CHAPTER 3

Supplementary Material: Specialist Report

(A) Vegetation and flora report

Strategic Environmental Assessment for the proposed Boegoebaai Port and Special Economic Zone, Northern Cape, South Africa

Work Package 1

(A) VEGETATION AND FLORA REPORT

Gretel van Rooyen

Noel van Rooyen

Pieter van Wyk

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Council for Industrial and Scientific Research

Executive Summary

From a vegetation ecology and flora perspective the major source of impacts from the Boegoebaai Port and SEZ development will result directly or indirectly from vegetation clearance with the associated species loss, habitat loss and transformation.

The Boegoebaai Port and SEZ site is located in the Desert and Succulent Karoo Biomes of South Africa. Compared to other deserts with the same level of aridity globally, the Desert Biome in South Africa is exceptionally rich in plant species and also hosts a large number of endemic plant species. The Succulent Karoo Biome is recognised as an IUCN global hotspot of diversity and one of only two global hotspots that are entirely arid. To qualify as a hotspot, an area must have a high level of species diversity, a high percentage of endemic species and a substantial number of threatened species. Due to the high levels of biodiversity in both the Succulent Karoo and Desert vegetation, the Boegoebaai Port and SEZ site encompasses many features of High or Very High sensitivity.

The provisional checklist for the site contains 390 plant species that have been confirmed as occurring on site. The confirmed on-site checklist includes eight plant species with a Critically Endangered IUCN status, nine plant species classified as Endangered, 15 as Vulnerable, seven as Near Threatened, six as Data Deficient and one as Rare. Thus, in total 46 species on site are classified as SCC, representing 11.8% of all species on site. It is likely that this provisional checklist, as well as the SCC list, is not yet complete since the mined area to the west of the R382 has been poorly collected because of the restricted access to the area.

The receiving environment in the Boegoebaai Port and SEZ site hosts many features that indicate priority habitat for biodiversity conservation, such as:

- Two **Critically Endangered** ecosystems, the **Richtersveld Coastal Duneveld** and the **Namib Seashore Vegetation**.
- Large areas are classified as **irreplaceable CBA 1s** or as **optimal CBA 2s**;
- Habitat to **Critically Endangered** plant species;
- Portions are included in the **National Protected Area Expansion Strategy** (NPAES);
- Inclusion into an internationally recognised **Key Biodiversity Area** (KBA); and
- The **Critically Endangered Namib Lichen Fields**, *ca.* 13 km north of the site, a small ecosystem type at risk of collapse due to high rates of habitat loss in the past. These lichen fields are extremely sensitive to air pollution and care must be taken that the proposed development does not negatively impact this unique ecosystem.

A broad-scale, screening level, on-site reconnaissance and evaluation of the vegetation was conducted. The field evaluation was supported by available data. A small number of surveys were done during the reconnaissance visit. These data were classified and nine plant communities identified and described and a broad-scale vegetation map produced.

The Terms of Reference for the vegetation and flora component of the SEA required the ground-truthing of the environmental sensitivities indicated by the Screening Tool. The available information used to produce the sensitivity maps for the current assessment of the Boegoebaai SEA is at a coarse scale. The sensitivity

ratings were applied per plant community and relied on the presence of various features within a plant community.

The Screening Tool rated the sensitivity of the Plant Theme as being **Medium** based on the presence of model-derived suitable habitat for threatened and/or rare species. Using currently available databases, 46 SCC have been noted on site and consequently an upscaling of the Plant Theme to **Very High** is recommended with ca. 75% of the site having a Very High sensitivity (Figure Aa). The Screening Tool rated the sensitivity of the Relative Terrestrial Biodiversity Theme as **Very High**. The current assessment supported a **Very High** sensitivity for most of the site (75%; Figure Ab) and although the plant community that was previously mined is located within the area mapped as a Critically Endangered ecosystem (Richtersveld Coastal Duneveld) it was classified as transformed in the current assessment and could thus be used for development provided that areas of priority habitat are not negatively impacted by the development. The transformed areas from a botanical perspective cover 15% of the site.

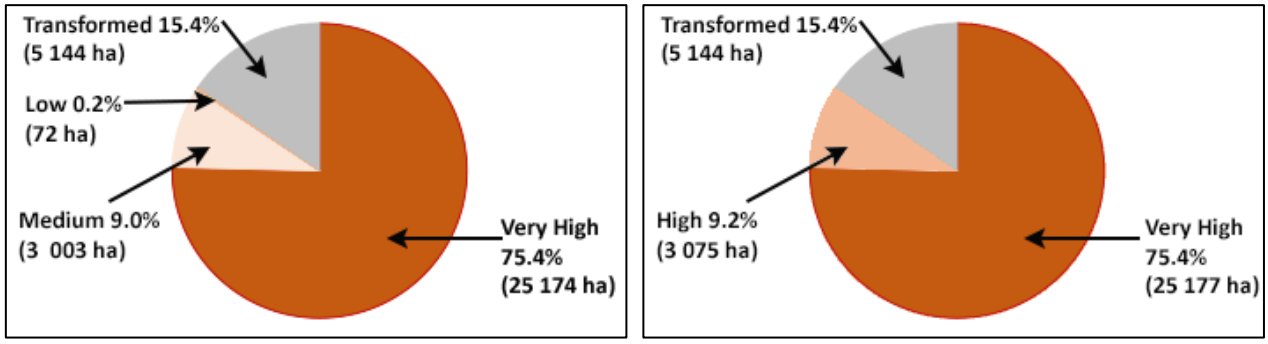

Figure A: Areas covered by the various sensitivity classes in (a) the Plant Theme (High sensitivity is too small to indicate in the figure and covers 0.01% of the total area = 3 ha) and (b) the Relative Terrestrial Biodiversity Theme as assessed during the current evaluation.

The sensitivity maps provided in this vegetation and flora report represent screening level baseline maps that need to be updated when detailed studies of the site become available or when major revisions of the data layers, are produced. It is strongly recommended that as a priority the current coarse-scale vegetation map is refined to inform the planning and layout of the Port and SEZ. **Considering the large areas with a Very High sensitivity rating, it would be prudent to conduct an in-depth, fine-scale analysis of the vegetation to produce a detailed vegetation map of the entire area as soon as possible, rather than conducting multiple EIAs at different levels of detail by an array of botanical specialists over a long period of time. Such a map will significantly contribute towards planning the layout of the port and SEZ and could potentially avoid placing footprints in areas that could possibly not receive Environmental Authorization.**

During the planning phase, areas of **Very High** sensitivity should be avoided, and as far as possible areas of **High** sensitivity should also be avoided. Residual impacts on irreplaceable biodiversity (Very High sensitivity) cannot be offset since that would prevent national biodiversity targets from being met. Avoidance would in the first place imply revisiting the alternative port and SEZ options. For possible alternative sites, consult Botha & Desmet (2022) or the presentation given by TNPA (meeting 10 October 2024), where a site approximately 18 km north of Port Nolloth was identified (p. 6) (https://www.csir.co.za/sites/default/files/Documents/Appendix%20C_Overview%20of%20Boegoebaai%20Site%20Selection%20process.pdf). Although offset options are not applicable to impacts of Very High sensitivity, offsets may be required for impacts of High or Medium sensitivity.

The potential benefits of the Boegoebaai Port and SEZ development must be evaluated against the irreversible loss of plant and vegetation diversity and ecosystem services. The current high-level evaluation of the botanical component of the site has demonstrated a Very High sensitivity for the Plant as well as

Relative Terrestrial Biodiversity Themes and consequently the proposed development requires a cautious approach with a strong emphasis on the conservation of the botanical diversity. Mitigation measures cannot eliminate irreversible losses of critical habitats or Critically Endangered species and avoidance will be the only option. Alternative sites where the impacts on the receiving environment have lower ecological sensitivities could potentially achieve development goals with minimal environmental trade-offs.

Abbreviations and Acronyms

Acronym	Explanation
AIS	Alien Invasive Species
AOO	Area of Occupancy
CBA	Critical Biodiversity Area
CBD	Convention on Biodiversity
CR	Critically Endangered
CSIR	Council for Scientific and Industrial Research
DFFE	Department of Forestry, Fisheries and Environment
DEA	Department of Environmental Affairs
EGI	Electricity Grid Infrastructure
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	Endangered
EOO	Extent of Occurrence
ESA	Ecological Support Area
EWT	Endangered Wildlife Trust
GHG	Greenhouse gas
GIS	Geographic Information System
IDP	Integrated Development Plan
IFC	International Finance Corporation
IEMP	Integrated Environmental Management Plan
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act (107/1998)
NEM:BA	National Environmental Management: Biodiversity Act (10/2004)
NEM:PAA	National Environmental Management: Protected Areas Act (57/2003)
NFA	National Forest Act (84/1998)
NFEPA	National Freshwater Ecosystem Priority Areas
NHS	National Heritage Site
NPAES	National Protected Area Expansion Strategy
NT	Near Threatened
ONA	Other Natural Area
PA	Protected Area
SACAD	South African Conservation Areas Database
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SAPAD	South African Protected Areas Database
SCC	Species of Conservation Concern
SDF	Spatial Development Framework
SEA	Strategic Environmental Assessment
TNPA	Transnet National Ports Authority
ToPS	Threatened or Protected Species Regulations (2013)
TOR	Terms of Reference
VU	Vulnerable
WHS	World Heritage Site

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Terms of Reference

Deliverables:

Preparation of an electronic report (in English), which will be integrated as a Chapter in the overall SEA report. Provide spatial data in .shp or .kmz format.

Meetings / feedback sessions:

Attend occasional virtual meetings to plan work, discuss findings with the broader research team and present findings to the Project Steering Committee and Working Group.

Data sharing and reference library:

CSIR will make available a reference library containing useful literature, planning documents and spatial data. Other parties undertake to consult and use such documentation as needed. No distribution of this information to external parties without permission.

Scope summary:

A local-scale, spatially focused SEA report identifying sensitivities within the proposed port and SEZ development covering ~33 500 ha ("Boegoebaai Port and SEZ SEA"). Expert on-site, ground-truthing of environmental sensitivities of the Screening Tool by a broad-scale, on-site evaluation supported by existing data and preparation of updated spatial data. The outcome will inform the planning of the Port and SEZ, as well as provide references and recommendations for future project specific Environmental Impact Assessments.

Role:

Integrating (Lead) Author on the Terrestrial and Aquatic Ecology chapter (WP 1 Report). Incorporate findings from Contributing Authors on flora, fauna, avifauna, bats and aquatic ecology, for WP1.

Specific tasks:

1. Plan of Study:

Outline the approach, data requirements, assumptions, limitations and timeframe of tasks.

Provide report / chapter framework.

2. Description of the receiving environment:

Describe the land use dynamics and change trends of the receiving environment and broader region as it relates to your topic. This will feed into the dynamic baseline scenario (Sc0) used in WP2 "Regional SEA" as needed – "how is the ecological system changing even if a GH_2 economy does not realise?".

Describe the key characteristics of the receiving environment as it pertains to your area of expertise - "What, where, why is it important?" Spatially explicit as far as possible.

3. Site visit / ground-truthing:

Site visit to augment the receiving environment description, and to map and verify environmental sensitivity.

4. To the extent possible, provide additional data / actions required for assessment as related to biodiversity offsets, using existing data, satellite imagery and what is observed within the constraints of the fieldwork:

Identify areas with natural sand movement or recent blowouts (due to disturbance such as from mining) should be categorized differently, possibly as "rehab possible," indicating potential for rehabilitation.

Gather data on the occurrence of SCC within the port and SEZ footprint areas.

Unique occurrences, such as those on the Boegoeberg Twins, are particularly important to note.

5. Sensitivity analysis:

Spatial layers distinguishing relative sensitivity of the receiving environment (Low, Medium, High, Very High).

Verified and refined based on site visit / ground-truthing.

6. *Aspects and impacts register:*

Potential impacts (negative and positive) that may arise from the planned activities and infrastructure (based on a project description provided by CSIR).

7. *Recommendations for planning and future EIA:*

Practical recommendations to inform the planning and layout of the Port and SEZ.

Practical recommendations for future EIA studies.

Practical recommendations to enhance positive impacts and reduce negative impacts.

Assumptions, limitations and uncertainties

This is a strategic-level, predominantly desktop assessment, aimed at identifying potential, botanically related environmental sensitivities based on existing spatial data at a high level. No detailed fieldwork was done and limited raw data were collected and analysed. Species records obtained from P. van Wyk were used and supplemented by existing databases, e.g. NewPosa (SANBI) and iNaturalist and SANBI (2024). It should, however, be noted that the entire Port and SEZ site has not been intensively sampled or surveyed in the past because of the limited access to the mining area. Consequently, some areas may have no botanical records in existing biodiversity databases. Species records used in this study are therefore more common in areas that were easy to access. Furthermore, species data sets are seldom comprehensive and the absence of species records is not equivalent to the absence of SCC.

The site visit was conducted from 31 August – 3 September 2024, which is normally the most favourable time of year for field work in the Succulent Karoo. Most of the Richtersveld as well as the current assessment area suffered from an extreme drought from 2011 to 2022 (peak in 2019) which killed many plants and entire populations. Recovery may take many years and it is likely that the complete species pool was not present in 2024. Furthermore, the low rainfall during the winter of 2024 was not ideal for annual and geophytic plant species.

The available information used to derive the sensitivity maps is at a coarse scale. Sensitivity ratings relied on an assessment of various features within the plant communities that were distinguished. The ratings were applied per community due to a lack of point data covering the area. Because many of the plant communities are large, the current analysis and mapping of sensitive features is at a broad scale and many small or localised features were not mapped although they may be present.

