauna, and flora, and impair their ability to respond to environmental fluctuations.

6.4 Assessment of Impacts

The impacts identified above are assessed below, during the site-establishment and operational phases of the facility as well as before and after mitigation.

6.4.1 Assessment of impacts associated with Site-establishment and Operational Phases

Impact 1: *Potential Impacts on vegetation and Species of Conservation Concern*

Impact Nature: Vegetation clearing will lead to the loss of current habitat within the proposed mining footprint and is an inevitable consequence of this type of activity.

This will lead to localised or more extensive reduction in the overall extent of vegetation. There are factors that may aggravate this potential impact. For example, where this vegetation has already been stressed due to degradation and transformation at a regional level, or has a very restricted distribution, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat and a change in the conservation status (current conservation situation). Consequences of the potential impact of loss of indigenous natural vegetation occurring may include:

- » negative change in conservation status (Driver et al. 2005);
- » increased vulnerability of remaining portions to future disturbance;
- » general loss of habitat for sensitive species;
- » loss in variation within sensitive habitats due to loss of portions of it;
- » general reduction in biodiversity;
- » increased fragmentation (depending on location of impact);
- » disturbance to processes maintaining biodiversity and ecosystem goods and services; and
- » loss of ecosystem goods and services.

Plant species are especially vulnerable to mining developments since they cannot move out of the path of the mining activities, and are also affected by overall habitat loss.

Threatened species include those classified as Critically Endangered, Endangered, or Vulnerable. For other species, a loss of individuals or localised populations is unlikely to lead to altered conservation status. However, for threatened species, loss of a population or individuals could lead to a direct change in conservation status, and possibly even extinction. This may arise if the proposed infrastructure is located where it will impact such individuals or populations. Consequences may include:

- » fragmentation of populations of affected species;
- » reduction in area of occupancy of affected species;
- » reduction in extent of occurrence of affected species, if localised populations are far apart in geographical extent; and
- » loss of genetic variation within affected species and subsequent erosion of adaptability toward environmental changes.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chance of survival of the species.

	Without Mitigation	**With Mitigation**
Extent	Site Specific (1)	Site Specific (1)
Duration	Permanent (5)	Moderate Term (3)
Magnitude	High (8)	Moderate (6)
Probability	Definite (5)	Definite (5)
Significance	High (70)	Medium (50)
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Loss of resources	Limited loss of resources
Can impacts be mitigated?	To a limited extent. A stable vegetation cover will allow for some functionality to return, but an establishment of an original fynbos	

	cover representative of the region is near impossible. The most appropriate mitigation measure will be to 1) minimize the extent of the footprint, 2) to set aside an appropriate size of pristine equivalent habitat (preferably 30 ha for each 1 ha impacted) allowing for most of the species to persist outside of the mining area, and 3) to rehabilitate areas that have been mined, so that the loss can be regarded as acceptable without impacting the status of the vegetation type, as well as Species of Conservation Concern.
Residual Impacts	» A permanently altered vegetation cover.

Impact 2: *Potential impacts on local fauna, especially threatened animals, due to disturbance and a loss of available habitat and migration routes*

Impact Nature: Threatened animal species are indirectly affected primarily by the overall loss of habitat, since direct construction impacts can often be avoided due to movement of individuals from the path of construction. Animals are generally highly mobile and, in most cases, can move away from a potential threat.

Threatened species include those classified as Critically Endangered, Endangered, or Vulnerable. For other species, a loss of individuals or localised populations is unlikely to lead to altered conservation status. However, for threatened species, loss of a population or individuals could lead to a direct change in conservation status, and possibly even extinction. This may arise if the proposed infrastructure is located where it will impact such individuals or populations. Consequences may include:

- » fragmentation of populations of affected species;
- » reduction in area of occupancy of affected species;
- » reduction in extent of occurrence of affected species, if localised populations are far apart in geographical extent; and
- » loss of genetic variation within affected species and subsequent erosion of adaptability toward environmental changes.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chance of survival of the species.

	Without Mitigation	**With Mitigation**
Extent	Site Specific (1)	Site Specific (1)
Duration	Long Term (4)	Moderate Term (3)
Magnitude	Moderate (6)	Minor (4)
Probability	Definite (5)	Probable (3)
Significance	**Medium (55)**	**Low (24)**
Status	Negative	Negative
Reversibility	Limited extent with effective rehabilitation	Relatively high reversibility with effective rehabilitation

Irreplaceable loss of resources	Some loss of resources	Limited loss of resources
Can impacts be mitigated?	To a limited extent. A stable vegetation cover will allow for some functionality to return, but an establishment of a natural fynbos cover representative of the region is near impossible. The most appropriate mitigation measure will be to 1) minimize the extent of the footprint, 2) to set aside an appropriate size of pristine equivalent habitat (preferably 30 ha for each 1 ha impacted) allowing for most of the species to persist outside of the mining area, and 3) to rehabilitate areas that have been mined, so that the loss can be regarded as acceptable and to allow for some faunal species to return to the area (most of which will be generalists and opportunistic species). Habitat (fynbos) specialists will likely not return to the area.	
Residual Impacts	» A permanently altered habitat that will be inhabited by some of the more adaptable and generalist species, with a likelihood of the fynbos habitat specialists not returning to the area.	

Impact 3: *Impact on drainage lines*

Impact Nature: There are no wetlands/drainage lines within proposed alternative mining areas 1 and 2, but there are a number of ephemeral drainage lines nearby. A drainage line transects alternative area 3 in the centre. At their headwater/upper portions, these drainage lines tend to be steep-sided mini valleys. Mining could lead to indirect damage to these areas and their catchments, and may impact the replenishment of downslope aquifers, since most of these drainage lines dissipate into the sand dune with runoff seeping down into aquifers. These drainage lines usually serve as important habitats for many species, including those with a restricted distribution ranges or Species of Conservation Concern.

	Alternative areas 1 and 2		**Alternative area 3**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Extent	Local (3)	Site Specific (1)	Local (3)	Site Specific (1)
Duration	Permanent (5)	Long Term (4)	Permanent (5)	Long Term (4)
Magnitude	High (8)	Small (2)	High (8)	High (8)
Probability	Definite (5)	Probable (3)	Highly Probable (4)	Highly Probable (4)
Significance	**High (80)**	**Low (21)**	**High (64)**	**Medium (52)**
Status	Negative	Negative	Negative	Negative
Reversibility	Low	Low	Low	Low
Irreplaceable loss of resources	Some loss of resources	Avoid loss of resources	Some loss of resources	Some loss of resources

Can impacts be mitigated?	The most secure mitigation measure will be avoidance of these habitat types. Specifically, mining in alternative area 3 would destroy the dissipation surface for water runoff, since the drainage line spreads out over most of the central part of the area. This could lead to increased erosion risk caused by accelerated waterflows, unless mitigated by specialist techniques that counteract erosion.
Residual Impacts	» Without mitigation these drainage systems will be lost, resulting in an altered surface hydrology, as well as the area's contribution to the replenishment of downslope aquifers. » With mitigation measures implemented (avoidance of these features or implementing suitable corrective actions), there will be no (avoidance) or medium (in alternative area 3) residual impact on these drainage lines.

Impact 4: *Potential increased erosion risk and destabilisation of the dune plume during- and post-operational phase*

Impact Nature: During the operational phase, there will be a lot of disturbed and loose soil at the site which will render the area highly vulnerable to erosion. This is especially of concern for alternative area 2, which is characterised by very steep slopes. It is critically important that proper erosion control measures and structures are in place and strictly maintained over the lifespan of the project.

	Alternative area 1		**Alternative area 2**		**Alternative area 3**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Extent	Site Specific (1)	Site Specific (1)	Site Specific (1)	Site Specific (1)	Site Specific (1)	Site Specific (1)
Duration	Permanent (5)	Long Term (4)	Permanent (5)	Long Term (4)	Permanent (5)	Long Term (4)
Magnitude	Minor (4)	Minor (4)	High (8)	Moderate (6)	High (8)	Moderate (6)
Probability	Definite (5)	Probable (3)	Definite (5)	Highly Probable (4)	Definite (5)	Probable (3)
Significance	**Medium (50)**	**Low (27)**	**High (70)**	**Medium (44)**	**High (70)**	**Medium (33)**
Status	Negative	Negative	Negative	Negative	Negative	Negative
Reversibility	Low	Low	Low	Low	Low	Low
Irreplaceable loss of resources	Some loss of resources		Some loss of resources		Some loss of resources	
Can impacts be mitigated?	Yes, to a large extent in alternative area 1, but less so in alternative area 2. Alternative area 3 might require additional erosion control (that results from water flows)					

Residual Impacts	With appropriate avoidance and mitigation, residual impacts will be **low in alternative area 1, but medium to high in alternative areas 2 and 3.**

Impact 5: *Increased alien plant invasion during the operational phase*

Impact Nature: Increased alien plant invasion is one of the greatest risk factors associated with this activity. The disturbed and bare ground that is likely to be present at the site during and after the operational phase would leave the site vulnerable to alien plant invasion during the operation phase if not managed. Furthermore, the National Environmental Management Biodiversity Act (Act No. 10 of 2004), as well as the Conservation of Agricultural Resources Act, (Act No. 43 of 1983) requires that listed alien species are controlled in accordance with the Act.

Major factors contributing to invasion by alien invader plants includes inter alia high disturbance (such as clearing for construction activities) and negative grazing practices (Zachariades et al. 2005). Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins et al. 2003). Consequences of this may include:

- loss of indigenous vegetation;
- change in vegetation structure leading to change in various habitat characteristics;
- change in plant species composition;
- change in soil chemical properties;
- loss of sensitive habitats;
- loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
- fragmentation of sensitive habitats;
- change in flammability of vegetation, depending on alien species;
- hydrological impacts due to increased transpiration and runoff; and
- impairment of watercourse function.

	Without Mitigation	**With Mitigation**
Extent	Site Specific (1)	Site Specific (1)
Duration	Permanent (5)	Moderate Term (3)
Magnitude	Moderate (6)	Minor (4)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (48)**	**Low (24)**
Status	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources	Potential loss of resources	Unlikely
Can impacts be mitigated?	Yes, to a large extent	
Residual Impacts	With appropriate mitigation such as regular monitoring and eradication residual impacts will be **very low** and will likely comprise of few alien plants establishing for short periods of time between monitoring and eradication phases.	

6.4.2 Assessment of Cumulative Impacts

Cumulative Impact 1: *Reduced ability to meet conservation obligations and targets*

Impact Nature: The loss of unprotected vegetation types on a cumulative basis from the broader area impacts the Province's ability to meet its conservation targets.						
	Overall impact of the proposed project considered in isolation			**Cumulative impact of the project and other projects within the area**		
	Alternative area 1	*Alternative area 2*	*Alternative area 3*	*Alternative area 1*	*Alternative area 2*	*Alternative area 3*
Extent	Site Specific (1)	Site Specific (1)	Site Specific (1)	Site Specific (1)	Site Specific (1)	Site Specific (1)
Duration	Permanent (5)	Permanent (5)	Permanent (5)	Permanent (5)	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	High (8)	Moderate (6)	Moderate (6)	High (8)	Moderate (6)
Probability	Probable (3)	Highly Probable (4)	Probable (3)	Highly Probable (4)	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (36)**	**Medium (56)**	**Medium (36)**	**Medium (48)**	**Medium (56)**	**Medium (48)**
Status	Negative	Negative	Negative	Negative	Negative	Negative
Reversibility	Low	Low	Low	Low	Low	Low
Irreplaceable loss of resources	Some loss of resources	Some loss of resources	Some loss of resources	Some loss of resources	Some loss of resources	Some loss of resources
Can impacts be mitigated?	To a limited extent. A stable vegetation cover will allow for some functionality to return, but an establishment of an original fynbos cover representative of the region is near impossible. The most appropriate mitigation measure will be to 1) minimize the extent of the footprint, 2) to set aside an appropriate size of pristine equivalent habitat (preferably 30 ha for each 1 ha impacted) allowing for most of the species to persist outside of the mining area, and 3) to rehabilitate areas that have been mined, so that the loss can be regarded as acceptable without impacting the status of the vegetation type, as well as Species of Conservation Concern.					

Cumulative Impact 2: *Impacts on Broad-Scale Ecological Processes*

Impact Nature: Transformation of intact habitat could potentially compromise ecological processes as well as ecological functioning of important habitats, and would: 1) contribute to the fragmentation of the landscape, and 2) potentially disrupt the connectivity of the landscape for fauna and flora, and impair their ability to respond to environmental fluctuations.

	Overall impact of the proposed project considered in isolation			**Cumulative impact of the project and other projects within the area**		
	Alternative area 1	*Alternative area 2*	*Alternative area 3*	*Alternative area 1*	*Alternative area 2*	*Alternative area 3*
Extent	Site Specific (1)	Site Specific (1)	Site Specific (1)	Local (3)	Local (3)	Local (3)
Duration	Permanent (5)	Permanent (5)	Permanent (5)	Permanent (5)	Permanent (5)	Permanent (5)
Magnitude	Minor (4)	Moderate (6)	Minor (4)	Moderate (6)	High (8)	High (8)
Probability	Probable (3)	Probable (3)	Probable (3)	Highly Probable (4)	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (30)**	**Medium (36)**	**Medium (30)**	**Medium (56)**	**High (64)**	**High (64)**
Status	Negative	Negative	Negative	Negative	Negative	Negative
Reversibility	Low	Low	Low	Low	Low	Low
Irreplaceable loss of resources	Some loss of resources	Some loss of resources	Some loss of resources	Some loss of resources	Some loss of resources	Some loss of resources
Can impacts be mitigated?	To a limited extent. A stable vegetation cover will allow for some functionality to return, but an establishment of an original fynbos cover representative of the region is near impossible. The most appropriate mitigation measure will be to 1) minimize the extent of the footprint, 2) to set aside an appropriate size of pristine equivalent habitat (preferably 30 ha for each 1 ha impacted) allowing for most of the species to persist outside of the mining area, and 3) to rehabilitate areas that have been mined, so that the loss can be regarded as acceptable without impacting the status of the vegetation type, as well as Species of Conservation Concern.					

6.5 Impact Mitigation and Management

IMPACT	MITIGATION
Site-Establishment and Operational Phase	
Impact 1: Potential Impacts on vegetation and Species of Conservation Concern	» A Biodiversity Offset Area, of appropriate size (preferably 30:1), should be delineated as a conservation compensation for the area that will be mined. » A pre-construction walk-through of the final mining footprint should be conducted, by a suitably qualified botanist, for Species of Conservation Concern that will be affected (also to comply with the Western Cape Nature Conservation Ordinance and DEADP permit conditions). Search and rescue of shrubs might not be feasible; however, most geophytes are easy to relocate. » Permits must be kept on-site and in the possession of the flora search and rescue team at all times. » Pre-construction environmental induction for all staff on site must be provided to ensure that basic environmental principles are adhered to. This includes awareness of no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimising wildlife interactions, remaining within demarcated construction areas, etc. » Contractor's EO must provide supervision and oversight of vegetation clearing activities and other activities which may cause damage to the environment, especially at the initiation of the project, when the majority of vegetation clearing is taking place. » Blanket clearing of vegetation must strictly be limited to the approved mining footprint and associated infrastructure. Zero clearing outside of approved footprints are allowed. » Phased mining and vegetation clearance should be done, wherein small strips are mined at a time. Vegetation in aeras outside of active mining strips must not be disturbed until mining progresses towards said areas. Furthermore, upon finishing a strip, immediate rehabilitation should occur wherein a stable vegetation cover, representative of the environment, is established. » A layer of topsoil must be stripped and stockpiled separately during site preparation and replaced over disturbed areas (preferably between 50 cm – 100 cm deep) upon strip completion. » All vehicles to remain on demarcated roads and no unnecessary driving in the veld outside these areas are allowed. » Regular dust suppression should occur during operation.