This predominantly desk-top approach used here was regarded as adequate for the purpose of an SEA. The disadvantage, however, is that the level of detail is not sufficient for biodiversity offset planning. It has been proposed that a detailed assessment of the vegetation and flora has to be made for each site-specific development proposal during the EIA phase. Alternatively, an in-depth, fine-scale analysis of the entire port and SEZ site could be scheduled as soon as possible to guide the footprint planning and to avoid areas that could possibly not receive environmental authorisation. These field surveys must be done in the appropriate season or preferably seasons to capture the geophytic and annual plant species component of the flora.

Gaps in knowledge: The Boegoebaai Port and SEZ area, particularly the section to the west of the tar road (R382), has not been subject to a detailed vegetation analysis. Because impacts on threatened species, natural and critical habitats and ecosystem on site are likely, the baseline data collection should include in-depth, fine-scale field surveys over multiple seasons to produce a fine-scale vegetation map that could be used to plan the layout of the port and SEZ. The field survey data should be recent and done in the appropriate season or preferably seasons. It could be considered to contract a consortium of specialists including the fields of botany, avifauna, herpetology, mammals (including bats as separate study) and invertebrates (invertebrates not assessed for current SEA) to produce fine-scale maps.

Disclaimer 1: The final update on the red list status of plant species (supplied by SANBI) was on 18 December 2024. At the time of finalising this report (20 May 2025) no further red list status updates had been received. We kindly acknowledge SANBI for the use of their data. This work forms part of the Boegoebaai Strategic Environmental Assessment (CSIR project EEMS086). The scientific material for this publication was developed through a collaborative effort involving various stakeholders and datasets contributed by the South African National Biodiversity Institute. It should be noted that the redlist status of some species indicated in this report differs from the report by Van Wyk (2025) because he has access to data that is not yet publicly available on the website of the Threatened Species Programme.

Disclaimer 2: This report is based on the 2016 Northern Cape Critical Biodiversity Areas map available from the SANBI Biodiversity GIS website. The 2024 Northern Cape CBA map has undergone several revision, but at the time of finalising this report (20 May 2025), the latest version was not yet publicly available on SANBI BGIS.

1. INTRODUCTION

In 2015, at the 21st Conference of Parties (COP), 195 countries signed an agreement to implement national strategies to keep global warming below 2°C above pre-industrial levels. Energy is one of the most carbon-intensive sectors and to achieve this target a radical change in energy production and consumption will be needed. Hydrogen produced from clean, renewable sources is termed "green hydrogen (GH_2)" and could potentially provide an opportunity to decarbonise the South African energy economy while also generating new revenues, creating jobs and developing skills.

From production to consumption the GH_2 value chain consists of many interlinked elements, each with its own barriers, challenges and risks. The production of green hydrogen is accomplished by electrolysis (either alkaline, proton exchange membrane (PEM), anion exchange membrane (AEM) or solid oxide), which is fuelled by electricity produced from renewable resources such as wind, solar or nuclear. Because hydrogen has a low energy density by volume it has to be treated to reduce its volume when being transported. Hydrogen is therefore either compressed or liquefied, or further synthesized into other energy carriers, such as ammonia, methane, methanol, liquid organic molecules, or liquid hydrocarbons, which have a higher energy density. The transport of hydrogen can be either by truck, ship or pipeline. Transporting compressed hydrogen by truck is viable for short distances and for low volumes. For longer distances, hydrogen is usually transported in liquid form, at low temperature.

Alternatively, hydrogen can be synthesised into ammonia. If ammonia is synthesized by the Haber-Bosch process it has the advantage that the non-hydrogen part of the molecule does not contain carbon and after dehydrogenation the nitrogen is returned to the atmosphere. Ammonia can be transported by truck, rail or ship, either compressed or liquefied, at conditions that are more favourable than those for pure hydrogen. Alternatively, methanol can be synthesized from green hydrogen by the addition of carbon dioxide.

The Boegoebaai Port and Special Economic Zone (SEZ), i.e. the study site, in the Northern Cape has been proposed to advance South Africa's GH_2 strategy. A Strategic Environmental Assessment (SEA) was initiated by a collaborative effort between the South African National Energy Development Institute (SANEDI), Northern Cape Economic Development Trade and Investment Promotion Agency (NCEDA), and Transnet National Ports Authority (TNPA). The Council for Scientific and Industrial Research (CSIR) has been appointed to undertake the independent SEA. The objective of the Boegoebaai SEA is to develop an integrated decision-making framework to guide the planning of the proposed Boegoebaai Port, Special Economic Zone (SEZ) and wider Namakwa region in a sustainable manner (Schreiner *et al.,* 2024). The conceptual layout of the project site to be assessed for Work Package 1 is shown in Figure 1 and includes the Port precinct (Zones 1 & 2) at 3 357 ha and the SEZ at 30 143 ha (Zones 3 – 10).

A phased approach has been proposed for constructing the infrastructure and facilities for the Boegoebaai Port and SEZ. This approach includes a short-term (Phase 1A) and long-term (Phase 1B) development plan for the port. The Boegoebaai SEZ is seen as a multifaceted hub, primarily focusing on the GH_2 project's downstream activities and facilitating the export of commodities through the proposed Boegoebaai Port. The SEZ will also be developed in phases and is envisaged to consist of eight subzones (Zones 3 – 10; Figure 1):

1. Port – 2 187 ha
2. Conservancy area – 1 170 ha
3. Confirmed green ammonia facility – 4 508 ha
4. SEZ Phase 1 – 499 ha
5. SEZ Phase 2 – 411 ha
6. SEZ Phase 3 – 833 ha
7. Future green hydrogen facility – 3 713 ha
8. Future expansion 01 – 3 408 ha
9. Future expansion 02 – 15 067 ha
10. Future tank farm – 1 704 ha

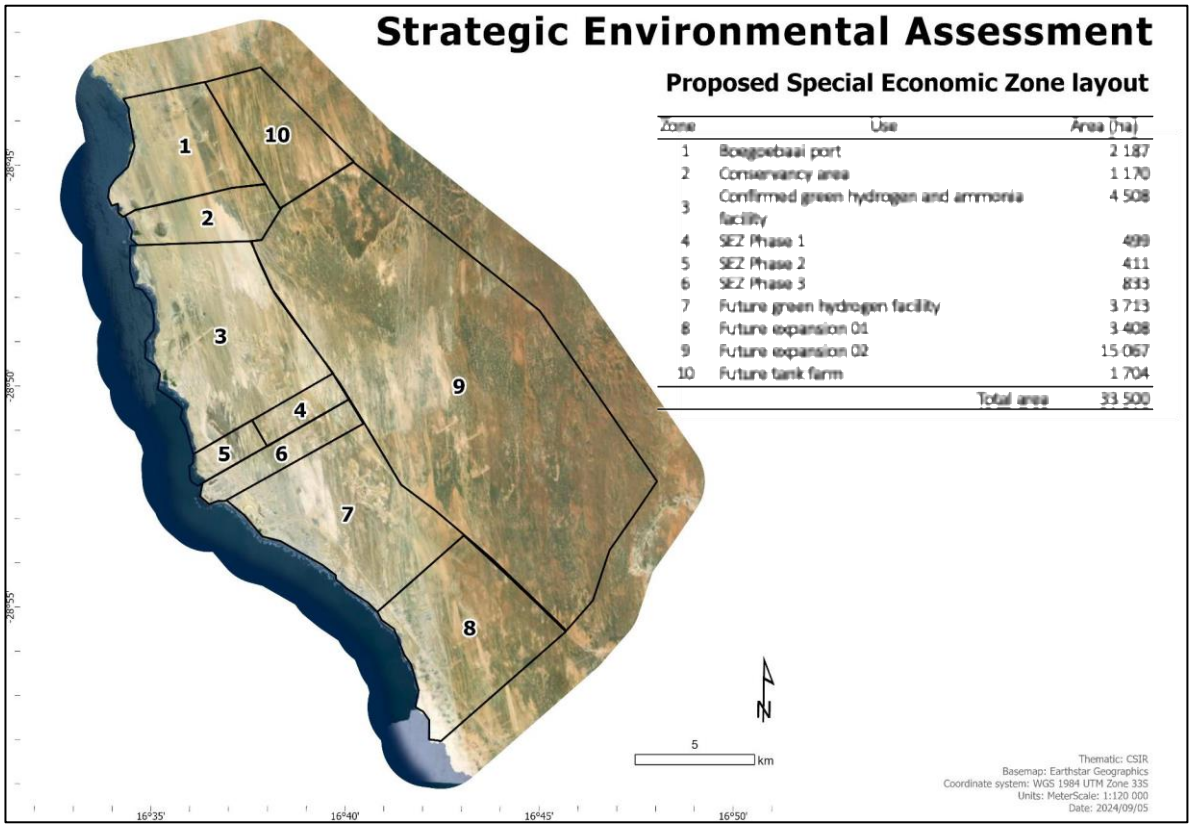

Figure 1: Layout of the Boegoebaai Port and Special Economic Zone (source: Schreiner *et al.,* 2024).

2. METHODOLOGY

In this section the methodology to conduct the SEA for the vegetation and flora component is outlined detailing the steps taken to ensure the satisfactory completion of the scope of work.

2.1 Approach

The study commenced as a desktop study, followed by a site visit at the end of August, beginning September 2024. The focus of the site visit was to undertake a site sensitivity evaluation to support or contradict the environmental sensitivity as identified in the Screening Tool provided by the Department of Forestry, Fisheries and Environment (DFFE) (Screening Tool, 2024). No provision was made for a detailed analysis of the vegetation in the scope of work. However, any Species of Conservation Concern (SCC) that was encountered during the site visit was recorded.

2.2 Data Sources

Sources of information for the vegetation and flora component included:

- Screening Tool Report generated for the revised Boegoebaai Port and SEZ layout on 20 August 2024 from the DFFE website (https://screening.environment.gov.za/screeningtool/#/pages/process). As per the best practise guideline that accompanies the Animal and Plant Species Protocol for the screening tool, please note that the **name of the sensitive species may not appear in the final EIA report nor any of the specialist reports released into the public domain**. It should be referred to as *sensitive plant* or *sensitive animal* and its threat status may be included, e.g. *critically endangered sensitive plant* or *endangered sensitive animal*.
- Descriptions of the vegetation types found in the area were obtained from Mucina & Rutherford (2006). The map was of the vegetation types was the revised national vegetation map produced by the South African National Biodiversity Institute (SANBI, 2012–2024 as amended).
- Conservation status of the vegetation types was obtained from the National List of Threatened Ecosystems (Skowno *et al.,* 2019; National Environmental Management: Biodiversity Act (NEM:BA) (10/2004), 2022).
- Information on endemic species per national vegetation type was obtained from Mucina & Rutherford (2006).
- The Northern Cape Critical Biodiversity Area Map (2016) was consulted for the occurrence of Critical Biodiversity Areas, Ecological Support Areas or Other Natural Areas (biodiversityadvisor.sanbi.org: accessed April 2024) to verify the Screening's Tool sensitivity of the Relative Terrestrial Biodiversity Theme. The 2024 Northern Cape CBA map has undergone several revision, but at the time of finalising this report (20 May 2025), the latest version was not yet publicly available on SANBI BGIS.
- Protected Areas were obtained from the Department of Forestry, Fisheries and Environment (DFFE). (https://egis.environment.gov.za/data_egis/data SAPAD_IR_2024_Q2_01 accessed October 2024).
- The National Protected Areas Expansion Strategy (NPAES 2010, 2018) was consulted for possible inclusion of the site into a protected area in the future (biodiversityadvisor.sanbi.org: accessed April 2024).
- A plant species checklist of the immediate environs of the site was obtained from the NewPosa database of the South African National Biodiversity Institute (SANBI) (Appendix A) (www.newposa.sanbi.org).

- The IUCN Red List Category (IUCN, 2021) for plant species was extracted from the Red List of South African Plants version 2024.1 (www.redlist.sanbi.org; Accessed on 2024/11/22) as provided by SANBI (2024) or from the website of the Threatened Species Programme of SANBI.
- The geology was obtained from the Geological Map 2816 Alexander Bay (Council for Geoscience, 2011).
- Land types were obtained from the Land Type Map 2816 Alexander Bay (Land Type Survey Staff, 1986).
- The following topocadastral maps were consulted: 2816DA Grootderm; 2816DB Rooibank; 2816DC Visagiesfontein; 2816DD Holgat (Chief Directorate of Surveys and Mapping, 2007).
- The Northern Cape National Conservation Act (NCNCA, 2009) was consulted to establish provincially protected and specially protected status of plant species.
- The National Protected tree list of the National Forestry Act (NFA, 2024) was checked for the occurrence of any protected tree species.
- Van Wyk & Smith (2001) and Jürgens (1991, 1997) were consulted for inclusion in a Centre of Endemism.
- The Key Biodiversity Area (KBA) website was accessed to identify the presence of a KBA on site.

2.3 Site visit and mapping

In preparation for the site visit a habitat map of the Port and SEZ site was prepared based on the geology, terrain and areas transformed by mining. Additionally, a satellite image of the site was stratified into homogeneous terrain/ vegetation units or habitats and as many of these units as feasible were visited and species lists of the most prominent species compiled. As backdrop for the mapping of the homogeneous units a 2024 Sentinel natural colour satellite image with a 10 m resolution over Copernicus Hill-shading was used. The image was a 24-bit composite image of bands 4,3,2 as RGB. The image was imported into Adobe Photoshop® for the habitat mapping. The study area was then stratified into habitat units by hand drawing on the Sentinel image. Mapping of habitats units was guided by:

- terrain/topography of the image;
- vegetation cover;
- background colour of the image;
- texture of the image;
- geology; and
- areas transformed by deep surface mining.

Fieldwork was conducted by P. van Wyk, accompanied by N. van Rooyen and G. van Rooyen and limited to recording the most prominent plant species at 37 sites spread across the study site. The species data were classified into groups of associated species representing various plant communities or habitats on site.

For the vegetation and sensitivity maps, the Photoshop layer, containing the mapped paths (lines), was exported and incorporated into a GIS environment. This map was cleaned of line annotations in a raster environment and then converted to a vector map.

2.4 Sensitivity mapping

The methodology used to compile sensitivity maps for the Boegoebaai Port and SEZ is explained in detail in Section 5. The sensitivity maps are compared to those for the Plant Theme and Relative Terrestrial Biodiversity Theme generated by the Screening Tool (2024).

2.5 Provisional plant species checklist

The checklist of plant species (Appendix A) was compiled from data provided by (i) P. van Wyk, (ii) species recorded during the site visit, (iii) supplemented by data from iNaturalist (https://www.inaturalist.org/taxa/) and (iv) from the NewPosa database of the South African National Biodiversity Institute (www.newposa.sanbi.org) and SANBI (2024). Additionally, data provided by P. van Wyk for a somewhat larger area in the Richtersveld, which could potentially be affected by the Boegoebaai development has also been included. Appendix A also includes species listed by Desmet (1996) although his study area stretched from Alexander Bay to Port Nolloth. Desmet's study area was thus substantially larger than the current Boegoebaai Port and SEZ site. However, no coordinates for the species were provided by Desmet to confirm their presence on site.

The IUCN, conservation and protected status of all plant species provided in Appendix A were determined from available literature and Acts, e.g. SANBI (2024), Red list database (www.redlist.sanbi.org); NEM:BA (ToPS list) (2023); NCNCA (2009); NFA (2024) and CITES (2024, https://cites.org/sites/default/files/eng/app/2024/E-Appendices-2024-05-25.pdf).

3. DESCRIPTION OF THE RECEIVING ENVIRONMENT

The proposed Boegoebaai Port and SEZ site is located in the Namaqualand District, Richtersveld Local Municipality, on the West Coast in the northwestern corner of the Northern Cape province, approximately 18 km south of the small mining town of Alexander Bay. It includes parts of the farms Rietfontein (portion 0), Korridor Wes 1 (portions 0 & 1) and Korridor Wes 2 (portions 0, 3, 4, 6 & 8). The highest point on site is Visagiesfonteinkop at 319.2 m. Several depressions occur on site, with the most noteworthy being Visagiespan and Rietfonteinpan (Figure 2).

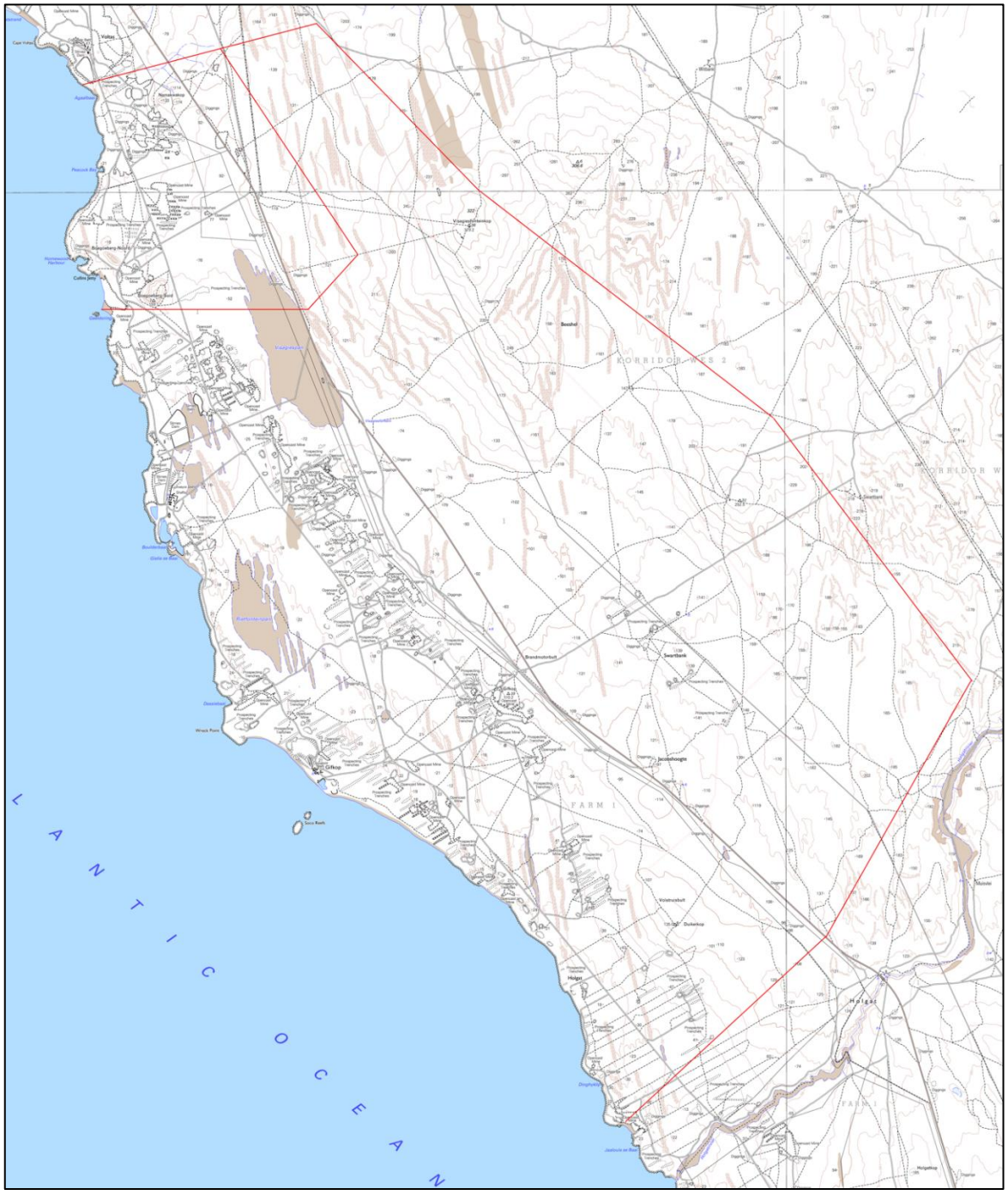

Figure 2: Topocadastral map indicating the Boegoebaai Port and SEZ site outlined in red (source: Topocadastral maps: 2816DA Grootderm; 2816DB Rooibank; 2816DC Visagiesfontein; 2816DD Holgat; Chief Directorate of Surveys and Mapping, 2007).

3.1 Abiotic environment

3.1.1 Climate

Vegetation patterns and processes depend on the climate and to understand these patterns and processes a knowledge of the climate is essential. According to the Köppen-Geiger climate classification both Alexander Bay and Port Nolloth have a BWk climate i.e. a cool, desert climate with a winter rainfall. The aridity of this coastal area can be ascribed to the South Atlantic anticyclone and the cold Benguela current. There is a general decrease in rainfall from south to north along the West Coast, with a concomitant increase in the unreliability of the rainfall expressed as the co-efficient of variation of the mean annual rainfall. The mean annual temperature and rainfall recorded in Alexander Bay, approximately 18 km to the north of the proposed Boegoebaai Port site, is 16.5°C and ca. 80 mm respectively, whereas the mean annual temperature and rainfall recorded in Port Nolloth, approximately 60 km to the south of the Port site, is 16.9°C and ca. 94 mm respectively (Figure 3). Due to the moderating effect of the Atlantic Ocean the mean monthly temperatures show only a 5°C range at Alexander Bay and a 5.4°C range at Port Nolloth during the course of a year. At both Alexander Bay and Port Nolloth, January is the month with the highest mean relative humidity and July the lowest.

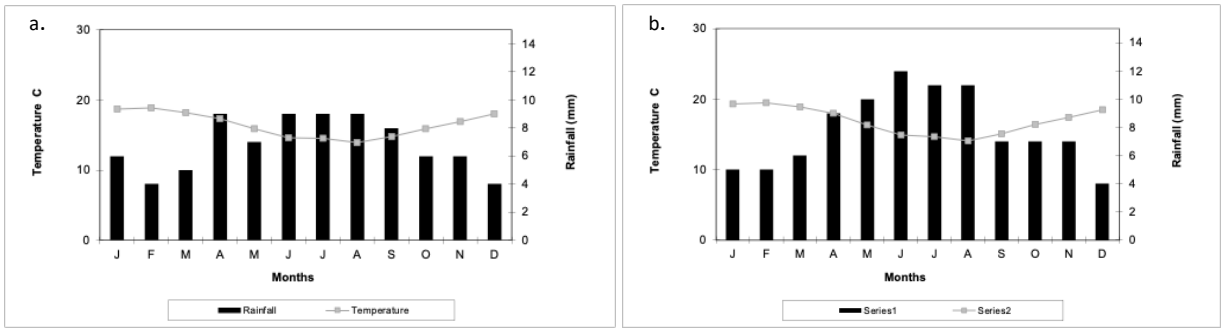

Figure 3: Mean monthly rainfall and temperature for (a) Alexander Bay and (b) Port Nolloth (https//en.climate-data.org).

A distinctive feature of the desert climate at the study site is the occurrence of fog. The sea fog results from the advection of relatively warm moist air over the cold water of the Benguela-upwelling zone (Olivier, 2002). The extent of this upwelling zone varies seasonally and depends on prevailing climatic conditions. High fog occurrence along the West Coast of South Africa is most often on the coastal plain, generally at elevations <200 m a.s.l. The highest fog day frequency is found at the coast and there is a decrease with distance from the sea. The main fog season at Port Nolloth is during the summer-autumn period, however, at Alexander Bay the fog season occurs more during an autumn-winter regime (Olivier, 2002). The mean annual fog day frequency at Alexander Bay is 84 days (maximum 145; minimum 49) and at Port Nolloth 139 days (maximum 180; minimum 64). Fog supplements the meagre rainfall in the region and is a more reliable source of moisture than rainfall (Gottlieb, 2019). Heavy dew further supplements the mean annual rainfall.

The area experiences strong winds that cause dust and sand storms with associated erosion of topsoil material and sandblasting, which has a destructive effect on the vegetation. This destructive wind action is particularly prominent in areas where the vegetation has been degraded and is sparse (Desmet, 1996). Hot, dry easterly berg winds blowing off the interior plateau, roughly at right angles to the coast occur mainly in winter. These berg winds, with associated sand storms, cause a rapid increase in temperature and have a desiccating effect on the vegetation.

3.1.2 Terrain types

A terrain type describes the terrain or relief of an area by means of the percentage level land and local relief. The Port section is covered mostly by 'level plains with some relief' with small segments of 'plains

with open high hills or ridges' and 'plains with open low hills or ridges' (Figure 4). Along the coast and in the northeastern part of the SEZ section, the terrain type consists primarily of 'plains with open high hills or ridges', while the largest area of the SEZ section is covered by 'plains with open low hills or ridges'.

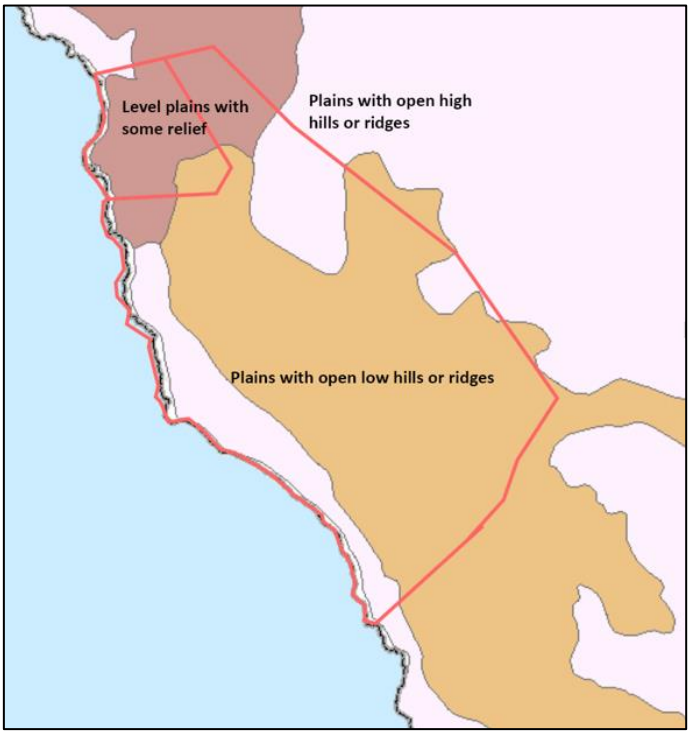

Figure 4: Terrain types in the Boegoebaai Port and SEZ site (source: https://ndagis.nda.agric.za/).

3.1.3 Drainage

There are no major drainage lines on site. The Orange River is the only perennial river in the region and is located approximately 20 km to the north of the site. The Holgat River lies approximately 2 km south of the site and is ephemeral, flowing only after high rainfall events mostly occurring in its upper catchment, which is remote from the coast. The Boegoebaai Port and SEZ site lies in the Orange River Management Area, in the F10C Quaternary catchment (https://ndagis.nda.agric.za/).

3.1.4 Geology

There is generally a close relationship between the occurrence of plant communities and the geological substrate as well as the soils derived from these substrates.