	» No plants may be translocated or otherwise uprooted or disturbed for rehabilitation or other purposes without express permission from the Contractor's EO or without the relevant permits. » No fires must be allowed on-site.
Impact 2: Potential impacts on local fauna, especially threatened animals, due to disturbance and a loss of available habitat and migration routes	» A Biodiversity Offset Area, of appropriate size (preferably 30:1), should be delineated as a conservation compensation for the area that will be mined. » Any fauna directly threatened by the operational activities should be removed to a safe location by the ECO or other suitably qualified person, e.g., the Contractor's EO. » All personnel should undergo environmental induction with regards to fauna, and in particular, awareness about not harming or collecting species such as snakes, tortoises, and owls, which are often persecuted out of superstition. » All hazardous materials used should be stored appropriately to prevent site contamination. Any accidental chemical, fuel, or oil spills that occur on site should be cleaned up in a manner appropriate to the nature of the spill. » All vehicles should adhere to a low-speed limit (30 km/h is recommended) to avoid collisions with susceptible species such as snakes and tortoises. » When possible, no activity should be undertaken at the site between sunset and sunrise, except for security personnel guarding the development. » No litter, food, or other foreign material should be left in or around the site, and should be placed in animal proof rubbish and litter areas that are clearly demarcated and fenced.
Impact 3: Impact on drainage lines	» All drainage areas should be avoided and regarded as No-Go areas, unless approved by a hydrologist/wetland specialist.
Impact 4: Potential increased erosion risk and destabilisation of the dune plume during- and post-operational phase	» Any observed erosion problems arising within the mining area due to mining activities should be rectified immediately and monitored thereafter to ensure that they do not re-occur. » Mining within steep slopes will need to ensure that adequate slope protection is provided; consultation with mining experts/engineers is highly recommended. » Blanket clearing of vegetation must strictly be limited to the approved mining footprint and associated infrastructure. Zero clearing outside of approved footprints are allowed. » Phased mining and vegetation clearance should be done, wherein small strips are mined at a time. Vegetation in aeras outside of active mining strips must not be disturbed until mining progresses towards said areas. Furthermore, upon finishing a strip, immediate rehabilitation should occur wherein a stable vegetation cover, representative of the environment, is established. » Roads and other disturbed areas within the project area should be regularly monitored and remedied for erosion problems, and problem areas should receive follow-up monitoring to assess the success of the remediation.

	» Silt/sediment traps/barriers should be used where the danger exists of topsoil or material stockpiles eroding and entering downstream drainage lines and other sensitive areas. » These sediment/silt barriers should be regularly maintained and cleared so as to ensure effective drainage of the areas. » Topsoil should be removed and stored separately from subsoil. Topsoil should be reapplied where appropriate as soon as possible in order to encourage and facilitate rapid regeneration of the natural vegetation on cleared areas. » Stockpiles must be protected from erosion, stored on flat areas where possible, and be surrounded by appropriate berms. » Any erosion points created during construction should be filled and stabilized immediately. » Practical phased development and vegetation clearing should be practiced so that cleared areas are not left un-vegetated and vulnerable to erosion for extended periods of time. » Construction of gabions and other stabilisation features must be undertaken to prevent erosion, where deemed necessary.
Impact 5: Increased alien plant invasion during the operational phase	» Alien species must be removed from the site as per NEMBA requirements. » A suitable weed management strategy should be implemented in the construction and operational phases. » Regular monitoring for alien plants at the site should occur and could be conducted simultaneously with erosion monitoring. » Any alien plants that are detected should be controlled and cleared using the recommended control measures for each species to ensure that the problem is not exacerbated or does not re-occur and increase to problematic levels. » Clearing methods should aim to keep disturbance to a minimum and must be undertaken in accordance with relevant guidelines. » No planting or importing of any alien species to the site for landscaping, rehabilitation, or any other purpose should be allowed.
Cumulative Impacts	
Cumulative Impact 1: Reduced ability to meet conservation obligations and targets	» A Biodiversity Offset Area, of appropriate size (preferably 30:1), should be delineated as a conservation compensation for the area that will be mined. » The activity footprints of various proposed or approved mining locations and other development proposals in the area must be kept to a minimum and a stable vegetation cover should be encouraged to return during the post-operational phase. » Reduce the footprint of mining areas within sensitive habitat types as much as possible.
Cumulative Impact 2: Impacts on Broad-Scale Ecological Processes	» A Biodiversity Offset Area, of appropriate size (preferably 30:1), should be delineated as a conservation compensation for the area that will be mined. » The activity footprints of various proposed or approved mining locations and other development proposals in the area must be kept to a minimum and a stable vegetation cover should be encouraged to return during the post-operational phase. » Reduce the footprint of mining areas within sensitive habitat types as much as possible.

7. REHABILITATION AND NOTES ON BIODIVERSITY OFFSETTING

7.1 Biodiversity offsetting

Biodiversity offsetting will be discussed in detail in another specialist report. However, since the findings of this report contributes in part to said other report, biodiversity offsetting will briefly be mentioned and summarised here, as well as which of the current findings will bear significance.

Biodiversity offsetting entails, ideally, the setting aside of areas of equivalent habitat/species composition to the area that will be impacted on by development, so as to secure and conserve remaining habitats (DEA & DP 2015). Biodiversity offsetting is especially important in the Western Cape, since the province has an exceptionally high level of globally unique biodiversity, and its ecosystems provide important goods and services, for example the reliable supply of clean water, ecotourism, and coastal protection.

Land-intensive developments significantly threaten the remaining biodiversity in the Western Cape. The objective of biodiversity offsetting is to prevent the undermining of biodiversity targets, to maintain ecological integrity, and to ensure sustainable development. Therefore, it aims to ensure that applicants properly compensate for the residual impacts on biodiversity and ecosystem services.

Four main types of biodiversity offset can be considered (DEA & DP 2015):

- "**Like for like**" / "**in kind**": Here, the biodiversity in the offset area is the same as in the affected area(s). This type of offset is considered the most appropriate in the Western Cape. Like for like offsetting is especially important when threatened ecosystems and/or species will be impacted.
- "**Trading up**": This involves offsetting an appropriate area, of different habitat, that is of higher conservation priority and threatened status, to the area that will be impacted on by the proposed development.
- "**Out of kind**": This involves offsetting an appropriate area, of different habitat from the area that will be impacted on by the proposed development, which is located in a priority area for biodiversity conservation. This is usually considered when the like for like option is not possible, but where a similar ecosystem can be granted protection when it is in need of this.
- "**Monetary compensation**": This comprises monetary contributions to an accredited biodiversity conservation trust for exclusively acquiring and managing priority habitats, and/or providing funds to expand or manage public protected areas. This is usually appropriate only in exceptional cases if no suitably sized offset land parcels can be found or acquired.

As a general note, "trading down" or providing a biodiversity offset of lower biodiversity value is not permitted, and thus only the four aforementioned types may be considered when offsetting is required.

Breede Sand Fynbos is a listed ecosystem of which little remains in total (sections 4.1, 5.1). The site also contains one of the largest contiguous areas of Breede Sand Fynbos that still remains. Although Breede Sand Fynbos is currently listed as a Vulnerable ecosystem, which would require a 3:1 offset ratio, the proposed mining alternative areas lie completely within a Critical Biodiversity Area 1 (irreplaceable area), and thus the required offset ratio is 30:1 (DEA & DP 2015). In other words, for every unit of land that will be impacted by the proposed development(s), 30 equivalent units must be offset. Preliminary communication with CapeNature have also confirmed that a 30:1 will be applicable to the current project (personal communication Douglas Macfarlane, Biodiversity Offset Specialist).

The applicant is applying for a total of 4 ha for proposed mining activities, which will require a total of 120 ha of Breede Sand Fynbos to be offset (since the proposed areas would only impact Breede Sand Fynbos). The other habitats on site, namely North Sonderend Sandstone Fynbos and Robertson Karoo, are neither equivalent in type nor in conservation status. North Sonderend Sandstone Fynbos predominantly has a different suite of species compared to Breede Sand Fynbos, and as such does not qualify to be considered in the like for like basis in offsetting. Also, it has a lower threat status, and by definition does not qualify to compensate as biodiversity offsetting (DEA & DP 2015). The same is true for Robertson Karoo.

The farm Zandberg Fontein contains a total of about 169 ha of Breede Sand Fynbos, of which 148 ha is still in pristine condition, while 9 ha has moderate rehabilitation potential and 11 ha is heavily degraded, being mostly invaded by *Acacia saligna* and heavily overgrazed (Figure 20). Therefore, the advantage of the current offset proposal is that it will secure biodiversity of the same type (like for like), which is also pristine in nature and free of any disturbance, such as invasive aliens, erosion (except natural) etc., and is simultaneously wholly contained within the farm boundaries. Thus, an offset area is an appropriate compensation for the area that will be lost, since it can be considered as a "first prize" option.

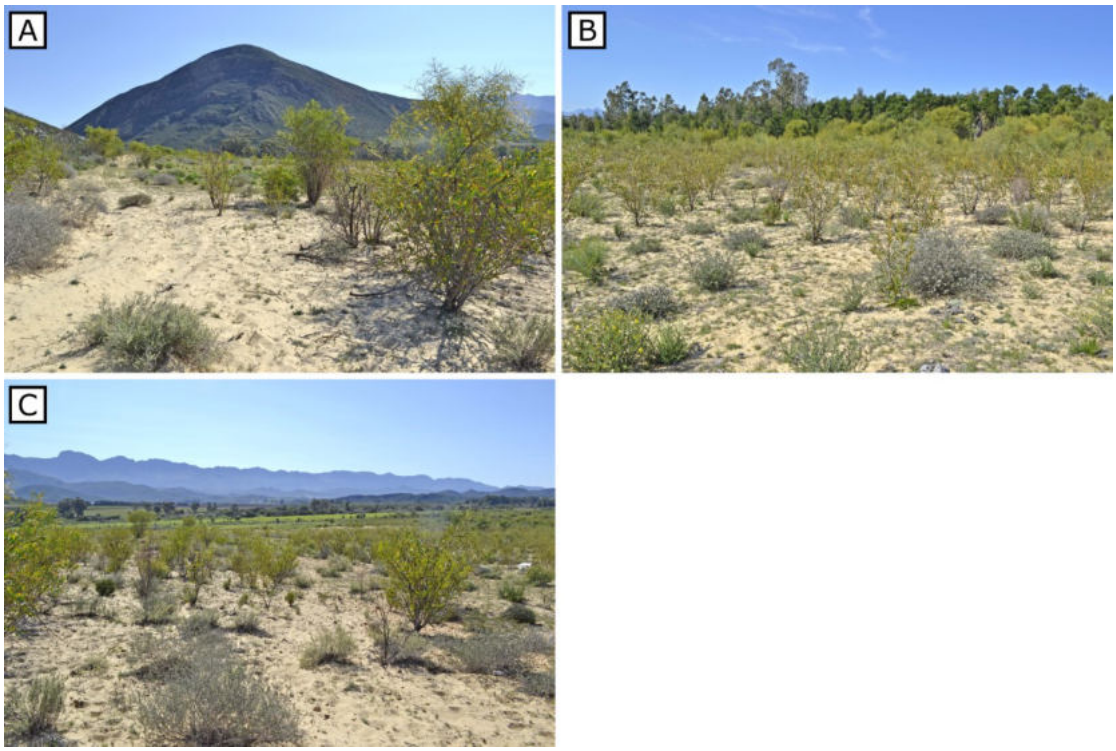

Figure 20: Representative photos of the section of degraded Breede Sand Fynbos in the northern part of the site (see Figure 12). Views are towards the north (A), southeast (B), and east (C).

7.2 Rehabilitation of mined areas

In conjunction with biodiversity offsetting, rehabilitation of mined areas will be crucial for minimizing and mitigating the impacts of the proposed mining activities. Site inspection revealed that there is good potential for mined areas to be rehabilitated to a state that supports most of the species characteristic of Breede Sand Fynbos. Specifically, current mining area 1 has a decent amount of vegetation cover (Figure 21), and supports a large number of species characteristic of Breede Sand Fynbos, together with large numbers of individuals of some Red List species that occur in the surrounding Breede Sand Fynbos, as well as North Sonderend Sandstone Fynbos (Figure 22). The fact that rehabilitated areas can enable the return and persistence of Breede Sand Fynbos Species of Conservation Concern, together with the fact that a suitable amount of Breede Sand Fynbos is available on site for biodiversity offsetting, will greatly mitigate the impacts of the proposed mining activities.

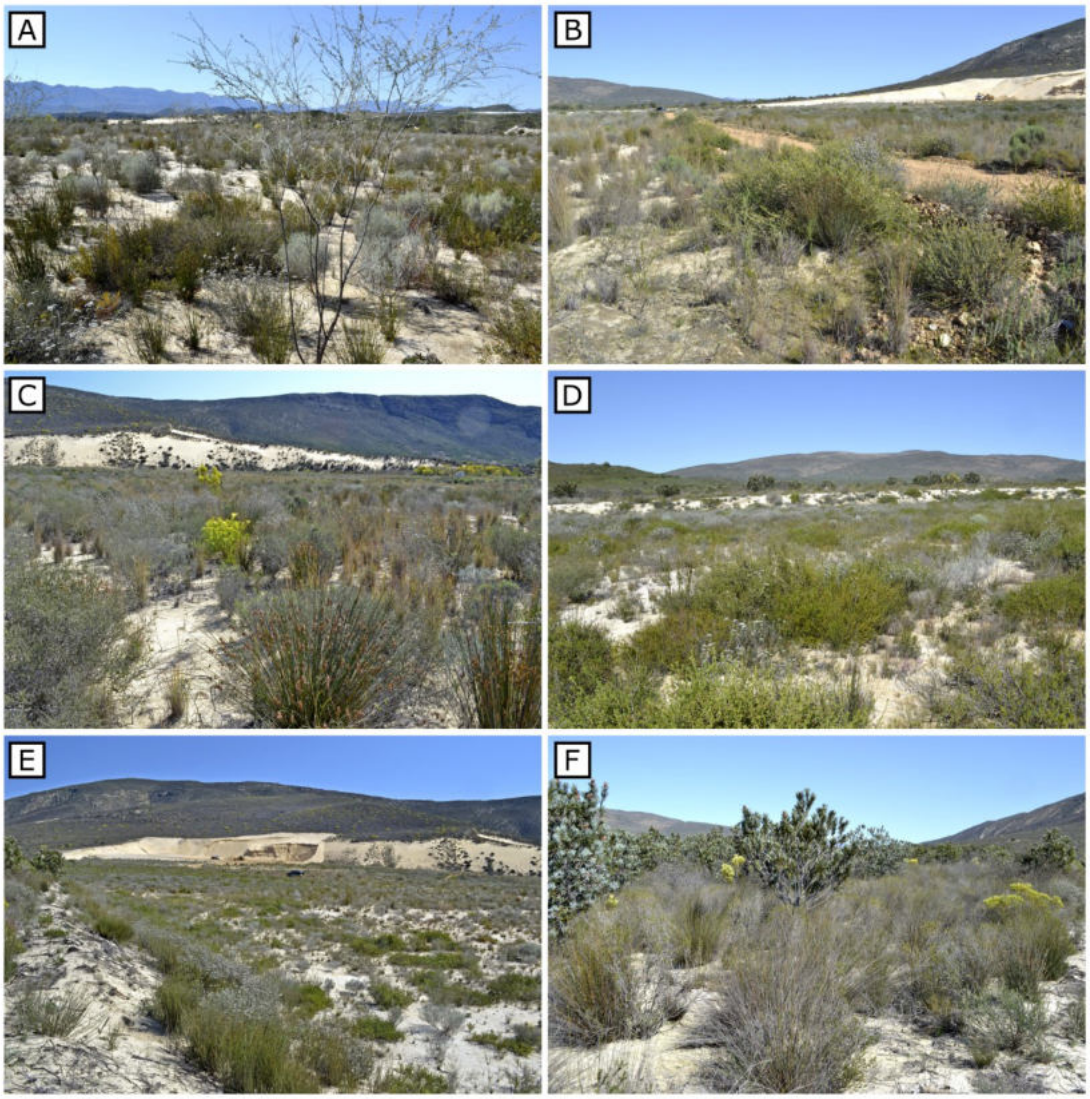

Figure 21: Representative photos of the mined-out area at the southern end of current mining area 1 (see Figure 7). A – D were taken inside the mining footprint, while E shows the fringe/edge of the mining area (where the dune starts), and F shows the undisturbed, pristine Breede Sand Fynbos vegetation directly behind the dune edge (in F). The mined-out area supports a diversity of species, many of which occur in pristine Breede Sand Fynbos, including some Red List species (see Figure 22). The only species that are absent, likely due to the shallowness of the sand layer, is *Protea laurifolia* (seen as the tall shrubs in F).