Geologically, the Namaqualand coast consists of Precambrian rock overlain by Cenozoic sediments. The basement geology, dating back to the Precambrian is visible in a few rocky outcrops in the study area (Desmet, 1996). The Port and SEZ site falls in the Gariep Supergroup, Holgat Formation, which lies to the south of the Schakalsberge Thrust (Figure 5) (Council for Geoscience, 2011). To the north of the thrust lie the Oranjemund and Grootderm Formations. The most prominent outcrops in the study site, consisting of schist, greywacke, quartzite and arkose (Nho) of the Holgat Formation, are the Boegoeberg Twins (i.e. Boegoeberg North and Boegoeberg South). Other examples where the basement geology is exposed are the low outcrops in the north of the study site and east of Cape Voltas (e.g. Namakwakop); near Rietfonteinpan; Gifkop; and Volstruisbult; as well as the exposed bedrock along the rocky shore. The canyon of the Holgat River, where the basement geology is also exposed, lies south of the study area. To the east of the R382 tar road some coarse-grained porphyritic granite outcrops occur (ϵsw).

The Cenozoic sediments of the coastal shelf are represented by an array of sediments of Tertiary and Quaternary age. Among the Quaternary sediments on site are: Q-s2 = white aeolian sand; Q-s3 = red

aeolian sand; Q-s4 = saline soil; Q-s5 = surficial sandy soil; Qsw = white to grey dune sand; Qkk = young aeolian, reddish, mobile, vegetated sediment; and Qcu = coarse gravels (Figure 5). Large areas of saline soils (Q-s4) occur at Visagiespan and Rietfonteinpan and near Rietfontein. The surface of the pans is a white to grey silt and clay soil (Mucina & Rutherford 2006) which is underlain by a layer of compacted green sand (De Villiers & Söhnge, 1959 as cited in Desmet 1996). The salt pans are nearly permanently dry.

The Tertiary sediments are represented by three shoreline terraces also referred to as 'packages': Th = 30 m shoreline terrace (or Hondeklip Bay Member); Tav = 50 m terrace (or Avontuur Member); and Tkl = 90 m shoreline terrace (or Kleinsee Member) (Figure 5). These three marine units, containing warm-water molluscan assemblages, are consistently represented along the West Coast (Roberts *et al.,* 2006). The sediments of the 90 m package comprise a basal gravel with abundant silcrete clasts and overlying, reddened sands with heavy-mineral-rich laminae. The 50 m package was laid down when the sea regressed from a maximum of 50 m a.s.l. It consists of fine-grained, green, lower shoreface sands overlying basal gravels. The 30 m package forms another regressional marine sequence. Its lower contact can be traced as a seaward-inclined horizon of pebbles and scattered cobbles (Roberts *et al.,* 2006).

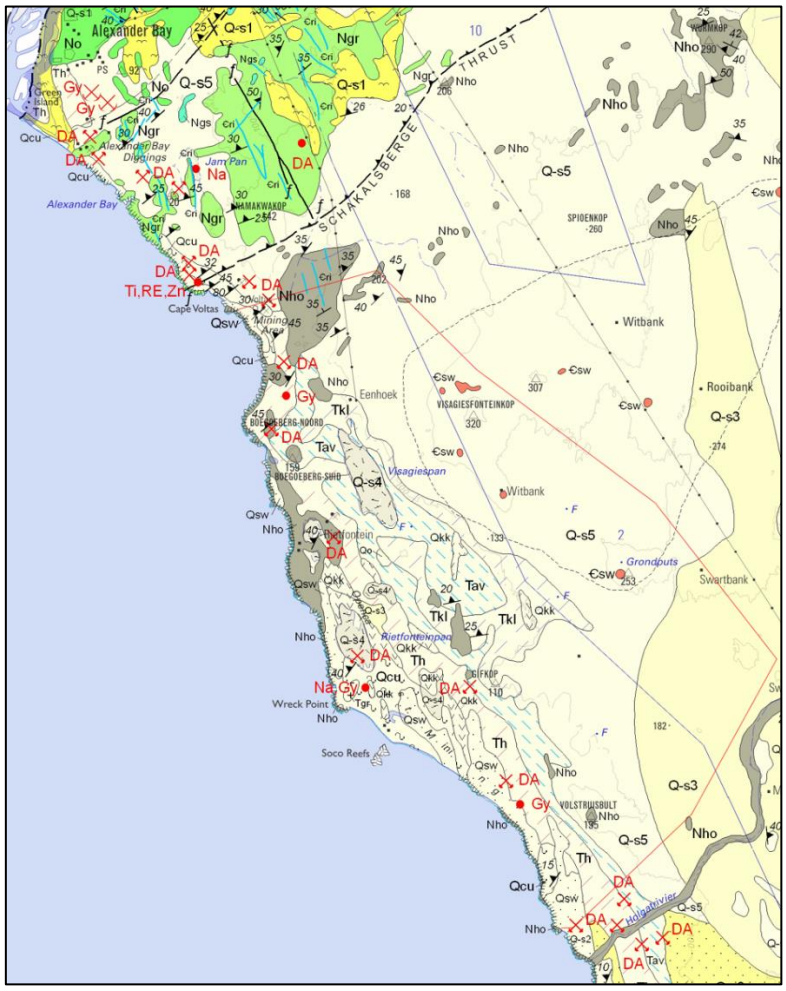

Figure 5: Detailed geology in the Boegoebaai Port and SEZ site (Council for Geoscience, 2011).

3.1.5 Soils

Soils on site are sandy with little or no profile development. The soils are well-aerated and well-drained with loosely packed sand particles. These soils are poor conductors of heat and temperature drops rapidly with increasing soil depth. The sandy soils have a low clay and silt content. The lack of fine-grained particles results in a low water holding capacity and a low nutrient content. These sands are thus not favourable for

plant growth and consequently also have a low organic matter content. Below a 30 cm depth in dune sand there is little evaporative loss and this water is available to deep-rooted perennial plants.

Mobile dune soils have little or no vegetation mainly because of the sandblasting associated with the strong winds. Once plains become vegetated, soil particles may be trapped by plant canopies and gradually lead to the development of phytogenic mounds. Once the silt and clay content of the top sand layer reaches a certain level, a biological crust can develop.

Replacement commonly occurs in the sandy soils along the West Coast when soluble components are eluviated and later crystallised in the subsoil to form cemented hardpan formations (Desmet, 1996). Calcrete, dorbank and silcrete are the most prominent replacement products. Along the West Coast of South Africa, calcrete occurs as an almost ever-present layer under the surface sand of the dune landscape up to the edge of the near shore zone. Calcrete is formed when calcium bicarbonate in the soil solution is precipitated and later crystallised as calcium carbonate in a lower horizon. It is a slow process and rainfall dependent. Plant roots cannot penetrate calcrete. Dorbank is another common replacement product and is usually found lying above the calcrete layer. It is a hard subsurface horizon, generally with a red or reddish brown colour. Dorbank is associated with soils developed from unconsolidated parent materials. Unconsolidated material underlying the dorbank is generally weakly structured and highly calcareous or gypsic. The third type of replacement product encountered on the West Coast is silcrete. Silcrete occurs at or near the soil surface and can range in thickness from less than 1 m up to 5 m.

Various soil hazards have been identified in the Boegoebaai Port and SEZ sections. These hazards relate to wind and water erosion susceptibility, crusting susceptibility and soil compaction susceptibility (Figure 6).

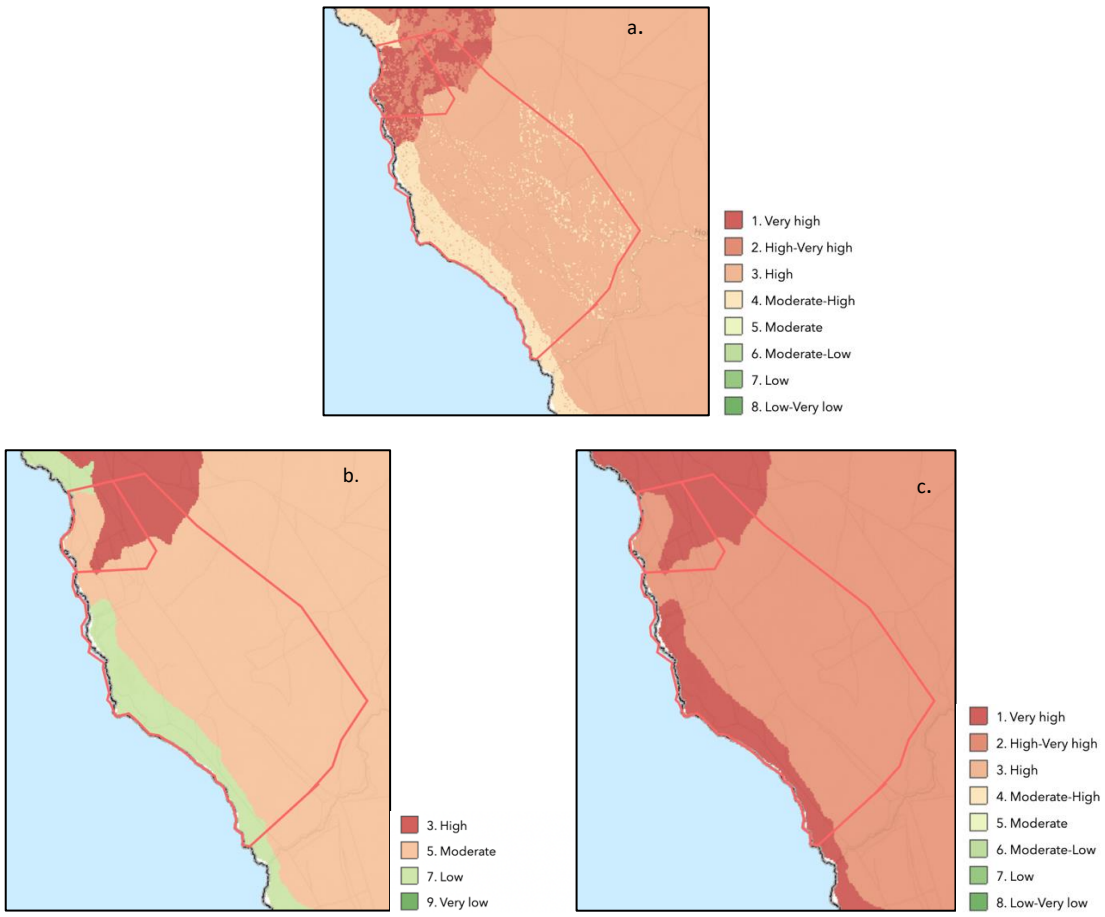

Figure 6: Soil hazard susceptibility in the Boegoebaai Port and SEZ site (a) water erosion susceptibility; (b) crusting susceptibility; and (c) soil compaction susceptibility (https://ndagis.nda.agric.za/).

- *Wind erosion susceptibility:* Soils in the entire site have a **Very High** susceptibility to wind erosion.
- *Water erosion susceptibility:* The water erosion susceptibility of almost the entire Port section is rated as **Very High** or **High-Very High**. The coastal zone's soil in the SEZ section has a **Moderate-High** susceptibility to water erosion, whereas the susceptibility of soils of the inland part of the SEZ section is mostly **High**, but **Very High** or **High-Very High** in the northern part (Figure 6a).
- *Crusting susceptibility:* The crusting susceptibility of the soil is generally **Low** along the coast except in the Port section where it is **Moderate**. Most of the inland area of the SEZ has a **Moderate** crusting susceptibility but in the eastern part of the Port and northeastern part of the SEZ it is rated as **High** (Figure 6b)**.**
- *Soil compaction susceptibility:* Soil compaction susceptibility is rated as **Very High** along the coast in the SEZ section and in the inland part of the Port and northeastern area of the SEZ. The soil's susceptibility to compaction in the remainder of the study site is **High-Very High** Figure 6c).

3.1.6 Land Types

Land types are areas with a uniform climate, terrain form and soil pattern. Within a land type, terrain unit 1 represents a crest; 2 = scarp; 3 = midslope; 4 = footslope; and 5 = valley bottom. The study area falls in the Ah, Ai, Fc, and Ha Land Types (Du Plessis, 1987) (Figure 7).

Figure 7: Land types in the Boegoebaai Port and SEZ site (https://ndagis.nda.agric.za/).

- The Ah Land Type comprises red and yellow apedal, freely drained soils with a high base status and usually <15% clay, whereas the Ai Land Type comprises yellow apedal, freely drained soils with a high base status and usually <15% clay. The following A Land Types occur on site:
    - Land Type Ah35 occurs on yellow and red, Tertiary to Recent wind-blown sands. Terrain units 1, 3, 4 and 5 cover 20%:45%:30%:5% of the terrain respectively.
    - Land Type Ah36 occurs on red and yellow Tertiary to Recent wind-blown sands. Terrain units 1, 3, 4 and 5 cover 25%:35%:38%:2% of the terrain respectively.

- Land Type Ai10 occurs mainly on greywacke, schist and arkose of the Holgat Suite, Gariep Complex covered by young aeolian sands. Terrain units 1, 3, 4 and 5 cover 20%:30%:40%:10% of the terrain respectively.

- Map units Fa - Fe accommodate pedologically young landscapes that are not predominantly rock and not predominantly alluvial or aeolian and in which the dominant soil forming processes have been rock weathering, the formation of orthic topsoil horizons and clay illuviation, typically giving rise to lithocutanic horizons. Fc refers to land where lime is generally present in the entire landscape

  - Land Type Fc129 occurs mainly on greywacke, schist and arkose of the Holgat Suite, Gariep Complex. Terrain units 1, 3, 4 and 5 are present on site and cover 15%:30%:50%:5% of the terrain respectively.

- The Ha Land Type refers to grey, regic sands and accommodates areas where deep, grey sands are dominant.

  - Land Type Ha32 occurs on young aeolian sands. Terrain units 1, 3, 4 and 5 are present and cover 30%:40%:15%:15% of the terrain respectively.

3.1.7 Land Cover

According to the 2022 land cover map of South Africa (SANLC) (DFFE, 2022), the western portion of the Port section running along the coast is covered predominantly by mine tailings and dumps with some patches of 'other bare areas' (Figure 8a). Further inland the Port section consists mostly of 'other bare areas' with a band of mine tailings and dumps running along the tar road R382. Only a small fraction of the Port section is covered by low shrubland of the Succulent Karoo. The Conservancy Area additionally contains the dry Visagiespan and an artificially flooded mine dam. The SEZ is dominated by mine tailings and dumps as well as other bare areas to the west of the tar road (R382), while to the east of the tar road, the land cover is primarily low succulent shrubland and other bare areas. Small areas of mine infrastructure, dry pans and coastal sand and dunes (mostly in the southwest) are also present in the SEZ section.

Comparing the 2022 land cover map to the 2020 and 2018 land cover maps (Figure 8a, 8b & 8c), the most prominent change is the increase in the area mapped as bare area and this has mostly been to the detriment of low succulent shrubland. This trend could probably largely be attributed to the severe drought conditions that the region had experienced since the early 2010s.

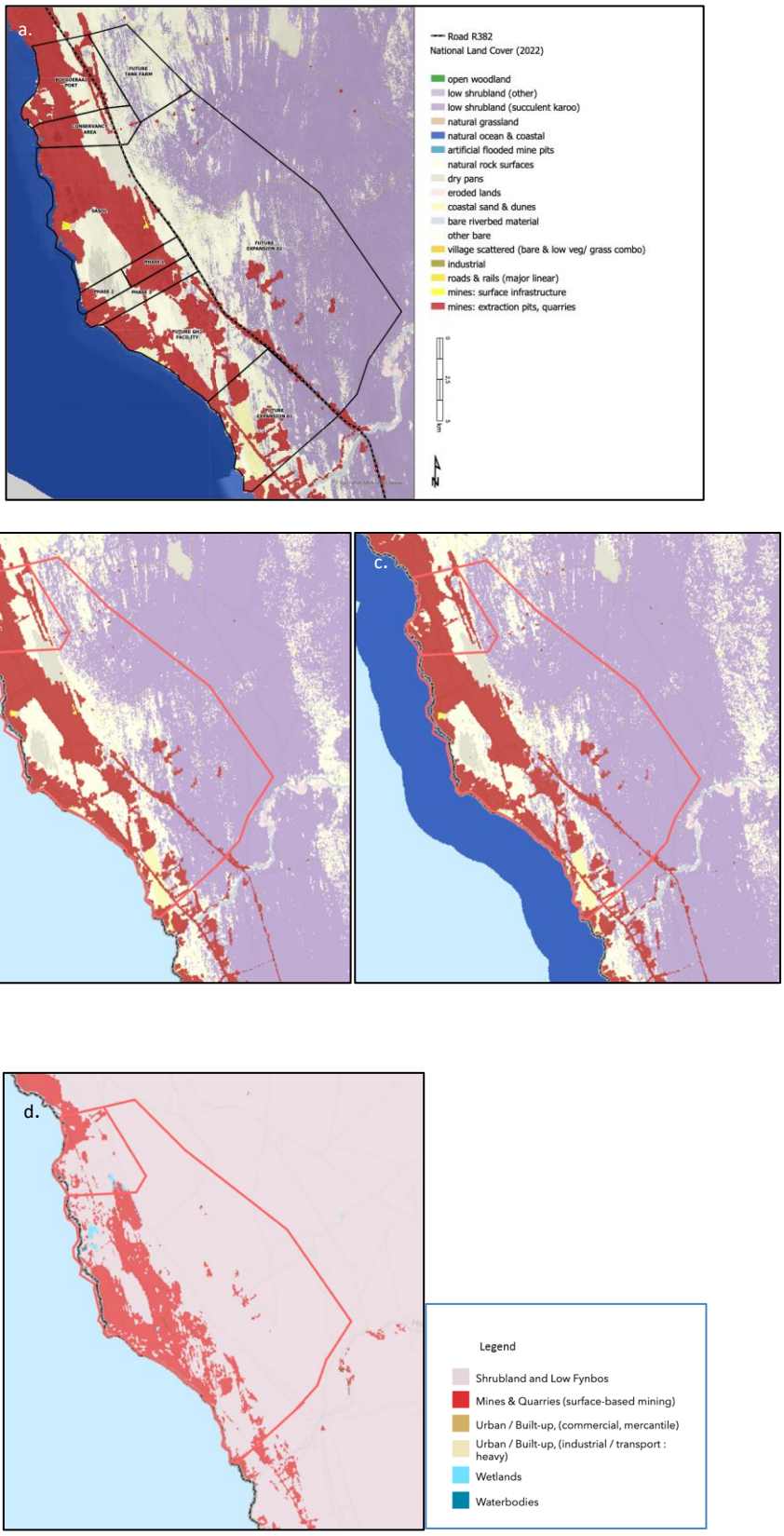

Figure 8: Land cover maps of the Boegoebaai Port and SEZ site of (a) 2022 (DFFE, 2022); (b) 2020; (c) 2018; and (d) 2000 (https://ndagis.nda.agric.za/).

The land cover map of 2000 (Figure 8d) used a different legend to the later versions. Although the areas classified as mines and quarries were somewhat smaller in 2000 than in 2018, 2020 and 2022, particularly in the Port Section, the most prominent change is that the entire area not affected by mining activities, was classified as low shrubland or fynbos with no bare areas identified. Furthermore, the pans/depressions were partly classified as wetlands.

3.2 Biodiversity attributes

3.2.1 Vegetation and flora

The study of the vegetation in South Africa has evolved over time and various authors have interpreted the vegetation in different ways. Vegetation maps of South Africa compiled in the nineteenth and early twentieth century were mostly of a phytogeographical nature with most geographers relying on descriptions of early explorers to compile their maps. The earliest maps were quite simple with more detail being added gradually. Many of these early phytogeographers agreed that the northwestern part of the country was part of the so-called Karroo, Karroo Region or Karroo Desert (Marloth, 1908) (note earlier spelling of Karoo). In a revised map Bolus (1905, in Marloth, 1908) termed it the 'Western Region', whereas Marloth (1908) labelled it 'Western Littoral'.

More detailed mapping of the vegetation types in South Africa started in the 1930s. Pole Evans (1936) produced the first vegetation map of South Africa in which he recognised 12 vegetation types in total. The study area is located in the so-called 'Succulent Desert Plants & Desert Grass' unit of Pole Evans (1936). In 1938, Adamson produced a vegetation map in which he recognised 14 vegetation types with the study area located in the so-called 'Coastal Succulent Bush' unit. Acocks's (1953) map of the Veld Types of South Africa was intended to depict the distribution of the agro-economic divisions of the vegetation in the country. He defined a veld type as a 'unit of vegetation whose range of variation is small enough to permit the whole of it to have the same farming potential'. According to Acocks (1953) the study area falls in the Strandveld of the West Coast as well as in the Succulent Karoo, whereas Low & Rebelo (1998) classified the study area as part of the Strandveld Succulent Karoo and the Lowland Succulent Karoo.

Phytogeographically, the study area lies in the Namaqualand-Karoo Domain as delineated by Lebrun (1947). Monod (1957) was the first to recognise the Karoo-Namib Region consisting of the Namaqualand, Karoo and Namib Domains, with the study area lying in the Namib Domain. Later phytogeographical studies by Volk (1966), Werger (1978) and White (1983) all recognised the Karoo-Namib Region, but differed in their delineation of the region. In 1983, White published his seminal work on the vegetation of Africa, which is currently accepted as the reference work on African phytogeography. According to White (1983), the study area is phytogeographically part of the Karoo-Namib Regional Centre of Endemism. In his phytogeographic sub-division of the Namib-Region, Jürgens (1991) recognised a Greater Cape Flora and a Palaeotropis (Palaeotropical Kingdom). The Boegoebaai site falls in the Succulent Karoo Region of the Greater Cape Flora.

The current mapping of the national vegetation types is an updated version (SANBI 2012-2024) of Mucina & Rutherford (2006). Descriptions of the national vegetation types appear in Mucina & Rutherford (2006).

3.2.2 Biomes

The study area includes two biomes, *viz*. the Desert and Succulent Karoo Biomes.

- *Desert Biome*

The Desert Biome in South Africa is defined on the basis of a mean annual rainfall of <80 mm and a sparse perennial vegetation cover of 10% and consists of a western and eastern section. The western section or Southern Namib Desert Bioregion is characterised by winter rainfall and a high incidence of fog, whereas the eastern section or Gariep Desert Bioregion is characterised by summer rainfall and the absence of fog. The Southern Namib Desert Bioregion shows floristic affinities and evolutionary links to the Succulent Karoo Biome and is part of the Greater Cape Floristic Region (Jürgens, 1991).

When compared to other deserts with the same level of aridity globally, the Desert Biome in South Africa is exceptionally rich in plant species and also hosts a large number of endemic plant species (Mucina & Rutherford, 2006).

The main land use in the Desert Biome is communal farming with severe degradation occurring around stockposts. Invasions by alien plant species is limited, with the most prominent species being *Neltumia glandulosa* (=*Prosopis glandulosa), Nicotiana glauca, Atriplex lindleyi* subsp. *inflata* and *Ricinus communis*. Mining has degraded large areas along the West Coast and along the Orange River, leaving scars that cannot be restored easily.

- *Succulent Karoo Biome*

The Succulent Karoo Biome in South Africa extends from the Desert Biome south of the Orange River through the western parts of the Northern Cape and Western Cape to the Little Karoo in the south. It is an arid region with a low winter rainfall (mean annual rainfall ranging from approximately 100 – 200 mm) with the percentage of summer rainfall gradually increasing eastwards. Fog is frequent in the coastal region. The incidence of frost increases with distance from the coast.

The Succulent Karoo is renowned for its unrivalled levels of diversity and endemism for an arid region (Cowling & Hillton-Taylor, 1999; Cowling *et al.*, 1999; Desmet & Cowling, 1999; Desmet, 2007). It is recognised by the International Union for Conservation of Nature (IUCN) as a global hotspot of diversity (CEPF, 2003; Mittermeier *et al*., 2000; Myers *et al.,* 2000), and one of only two hotspots that are entirely arid (https://www.cepf.net/our-work/biodiversity-hotspots). To qualify as a hotspot, it has to be shown that the area contains a high level of species diversity, a high percentage of endemic species and a substantial number of threatened or endangered species. Springtime mass flowering displays of annual plants draws thousands of tourists annually and is a valuable source of income to the region.

Most of the biome is used for livestock farming. Crop farming is limited due to the low rainfall and nutrient-poor soils. Severe overgrazing has led to widespread land degradation and a reduction in the overall species diversity (Jürgens *et al.*, in press; Le Maitre *et al.*, 2009; Mucina & Rutherford 2006; Walker *et al.,* 2018;). Due to the harsh environment in the Succulent Karoo, a limited number of alien invasive plant species (AIPS) occur. The most prominent AIPS are *Arundo donax*, *Atriplex lindleyi* subsp*. inflata*, *Atriplex nummularia*, *Nerium oleander*, *Cenchrus setaceus (=Pennisetum setaceum)*, *Neltumia glandulosa* (=*Prosopis glandulosa)* and *Tamarix ramosissima* (Milton *et al.*, 1999; Mucina & Rutherford, 2006; Van Wilgen *et al.,* 2008).

Mining for diamonds along the West Coast has irreversibly transformed some landscapes because ecological restoration is extremely challenging in this arid region (Desmet, 1996). Conservation efforts in the Succulent Karoo are furthermore threatened by illegal harvesting of plants for the medicinal and horticultural trades. Furthermore, climate change has been identified as a significant threat to the region because of the high levels of biodiversity and the dependence of the population on natural resources, livestock production and dryland agriculture (Davis *et al.,* 2016; Rutherford *et al.,* 2000; Walker *et al*., 2018). A study by Broennimann *et al*. (2006) found that geophytes and succulents, which make up over half of the plant species in Namaqualand, were particularly vulnerable to climate change.

3.2.3 National Vegetation Types and their threatened status

Five National Vegetation Types are represented in the study area, belonging to two different biomes and an Azonal Coastal Vegetation Type (Mucina & Rutherford, 2006 as revised by SANBI in 2024) (Figure 9).

- Succulent Karoo Biome:
  - Richtersveld Coastal Duneveld (SKs 1)
  - Northern Richtersveld Yellow Duneveld (SKs 2)
  - Richtersveld Sandy Coastal Scorpionstailveld (SKs 4)
- Desert Biome:
  - Western Gariep Plains Desert (Dn 3)

- Azonal Coastal Vegetation Type:
  - Namib Seashore Vegetation (AZd 1)

Richtersveld Coastal Duneveld (SKs 1)

This vegetation type occurs as a belt of 1–12 km broad along the Atlantic coast from approximately Alexander Bay to halfway between Port Nolloth and Kleinzee. In the Port and SEZ site this vegetation type is underlain by the Holgat Formation of the Gariep Supergroup which is covered with wind-blown, white sands (Mucina & Rutherford, 2006). The landscape is generally flat. The various habitat types are defined primarily by the depth of the soil and the presence of a soil crust (Mucina & Rutherford, 2006).