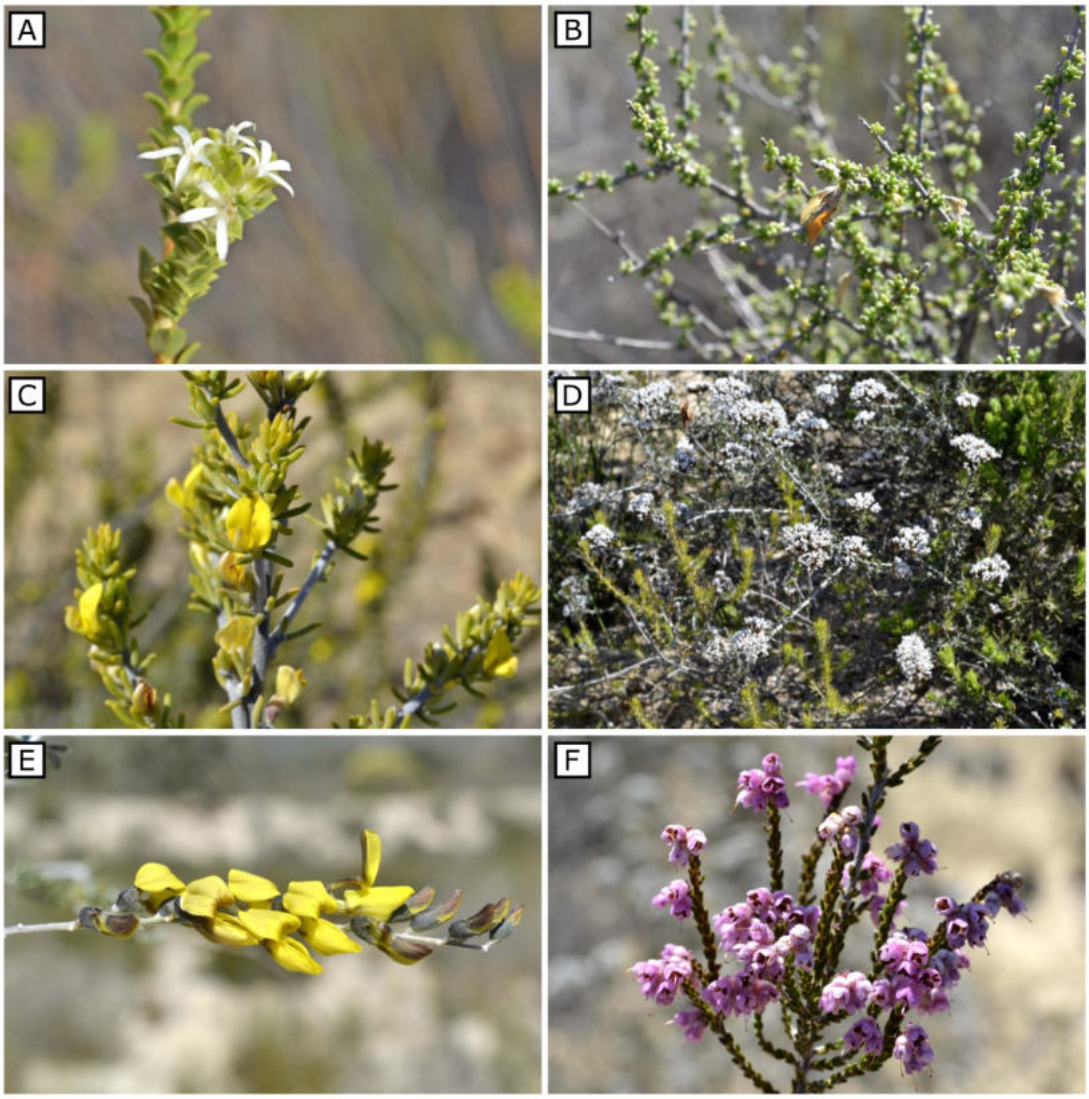

Figure 22: The mined-out area of current mining area 1 has been left to passively restore for a few years and currently supports a variety of species. Although it include one dominant species (*Aspalathus ciliaris*) that is different to that of the surrounding Breede Sand Fynbos, this area freely supports numerous Breede Sand Fynbos species, as well as three of the Red List species that occur in Breede Sand Fynbos (BSF), and one that occurs in North Sonderend Sandstone Fynbos (NSSF), namely: A) *Euchaetis pungens* (Vulnerable; BSF), B) *Aspalathus lactea* subsp. *breviloba* (Vulnerable; BSF), C) *Aspalathus burchelliana* (Endangered; NSSF), and D) *Metalasia adunca* (Near Threatened; BSF). It also supports some of the rarer, though Least Concern species, such as E) *Wiborgia obcordata*, as well as some of the abundant species, such as F) *Erica plumosa*.

The ideal rehabilitation plan includes both concurrent rehabilitations, where rehabilitation is implemented alongside mining, and final rehabilitation, which is carried out once mining ceases and the mine enters the decommissioning and closure phases. Key aspects to consider for rehabilitation are now discussed.

7.2.1 Preventing and correcting soil erosion and compaction

It is imperative that, while vegetation is still establishing, soil erosion and compaction is carefully monitored and controlled. This is especially crucial where

slopes are steep, as is the case with alternative area 2, as well as the northern part of alternative area 3.

Soil Erosion:

The following measures will greatly aid with erosion control:

- Implementing proper storm water management.
- Immediately correcting any erosion that occurs in order to minimise further erosion.
- For areas that have already eroded, suitable soil representative of the locality/vegetation type should be sourced, added to erosion areas, and properly landscaped to reduce, or ideally prevent, erosion from reoccurring.
- Grazing animals should not be allowed in rehabilitation areas during the rehabilitation process so that a suitable vegetation cover can establish properly.
- Where possible, reinstate pre-mining drainage patterns as far as possible.

As a preventative action, it is also crucial that any unnecessary disturbance and removal of vegetation is avoided at all costs.

Soil compaction:

Soil compaction greatly increases surface water runoff and impedes the quick and effective establishment of a suitable vegetation cover. It should thus be limited/prevented.

The following measures can be implemented to mitigate soil compaction:

- Avoid the use of wet soils and avoid moving and layering soils when wet; using dry soil will reduce compaction.
- Avoid the use of heavy machinery for spreading and levelling soils. The truck and shovel method should instead be implemented to minimize compaction.
- End-tipping should ideally be used by soil depositing trucks (i.e., soil is deposited in one place and spread out from there), and such trucks should avoid or minimize driving on soils to reduce or prevent soil compaction.
- Soils should be smoothed completely before revegetation commences.
- Designated access routes should be clearly established, and only these routes should be used so that soils are not unnecessarily compacted.
- Once an area has been mined, the topsoil should be replaced as soon as possible so that rehabilitation can start. The topsoil should be of the same type and quality as that of an equivalent benchmark site; in this case, pristine Breede Sand Fynbos.

7.2.2 Establishment of suitable vegetation cover

It is imperative that any mined areas are re-vegetated as soon as possible. The ultimate goals of re-vegetation include:

- Preventing erosion and avoiding further soil loss.
- Restoring the affected area to the best possible condition compared to the original state or equivalent benchmark/pristine areas.
- Reduce, or ideally prevent, surface runoff and the carrying away of topsoil so that sedimentation into rivers and wetlands is reduced.
- Restore as best possible ecosystem functioning, via plant succession, so that the local biodiversity can return, preferably to conditions as close to the original state as possible.

A suitable layer of topsoil, of the same type and quality as that of an equivalent benchmark site (in this case, pristine Breede Sand Fynbos) to that of the mined area, should immediately be applied to an area after it has been fully mined, and before revegetation of that area commences. Here, the recommended depth of soil is between 50 cm – 100 cm. This is based on observations made for the pristine Breede Sand Fynbos occurring directly to the southern border of current mining area 1 (Figure 21; also see Figure 12 for locality). This depth seems to be similar, and somewhat deeper, than the depth of the areas that have passively restored and which contain a good number of species, both SoCC and non-SoCC, characteristic of Breede Sand Fynbos. The added depth would likely also allow the establishment of *Protea laurifolia*, *Leucadendron salignum*, and *Leucospermum calligerum*, species that were absent in current mining area 1 but that are characteristic of adjacent Breede Sand Fynbos.

Re-establishing sand fynbos can prove to be difficult; however, hand sowing can be used to increase the chances of fynbos reestablishment. Recommended species to be used, which are characteristic of the environment (Breede Sand Fynbos), are:

- *Aspalathus lactea* subsp. *breviloba*
- *Aspalathus quinquefolia* subsp. *quinquefolia*
- *Crassothonna alba*
- *Disparago ericoides*
- *Ehrharta villosa* var. *villosa*
- *Erica plumosa*
- *Erica serrata*
- *Euchaetis pungens*
- *Leucadendron salignum*
- *Leucospermum calligerum*
- *Metalasia adunca*
- *Metalasia erubescens*
- *Polpoda capensis*
- *Prismatocarpus brevilobus*
- *Protea laurifolia*
- *Rafnia capensis* subsp. *capensis*
- *Senecio arenarius*
- *Stipagrostis zeyheri* subsp. *zeyheri*
- *Stoebe nervigera*
- *Struthiola fasciata*
- *Thamnochortus lucens*
- *Wachendorfia paniculata*
- *Willdenowia incurvata*
- *Willdenowia sulcata*

It is recommended that seeding be done immediately before or after good rains so as to maximize the chances of seed germination and establishment. Seeds can be sown into finely tilled and freshly prepared seedbeds. A thin layer of mulch can be used, especially during the initial rehabilitation phase, to increase the water retention ability of the soils in order to increase the probability of seed germination. It is, however, crucial to use a good quality mulch free of weeds and weed propagules, and regular monitoring for, and removal of, alien plants should be done if this option is used.

It is also important to note that most fynbos seeds require smoke treatment to stimulate germination, and it is therefore highly recommended that any seeds used for revegetation be smoke treated at least 24 hours prior to seeding (smoke primer discs are available from Seeds for Africa: https://www.seedsforafrica.co.za).

Regular surveys should be conducted by a qualified botanical expert to assess the plant community composition (species richness and abundances) to determine the extent to which the target community (Breede Sand Fynbos) has been obtained. It is also important that adequate temporal sampling be done, i.e., preferably spring and winter, so that most species are captured for assessment purposes.

7.2.3 Pollution control

It is important that all vehicles and equipment used during the rehabilitation process be regularly serviced and inspected for any hydrocarbon leakages. This will prevent, or at least minimize, the chances of hydrocarbon spills occurring and polluting the environment, which would hamper rehabilitation efficacy.

7.2.4 Weed/Invasive plant control

Invasive alien plant species are a global problem, and their impacts on ecosystems are numerous, including impacts on local aboveground biodiversity (e.g., reducing native species richness and diversity, and altering native plant community structures) and soils (e.g., altering soil nutrient cycling and soil microbial functioning) (Keet et al., 2021). Moreover, alien plant invasions can quickly get out of hand if they are not controlled as early as possible, and it is therefore crucial that monitoring be conducted continually and that any weedy or listed alien species be removed immediately. Section 5.3 provides details on which alien species were found on site; of these species, *Acacia cyclops* and *A. saligna* are the most likely to invade mined areas, since they are well adapted to invaded sandy soils.

Alien plants can be managed as follows:

- Mechanical methods: hand pulling (for small plants and seedlings), and ring barking and felling (for larger individuals such as trees)
- Chemical control: making use of herbicides, taking care to use appropriate herbicides for each species and context (e.g., selective vs non-selective, contact vs systemic herbicides etc.), as well as the appropriate methods for application.

Note that by law (NEMBA), listed invasive alien plants must be controlled. Also, any new plantings of listed invasive alien plants are strictly forbidden.

It is imperative that, during all alien plant control operations, damage to the environment is minimized, or ideally prevented. It is also crucial that follow up control (removing seedlings, saplings, and coppice regrowth) is regularly done for at least three consecutive growing seasons for any area in which invasive species were removed, and that such areas (and other areas) be continually monitored and their species lists updated, since re-invasion from neighbouring properties is always a distinct possibility.

7.2.5 Monitoring and maintenance during and after rehabilitation

Monitoring ensures that all rehabilitation objectives are met and that the rehabilitation process is followed. Rehabilitation should carefully be monitored during the operational phase, as well as the post-operational phase when the desired final ecosystem is being established. The following aspects should closely and regularly be monitored:

- Topsoil depth: it is crucial that a proper topsoil depth is maintained; here, that recommended depth is between 50 cm – 100 cm based on observations surrounding current mining area 1.
- Soil erosion status: any existing erosion should be controlled, and any new erosion that arises should be corrected immediately.
- Vegetation cover and species diversity: vegetation should regularly be assessed to determine whether target species have established and whether a sufficient vegetation cover has been obtained (both commensurate with surrounding Breede Sand Fynbos).
- Proportion of mined areas that have adequately been rehabilitated.

As a final note, it is important that appropriate veld management is employed for all fully rehabilitated areas (e.g., applying appropriate fire regimes, stocking rates etc.) so as to aid the proper functioning of such areas.

8. CONCLUSION

The existing Zandberg Sand Mine is located within Portion 4 of the Farm Zandberg Fontein 97 located approximately 7 km south-west of the town of Robertson. The Mining Right Holder (Zandberg Sandput (Pty) Ltd) intends on expanding the MR footprint with an additional 4 ha, in either of three alternative areas. Subsequently a Section 102 is being applied for.

Nkurenkuru Ecology and Biodiversity (Pty) Ltd has been appointed by GreenMined Environmental (Pty) Ltd to conduct a botanical assessment of the proposed target area for the expansion in order to provide a professional opinion on botanical issues pertaining to the target area to aid in future decisions regarding the proposed project. This report sets out the findings of the botanical study and assessment.

From a botanical and ecological perspective, it was found that the entire project site is located within a near-natural to natural area with minimal disturbance. All proposed alternative areas are located within a Vegetation Type (Breede Sand Fynbos) listed as Vulnerable. Furthermore, almost the entire farm is located within a CBA1, with the area being confirmed, during the site visit, to comply with the criteria classifying this area as a CBA1. Developments of this nature would not be acceptable within a CBA1 and do not comply with the land use practices allowed for within such CBAs, unless the appropriate mitigation measures are implemented, specifically biodiversity offsetting and rehabilitation of mined areas.

During this assessment it was determined that the farm contains a large area (148 ha) of pristine Breede Sand Fynbos. Thus, there is enough (minimum 120 ha for a 30:1 offset ratio) Breede Sand Fynbos to compensate, as a biodiversity offset aera, for the proposed mining area. Also, site observations confirm that already mined areas have the potential to support many species characteristic of Breede Sand Fynbos, including Species of Conservation Concern. It is therefore recommended that mined areas be rehabilitated as soon as they have been completely mined.

In order to further minimize impacts, it is recommended that alternative area 1 is chosen for mining activities, since it will reduce impacts such as erosion, and it contains lower numbers of individual Species of Conservation Concern (but not species per se) than alternative areas 2 and 3. However, alternative area 3 is also a viable option, since it has the smallest perimeter of all three alternative areas, which would minimize edge effects. However, alternative area 3 contains within it a drainage/seepage area, which should be regarded as a no-go area unless a hydrologist/wetland specialist conducts a site inspection and approves the area for mining.

Therefore, it is the opinion of the specialists that the development may be authorised strictly within the specified area, subject to the implementation of the recommended mitigation measures.

As part of this Assessment a detailed field survey of the vegetation was undertaken on 31 January 2020 and on 25 August 2021.