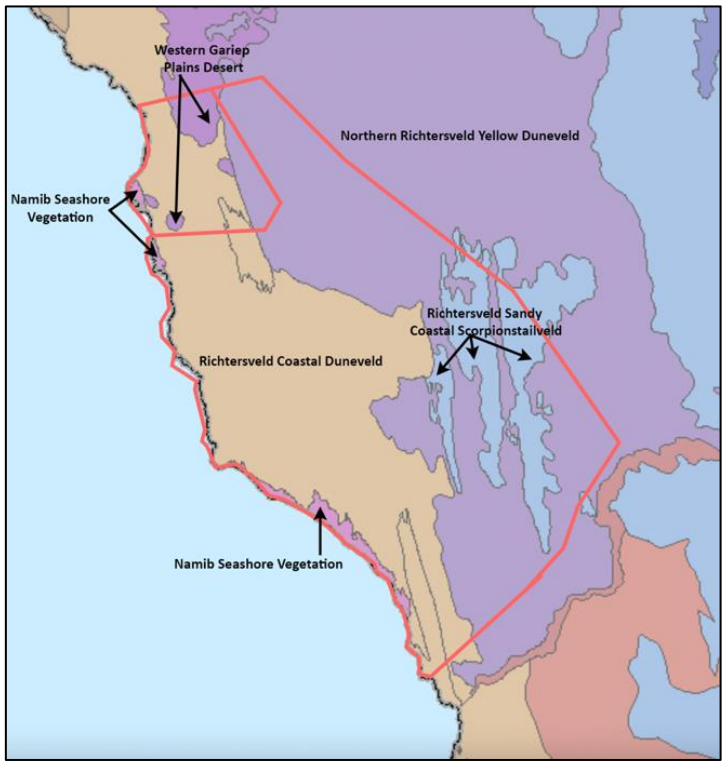

Figure 9: National Vegetation Types in the Boegoebaai Port and SEZ site (Mucina & Rutherford, 2006 as revised by SANBI in 2024).

The dominant succulent shrub species are *Cephalophyllum ebracteatum* (VU), *Euphorbia mauritanica, Crassothonna sedifolia, Salsola nollothensis* and *Roepera morgsana.* Other noteworthy succulents include *Amphibolia rupis-arcuatae, Drosanthemum luederitzii, Euphorbia caput-medusae, Jordaaniella cuprea, Lampranthus stipulaceus, Manochlamys albicans, Stoeberia utilis* and *Roepera cordifolia*. Non-succulent shrubs include *Asparagus capensis, Atriplex vestita* and *Pteronia glabrata* and herbs are represented by *Grielum grandiflorum, Mesembryanthemum dinteri* and *Fenestraria rhopalophylla*. The most prominent graminoids are *Cladoraphis cyperoides, Chaetobromus involucratus* and *Stipagrostis ciliata*. Biogeographically important taxa include the Namaqualand endemics *Stoeberia beetzii* and *Arctotis decurrens*, whereas *Amphibolia succulenta* (NT) is a Richtersveld endemic species.

The Richtersveld Coastal Duneveld has a **Critically Endangered** status with a conservation target of 26%. It is currently poorly protected.

Northern Richtersveld Yellow Duneveld (SKs 2)

This vegetation unit occupies the land 5–25 km from the coast from southern Namibia to the Holgat River. These yellow, wind-blown sands are older than the white dune sands closer to the ocean. The more-or-less south-north orientated dune ridges and accompanying valley systems of the ancient dune fields are still

partly visible, but erosion and sedimentation have shaped a landscape of relatively saline valleys with silty or loamy soil. Heuweltjies may be present in this vegetation type (Mucina & Rutherford, 2006).

The Northern Richtersveld Yellow Duneveld is a diverse vegetation unit. The dominant succulent shrub species are *Euphorbia burmannii, Euphorbia rhombifolia, Euphorbia mauritanica, Crassothonna cylindrica* and associated species such as *Cephalophyllum ebracteatum* (VU)*, Cheiridopsis robusta, Didelta carnosa, Jordaaniella cuprea, Lampranthus stipulaceus, Salsola tuberculata* and *Roepera morgsana*. Low shrubs include *Asparagus capensis, Calobota cinerea* and *Calobota angustifolia* and herbs are represented by *Grielum humifusum, Oncosiphon piluliferum* and *Mesembryanthemum schlichtianum*. The most prominent graminoid is *Cladoraphis cyperoides*. Biogeographically important taxa include the Namaqualand endemic *Mesembryanthemum decurvatum*, while *Amphibolia succulenta* (NT) is a Richtersveld endemic and *Mesembryanthemum pseudoschlichtianum, Mesembryanthemum pellitum* and *Eberlanzia sedoides* are Gariep endemic species.

The Northern Richtersveld Yellow Duneveld has a **Least Concern** status with a conservation target of 26%. The vegetation type is not protected.

Richtersveld Sandy Coastal Scorpionstailveld (SKs 4)

Within the Port and SEZ study site, SKs 4 occurs in the southeastern corner as three north-south trending bands. The unit is clearly visible on satellite images due to the darker colour caused by the biological soil surface crusts (Mucina & Rutherford, 2006). Habitat variability is largely a function of soil type and vegetation age, which are controlled by the proportion of wind-blown sand as well as severity of grazing. Soils are sandy loams partly covered by yellow and red wind-blown sands which are in turn covered by a well-developed soil crust.

The dominant succulent shrub species are *Mesembryanthemum pseudoschlichtianum, Cephalophyllum ebracteatum* (VU), *Stoeberia beetzii* and *Crassothonna cylindrica* with associated species such as *Mesembryanthemum serotinum, Cheiridopsis robusta, Euphorbia burmannii, Euphorbia rhombifolia, Euphorbia mauritanica* and *Roepera morgsana*. Low shrubs are represented by *Calobota angustifolia* and *Asparagus capensis* and herbs include *Oncosiphon piluliferum* and *Trachyandra falcata*. The most prominent graminoid is *Cladoraphis cyperoides.* Overall, prominent species in the Richtersveld Sandy Coastal Scorpionstainveld agree well with the prominent species in the Northern Richtersveld Yellow Duneveld. The old, stabilised vegetation is dominated by *Mesembryanthemum pseudoschlichtianum* (locally known as groot skerpioenbos)*, Crassothonna cylindrica, Stoeberia beetzii, Cephalophyllum ebracteatum* (VU)*, Calobota angustifolia* and *Mesembryanthemum decurvatum.* Biogeographically important taxa include the Namaqualand endemics *Mesembryanthemum decurvatum, Mesembryanthemum pellitum* and *Stoeberia beetzii,* while *Eberlanzia ebracteate* and *Mesembryanthemum pseudoschlichtianum* are Gariep endemic species.

The Richtersveld Sandy Coastal Scorpionstailveld (SKs 4) has a **Least Concern** status with a conservation target of 26%. The vegetation type is represented in the Richtersveld Cultural and Botanical Heritage Landscape.

Western Gariep Plains Desert (Dn 3)

This vegetation types occurs predominantly in the northeastern Port section, with a few other small patches. The landscape is dominated by plains with undulating hills and rocky outcrops, the most notable of which are the Boegoeberg Twins with steep rocky slopes. The underlying rocks in this unit are mainly metasediments and metavolcanics of the Gariep Supergroup which are covered with young surficial deposits. The rocks consist of quartz-feldspar, gneiss, schist, subordinate amphibolite and minor ultramafic rock (Mucina & Rutherford, 2006).

The dominant succulent shrubs are *Mesembryanthemum marlothii, Cephalophyllum ebracteatum* (VU)*, Othonna lasiocarpa, Crassothonna sedifolia, Stoeberia beetzii, Mesembryanthemum dinteri, Amphibolia rupis-arcuatae, Cheiridopsis brownii* (EN), *Conophytum saxetanum* (EN)*, Crassula deceptor, Dracophilus dealbatus* (CR)*, Drosanthemum luederitzii, Euphorbia stapelioides, Euphorbia caput-medusae, Monsonia patersonii* (VU)*, Psammophora modesta* (VU)*, Pteronia glabrata* and *Tylecodon schaeferianus* (VU). Low shrubs include *Asparagus capensis, Hermannia gariepina* and *Lycium decumbens*. Herbs are represented by *Pelargonium sibthorpiifolium* (CR) and the most prominent graminoid is *Cladoraphis cyperoides.*

The Western Gariep Plains Desert is not statutorily protected. It has a **Least Concern** status with a conservation target of 28%. However, the threatened status of the Richtersveld Vegetation Types are currently being re-assessed. The current **Least Concern** status for the Western Gariep Plains Desert is inadequate and it is likely that it will be upgraded by the responsible authority.

Namib Seashore Vegetation (AZd 1)

This vegetation type is located along the coast between the Orange River mouth and the Holgat River. The beaches are slightly sloping and bordered by mobile as well as fixed sand dunes. Both beaches and dunes are formed by recent, marine, sandy sediments. The dominant succulent shrubs are *Lycium tetrandrum* and *Tetragonia fruticosa* together with *Didelta carnosa* and *Roepera clavata*. Low shrubs include *Asparagus capensis* and *Hebenstretia cordata* and the most prominent graminoid is *Cladoraphis cyperoides*. Biogeographically important taxa in this unit are the West Coast endemics *Salsola nollothensis, Amphibolia rupis-arcuatae, Arctotis decurrens, Drosanthemum luederitzii, Kewa angrae-pequenae* and *Fenestraria rhopalophylla*, whereas *Lycium decumbens* and *Mesembryanthemum marlothii* are Gariep endemic species.

The Namib Seashore Vegetation has a **Critically Endangered** status with a conservation target of 26%. It is not protected and almost totally transformed by mining.

3.2.4 Centres of Endemism

The Boegoebaai Port and SEZ site falls within the Gariep Centre of Endemism as defined by Van Wyk and Smith (2001). This centre of endemism is a combination of two quite distinct climatic, biogeographic and evolutionary units (Jürgens, 1991, Jürgens *et al.,* 1997; Mucina & Rutherford, 2006). Jürgens (1991, 1997) studied the distribution ranges of a very large number of species and proposed to split the Gariep Centre of Endemism into 'East Gariep Centre' for the palaeotropical summer rainfall elements in the east and a 'West Gariep Centre' for the Greater Cape winter rainfall elements, incidence of fog and floristic affinities with the Succulent Karoo Biome. The study area lies in the western section of the Gariep Centre of Endemism that is characterised by a winter rainfall, the incidence of fog and floristic affinities with the Succulent Karoo Biome. This western section is part of the Southern Namib Desert Bioregion (part of the Namib Desert) as opposed to the eastern part that belongs to the Gariep Desert Bioregion (part of the Gariep Desert) (Mucina & Rutherford, 2006).

At a lower hierarchical level within the West Gariep Centre, a "Western Gariep Circle" has been identified as a local centre of endemism stretching from Alexander Bay to Sendelingsdrift/Lorelei. Several SCC on site are endemic to South Africa, although a large proportion of SCC are distributed from southern Namibia into the northwestern Richtersveld.

3.2.5 Flora

A provisional checklist of the Boegoebaai Port and SEZ site appears in Appendix A. This provisional checklist contains 390 plant species that have been confirmed occurring on site from data collected by P. van Wyk, the current site visit in 2024, iNaturalist; the SANBI NewPosa website and data supplied by SANBI (2024). According to SANBI's (SANBI, 2020) definition of Species of Conservation Concern (SCC), these are species that have a high conservation importance in terms of preserving South Africa's high floristic and faunal diversity and include not only threatened species, but also those classified as Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining, Data Deficient - Insufficient Information (DDD) and Data Deficient – Taxonomic (DDT) (www.redlist.SANBI.org). The confirmed on-site checklist includes eight species with a Critically Endangered IUCN status (2.0% of all species confirmed for the site); nine species classified as Endangered (2.3% of all species); 15 species as Vulnerable (3.8% of all species); seven species as Near Threatened (1.8% of all species); six species as Data Deficient (1.5% of all species); and one species as Rare (0.3% of all species). Thus, in total 46 species are classified as SCC representing 11.8% of all species confirmed for the site. Twenty one species that fall within the Boegoebaai and associated infrastructure development footprint are currently listed as Least Concern, but could potentially become SCC should the Boegoebaai development proceed. Moreover, 163 Northern Cape provincially protected or specially protected and 20 CITES-listed species were also recorded on site.

Considering the limited access to the mining area to the west of the R382, the on-site checklist probably does not represent a full inventory of plant species occurring on site. The species list by Desmet (1996) comprises a list of species recorded in an approximately 10 km strip along the coast from Port Nolloth to Alexander Bay. Although Desmet's study area included a large portion of habitat that could be regarded as similar to the Boegoebaai site, it does include several additional habitats and vegetation types not present on the Boegoebaai site. Nevertheless, some additional species on Desmet's list (1996) could potentially also occur on site should small pockets of similar habitat be present (no coordinates were provided to check for species on site).

The impacts of such a large development such as the Boegoebaai Port and SEZ will generally not be limited to the site but will be more widespread and land adjoining the site will likely also be affected. The second list by P. van Wyk in Appendix A was compiled after the first preliminary location of the project became available. This preliminary layout stretched to Kortdoorn and Grootderm along the Orange River, an area in the Richtersveld with a particularly high concentration of SCC. This list of Van Wyk adds 29 SCC (some also listed by Desmet (1996)) that are at present not listed for the site as currently delineated. Although habitats closer to the Orange River differ from those on the current site, these areas could be targeted by plant poaching activities due to increased human activities as a result of the development.

Aliens were not common on site. The only alien species recorded for the site were *Atriplex lindleyi* subsp. *inflata*, *Nicotiana glauca* and *Opuntia ficus-indica*.

3.2.6 Critical Biodiversity areas (CBAs), Ecological Support Areas (ESAs), Other Natural Areas (ONAs)

Critical Biodiversity Areas (CBAs) are areas required to meet biodiversity targets for ecosystems, species or ecological processes. CBAs are regarded as areas of high biodiversity and ecological value and need to be kept in a natural or near-natural state, with no further loss of habitat or species to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. The definitions for CBAs are (SANBI, 2018):

- CBA 1: Areas that are irreplaceable for meeting biodiversity targets. There are no other options for conserving the ecosystems, species or ecological processes in these areas.
- CBA 2: Areas that are the best option for meeting biodiversity targets, in the smallest area, while avoiding conflict with other land uses.