Specific outcomes required from this report include the following:

- To define the Present Ecological State (PES) of the terrestrial ecological resources in the vicinity of the study site;
- To conduct a floral Species of Conservation Concern (SCC) assessment;
- To identify and consider all sensitive landscape and ecologically important features;
- To determine the environmental impacts that the proposed mine might have on the terrestrial ecology associated with the footprint area; and
- To develop mitigation and management measures for all phases of the development.

General Results

- The project site is located on a dune plume of Breede Sand Fynbos that covers an area of approximately 597 ha (although the true extent of this might be less). This dune plume has settled along the south-eastern slope of the Sandberg Mountain Range, which is a narrow range running in a south-west to north-east direction.
- This dune plume is dissected (mostly within the southern portion of the dune) by short, narrow ephemeral drainage lines running perpendicular to the mountain range and either draining into the large drainage system to the east, or merely dissipating into the sand plume to eventually seep into the underlying aquifers.
- Where the dune plume thins out along the upper slopes of the Sandberg Mountain, sandstone outcrops become exposed. Sandstone outcrops also occur lower down as isolated features where erosion has exposed them, especially along the steeper slopes associated with some of the drainage lines.
- The following habitat types were identified:
  - Dense, well-developed fynbos occurring on the stabilised portions of the dune plume;
  - Sparse Fynbos occurring on the semi-mobile portions of the dune plume;
  - Active, mobile portions of the dune plume largely devoid of vegetation;
  - Drainage lines

National and regional conservation context:

- The vegetation of the study site resembles pristine forms of Breede Sand Fynbos throughout the majority of the site, together with pristine North Sonderend Sandstone Fynbos in the Western and southwestern corner,

adjacent to drainage lines. Breede Sand Fynbos has been classified as Vulnerable by Mucina and Rutherford (2006) with 45% being already transformed and a conservation target of 30%. Furthermore, this area is also listed as Vulnerable within the Threatened Ecosystem List (NEMA:BA).

» From a provincial conservation perspective, the entire mining footprint is located almost entirely within a CBA1, which ground-truthing confirmed. Areas classified as CBA1 are regarded as "areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure" (WCSBP 2017).

Flora specific results

» Ground truthing of the site confirmed a total of 109 species present, 56 of which are characteristic of Breede Sand Fynbos.
» A total of 32 Species of Conservation Concern species were present in Breede Sand Fynbos and North Sonderend Sandstone Fynbos, and lcuded 10 Red List species (2 EN; 5 VU; 1 NT; 2 DD).
» In terms of ecological sensitivity and conservation value / importance, the pristine nature of the vegetation (no invasive aliens, no transformation, no secondary vegetation), the unique micro-habitats present, and the various important functions and services provided by these habitats and their vegetation cover, means that the entire site can be classified as highly sensitive.

Sensitivity and associated development recommendations

» The entire project area is regarded as highly sensitive.
» Alternative area 1 is the preferred area for the proposed mining extension; however alternative area 3 is another possibility if approved by a hydrologist/wetland specialist.
» All drainage lines are regarded as high sensitivity, No-Go features.
» The proposed mining area can be regarded as acceptable loss only if an appropriately sized biodiversity offset area is demarcated, and if mined areas are properly rehabilitated.

Cumulative Impacts

» If the footprint of 4 ha is approved it is highly likely that this development will contribute to the cumulative impacts of the area:
    - Affecting the conservation targets set out by the province for this region;
    - Impact the conservation targets set out for the vegetation type and ecosystem (at national level).
    - Compromise the ecological functioning of the larger “natural” environment; and

- Disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.

» However, the loss will be mitigated by an appropriately sized biodiversity offset area and rehabilitating of mined areas, and would then contribute significantly less to the cumulative impacts as described above.

Terrestrial Impact Assessment

» The most significant impacts associated with the development will be vegetation destruction and disturbance, some local habitat loss, and potential temporary faunal disturbance. Furthermore, these disturbed areas may become prone to erosion and invasion with invasive alien plants.

» A summary of pre- and post-mitigation impact significance ratings for the different impacts and risks factors identified for the proposed development are provided below.

Phase	Impact	Significance Without Mitigation	Significance With Mitigation
Site Establishment & Operation	Potential Impacts on vegetation and Species of Conservation Concern	High (70)	Medium (50)
	Potential impacts on local fauna, especially threatened animals, due to disturbance and a loss of available habitat and migration routes	Medium (55)	Low (24)
	Impact on drainage areas	AA1 & 2: High (80)	AA1 & 2: Low (21)
		AA3: High (64)	AA3: Medium (52)
	Potential increased erosion risk and destabilisation of the dune plume during- and post-operational phase	AA1: Medium (50)	AA1: Low (27)
		AA2: High (70)	AA2: Medium (44)
		AA3: High (70)	AA3: Medium (33)
	Increased alien plant invasion	Medium (48)	Low (24)

		Overall impact of the proposed project considered in isolation			Cumulative impact of the project and other projects within the area		
		Alternative area 1	*Alternative area 2*	*Alternative area 3*	*Alternative area 1*	*Alternative area 2*	*Alternative area 3*
Cumulative	Reduced ability to meet conservation obligations and targets	Medium (36)	Medium (56)	Medium (36)	Medium (48)	Medium (56)	Medium (48)
	Impacts on Ecological Support Areas and Broad-Scale Ecological Processes	Medium (30)	Medium (36)	Medium (30)	Medium (56)	High (64)	High (64)

Important recommendations and mitigation measures

» Since the applicant is applying for a total of 4 ha for proposed mining activities, a total of 120 ha of Breede Sand Fynbos should be used as biodiversity offset.
» Phased mining and vegetation clearance should be done. All vegetation outside of the active mining benches should not be disturbed until it is time for that specific area to be mined. Furthermore, upon progressing from one mining bench to the next, immediate rehabilitation should start on the mined-out bench.
» The following aspects should be noted regarding the rehabilitation of sand fynbos:
  - Sand Fynbos occurs on acidic, deep, loose, sandy soils which are easily destabilized and prone to wind erosion.
  - Wind-blown sand damages vegetation and makes it difficult to establish vegetation cover, therefore anti-soil erosion measures may be required.
  - Disturbed areas are slow to self-repair, therefore active restoration (e.g., sowing and planting) will be required.
  - Ecological restoration does not substitute for sustainably managing and protecting intact native ecosystems.
  - Fynbos ecosystems are prone to invasion by alien species and alien plant invasion is the second biggest cause of biodiversity loss after direct habitat loss. The management and eradication of Invasive Alien Plants (IAPs) are therefore a critical portion of the rehabilitation process and a detailed IAP Management Plan is should be in place.

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10. APPENDICES

Appendix 1: Plant Species List (Site and POSA Generated List)

The species list presented here is a combination of online (POSA) and site survey data.
Descriptions of colours and symbols are given below:

Species in **bold:** Observed on site and present in online databases.
Species highlighted in green: Observed on site, but not present in online databases.
Species highlighted in blue: Alien.
Species marked with "*": Provincially protected.
Species marked with "†": Red Listed.

Family	Species	IUCN	Family	Species	IUCN	Family	Species	IUCN
Achariaceae	*Kiggelaria africana*	LC	Asteraceae	*Zyrphelis microcephala* subsp. *microcephala*	LC	Iridaceae	***Tritonia pallida**	
Aizoaceae	†**Acrodon purpureostylus*	EN	Balanophoraceae	*Mystropetalon thomii*	LC	Iridaceae	**Tritonia pallida* subsp. *pallida*	LC
Aizoaceae	**Aizoon karooicum*	LC	Blechnaceae	*Blechnum punctulatum* var. *punctulatum*	LC	Iridaceae	†**Watsonia aletroides*	NT
Aizoaceae	†**Antimima leipoldtii*	VU	Boraginaceae	*Heliotropium supinum*		Juncaceae	*Juncus bufonius*	
Aizoaceae	†**Brianhuntleya intrusa*	NT	Boraginaceae	*Lobostemon echioides*	LC	Lamiaceae	*Ballota africana*	LC
Aizoaceae	****Carpobrotus edulis* subsp. *edulis***	**LC**	**Boraginaceae**	***Lobostemon fruticosus***	**LC**	Lamiaceae	*Leonotis leonurus*	LC
Aizoaceae	**Carpobrotus mellei*	LC	Boraginaceae	†*Lobostemon gracilis*	NT	Lamiaceae	*Mentha longifolia* subsp. *capensis*	LC

Aizoaceae	**Cephalophyllum purpureo-album*	LC	Boraginaceae	*Lobostemon laevigatus*	LC	Lamiaceae	*Salvia africana*	
Aizoaceae	**Conophytum ficiforme*	LC	Boraginaceae	*Lobostemon strigosus*	LC	Lamiaceae	*Salvia chamelaeagnea*	LC
Aizoaceae	**Conophytum truncatum* subsp. *viridicatum*	LC	Boraginaceae	*Trichodesma africanum*	LC	Lamiaceae	*Stachys aethiopica*	LC
Aizoaceae	**Delosperma* sp.		Brassicaceae	*Brassica* sp.		Limeaceae	*Limeum dinteri*	LC
Aizoaceae	**Drosanthemum lique*	LC	**Brassicaceae**	***Heliophila africana***	**LC**	**Lobeliaceae**	***Cyphia volubilis***	**LC**
Aizoaceae	**Drosanthemum* sp.		Brassicaceae	*Heliophila bulbostyla*	LC	Lobeliaceae	*Monopsis scabra*	LC
Aizoaceae	**Drosanthemum speciosum*	LC	Brassicaceae	*Heliophila cornuta* var. *squamata*	NE	Malvaceae	*Abutilon dinteri*	LC
Aizoaceae	*†*Drosanthemum striatum*	VU	Brassicaceae	*Heliophila crithmifolia*	LC	Malvaceae	*Anisodontea fruticosa*	LC
Aizoaceae	**Galenia africana*	LC	Brassicaceae	*Heliophila meyeri* var. *minor*	LC	Malvaceae	*†Anisodontea gracilis*	DD
Aizoaceae	**Galenia cymosa*	LC	Brassicaceae	*Heliophila pendula*	LC	Malvaceae	*Hermannia burkei*	LC
Aizoaceae	**Galenia filiformis*	LC	Brassicaceae	*Heliophila scoparia*		Malvaceae	*Hermannia comosa*	LC
Aizoaceae	**Galenia fruticosa*	LC	Brassicaceae	*Heliophila suavissima*	LC	Malvaceae	*Hermannia confusa*	LC
Aizoaceae	**Galenia pubescens*	LC	Brassicaceae	*Heliophila subulata*	LC	Malvaceae	*Hermannia cuneifolia* var. *cuneifolia*	LC
Aizoaceae	**Galenia secunda*	LC	Brassicaceae	*Heliophila tulbaghensis*	LC	Malvaceae	*Hermannia filifolia* var. *filifolia*	NE
Aizoaceae	**Glottiphyllum difforme*	LC	Brassicaceae	*Lepidium desertorum*	LC	Malvaceae	*Hermannia filifolia* var. *grandicalyx*	NE
Aizoaceae	**Lampranthus haworthii*	LC	Brassicaceae	*Sisymbrium capense*	LC	Malvaceae	*Hermannia hyssopifolia*	LC
Aizoaceae	**Lampranthus* sp.		Bruniaceae	**Brunia monogyna*	LC	Malvaceae	*Hermannia incana*	LC
Aizoaceae	**Leipoldtia schultzei*	LC	**Cactaceae**	***Opuntia ficus-indica***	**NE**	Malvaceae	*Hermannia pinnata*	LC
Aizoaceae	**Mesembryanthemum articulatum*		**Campanulaceae**	***Prismatocarpus brevilobus***	**LC**	Malvaceae	*Hermannia pulverata*	LC
Aizoaceae	**Mesembryanthemum bicorne*		Campanulaceae	*Prismatocarpus campanuloides* var. *campanuloides*	NE	Malvaceae	*Hermannia* sp.	
Aizoaceae	**Mesembryanthemum englishiae*		Campanulaceae	*Roella ciliata*	LC	Menispermaceae	*Cissampelos capensis*	LC
Aizoaceae	**Mesembryanthemum grossum*		Campanulaceae	*Siphocodon spartioides*	LC	**Molluginaceae**	***Polpoda capensis***	**LC**
Aizoaceae	**Mesembryanthemum junceum*		Campanulaceae	*Wahlenbergia albens*	LC	Molluginaceae	*Psammotropha anguina*	LC
Aizoaceae	**Mesembryanthemum pallens* subsp. *lanceum*		Campanulaceae	*Wahlenbergia exilis*	LC	Montiniaceae	*Montinia caryophyllacea*	LC
Aizoaceae	**Mesembryanthemum varians*		Campanulaceae	*Wahlenbergia neorigida*	LC	Moraceae	*Ficus cordata* subsp. *cordata*	LC
Aizoaceae	**Ruschia caroli*	LC	**Campanulaceae**	***Wahlenbergia nodosa***	**LC**	Myricaceae	*Morella integra*	LC
Aizoaceae	**Ruschia lineolata*	LC	Campanulaceae	*Wahlenbergia paniculata*	LC	Myrtaceae	*Eucalyptus camaldulensis*	
Aizoaceae	**Ruschia orientalis*	LC	Caryophyllaceae	*Dianthus caespitosus* subsp. *pectinatus*	LC	**Myrtaceae**	***Eucalyptus cladocalyx***	**NE**

Aizoaceae	***†*Ruschia pungens***	**DD**	Caryophyllaceae	*Silene undulata*		Myrtaceae	*Eucalyptus longifolia*	
Aizoaceae	**Ruschia* sp.		Caryophyllaceae	*Silene undulata* subsp. *undulata*	LC	Oleaceae	*Olea europaea* subsp. *cuspidata*	
Aizoaceae	****Ruschiella argentea***	**LC**	**Casuarinaceae**	***Casuarina equisetifolia***	**NE**	Onagraceae	*Epilobium hirsutum*	LC
Aizoaceae	***†*Stayneria neilii***	**VU**	Celastraceae	*Cassine parvifolia*	LC	Orchidaceae	**Bartholina burmanniana*	LC
Aizoaceae	****Tetragonia fruticosa***	**LC**	Celastraceae	*Gloveria integrifolia*	LC	Orchidaceae	**Ceratandra atrata*	LC
Aizoaceae	**Tetragonia robusta*	LC	Celastraceae	*Gymnosporia buxifolia*	LC	Orchidaceae	**Disa bifida*	LC
Aizoaceae	**Tetragonia saligna*	LC	Celastraceae	*Maytenus acuminata* var. *acuminata*	LC	**Orchidaceae**	****Disperis capensis***	**LC**
Aizoaceae	**Tetragonia spicata*	LC	**Celastraceae**	***Maytenus oleoides***	**LC**	Orchidaceae	**Holothrix secunda*	LC
Aizoaceae	**Tetragonia verrucosa*	LC	Colchicaceae	*Colchicum capense* subsp. *capense*	LC	Orchidaceae	**Holothrix villosa* var. *villosa*	LC
Aizoaceae	**Trichodiadema densum*	LC	Crassulaceae	*Adromischus caryophyllaceus*	LC	Orchidaceae	**Pterygodium orobanchoides*	LC
Alliaceae	*Tulbaghia capensis*	LC	Crassulaceae	*Adromischus filicaulis* subsp. *marlothii*	LC	Orobanchaceae	**Harveya bodkinii*	LC
Amaranthaceae	*Amaranthus thunbergii*	LC	Crassulaceae	*Adromischus* sp.		Orobanchaceae	**Harveya squamosa*	LC
Amaranthaceae	*Atriplex lindleyi* subsp. *inflata*		Crassulaceae	*Adromischus triflorus*	LC	Orobanchaceae	*Hyobanche rubra*	LC
Amaranthaceae	*Atriplex semibaccata*		Crassulaceae	*Cotyledon orbiculata* var. *orbiculata*	LC	**Orobanchaceae**	***Hyobanche sanguinea***	**LC**
Amaranthaceae	*Atriplex vestita* var. *appendiculata*	LC	Crassulaceae	*Cotyledon orbiculata* var. *spuria*	LC	Orobanchaceae	*Orobanche ramosa*	NE
Amaranthaceae	*Chenopodium album*		Crassulaceae	*Cotyledon* sp.		Oxalidaceae	*Oxalis eckloniana* var. *sonderi*	LC
Amaranthaceae	*Chenopodium mucronatum*	LC	Crassulaceae	*Crassula biplanata*	LC	Oxalidaceae	*†Oxalis leptocalyx*	DD
Amaranthaceae	*Chenopodium murale* var. *murale*		Crassulaceae	*Crassula capitella* subsp. *thyrsiflora*	LC	Oxalidaceae	*†Oxalis lindaviana*	DD
Amaranthaceae	*Manochlamys albicans*	LC	Crassulaceae	*Crassula inanis*	LC	**Oxalidaceae**	***Oxalis obtusa***	**LC**
Amaranthaceae	*Salsola adversariifolia*	LC	Crassulaceae	*Crassula multiflora* subsp. *multiflora*	LC	Oxalidaceae	*†Oxalis pardalis*	DD
Amaranthaceae	*Salsola aphylla*	LC	Crassulaceae	*Crassula muscosa* var. *muscosa*	NE	Oxalidaceae	*†Oxalis pseudohirta*	CR
Amaranthaceae	*Salsola kali*		Crassulaceae	*Crassula natans* var. *minus*	LC	Oxalidaceae	*Oxalis zeyheri*	LC
Amaranthaceae	*Salsola* sp.		Crassulaceae	*Crassula pubescens* subsp. *pubescens*	LC	Peraceae	*Clutia alaternoides* var. *angustifolia*	LC
Amaranthaceae	*Sarcocornia pillansii* var. *pillansii*	LC	Crassulaceae	*Crassula rupestris* subsp. *rupestris*	LC	Peraceae	*Clutia laxa*	LC
Amaranthaceae	*Sarcocornia* sp.		Crassulaceae	*Crassula saxifraga*	LC	Peraceae	*Clutia marginata*	LC
Amaryllidaceae	**Boophone disticha*	LC	Crassulaceae	*Crassula* sp.		Peraceae	*Clutia polifolia*	LC
Amaryllidaceae	****Brunsvigia orientalis***	**LC**	Crassulaceae	*Crassula strigosa*	LC	Peraceae	*Clutia pubescens*	LC
Amaryllidaceae	**Brunsvigia striata*	LC	Crassulaceae	*Crassula tetragona* subsp. *tetragona*	LC	**Pinaceae**	***Pinus roxburghii***	**NE**

Amaryllidaceae	**Gethyllis spiralis*	LC	Crassulaceae	*Crassula vaillantii*		Plumbaginaceae	*†Limonium purpuratum*	EN
Amaryllidaceae	**Gethyllis transkarooica*	LC	Crassulaceae	*Tylecodon* sp.		Poaceae	*Aristida junciformis* subsp. *junciformis*	LC
Amaryllidaceae	**Gethyllis villosa*	LC	Crassulaceae	*Tylecodon ventricosus*	LC	Poaceae	*Bromus pectinatus*	LC
Amaryllidaceae	**Haemanthus sanguineus*	LC	Cucurbitaceae	*Citrullus lanatus*	LC	Poaceae	*Capeochloa arundinacea*	LC
Amaryllidaceae	**Nerine humilis*	LC	Cucurbitaceae	*Cucumis myriocarpus* subsp. *leptodermis*	LC	**Poaceae**	***Capeochloa cincta* subsp. *cincta***	**LC**
Amaryllidaceae	**Nerine sarniensis*	LC	Cucurbitaceae	*Kedrostis nana* var. *zeyheri*	LC	Poaceae	*Cymbopogon marginatus*	LC
Anacampserotaceae	*Anacampseros lanceolata* subsp. *lanceolata*	LC	Cyperaceae	*Chrysitrix capensis*		Poaceae	*Cynodon dactylon*	LC
Anacampserotaceae	*Anacampseros telephiastrum*	LC	Cyperaceae	*Cyperus marginatus*	LC	Poaceae	*Digitaria eriantha*	LC
Anacardiaceae	*Schinus molle*	NE	**Cyperaceae**	***Ficinia deusta***	**LC**	Poaceae	*Ehrharta calycina*	LC
Anacardiaceae	***Searsia dissecta***	**LC**	Cyperaceae	*Ficinia nigrescens*	LC	Poaceae	*Ehrharta delicatula*	LC
Anacardiaceae	*Searsia glauca*	LC	Cyperaceae	*Ficinia ramosissima*	LC	Poaceae	*Ehrharta erecta* var. *erecta*	LC
Anacardiaceae	*Searsia laevigata* var. *laevigata* forma *laevigata*	NE	Cyperaceae	*Isolepis trachysperma*	LC	Poaceae	*Ehrharta longiflora*	LC
Anacardiaceae	*Searsia lancea*	LC	**Cyperaceae**	***Scirpoides thunbergii***	**LC**	Poaceae	*Ehrharta triandra*	LC
Anacardiaceae	*Searsia pallens*	LC	Cytinaceae	*Cytinus sanguineus*	LC	**Poaceae**	***Ehrharta villosa* var. *villosa***	**LC**
Anacardiaceae	*Searsia rehmanniana* var. *glabrata*	LC	Ditrichaceae	*Pleuridium ecklonii*		Poaceae	*Eragrostis curvula*	LC
Anacardiaceae	*Searsia rosmarinifolia*	LC	**Ebenaceae**	***Diospyros glabra***	**LC**	Poaceae	*Eragrostis obtusa*	LC
Anacardiaceae	*Searsia scytophylla* var. *scytophylla*	NE	Ebenaceae	*Euclea undulata*	LC	Poaceae	*Eragrostis rotifer*	LC
Anacardiaceae	*Searsia tomentosa*	LC	Ericaceae	**Erica abietina* subsp. *aurantiaca*	LC	Poaceae	*Festuca scabra*	LC
Anacardiaceae	*Searsia undulata*	LC	Ericaceae	**Erica anguliger*	LC	Poaceae	*Hordeum murinum* subsp. *leporinum*	NE
Anemiaceae	*Mohria caffrorum*	LC	Ericaceae	**Erica arachnocalyx*	LC	**Poaceae**	***Hyparrhenia hirta***	**LC**
Apiaceae	***Anginon difforme***	**LC**	Ericaceae	**Erica articularis* var. *articularis*	LC	Poaceae	*Koeleria capensis*	LC
Apiaceae	*Anginon swellendamensis*	LC	Ericaceae	**Erica axillaris*	LC	Poaceae	*Lamarckia aurea*	NE
Apiaceae	*Annesorhiza triternata*	LC	Ericaceae	**Erica bruniades*	LC	Poaceae	*Leptochloa fusca*	LC
Apiaceae	*Centella glabrata* var. *glabrata*	NE	Ericaceae	**Erica caffra*		Poaceae	*Parapholis incurva*	NE
Apiaceae	*Centella linifolia* var. *linifolia*	LC	Ericaceae	**Erica coccinea* subsp. *coccinea*	LC	**Poaceae**	***Pennisetum setaceum***	**NE**
Apiaceae	*Centella macrocarpa* var. *macrocarpa*	LC	Ericaceae	**Erica corifolia* var. *corifolia*	LC	Poaceae	*Pentameris acinosa*	LC
Apiaceae	***Centella restioides***	**LC**	Ericaceae	**Erica daphniflora* var. *leipoldtii*	LC	Poaceae	*Pentameris airoides* subsp. *airoides*	LC
Apiaceae	*Centella* sp.		Ericaceae	**Erica embothriifolia* var. *embothriifolia*	LC	Poaceae	*Pentameris aristidoides*	LC

Apiaceae	†*Centella thesioides*	VU	Ericaceae	**Erica equisetifolia*	LC	Poaceae	*Pentameris colorata*	LC
Apiaceae	*Chamarea* sp.		Ericaceae	**Erica eriocephala*	LC	Poaceae	*Pentameris densifolia*	LC
Apiaceae	*Lichtensteinia trifida* var. *trifida*	LC	Ericaceae	**Erica exleeana*	LC	Poaceae	*Pentameris eriostoma*	LC
Apiaceae	*Torilis arvensis*		Ericaceae	**Erica glutinosa* var. *glutinosa*	LC	**Poaceae**	***Pentameris pallida***	**LC**
Apocynaceae	**Astephanus triflorus*	LC	Ericaceae	*†*Erica greyi*	DD	Poaceae	*Pentameris patula*	LC
Apocynaceae	**Carissa bispinosa*	LC	Ericaceae	**Erica hispidula* var. *hispidula*	LC	Poaceae	*Pentameris pusilla*	LC
Apocynaceae	*†*Ceropegia fimbriata* subsp. *connivens*	DD	**Ericaceae**	****Erica imbricata***	**LC**	Poaceae	*Pentameris pyrophila*	LC
Apocynaceae	*†*Duvalia elegans*	VU	Ericaceae	**Erica inflata*	LC	Poaceae	*Polypogon monspeliensis*	NE
Apocynaceae	****Eustegia minuta***	**LC**	Ericaceae	**Erica karooica*	LC	Poaceae	*Puccinellia angusta*	LC
Apocynaceae	**Gomphocarpus cancellatus*	LC	Ericaceae	**Erica labialis*	LC	Poaceae	*Schismus barbatus*	LC
Apocynaceae	**Gomphocarpus fruticosus* subsp. *fruticosus*	LC	Ericaceae	**Erica leucanthera*	LC	Poaceae	*Setaria verticillata*	LC
Apocynaceae	**Microloma sagittatum*	LC	Ericaceae	**Erica monsoniana* var. *monsoniana*	LC	**Poaceae**	***Stipagrostis zeyheri* subsp. *zeyheri***	**LC**
Apocynaceae	**Stapelia hirsuta* var. *vetula*	LC	Ericaceae	**Erica nudiflora*	LC	Poaceae	*Tenaxia disticha*	
Apocynaceae	*†*Stapelia paniculata* subsp. *paniculata*	NT	Ericaceae	**Erica ovina* var. *ovina*	LC	Poaceae	*Tenaxia stricta*	LC
Apocynaceae	*†*Stapelia paniculata* subsp. *scitula*	VU	Ericaceae	*†*Erica ovina* var. *purpurea*	DD	Poaceae	*Tribolium curvum*	LC
Apocynaceae	*†*Stapeliopsis breviloba*	VU	Ericaceae	**Erica perlata*	LC	Poaceae	*Tribolium echinatum*	LC
Apocynaceae	*†*Tavaresia meintjesii*	DD	Ericaceae	**Erica peziza*	LC	Poaceae	*Tribolium hispidum*	LC
Aquifoliaceae	*Ilex mitis* var. *mitis*	LC	**Ericaceae**	***†*Erica pilosiflora* subsp. *pilosiflora***	**VU**	Poaceae	*Tribolium obtusifolium*	LC
Araceae	*Zantedeschia aethiopica*	LC	Ericaceae	*†*Erica pilosiflora* subsp. *purpurea*	VU	Poaceae	*Tribolium* sp.	
Arecaceae	***Livistona chinensis***	**NE**	Ericaceae	**Erica plukenetii* subsp. *breviflora*	LC	Podocarpaceae	*Afrocarpus falcatus*	
Asparagaceae	*Asparagus aethiopicus*	LC	Ericaceae	**Erica plukenetii* subsp. *plukenetii*	LC	Podocarpaceae	*Podocarpus elongatus*	LC
Asparagaceae	*Asparagus capensis* var. *capensis*	LC	**Ericaceae**	****Erica plumosa***	**LC**	Polygalaceae	*Muraltia dumosa*	LC
Asparagaceae	*Asparagus declinatus*	LC	Ericaceae	**Erica quadrangularis*	LC	Polygalaceae	*Muraltia horrida*	LC
Asparagaceae	*Asparagus mucronatus*	LC	Ericaceae	**Erica rigidula*	LC	Polygalaceae	*Muraltia macrocarpa*	LC
Asparagaceae	***Yucca gloriosa***	**NE**	Ericaceae	**Erica selaginifolia*	LC	Polygalaceae	*Muraltia muraltioides*	LC
Asphodelaceae	***†*Aloe perfoliata* var. *glauca***	**DD**	**Ericaceae**	****Erica serrata***	**LC**	Polygalaceae	*Muraltia ononidifolia*	LC
Asphodelaceae	†*Astroloba rubriflora*	VU	Ericaceae	**Erica setacea*	LC	**Polygalaceae**	***Muraltia rhamnoides***	**LC**
Asphodelaceae	*Bulbine cepacea*	LC	**Ericaceae**	****Erica similis***	**LC**	Polygalaceae	*Muraltia* sp.	
Asphodelaceae	*Bulbine favosa*	LC	**Ericaceae**	****Erica sonderiana***	**LC**	Polygalaceae	*Muraltia spinosa*	LC
Asphodelaceae	*Bulbine foleyi*	LC	Ericaceae	**Erica sphaerocephala*	LC	Polygalaceae	*Polygala erioptera* subsp. *petraea*	LC

Asphodelaceae	*Bulbine frutescens*	LC	Ericaceae	**Erica totta*	LC	Polygalaceae	*Polygala fruticosa*	LC
Asphodelaceae	*Bulbine lagopus*	LC	Ericaceae	**Erica vanheurckii*	LC	Polygalaceae	*Polygala scabra*	LC
Asphodelaceae	*Bulbine mesembryanthoides* subsp. *mesembryanthoides*	LC	**Euphorbiaceae**	***Euphorbia burmannii***	**LC**	Polygalaceae	*Polygala wittebergensis*	LC
Asphodelaceae	*Bulbinella nutans* subsp. *nutans*	LC	Euphorbiaceae	*Euphorbia clandestina*	LC	Polygonaceae	*Oxygonum alatum* var. *alatum*	LC
Asphodelaceae	*Bulbinella triquetra*	LC	Euphorbiaceae	*Euphorbia inaequilatera*	LC	Polygonaceae	*Persicaria madagascariensis*	
Asphodelaceae	*Gasteria carinata* var. *carinata*	LC	Euphorbiaceae	*Euphorbia mauritanica*	LC	Polygonaceae	*Rumex cordatus*	LC
Asphodelaceae	*Gasteria carinata* var. *verrucosa*	LC	Euphorbiaceae	*†Euphorbia nesemannii*	NT	Polygonaceae	*Rumex sagittatus*	LC
Asphodelaceae	*Gasteria disticha* var. *disticha*		Euphorbiaceae	*Ricinus communis* var. *communis*	NE	Potamogetonaceae	*Potamogeton pectinatus*	LC
Asphodelaceae	*†Gasteria disticha* var. *langebergensis*	EN	Fabaceae	*Acacia cultriformis*	NE	Pottiaceae	*Didymodon xanthocarpus*	
Asphodelaceae	*Gasteria pillansii* var. *pillansii*	LC	**Fabaceae**	***Acacia cyclops***	**NE**	Pottiaceae	*Pseudocrossidium crinitum*	
Asphodelaceae	*Gasteria retusa*	LC	**Fabaceae**	***Acacia saligna***	**NE**	Proteaceae	**Aulax cancellata*	LC
Asphodelaceae	*Gasteria* sp.		Fabaceae	*Amphithalea ciliaris*	LC	Proteaceae	*†*Aulax umbellata*	NT
Asphodelaceae	**Haworthia arachnoidea* var. *arachnoidea*	NE	Fabaceae	*†Amphithalea pageae*	VU	**Proteaceae**	****Leucadendron brunioides* var. *brunioides***	**LC**
Asphodelaceae	**Haworthia arachnoidea* var. *scabrispina*	NE	Fabaceae	*Aspalathus acuminata* subsp. *acuminata*	LC	Proteaceae	**Leucadendron eucalyptifolium*	LC
Asphodelaceae	**Haworthia cooperi* var. *cooperi*	NE	Fabaceae	*†Aspalathus araneosa*	VU	Proteaceae	*†*Leucadendron galpinii*	VU
Asphodelaceae	**Haworthia herbacea* var. *herbacea*	NE	Fabaceae	*Aspalathus biflora* subsp. *biflora*	LC	Proteaceae	**Leucadendron glaberrimum* subsp. *glaberrimum*	LC
Asphodelaceae	**Haworthia mirabilis* var. *maraisii*	NE	**Fabaceae**	***†Aspalathus burchelliana***	**EN**	**Proteaceae**	****Leucadendron salignum***	**LC**
Asphodelaceae	**Haworthia mirabilis* var. *meiringii*	NE	Fabaceae	*†Aspalathus candicans*	EN	Proteaceae	**Leucadendron spissifolium* subsp. *spissifolium*	LC
Asphodelaceae	**Haworthia mirabilis* var. *notabilis*	NE	**Fabaceae**	***Aspalathus ciliaris***	**LC**	Proteaceae	*†*Leucadendron teretifolium*	NT
Asphodelaceae	**Haworthia mirabilis* var. *triebneriana*	NE	Fabaceae	*Aspalathus cliffortioides*	LC	**Proteaceae**	****Leucospermum calligerum***	**LC**
Asphodelaceae	**Haworthia reticulata* var. *attenuata*	NE	Fabaceae	*Aspalathus cordata*	LC	Proteaceae	**Leucospermum cuneiforme*	LC
Asphodelaceae	**Haworthia reticulata* var. *hurlingii*	NE	Fabaceae	*Aspalathus divaricata* subsp. *divaricata*	LC	Proteaceae	*†*Leucospermum formosum*	EN
Asphodelaceae	**Haworthia reticulata* var. *reticulata*	NE	Fabaceae	*Aspalathus grandiflora*	LC	Proteaceae	**Leucospermum utriculosum*	LC
Asphodelaceae	**Haworthia reticulata* var. *subregularis*	NE	**Fabaceae**	***Aspalathus hirta* subsp. *hirta***	**LC**	Proteaceae	**Mimetes cucullatus*	LC
Asphodelaceae	**Haworthia* sp.		**Fabaceae**	***Aspalathus juniperina***	**LC**	**Proteaceae**	****Paranomus dispersus***	**LC**
Asphodelaceae	*Trachyandra falcata*	LC	Fabaceae	*Aspalathus juniperina* subsp. *juniperina*	LC	Proteaceae	**Protea amplexicaulis*	LC