Permissible land uses within Critical Biodiversity Areas are those that are compatible with maintaining the natural vegetation cover of CBAs in a healthy ecological state, and that do not result in loss or degradation of natural habitat (Pool-Stanvliet *et al*., 2017). In general, undesirable land uses in terrestrial CBAs are those that cause a loss of natural habitat or ecosystem functionality, such as: (i) industrial, commercial or residential developments; (ii) mining or prospecting; (iii) linear infrastructure that disrupts the connectivity of CBA corridors; and (iv) extensive or intensive grazing that results in species diversity being lost through selective grazing or over-grazing. In the Northern Cape incompatible land-uses in CBAs include business areas, mixed-use development areas, industrial development zones and the extractive industry (Oosthuyzen & Geldenhuys, 2024). It is thus clear that the Boegoebaai development constitutes an undesirable land use that would not be permissible in a CBA.

An Ecological Support Area (ESA) is not essential for meeting biodiversity targets, but plays an important role in supporting the ecological functioning in a CBA. ESAs need to be maintained in at least a functional and often natural state, but some limited habitat loss may be acceptable. Other Natural Areas (ONAs) have not been identified as a priority and retain most of their natural character and perform a range of biodiversity and ecological functions. Other Natural Areas (ONAs) are not required to meet biodiversity targets.

In the 2016 version of the Northern Cape CBA map, almost the entire Port and SEZ sections not affected by mining has been classified as CBA, either CBA 1 or CBA 2, with a single small ESA and ONA occurring near the southern boundary of the site along the tar road (Figure 10). All areas that have been transformed by mining were not classified.

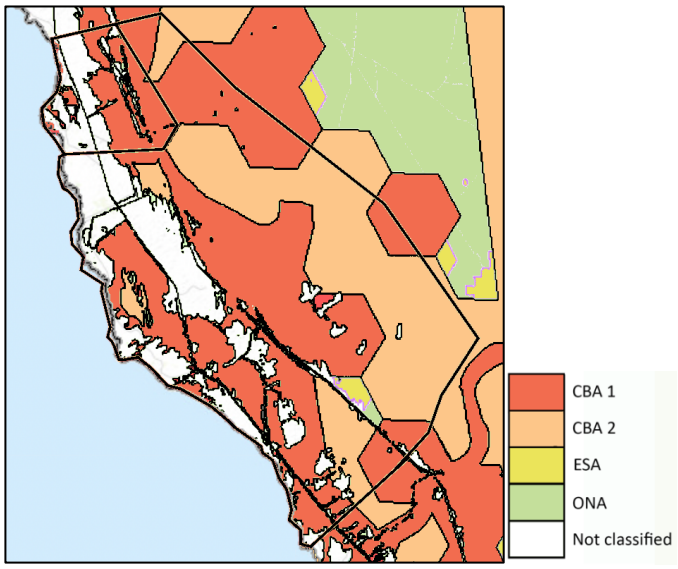

Figure 10: 2016 Northern Cape Critical Biodiversity Area map of the Boegoebaai Port and SEZ site.

3.2.7 Protected Areas and National Protected Area Expansion Strategy

The study site is not part of a protected area (https://egis.environment.gov.za/data_egis/data SAPAD_IR_2024_Q2_01) (Figure 11). The closest protected area to the site is the Richtersveld Cultural & Botanical Landscape, which has a Natural Heritage Site status declared in terms of the World Heritage Convention Act.

To the north of the site lie the Orange River Mouth Nature Reserve and the Orange River Mouth Wetland, the latter is classified as a Ramsar Site (https://rsis.ramsar.org/ris/526).

Although the Port section has not been included in the Protected Areas Expansion Strategy, a substantial portion of the SEZ has been included as Focus Areas in the National Protected Areas Expansion Strategy (NPAES, 2018) (Figure 12).

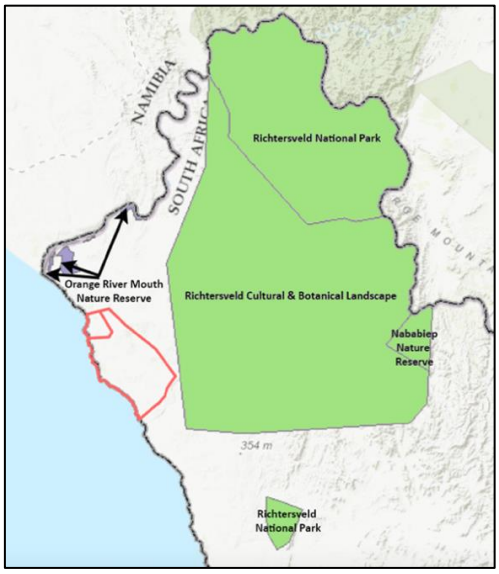

Figure 11: Protected Area map in the environs of the Boegoebaai Port and SEZ (https://ndagis.nda.agric.za/).

Figure 12: National Protected Areas Expansion Strategy around the Boegoebaai Port and SEZ (NPAES, 2018).

3.2.8 Key Biodiversity Areas

The Key Biodiversity Area (KBA) Partnership (https://www.keybiodiversityareas.org/about-kbas) strives to prevent the rapid loss of biodiversity by supporting nationally led efforts to identify KBAs that are of global importance for the maintenance of biodiversity (KBA, 2024). The KBA Programme assists in identifying, mapping, monitoring and conserving these areas. It also provides background information on the biodiversity to assist governments and other stakeholders in decision-making on where to avoid development and how best to manage the land. A site qualifies as a global KBA if it meets one or more of 11 internationally agreed scientific criteria relating to (i) threatened biodiversity, (ii) geographically restricted biodiversity, (iii) ecological integrity, (iv) biological processes, and (v) irreplaceability.

The Boegoebaai Port and SEZ site is located in the Namaqualand Sandveld North KBA (Figure 13), which is a flat to slightly undulating coastal peneplain. The area is not protected but the site is managed primarily by a regional conservation authority responsible for enforcing statutory regulations. The species-rich vegetation is dominated by succulent dwarf shrubs as well as non-succulent dwarf shrubs or shrubs. The Namaqualand Sandveld North KBA met 10 criteria (A1a[1], A1b, A1d, A2, B1, B2, B3a, B4, D1a and E) to qualify as KBA.

The rationale for qualifying as KBA was set out as follows: *'Based on current available information, 45 species meet one or more KBA criteria for this site. The KBA trigger species at this site include amphibians, birds, butterflies, mammals, plants and reptiles. The site meets criterion A1 due to the presence of significant proportions of the global populations of 11 threatened species. The site regularly holds 35 individual geographically restricted species, therefore meeting criterion B1. Assemblages of co-occurring range-restricted species in the Amphibia, Caryophyllales, Reptilia, and Saxifragales taxonomic groups regularly present within the site meet criterion B2. An aggregation of at least 1% of the global population of one species is regularly present at the site, therefore it meets criterion D1. A quantitative analysis of irreplaceability indicates that the site is 100% irreplaceable for the global persistence of 9*

[1] A1a: ≥0.5% of the global population size AND ≥5 reproductive units of a CR or EN species; A1b: ≥1% of the global population size AND ≥10 reproductive units of a VU species; A1d; ≥0.2% of the global population size AND ≥10 reproductive units of a species assessed as VU due only to population size reduction in the past or present; A2; hold a significant proportion of the global extent of an ecosystem type facing a high risk of collapse; B1: Site regularly holds ≥10% of the global population size AND ≥10 reproductive units of a species; B2: Site regularly holds ≥1% of the global population size of each of a number of restricted-range species in a taxonomic group, determined as either ≥2 species OR 0.02% of the global number of species in the taxonomic group, whichever is larger; B3a: ≥0.5% of the global population size of each of a number of ecoregion-restricted species within a taxonomic group, determined as either ≥5 species OR 10% of the species restricted to the ecoregion, whichever is larger; B4: Site holds ≥20% of the global extent of an ecosystem type; D1a: An aggregation representing ≥1% of the global population size of a species, over a season, and during one or more key stages of its life cycle; E: Site has a level of irreplaceability of ≥0.90 (on a 0–1 scale), measured by quantitative spatial analysis, and is characterised by the regular presence of species with ≥10 reproductive units known to occur (or ≥ 5 units for EN or CR species).

species, therefore meeting criterion E. The site holds significant proportions of the global extent of 3 threatened ecosystems (meeting criterion A2) and 7 geographically restricted ecosystems (meeting criterion B4)'.

Additionally, 80 more potential trigger species meet minimum population parameter thresholds, but presence and/or minimum reproductive units required to meet KBA criteria cannot be confirmed with the available data.

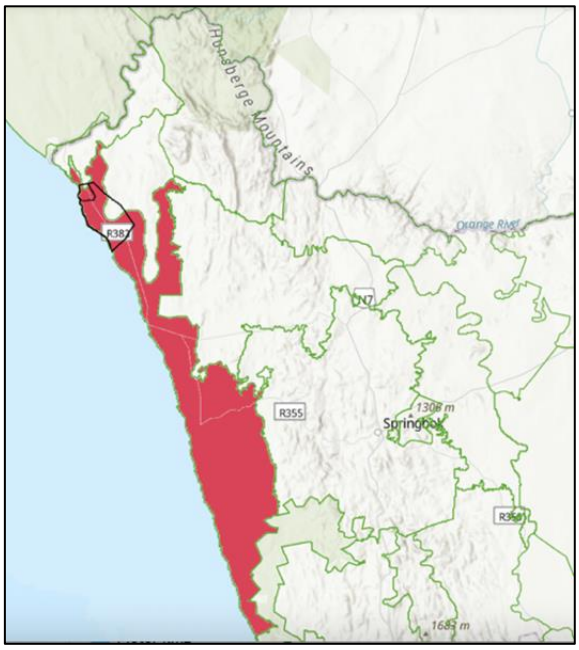

Figure 13: Location of the Namaqualand Sandveld North Key Biodiversity Area (https://www.keybiodiversityareas.org).

3.2.9 Areas with high concentrations of threatened species

Over the past years the South African National Biodiversity Institute (SANBI) has been re-evaluating the red list status of the flora from the region and produced a map depicting areas within the Richtersveld with a high concentration of threatened species (Van Wyk, 2024; Figure 14). Two areas with a high concentration of threatened species occur on site corresponding to the Boegoeberg Twins and Visagiesfonteinkop.

Most of the areas with a concentration of threatened species occur further north of the site in the environs of the Orange River at Kortdoorn and Grootderm (Figure 14). No indication has been given as to where employees for the green hydrogen project would be accommodated. Should accommodation be provided in Alexander Bay, this would encroach on the areas with a high concentration of threatened species. The influx of people to the broader region will increase the level of air pollution from road traffic and the region will likely experience increased pressure of illegal harvesting of plants for the medicinal and horticultural trades.

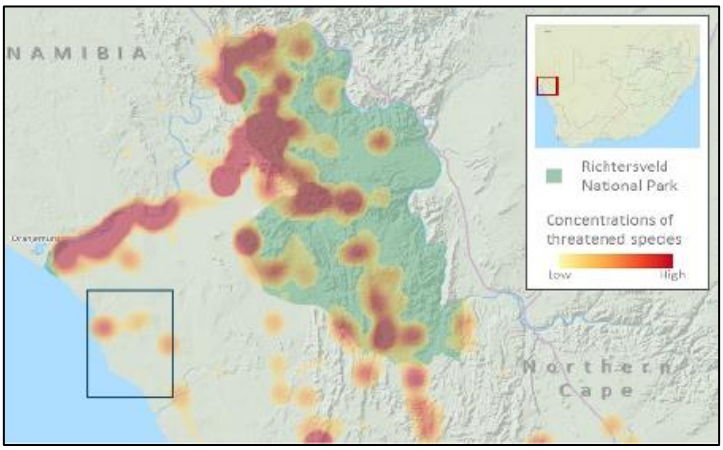

Figure 14: Map indicating areas with a concentration of threatened species in the Richtersveld with the Boegoebaai Port and SEZ shown as a rectangle (source: Van Wyk, 2024).

3.2.10 Lichen fields

Approximately 13 km to the north of the Boegoebaai Port and SEZ site, lies a Critically Endangered vegetation type, the Namib Lichen Fields. This small unit, covering less than 80 ha represents a globally unique habitat and has been proclaimed as a Natural Heritage Site. Compared to the lichen fields in Namibia, the fields near Alexander Bay, the only in South Africa, have a higher diversity as well as higher biomass of lichens. These lichen fields thus merit a very high conservation status (Jürgens & Niebel, 1991; Jürgens & Niebel-Lohmann, 1995).

Several environmental elements can be detrimental to lichens e.g. mobile sands (Jürgens & Niebel, 1991; Jürgens & Niebel-Lohmann, 1995); as well as dust and air pollution produced by road traffic. Most species live for decades and because they take up water and nutrients directly from the atmosphere they are exposed to the cumulative effects of pollutants (Nash, 2008). The Boegoebaai development is likely to exacerbate the negative effects of pollution and mobile sand.