Asphodelaceae	†*Trachyandra filiformis*	NT	**Fabaceae**	***†Aspalathus lactea* subsp. *breviloba***	**VU**	Proteaceae	**Protea aurea*	
Asphodelaceae	*Trachyandra flexifolia*	LC	Fabaceae	*Aspalathus laricifolia* subsp. *canescens*	LC	Proteaceae	**Protea aurea* subsp. *aurea*	LC
Asphodelaceae	***Trachyandra revoluta***	**LC**	Fabaceae	*Aspalathus longipes*	LC	Proteaceae	**Protea humiflora*	LC
Asphodelaceae	*Tulista pumila*	LC	Fabaceae	*†Aspalathus macrocarpa*	VU	Proteaceae	**Protea laevis*	LC
Aspleniaceae	*Asplenium cordatum*	LC	Fabaceae	*Aspalathus nigra*	LC	**Proteaceae**	****Protea laurifolia***	**LC**
Aspleniaceae	*Asplenium trichomanes* subsp. *quadrivalens*	LC	Fabaceae	*Aspalathus pachyloba* subsp. *macroclada*	LC	Proteaceae	**Protea lorifolia*	LC
Asteraceae	*Amellus strigosus* subsp. *strigosus*	LC	**Fabaceae**	***Aspalathus quinquefolia* subsp. *quinquefolia***	**LC**	Proteaceae	**Protea neriifolia*	LC
Asteraceae	*Arctotheca calendula*	LC	Fabaceae	*Aspalathus spinosa* subsp. *flavispina*	LC	Proteaceae	**Protea nitida*	LC
Asteraceae	*Arctotis acuminata*	LC	Fabaceae	*Aspalathus spinosa* subsp. *glauca*	LC	Proteaceae	**Protea punctata*	LC
Asteraceae	*Arctotis arctotoides*	LC	Fabaceae	*Aspalathus spinosa* subsp. *spinosa*	LC	Proteaceae	**Protea repens*	LC
Asteraceae	***Arctotis incisa***	**LC**	Fabaceae	*Aspalathus spinosissima* subsp. *tenuiflora*	LC	Proteaceae	*†*Protea scabra*	NT
Asteraceae	*Arctotis* sp.		Fabaceae	*Aspalathus stenophylla*	LC	Proteaceae	**Protea scolopendriifolia*	LC
Asteraceae	*Arctotis sulcocarpa*	LC	Fabaceae	*†Aspalathus steudeliana*	VU	Proteaceae	**Protea subulifolia*	LC
Asteraceae	***Athanasia quinquedentata* subsp. *quinquedentata***	**LC**	Fabaceae	*Aspalathus submissa*	LC	Proteaceae	**Serruria acrocarpa*	LC
Asteraceae	***Athanasia trifurcata***	**LC**	Fabaceae	*Aspalathus tridentata* subsp. *tridentata*	LC	Proteaceae	*†*Serruria fasciflora*	NT
Asteraceae	*†Berkheya angusta*	VU	Fabaceae	*Aspalathus triquetra*	LC	**Proteaceae**	****Serruria gremialis***	**LC**
Asteraceae	*Berkheya armata*	LC	Fabaceae	*Aspalathus tuberculata*	LC	Proteaceae	**Spatalla parilis*	LC
Asteraceae	*Berkheya coriacea*	LC	Fabaceae	*Calobota cytisoides*	LC	Pteridaceae	*Cheilanthes capensis*	LC
Asteraceae	*Berkheya heterophylla* var. *radiata*	LC	Fabaceae	*Crotalaria excisa* subsp. *excisa*	LC	Ranunculaceae	*Clematis brachiata*	LC
Asteraceae	*Chrysocoma acicularis*	LC	Fabaceae	*Desmodium repandum*	LC	Restionaceae	*Cannomois* sp.	
Asteraceae	***Chrysocoma ciliata***	**LC**	Fabaceae	*Hypocalyptus coluteoides*	LC	Restionaceae	*Cannomois virgata*	LC
Asteraceae	*Chrysocoma valida*	LC	Fabaceae	*Hypocalyptus sophoroides*	LC	**Restionaceae**	***Elegia filacea***	**LC**
Asteraceae	*Cineraria lobata* subsp. *lobata*	LC	Fabaceae	*Indigofera amoena*	LC	Restionaceae	*Elegia stokoei*	LC
Asteraceae	*Cineraria platycarpa*	LC	Fabaceae	*Indigofera candicans*	LC	Restionaceae	*Restio curviramis*	LC
Asteraceae	*Conyza scabrida*		Fabaceae	*Indigofera heterophylla*	LC	Restionaceae	*Restio filiformis*	LC
Asteraceae	*Cotula coronopifolia*	LC	Fabaceae	*Indigofera jucunda*	LC	Restionaceae	*Restio gaudichaudianus*	LC

Asteraceae	***Crassothonna alba***	**LC**	Fabaceae	*Indigofera verrucosa*	LC	Restionaceae	*Restio paniculatus*	LC
Asteraceae	*Crassothonna cacalioides*	LC	**Fabaceae**	***Lebeckia sepiaria***	**LC**	Restionaceae	*Restio patens*	LC
Asteraceae	*Crassothonna cylindrica*	LC	Fabaceae	*Lessertia frutescens* subsp. *frutescens*	LC	Restionaceae	*Restio quadratus*	LC
Asteraceae	*Cullumia patula*		Fabaceae	*Lessertia pauciflora* var. *pauciflora*	LC	**Restionaceae**	***Restio sieberi***	**LC**
Asteraceae	***Cullumia sulcata* var. *sulcata***	**LC**	Fabaceae	*Liparia umbellifera*	LC	Restionaceae	*Restio* sp.	
Asteraceae	*†Curio crassulifolius*	DD	Fabaceae	*Lotononis caerulescens*	LC	Restionaceae	*Restio strictus*	LC
Asteraceae	*Curio talinoides* var. *aizoides*	NE	Fabaceae	*†Lotononis prostrata*	NT	**Restionaceae**	***Thamnochortus lucens***	**LC**
Asteraceae	*Cymbopappus adenosolen*	LC	Fabaceae	*†Lotononis rigida*	VU	Restionaceae	*Thamnochortus obtusus*	LC
Asteraceae	*Dicerothamnus rhinocerotis*		Fabaceae	*Lotononis* sp.		Restionaceae	*Willdenowia bolusii*	LC
Asteraceae	*Dicoma fruticosa*	LC	Fabaceae	*Melolobium exudans*	LC	**Restionaceae**	***Willdenowia incurvata***	**LC**
Asteraceae	*Dimorphotheca chrysanthemifolia*	LC	Fabaceae	*Melolobium lampolobum*	LC	**Restionaceae**	***Willdenowia sulcata***	**LC**
Asteraceae	*Dimorphotheca zeyheri*	LC	Fabaceae	*Melolobium* sp.		Rhamnaceae	*Phylica aemula* var. *aemula*	LC
Asteraceae	***Disparago ericoides***	**LC**	Fabaceae	*Otholobium candicans*	LC	Rhamnaceae	*Phylica callosa*	LC
Asteraceae	*Dolichothrix ericoides*	LC	Fabaceae	*Otholobium nitens*		Rhamnaceae	*Phylica litoralis*	LC
Asteraceae	*Edmondia fasciculata*	LC	Fabaceae	*Otholobium spicatum*	LC	Rhamnaceae	*Phylica parviflora*	LC
Asteraceae	***Elytropappus rhinocerotis***	**LC**	Fabaceae	*Otholobium virgatum*	LC	Rhamnaceae	*Phylica rogersii*	LC
Asteraceae	*Erigeron canadensis*		Fabaceae	*Podalyria biflora*	LC	Rhamnaceae	*Phylica* sp.	
Asteraceae	*Eriocephalus africanus* var. *paniculatus*	LC	**Fabaceae**	****Podalyria calyptrata***	**LC**	Rhamnaceae	*Phylica spicata* var. *spicata*	LC
Asteraceae	*Eriocephalus ericoides* subsp. *ericoides*	LC	Fabaceae	*Podalyria myrtillifolia*	LC	Rhamnaceae	*Phylica vulgaris* var. *major*	LC
Asteraceae	*Euryops othonnoides*	LC	Fabaceae	*Podalyria rotundifolia*	LC	**Rhamnaceae**	***Trichocephalus stipularis***	**LC**
Asteraceae	*Euryops* sp.		Fabaceae	*Psoralea restioides*	LC	Roridulaceae	**Roridula dentata*	LC
Asteraceae	*Euryops tenuissimus* subsp. *tenuissimus*	LC	Fabaceae	*Psoralea verrucosa*	LC	Rosaceae	*Cliffortia burchellii*	LC
Asteraceae	*Felicia denticulata*	LC	Fabaceae	*Rafnia acuminata*	LC	Rosaceae	*Cliffortia crenata*	LC
Asteraceae	*Felicia fascicularis*	LC	**Fabaceae**	***Rafnia capensis* subsp. *capensis***	**LC**	Rosaceae	*Cliffortia erectisepala*	LC
Asteraceae	*Felicia filifolia* subsp. *schaeferi*	LC	Fabaceae	*Rhynchosia adenodes*	LC	**Rosaceae**	***Cliffortia ruscifolia* var. *ruscifolia***	**LC**
Asteraceae	*Felicia minima*	LC	Fabaceae	*Rhynchosia capensis*	LC	Rosaceae	*Cliffortia tricuspidata*	LC
Asteraceae	*Gazania krebsiana* subsp. *krebsiana*	LC	Fabaceae	*Vachellia karroo*	LC	Rubiaceae	*Anthospermum aethiopicum*	LC
Asteraceae	*Gnaphalium confine*	LC	Fabaceae	*Wiborgia mucronata*	LC	**Rubiaceae**	***Anthospermum galioides* subsp. *galioides***	**LC**
Asteraceae	*Gorteria diffusa*		**Fabaceae**	***Wiborgia obcordata***	**LC**	Rubiaceae	*Galium spurium* subsp. *africanum*	LC
Asteraceae	*Gorteria integrifolia*		Fabaceae	*Wiborgia sericea*	LC	Rubiaceae	*Galium tomentosum*	LC

Asteraceae	*Helichrysum acrophilum*	LC	Fabaceae	*†Wiborgia tenuifolia*	NT	Ruscaceae	*†Eriospermum bowieanum*	VU
Asteraceae	*Helichrysum asperum* var. *albidulum*	LC	Fabaceae	*†Wiborgiella bowieana*	CR	Ruscaceae	*Eriospermum breviscapum*	LC
Asteraceae	*Helichrysum asperum* var. *glabrum*	LC	Fissidentaceae	*Fissidens pygmaeus*		Ruscaceae	*Eriospermum dielsianum* subsp. *dielsianum*	LC
Asteraceae	*Helichrysum cymosum* subsp. *cymosum*	LC	Fumariaceae	*Cysticapnos vesicaria* subsp. *vesicaria*	LC	Ruscaceae	*Eriospermum paradoxum*	LC
Asteraceae	*Helichrysum excisum*	LC	Gentianaceae	*Chironia baccifera*	LC	Rutaceae	**Acmadenia* sp.	
Asteraceae	*Helichrysum litorale*	LC	Geraniaceae	*Pelargonium abrotanifolium*	LC	Rutaceae	**Agathosma alticola*	LC
Asteraceae	*Helichrysum moeserianum*	LC	Geraniaceae	*Pelargonium alternans*		Rutaceae	*†*Agathosma foetidissima*	NT
Asteraceae	*Helichrysum odoratissimum* var. *odoratissimum*		Geraniaceae	*Pelargonium alternans* subsp. *alternans*	LC	Rutaceae	*†*Agathosma microcarpa*	VU
Asteraceae	*Helichrysum patulum*	LC	Geraniaceae	*Pelargonium crispum*	LC	Rutaceae	**Agathosma ovata*	LC
Asteraceae	*Helichrysum revolutum*	LC	**Geraniaceae**	***Pelargonium hermanniifolium***	**LC**	Rutaceae	**Agathosma* sp.	
Asteraceae	*Helichrysum rosum* var. *rosum*	LC	Geraniaceae	*Pelargonium karooicum*	LC	**Rutaceae**	****Agathosma stipitata***	**LC**
Asteraceae	*Helichrysum rutilans*	LC	Geraniaceae	*Pelargonium laevigatum* subsp. *diversifolium*	LC	Rutaceae	*†*Agathosma trichocarpa*	VU
Asteraceae	*Helichrysum sphaeroideum*	LC	Geraniaceae	*Pelargonium luteolum*	LC	Rutaceae	**Euchaetis flexilis*	LC
Asteraceae	*Helichrysum stoloniferum*	LC	**Geraniaceae**	***Pelargonium ovale* subsp. *ovale***	**LC**	**Rutaceae**	***†*Euchaetis pungens***	**VU**
Asteraceae	*Helichrysum tinctum*	LC	Geraniaceae	*Pelargonium papilionaceum*	LC	Rutaceae	**Macrostylis* sp.	
Asteraceae	*Heterolepis peduncularis*	LC	Geraniaceae	*Pelargonium peltatum*	LC	**Santalaceae**	***Colpoon compressum***	**LC**
Asteraceae	*Hymenolepis dentata*	LC	Geraniaceae	*Pelargonium setulosum*	LC	Santalaceae	*Thesium carinatum* var. *carinatum*	NE
Asteraceae	***Ifloga ambigua***	**LC**	Geraniaceae	*Pelargonium* sp.		**Santalaceae**	***Thesium euphrasioides***	**LC**
Asteraceae	*Ifloga anomala*	LC	Geraniaceae	*Pelargonium tetragonum*	LC	Santalaceae	*Thesium flexuosum*	LC
Asteraceae	***Lachnospermum fasciculatum***	**LC**	Geraniaceae	*Pelargonium undulatum*	LC	Santalaceae	*Thesium fragile*	
Asteraceae	*†Lachnospermum neglectum*	NT	Geraniaceae	*†Pelargonium violiflorum*	EN	Santalaceae	*Thesium juncifolium*	LC
Asteraceae	*†Lidbeckia pinnata*	EN	Haemodoraceae	*Wachendorfia multiflora*	LC	Santalaceae	*†Thesium microcarpum*	DD
Asteraceae	*Macledium spinosum*	LC	**Haemodoraceae**	***Wachendorfia paniculata***	**LC**	Santalaceae	*Thesium nigromontanum*	LC
Asteraceae	***Metalasia acuta***	**LC**	Hyacinthaceae	*Albuca acuminata*	LC	Santalaceae	*Thesium patulum*	LC
Asteraceae	***†Metalasia adunca***	**NT**	Hyacinthaceae	*Albuca canadensis*	LC	Santalaceae	*Thesium prostratum*	LC
Asteraceae	*Metalasia brevifolia*	LC	Hyacinthaceae	*Albuca* sp.		Santalaceae	*†Thesium repandum*	DD
Asteraceae	***Metalasia erubescens***	**LC**	Hyacinthaceae	*Albuca virens* subsp. *virens*	LC	Santalaceae	*Thesium* sp.	
Asteraceae	*Myrovernix longifolius*		Hyacinthaceae	*Albuca viscosa*	LC	Santalaceae	*Viscum continuum*	LC
Asteraceae	*Myrovernix scaber*		Hyacinthaceae	*Drimia intricata*	LC	Santalaceae	*Viscum rotundifolium*	LC

Asteraceae	*Oedera genistifolia*	LC	Hyacinthaceae	*Drimia karooica*	LC	**Sapindaceae**	***Dodonaea viscosa* var. *angustifolia***	**LC**
Asteraceae	***Oedera squarrosa***	**LC**	Hyacinthaceae	*Drimia media*	LC	Scrophulariaceae	*Chaenostoma aethiopicum*	LC
Asteraceae	*Oldenburgia papionum*	LC	Hyacinthaceae	*Eucomis regia*	LC	Scrophulariaceae	*Chaenostoma caeruleum*	LC
Asteraceae	*Oncosiphon piluliferus*	LC	Hyacinthaceae	**Lachenalia juncifolia*		Scrophulariaceae	*Chaenostoma decipiens*	LC
Asteraceae	*Osteospermum calendulaceum*	LC	Hyacinthaceae	*†*Lachenalia physocaulos*	EN	Scrophulariaceae	*Chaenostoma revolutum*	LC
Asteraceae	***Osteospermum junceum***	**LC**	Hyacinthaceae	**Lachenalia* sp.		Scrophulariaceae	*Chaenostoma uncinatum*	LC
Asteraceae	*Osteospermum monstrosum*	LC	Hyacinthaceae	*†*Lachenalia stayneri*	EN	Scrophulariaceae	**Diascia parviflora*	LC
Asteraceae	*Osteospermum oppositifolium*	LC	Hyacinthaceae	*Massonia depressa*	LC	Scrophulariaceae	**Diascia sacculata*	LC
Asteraceae	*Osteospermum polygaloides* var. *polygaloides*	LC	Hyacinthaceae	*Massonia echinata*	LC	Scrophulariaceae	*Freylinia lanceolata*	LC
Asteraceae	*Osteospermum rigidum* var. *elegans*	LC	Hyacinthaceae	*Ornithogalum capillare*	LC	Scrophulariaceae	*Freylinia undulata*	LC
Asteraceae	*Osteospermum scariosum* var. *scariosum*	NE	Hyacinthaceae	*Ornithogalum dubium*	LC	Scrophulariaceae	*Gosela eckloniana*	LC
Asteraceae	*Osteospermum spinosum* var. *spinosum*	LC	Hyacinthaceae	*Ornithogalum hispidum* subsp. *hispidum*	LC	Scrophulariaceae	*Hemimeris racemosa*	LC
Asteraceae	*Othonna auriculifolia*	LC	Hyacinthaceae	*Ornithogalum neopatersonia*	LC	Scrophulariaceae	*Jamesbrittenia atropurpurea* subsp. *atropurpurea*	LC
Asteraceae	*Othonna bulbosa*	LC	Hyacinthaceae	*Veltheimia capensis*	LC	Scrophulariaceae	*Limosella* sp.	
Asteraceae	*Othonna chromochaeta*	LC	Hypoxidaceae	*Empodium gloriosum*	LC	Scrophulariaceae	*Lyperia antirrhinoides*	LC
Asteraceae	*Othonna gymnodiscus*	LC	Hypoxidaceae	*Empodium plicatum*	LC	Scrophulariaceae	*Manulea* sp.	
Asteraceae	*Othonna lobata*	LC	Hypoxidaceae	*Pauridia aquatica*	LC	Scrophulariaceae	*Microdon parviflorus*	LC
Asteraceae	*Othonna parviflora*	LC	Hypoxidaceae	*Pauridia flaccida*	LC	Scrophulariaceae	*Microdon polygaloides*	LC
Asteraceae	*Othonna quinquedentata*	LC	Hypoxidaceae	*Pauridia serrata* subsp. *serrata*	LC	**Scrophulariaceae**	***Myoporum laetum***	**NE**
Asteraceae	*Pentzia incana*	LC	**Iridaceae**	****Aristea dichotoma***	**LC**	Scrophulariaceae	*Nemesia pageae*	LC
Asteraceae	*Phymaspermum trifidum*		Iridaceae	**Aristea spiralis*	LC	Scrophulariaceae	*Nemesia* sp.	
Asteraceae	*Printzia aromatica*	LC	**Iridaceae**	***†*Babiana leipoldtii***	**EN**	Scrophulariaceae	*Oftia africana*	LC
Asteraceae	*Pteronia camphorata* var. *longifolia*	NE	Iridaceae	**Babiana patula*	LC	Scrophulariaceae	*Pseudoselago humilis*	LC
Asteraceae	*Pteronia fasciculata*	LC	**Iridaceae**	****Babiana ringens* subsp. *ringens***	**LC**	Scrophulariaceae	*Pseudoselago langebergensis*	LC
Asteraceae	*Pteronia flexicaulis*	LC	Iridaceae	**Bobartia indica*	LC	Scrophulariaceae	*Selago albida*	LC
Asteraceae	*Pteronia hirsuta*	LC	Iridaceae	**Bobartia orientalis* subsp. *orientalis*	LC	Scrophulariaceae	*Selago eckloniana*	LC
Asteraceae	***Pteronia incana***	**LC**	Iridaceae	*†*Chasmanthe bicolor*	VU	**Scrophulariaceae**	***Selago fruticosa***	**LC**
Asteraceae	*Pteronia oblanceolata*	LC	Iridaceae	**Ferraria variabilis*	LC	Scrophulariaceae	*Selago gracilis*	LC
Asteraceae	*Pteronia paniculata*	LC	Iridaceae	*†*Freesia caryophyllacea*	NT	Scrophulariaceae	*Selago seticaulis*	LC
Asteraceae	*Pteronia* sp.		Iridaceae	**Freesia refracta*	LC	Scrophulariaceae	*Selago* sp.	

Asteraceae	*Rhynchopsidium pumilum*	LC	Iridaceae	**Geissorhiza heterostyla* subsp. *rosea*		Scrophulariaceae	*Selago thomii*	LC
Asteraceae	*Rhynchopsidium sessiliflorum*	LC	**Iridaceae**	****Gladiolus carinatus***	**LC**	Scrophulariaceae	*Selago triquetra*	LC
Asteraceae	*Senecio abbreviatus*	LC	Iridaceae	**Gladiolus floribundus*	LC	Scrophulariaceae	*Zaluzianskya synaptica*	LC
Asteraceae	*Senecio agapetes*	LC	Iridaceae	**Gladiolus grandiflorus*	LC	Solanaceae	*Lycium ferocissimum*	LC
Asteraceae	***Senecio arenarius***	**LC**	Iridaceae	**Gladiolus permeabilis* subsp. *edulis*	LC	Solanaceae	*Lycium oxycarpum*	LC
Asteraceae	*†Senecio erysimoides*	DD	Iridaceae	**Gladiolus permeabilis* subsp. *permeabilis*	LC	**Solanaceae**	***Nicotiana glauca***	**NE**
Asteraceae	*Senecio paarlensis*	LC	Iridaceae	**Gladiolus venustus*	LC	Solanaceae	*Solanum guineense*	LC
Asteraceae	*Senecio pinifolius*	LC	Iridaceae	**Hesperantha acuta*		Stilbaceae	*Halleria elliptica*	LC
Asteraceae	*Senecio purpureus*	LC	Iridaceae	**Hesperantha acuta* subsp. *acuta*	LC	Tecophilaeaceae	*Cyanella lutea*	
Asteraceae	*Senecio rigidus*	LC	Iridaceae	**Hesperantha falcata*	LC	Thymelaeaceae	*Gnidia laxa*	LC
Asteraceae	*Senecio rosmarinifolius*	LC	Iridaceae	**Ixia confusa*	LC	Thymelaeaceae	*Gnidia nitida*	LC
Asteraceae	*Senecio sarcoides*	LC	Iridaceae	**Ixia flexuosa*	LC	Thymelaeaceae	*Gnidia sericea* var. *sericea*	LC
Asteraceae	*Senecio sophioides*	LC	Iridaceae	**Ixia stenophylla*	LC	Thymelaeaceae	*Gnidia setosa*	LC
Asteraceae	*Senecio* sp.		Iridaceae	*†*Ixia vanzijliae*	VU	Thymelaeaceae	*Gnidia tenella*	LC
Asteraceae	*Stoebe aethiopica*	LC	Iridaceae	**Lapeirousia plicata* subsp. *effurcata*	LC	**Thymelaeaceae**	***†Lachnaea uniflora***	**VU**
Asteraceae	*Stoebe capitata*	LC	Iridaceae	**Lapeirousia pyramidalis* subsp. *pyramidalis*	LC	**Thymelaeaceae**	***Passerina obtusifolia***	**LC**
Asteraceae	*Stoebe muricata*		Iridaceae	**Moraea bipartita*	LC	Thymelaeaceae	*Passerina truncata* subsp. *monticola*	LC
Asteraceae	***Stoebe nervigera***	**LC**	Iridaceae	**Moraea fugax*	LC	Thymelaeaceae	*Struthiola argentea*	LC
Asteraceae	***Syncarpha canescens* subsp. *canescens***	**LC**	Iridaceae	**Moraea gawleri*	LC	Thymelaeaceae	*Struthiola ciliata*	LC
Asteraceae	*Syncarpha flava*	LC	Iridaceae	**Moraea longistyla*	LC	**Thymelaeaceae**	***Struthiola fasciata***	**LC**
Asteraceae	*Syncarpha gnaphaloides*	LC	Iridaceae	**Moraea polyanthos*	LC	Verbenaceae	*Chascanum cuneifolium*	LC
Asteraceae	*Syncarpha paniculata*	LC	Iridaceae	*†*Moraea radians*	EN	Violaceae	*Viola decumbens* var. *scrotiformis*	LC
Asteraceae	*Tarchonanthus camphoratus*	LC	Iridaceae	**Moraea setifolia*	LC	Violaceae	*Viola* sp.	
Asteraceae	*Troglophyton capillaceum* subsp. *capillaceum*	LC	Iridaceae	**Moraea* sp.		Zygophyllaceae	*Roepera divaricata*	
Asteraceae	*Ursinia anthemoides* subsp. *anthemoides*	LC	Iridaceae	**Moraea thomasiae*	LC	Zygophyllaceae	*Roepera flexuosa*	
Asteraceae	***Ursinia nana* subsp. *nana***	**LC**	Iridaceae	**Romulea tetragona*		Zygophyllaceae	*Roepera foetida*	
Asteraceae	*Ursinia pilifera*	LC	Iridaceae	**Sparaxis* sp.		Zygophyllaceae	*Roepera spinosa*	
Asteraceae	*Xanthium strumarium*		Iridaceae	**Thereianthus juncifolius*	LC	Zygophyllaceae	*Tribulus terrestris*	LC
Asteraceae	*Zyrphelis lasiocarpa*	LC	Iridaceae	**Tritonia flabellifolia* var. *flabellifolia*	LC	Zygophyllaceae	*Zygophyllum* sp.	

Appendix 2. Specialist CV.

CURRICULUM VITAE:

Gerhard Botha

Name:	:	Gerhardus Alfred Botha
Date of Birth	:	11 April 1986
Identity Number	:	860411 5136 088
Postal Address	:	PO Box 12500 Brandhof 9324
Residential Address	:	3 Jock Meiring Street Park West Bloemfontein 9301
Cell Phone Number	:	084 207 3454
Email Address	:	gabotha11@gmail.com
Profession/Specialisation	:	Ecological and Biodiversity Consultant
Nationality:	:	South African
Years Experience:	:	8
Bilingualism	:	Very good – English and Afrikaans

Professional Profile:

Gerhard is a Managing Director of Nkurenkuru Ecology and Biodiversity (Pty) Ltd. He has a BSc Honours degree in Botany from the University of the Free State Province and is currently completing a MSc Degree in Botany. He began working as an environmental specialist in 2010 and has since gained extensive experience in conducting ecological and biodiversity assessments in various development field, especially in the fields of conventional as well as renewable energy generation, mining and infrastructure development. Gerhard is a registered Professional Natural Scientist (Pr. Sci. Nat.)

Key Responsibilities:

Specific responsibilities as an Ecological and Biodiversity Specialist include, inter alia, professional execution of specialist consulting services (including flora, wetland and fauna studies, where required), impact assessment reporting, walk through surveys/ground-truthing to inform final design, compilation of management plans,

compliance monitoring and audit reporting, in-house ecological awareness training to on-site personnel, and the development of project proposals for procuring new work/projects.

Skills Base and Core Competencies

- Research Project Management
- Botanical researcher in projects involving the description of terrestrial and coastal ecosystems.
- Broad expertise in the ecology and conservation of grasslands, savannahs, karroid wetland, and aquatic ecosystems.
- Ecological and Biodiversity assessments for developmental purposes (BAR, EIA), with extensive knowledge and experience in the renewable energy field (Refer to Work Experiences and References)
- Over 3 years of avifaunal monitoring and assessment experience.
- Mapping and Infield delineation of wetlands, riparian zones and aquatic habitats (according to methods stipulated by DWA, 2008) within various South African provinces of KwaZulu-Natal, Mpumalanga, Free State, Gauteng and Northern Cape Province for inventory and management purposes.
- Wetland and aquatic buffer allocations according to industry best practice guidelines.
- Working knowledge of environmental planning policies, regulatory frameworks, and legislation
- Identification and assessment of potential environmental impacts and benefits.
- Assessment of various wetland ecosystems to highlight potential impacts, within current and proposed landscape settings, and recommend appropriate mitigation and offsets based on assessing wetland ecosystem service delivery (functions) and ecological health/integrity.
- Development of practical and achievable mitigation measures and management plans and evaluation of risk to execution
- Qualitative and Quantitative Research
- Experienced in field research and monitoring
- Working knowledge of GIS applications and analysis of satellite imagery data
- Completed projects in several Provinces of South Africa and include a number of projects located in sensitive and ecological unique regions.

Education and Professional Status

Degrees:

- *2015:* Currently completing a M.Sc. degree in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- *2009:* B.Sc. Hons in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- *2008:* B.Sc. in Zoology and Botany, University of the Free State, University of the Free State, Bloemfontein, RSA.

Courses:

- *2013*: Wetland Management (ecology, hydrology, biodiversity, and delineation) – University of the Free State accredited course.

- *2014*: Introduction to GIS and GPS (Code: GISA 1500S) – University of the Free State accredited course.

Professional Society Affiliations:

- The South African Council of Natural Scientific Professions: Pr. Sci. Nat. Reg. No. 400502/14 (Botany and Ecology).

Employment History

- December 2017 – Current: Nkurenkuru Ecology and Biodiversity (Pty) Ltd
- 2016 – November 2017: ECO-CARE Consultancy
- *2015 - 2016*: Ecologist, Savannah Environmental (Pty) Ltd
- *2013 – 2014*: Working as ecologist on a freelance basis, involved in part-time and contractual positions for the following companies
  - Enviroworks (Pty) Ltd
  - GreenMined (Pty) Ltd
  - Eco-Care Consultancy (Pty) Ltd
  - Enviro-Niche Consulting (Pty) Ltd
  - Savannah Environmental (Pty) Ltd
  - Esicongweni Environmental Services (EES) cc
- *2010 - 2012*: Enviroworks (Pty) Ltd

Publications

Publications:

- Botha, G.A. & Du Preez, P.J. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. S. *Afr. J. Bot*., **98**: 172-173.

Congress papers/posters/presentations:

- Botha, G.A. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. 41st Annual Congress of South African Association of Botanists (SAAB). Tshipise, 11-15 Jan. 2015.
- Botha, G.A. 2014. A description of the vegetation of the Nxamasere floodplain, Okavango Delta, Botswana. 10st Annual University of Johannesburg (UJ) Postgraduate Botany Symposium. Johannesburg, 28 Oct. 2014.

Other

- Guest speaker at IAIAsa Free State Branch Event (29 March 2017)
- Guest speaker at the University of the Free State Province: Department of Plant Sciences (3 March 2017):

References:

- Christine Fouché
  Manager: GreenMined (Pty) LTD
  Cell: 084 663 2399

- Professor J du Preez
  Senior lecturer: Department of Plant Sciences
  University of the Free State
  Cell: 082 376 4404

CURRICULUM VITAE:

Jan-Hendrik Keet, PhD

Address: Unit 29 Avignon, Hillcrest Road
Land en Zeezicht, Somerset West
South Africa
7130
Email: jhkeet@hotmail.com
Phone: +27 71 451 4853

Professional Profile:

Jan-Hendrik is currently a Director at Acuity JRK (Pty) Ltd. He holds a PhD in Botany from Stellenbosch University, with primary specialization in Invasive Alien Species. In terms of academics, he has published in, and reviewed for, well-respected, high-impact international scientific journals (such as Current Biology, New Phytologist, and Journal of Ecology), and is still actively involved in science research. He has also been involved with environmental impacts assessments since 2015, although during the early years it was mostly intermittent. However, for the past two years he has become more involved in botanical specialist studies. Finally, he is also a freelance academic/technical editor, proof-reader, and dissertation specialist, which includes, among other things, providing in-depth text editing (general and technical) and support for professionals, researchers/academics, and undergraduate and postgraduate students.

Expertise and experience

- Current: Freelance Academic/Technical Editor, Proof-reader, and Dissertation Specialist
- Current: Botanical Specialist
- Previous: Post-Doctoral Researcher – Centre for Invasion Biology (Department of Botany and Zoology), Stellenbosch University
- Specialisation: Botany, ecology, invasive plant species, and invasion biology
- Years of experience: 8 years
- Published in various national and international scientific journals

Skills and competencies

- Invasive species biology
- Plant biogeography and ecology
- Plant identification and taxonomy
- Vegetation surveys and mapping
- Soil microbiomes, function, and chemistry
- Geographic Information Systems
- Research Data Management
- Statistical Computing Methods
- Experimental Design & Analysis

Tertiary education

- *2015 – 2019: Stellenbosch University, Stellenbosch, South Africa. Doctor of Philosophy (Botany)*
- *2013 – 2014: University of the Free State, Bloemfontein, South Africa. Magister Scientiae (Botany)*
- *2012: University of the Free State, Bloemfontein, South Africa. Bachelor of Science Honours (Botany) - cum laude*
- *2009 – 2011: University of the Free State, Bloemfontein, South Africa. Bachelor of Science (Chemistry with Physics and Biology) - cum laude*

Employment history

- *2019 – 2021: Post-Doctoral Researcher – Centre for Invasion Biology (Department of Botany and Zoology), Stellenbosch University*
- *2011: Part-time demonstrator. Department of Plant Sciences, University of the Free State, Bloemfontein, South Africa*
- *2010: Part-time lab assistant. Department of Chemistry, University of the Free State, Bloemfontein, South Africa*
- *2007 – 2009: Shop Manager. Christian Tees, Brandwag Centre, Bloemfontein*

Certifications

- *SAGIC Invasive Species Consultant (Cape Town, South Africa), March 2016*
- *GIS Intermediate (NQF level 5): Hydrological modelling and terrain analysis using digital elevation models (University of the Free State, South Africa), 2014*
- *Good Laboratory Practice seminar presented by Merck Millipore South Africa, 2012*
- *Laboratory Safety seminar presented by Merck Millipore South Africa, 2012*

Appendix 3. Specialist's Work Experience and References

WORK EXPERIENCES

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References

Gerhard Botha

ECOLOGICAL RELATED STUDIES AND SURVEYS

Date Completed	Project Description	Type of Assessment/Study	Client
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Ecological Assessment (Basic Assessment)	Moeding Solar
2019	Expansion of the Raumix Aliwal North Quarry, Eastern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	GreenMined
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Faunal and Flora Rescue and Protection Plan	Zevobuzz
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Zevobuzz
2018	Proposed Kruisvallei Hydroelectric Power Generation Scheme in the Ash River, Free State Province	Ecological Assessment (Basic Assessment)	Zevobuzz

2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Ecological Assessment (Basic Assessment)	Eskom
2018	Clayville Thermal Plant within the Clayville Industrial Area, Gauteng Province	Ecological Comments Letter	Savannah Environmental
2018	Iziduli Emoyeni Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Emoyeni Wid Farm Renewable Energy
2018	Msenge Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Amakhala Emoyeni Renewable Energy
2017	H2 Energy Power Station near Kwamhlanga, Mpumalanga Province	Ecological Assessment (Scoping and EIA phase assessments)	Eskom
2017	Karusa Wind Farm (Phase 1 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	Soetwater Wind Farm (Phase 2 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Ecological Assessment	Savannah Environmental
2016 - 2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Ecological Assessment (Scoping and EIA phase assessments)	Cresco
2016	Buffels Solar 2 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	Buffels Solar 1 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	132kV Power Line and On-Site Substation for the Authorised Golden Valley II Wind Energy Facility near Bedford, Eastern Cape Province	Ecological Assessment (Basic Assessment)	Terra Wind Energy
2016	Kalahari CSP Facility: 132kV Ferrum–Kalahari–UNTU & 132kV Kathu IPP–Kathu 1 Overhead Power Lines, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Kalahari CSP Facility: Access Roads, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Karoshoek Solar Valley Development – Additional CSP Facility including tower infrastructure associated with authorised CSP Site 2 near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshoek Solar Valley Development –Ilanga CSP 7 and 8 Facilities near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshoek Solar Valley Development –Ilanga CSP 9 Facility near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Lehae Training Academy and Fire Station, Gauteng Province	Ecological Assessment	Savannah Environmental
2016	Metal Industrial Cluster and Associated Infrastructure near Kuruman, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Northern Cape Department of Economic Development and Tourism
2016	Semonkong Wind Energy Facility near Semonkong, Maseru District, Lesotho	Ecological Pre-Feasibility Study	Savannah Environmental
2015 - 2016	Orkney Solar PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy

2015 - 2016	Woodhouse 1 and Woodhouse 2 PV Facilities near Vryburg, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy
2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy
2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions
2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Expansion of the existing Komsberg Main Transmission Substation near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Proposed Karusa Facility Substation and Ancillaries near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Eskom Karusa Switching Station and 132kV Double Circuit Overhead Power Line near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Karusa Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Facility Substation, 132kV Overhead Power Line and Ancillaries, near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Soetwater Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Expansion of the existing Scottburgh quarry near Amandawe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental
2015	Expansion of the existing AFRIMAT quarry near Hluhluwe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental

2014	Tshepong 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Transalloys circulating fluidised bed power station near Emalahleni, Mpumalanga Province	Ecological Assessment (for EIA)	Trans-Alloys
2014	Umbani circulating fluidised bed power station near Kriel, Mpumalanga Province	Ecological Assessment (Scoping and EIA)	Eskom
2014	Gihon 75MW Solar Farm: Bela-Bela, Limpopo Province	Ecological Assessment (for EIA)	NETWORX Renewables
2014	Steelpoort Integration Project & Steelpoort to Wolwekraal 400kV Power Line	Fauna and Flora Pre-Construction Walk-Through Assessment	Eskom
2014	Audit of protected *Acacia erioloba* trees within the Assmang Wrenchville housing development footprint area	Botanical Audit	Eco-Care Consultancy
2014	Rehabilitation of the N1 National Road between Sydenham and Glen Lyon	Peer review of the ecological report	EKO Environmental
2014	Rehabilitation of the N6 National Road between Onze Rust and Bloemfontein	Peer review of the ecological report	EKO Environmental
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks
2011	Rocks Farm chicken broiler houses	Botanical Assessment (for EIA)	EnviroWorks
2011	Botshabelo 132 kV line	Ecological Assessment (for EIA)	CENTLEC
2011	De Aar Freight Transport Hub	Ecological Scoping and Feasibility Study	EnviroWorks
2011	The proposed establishment of the Tugela Ridge Eco Estate on the farm Kruisfontein, Bergville	Ecological Assessment (for EIA)	EnviroWorks
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Vegetation Rehabilitation Plan for illegally cleared areas	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Invasive Plant Management Plan	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Protected and Endangered Species Walk-Through Survey	NEOTEL
2011	Optic Fibre Infrastructure Network, Swartland Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2011	Optic Fibre Infrastructure Network, City of Cape Town Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2010	Construction of an icon at the southernmost tip of Africa, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	New boardwalk from Suiderstrand Gravel Road to Rasperpunt, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	Farm development for academic purposes (Maluti FET College) on the Farm Rosedale 107, Harrismith	Ecological Assessment (Screening and Feasibility Study)	Agri Development Solutions
2010	Basic Assessment: Barcelona 88/11kV substation and 88kV loop-in lines	Botanical Assessment (for EIA)	Eskom Distribution
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks

WETLAND DELINEATION AND HYDROLOGICAL ASSESSMENTS

Date Completed	Project Description	Type of Assessment/Study	Client
In progress	Steynsrus PV 1 & 2 Solar Energy Facilities near Steynsrus, Free State Province	Wetland Assessment	Cronimet Mining Power Solutions
2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners

2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Wetland Assessment (Basic Assessment)	Moeding Solar
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Wetland Assessment (Basic Assessment	Zevobuzz
2017	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy
2017	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Surface Hydrological Assessment (Basic Assessment)	Eskom
2017	Expansion of the Elandspruit Quarry near Ladysmith, KwaZulu-Natal Province	Wetland Assessment	Raumix
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Aquatic Assessment & Flood Plain Delineation	Savannah Environmental
2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Surface Hydrological Assessment (EIA phase)	Cresco
2016	Wolmaransstad Municipality 75MW PV Solar Energy Facility in the North West Province	Wetland Assessment (Basic Assessment)	BlueWave Capital
2016	BlueWave 75MW PV Plant near Welkom Free State Province	Wetland Delineation	BlueWave Capital
2016	Harmony Solar Energy Facilities: Amendment of Pipeline and Overhead Power Line Route	Wetland Assessment (Basic Assessment)	BBEnergy

AVIFAUNAL ASSESSMENTS

Date Completed	Project Description	Type of Assessment/Study	Client
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Avifauna Assessment (Basic Assessment)	Moeding Solar
2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Avifauna Assessment (Basic Assessment)	Eskom
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Avifauna Assessment (Basic Assessment)	Eskom
2016	TEWA Solar 1 Facility, east of Upington, Northern Cape Province	Wetland Assessment (Basic Assessment	Tewa Isitha Solar 1
2016	TEWA Solar 2 Facility, east of Upington, Northern Cape Province	Wetland Assessment	Tewa Isitha Solar 2

ENVIRONMENTAL IMPACT ASSESSMENT

- Barcelona 88/11kV substation and 88kV loop-in lines – BA (for Eskom).
- Thabong Bulk 132kV sub-transmission inter-connector line – EIA (for Eskom).
- Groenwater 45 000 unit chicken broiler farm – BA (for Areemeng Mmogo Cooperative).
- Optic Fibre Infrastructure Network, City of Cape Town Municipality – BA (for Dark Fibre Africa (Pty) Ltd).
- Optic Fibre Infrastructure Network, Swartland Municipality – BA (for Dark Fibre Africa).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – EMP (for Eskom).
- Lower Kruisvallei Hydroelectric Power Scheme (Ash river) – EIA (for Kruisvallei Hydro (Pty) Ltd).
- Construction of egg hatchery and associated infrastructure – BA (For Supreme Poultry).
- Construction of the Klipplaatdrif flow gauging (Vaal river) – EMP (DWAF).

ENVIRONMENTAL COMPLIANCE AUDITING AND ECO

- National long haul optic fibre infrastructure network project, Bloemfontein to Laingsburg – ECO (for Enviroworks (Pty) Ltd.).
- National long haul optic fibre infrastructure network project, Wolmaransstad to Klerksdorp – ECO (for Enviroworks (Pty) Ltd.).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – ECO (for Enviroworks (Pty) Ltd.).
- Construction and refurbishment of the Vredefort/Nooitgedacht 11kV power line – ECO (for Enviroworks (Pty) Ltd.).
- Mining of Dolerite (Stone Aggregate) by Raumix (Pty) Ltd. on a portion of Portion 0 of the farm Hillside 2830, Bloemfontein – ECO (for GreenMined Environmental (Pty) Ltd.).
- Construction of an Egg Production Facility by Bainsvlei Poultry (Pty) Ltd on Portions 9 & 10 of the farm, Mooivlakte, Bloemfontein – ECO (for Enviro-Niche Consulting (Pty) Ltd.).
- Environmental compliance audit and botanical account of Afrisam's premises in Bloemfontein – Environmental Compliance Auditing (for Enviroworks (Pty) Ltd.).

OTHER PROJECTS:

- Keeping and breeding of lions (*Panthera leo*) on the farm Maxico 135, Ficksburg – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Keeping and breeding of lions (*Panthera leo*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Keeping and breeding of wild dogs (*Lycaon pictus*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Existing underground and aboveground fuel storage tanks, TWK AGRI: Pongola – Environmental Management Plan (for TWK Agricultural Ltd).

- Existing underground fuel storage tanks on Erf 171, TWK AGRI: Amsterdam – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 14 000 L of fuel (diesel) aboveground on Erf 32, TWK AGRI: Carolina – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 23 000 L of fuel (diesel) above ground on Portion 10 of the Farm Oude Bosch, Humansdorp – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 16 000 L of fuel (diesel) aboveground at Panbult Depot – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks, TWK AGRI: Mechanisation and Engineering, Piet Retief – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks on Portion 38 of the Farm Lothair, TWK AGRI: Lothair – Environmental Management Plan (for TWK Agricultural Ltd).

WORK EXPERIENCES

&

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Jan-Hendrik Keet, PhD

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- International Association for Food Protection (IAFP; Louisville, Kentucky, USA), July 2019.
- Ecological Society of America Conference, (New Orleans, Louisiana, USA), August 2018 **Invasive legumes dramatically impact soil bacterial community structures but not function**

- Legumes for Life Workshop (Stellenbosch, South Africa), May 2018 **Legume-rhizobium symbiotic promiscuity and effectiveness do not affect plant invasiveness**
- Fynbos Forum Conference (Swellendam, South Africa), July 2017 **Assessing the impacts of invasive legumes on soil conditions and microbial community composition in a biodiversity hotspot**
- 43rd South African Association of Botanists Conference (Cape Town, South Africa), January 2017, **Legume-rhizobium symbiotic promiscuity and effectiveness do not affect plant invasiveness** *Best PhD presentation*
- 43rd Annual Research Symposium on the Management of Biological Invasions Conference (Worscester, South Africa), May 2016, **Legume-rhizobium symbiotic promiscuity does not determine plant invasiveness**
- Evolutionary dynamics of tree invasions: drivers, dimensions, and implications for management (Stellenbosch, South Africa), November 2015
- Neobiota: 8th International Conference on Biological Invasions (Antalya, Turkey), November 2014, **Assessing the threat and potential for management of Berberis spp. (Berberidaceae) in South Africa**
- 42nd Annual Symposium on the Management of Invasive Alien Plants (Karridene Beach Hotel, Durban, South Africa)
- XXth Association for the Taxonomic Study of the Flora of Tropical Africa International Conference (Stellenbosch, South Africa), January 2014
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<u>EIA and other surveys</u>

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