3.2.11 Sensitive areas as indicated by local knowledge

The following localities (Figures 15 & 16) were identified as sensitive for the reasons provided below:

- It is critical that the **Boegoeberg Twins**, are fully conserved in the Conservation Area (No 1, Figure 15a). According to the current delineation of the Conservation Area, Boegoeberg North is not entirely included. These two mountains host many threatened higher plant taxa and the lichen richness is exceptional (Van Wyk, 2024). Lichens are sensitive to air pollution and with the predominant southerly winds, air pollution coming from the SEZ may negatively impact the lichens on the Boegoeberg Twins. Boegoeberg South has already been severely impacted by the mining with a road that was built to erect telecommunication towers and sand that has accumulated onto the northern slopes. The green zone in Figure 15a should not be considered for development, as it will have detrimental negative impacts on areas of **High** sensitivity (Van Wyk, 2024).

- **Namakwakop** (No 2, Figure 15a) is a small hill with a lower species richness than the Boegoeberg Twins, but shares some species with them.

- **The coastline north of Collins Jetty** (no 3, Figure 15), is the most sensitive section of shoreline from both a biodiversity and heritage point of view. It includes rocky sections containing the highest concentration of Sensitive species 305 **(CR)** within the species' distribution range. It also includes sections of the **CR** Namib Seashore Vegetation. Furthermore, it is home to a breeding population of the Cape fur seal, a protected species.

- **Visagiesfonteinkop** (No 4, Figure 15b) is the highest point in the study area and is located to the east of the tar road (R382). It is an important habitat for desert rain frogs, *Breviceps macrops* (VU). It is also habitat to an undescribed species of *Pelargonium;* a new species of *Crassula*; important populations of *Ruschia pallens;* Sensitive species 720 (VU); *Ceropegia pulvinata (=Stapelia pulvinata);* Sensitive species 734 (VU); unique lichen flora, with several species not found on the Boegoeberg Twins nor in the Alexander Bay lichen fields. Visagiesfonteinkop is also home to unique insects that have not been recorded elsewhere on the coastal plains.

- The **Rooibank** (No 5b) **& Swartbank Heuweltjies** (No 5a) (Figure 15b) represent, the Richtersveld Sandy Coastal Scorpionstailveld where heuweltjies abound. Heuweltjies are associated with termites and evidence has been provided that some of the termite nests at the Buffels River in Namaqualand, have been occupied for up to 34 000 years (Francis *et al*., 2024) making these the oldest active termite features ever dated. Termites are ecosystem engineers creating nutrient rich loamy soil, which is favourable habitat for certain plant species.

- A large colony of **Brant's Whistling Rats** (*Parotomys brantsii*) (No 6, Figure 15b) was found on the SEZ site. Although these rats to do not alter species richness, they do reduce the vegetation cover. Their presence is often associated with an increase in reptile, raptor and small predator species.

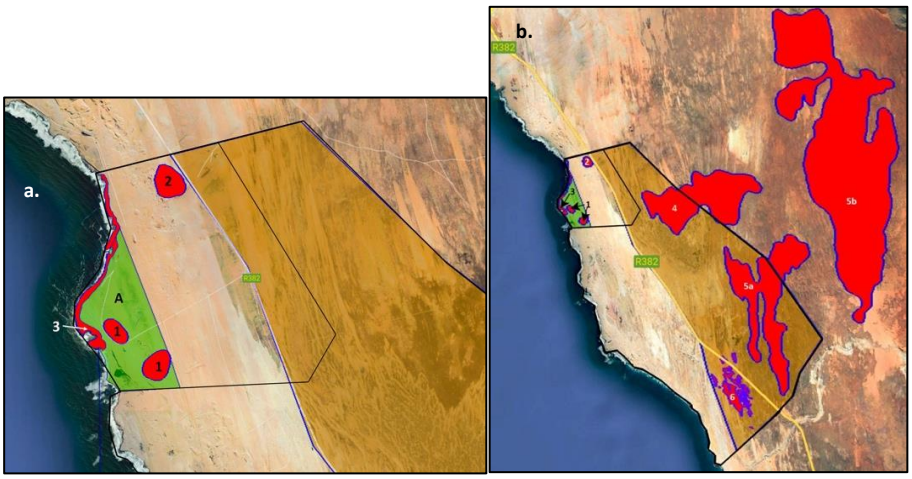

Figure 15: (a) Detail of the Port facility showing areas of **High** sensitivity as indicated by local knowledge; and (b) Areas of **High** sensitivity in the Boegoebaai Port and SEZ site. 1 = Boegoeberg Twins; 2 = Namakwakop; 3 = Rocky coastline; 4 = Visagiesfonteinkop; 5a = Swartbank heuweltjies; 5b = Rooibank heuweltjies; 6 = Brant's whistling rat colonies. Green zone (A) should not be considered for development (source: Van Wyk, 2024).

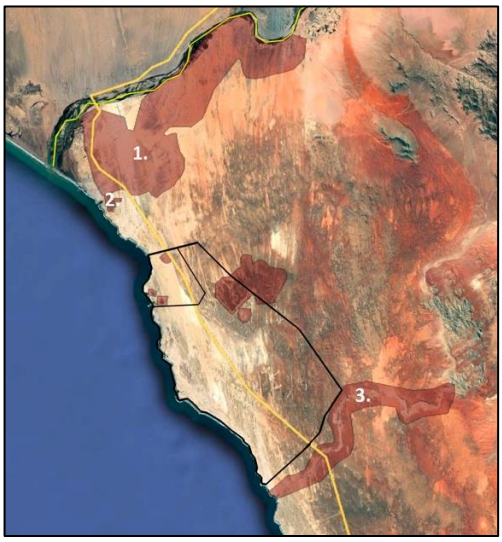

Figure 16: Some additional sensitive areas in the environs of the site. 1. Pagvlei, Grootderm and Brandkaros; 2. outcrops near Alexander Bay; and 3. Holgat River.

In Figure 16, some additional sensitive areas in the environs of the site are indicated e.g. Pagvlei, Grootderm and Brandkaros (no 1, Figure 16); some outcrops near Alexander Bay (no 2, Figure 16); and the lower course of the Holgat River (no 3, Figure 16). The area around Pagvlei, Grootderm and Brandkaros corresponds largely to one of the areas with a concentration of threatened species in the Richtersveld areas (Section 3.2.9, Figure 14).

3.2.12 Areas with a Low sensitivity

Habitats with a Low sensitivity (Van Wyk, 2024) are mainly as a result of past and present mining impacts, although some areas have a low sensitivity due to overgrazing. There are large areas where no more than 10 plant species occur, of which none has a threatened status. These areas trigger no environmental conservation concerns and could be chosen for future development (Figure 17) (see SEA Workpackage 2).

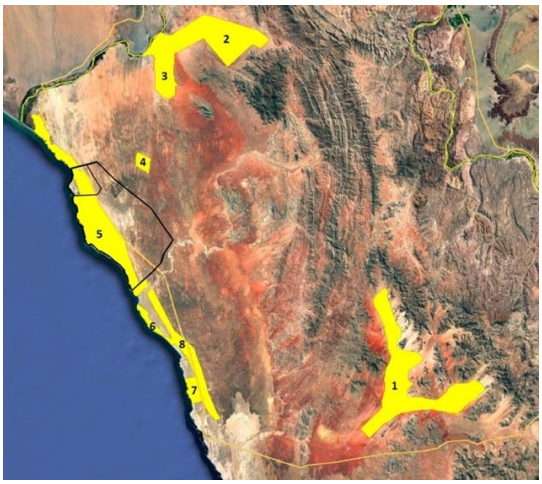

Figure 17: Areas of **Low** sensitivity in the environs of the Boegoebaai Port and SEZ site. 1. Grasvlakte; 2. Anniesvlakte; 3. Skilpadsand; 4. Witbank Expansion; 5. Phase 1 Development area 1; 6. Transformed coastal area south of site 1; 7. Transformed coastal area south of the proposed site; and 8. Transformed inland area south of site (Van Wyk, 2024).

3.2.13 Development proposals that have been approved for the site

There are currently two approved development proposals within the Boegoeberg Port and SEZ site (green boundaries in Figure 18) and another prospecting proposal has been submitted (light blue line in Figure 18):

- The 225 MW Richtersveld Wind Energy Facility (dark blue line in Figure 18); and
- The Namakwa Prospecting proposal (green line in Figure 18) to establish the presence of economic deposits of heavy minerals by non-invasive and invasive prospecting over a period of five years.

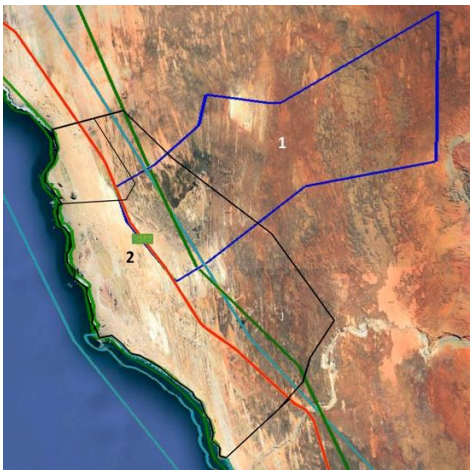

Figure 18: Location of the approved Richtersveld Wind Energy Facility (1) and the prospecting proposal (2).

3.2.14 Current land use

The main land uses in the region are mining and livestock farming. The Boegoebaai Port and SEZ land is owned by the Richtersveld Sida !Hub Community Property Association (CPA) (MDT, 2018). Alexkor SOC Limited (Alexkor) and the Richtersveld Mining Company (Pty) Ltd have formed a Pooling and Sharing Joint Venture (PSJV) to oversee mining activities relating to Alexkor's mining rights. The PSJV outsources most of the marine prospecting and mining operations to contractors.

Currently, mine dust/sand due primarily to soil disturbance by past diamond mining activities probably poses the greatest environmental threat to the natural environment both in the mining area and on adjacent land. The dust/sand plume development can be ascribed to prevailing winds and sand supply as well as coast line form. Early in this century a distinction could still be made between natural coastal sand plumes and mining-induced plumes, however, at present this distinction is lost and natural and mine-induced plumes have merged. A major cause for concern is the sand dune threatening Boegoeberg South.

Severe overgrazing in many areas of the Richtersveld has led to widespread land degradation and a reduction in the overall species diversity. Signs of overgrazing are particularly noticeable around stockposts. Some vegetation types are more vulnerable than others to overgrazing with heuweltjieveld being one of the vulnerable types. In recent years, the illegal collection of plants or plant poaching has escalated and has become a serious threat to many threatened succulent plant species in the Aizoaceae, Anacampserotaceae and Crassulaceae.

In a recent publication by Jürgens *et al.* (in press) the observed vegetation degradation in the Richtersveld (as well as in the current assessment area) was interpreted as a combination of anthropogenic causes and climate change. Jürgens *et al*. (in press) presented a conceptual model of how the vegetation in the coastal region of the Richtersveld is degraded by the anthropogenic impacts of farming (e.g. overgrazing), mining and roads. These human activities all degrade or reduce the vegetation cover and thereby trigger either the erosion of silt or the mobilisation of aeolian sand which is associated with sand abrasion and the

development of sand plumes. In the original vegetation state the silty soils are stable and often covered by a biological surface crust. Long-term heavy grazing, trampling, drought and sandblasting causes the development of an entirely new vegetation state composed of a different complement of species. There is thus a retrogression from a species-rich, stable and productive Succulent Karoo vegetation state to a species-poor, unstable and less productive grassy Desert vegetation state.

3.2.15 Ecosystem processes

The Boegoebaai Port and SEZ site lies in a hyper-arid region and years with below average annual rainfall are a common occurrence. Terrestrial ecosystems in the study area are subject to high wind speeds that result in severe aeolian erosion, transport and sedimentation (Jürgens *et al.,* in press). These processes have been exacerbated by the extreme transformation of the land by mining as well as overgrazing. The destructive action of the wind is particularly prominent in areas where the vegetation has been degraded and is sparse (Desmet, 1996). The sandblasting reduces photosynthetic activity and affects plant reproduction with young plants being particularly vulnerable. Eventually the vegetation becomes buried under the aeolian sand.

It is critical that the trajectories of sand and dust transport as well as air pollution from the proposed development is modelled. Mitigation measures to stabilise the sand before it impacts on priority ecosystems (e.g. the Namib Lichen Fields and the Orange River Estuary) further north are crucial. Mitigation measures would also be needed to prevent air pollution from the development.

Ecological processes such as primary production, decomposition, nutrient cycling and fluxes of nutrients and energy will all be altered by the clearing of the vegetation at the footprints of the infrastructure. Disruption of broad-scale ecological processes such as dispersal, migration or the ability of fauna to respond to fluctuations in climate or other conditions will depend on the presence of ecological corridors and the size of the disturbed area in relation to the adjacent landscape where no change to the ecological processes is anticipated.

Plant families contributing most species to the provisional on-site checklist were the Aizoaceae and Asteraceae. Seed dispersal in the Aizoaceae is generally quite restricted in space and time. The plants possess fruits that open when moistened to allow the seeds to escape and close again during dry weather. Primary dispersal is usually over very short distances. However, seed dispersal occurs only when it rains and conditions for germination should be suitable. In an area where moisture is a limiting factor, linking dispersal with water availability should have an advantage. In contrast, the seeds (fruits) of the Asteraceae are often well equipped with mechanisms that aid wind dispersal (e.g. wings or plumes). Habitat fragmentation will therefore have a greater negative effect on the Aizoaceae than the Asteraceae and recolonisation after a major disturbance will be slower in the Aizoaceae.

Psammophytes are plants or animals that thrive in sandy environments. Psammophilous plants exhibit many survival strategies such as mechanisms to reduce water loss by having small leaves or the shedding of plant parts. A noteworthy adaptation of some Namib psammophytes is their ability to harvest fog, while other species produce succulent leaves, stems and/or roots. Some psammophilous plants survive wind erosion due to the possession of a thick sheath around their roots that have the ability to withstand root exposure and sandblasting, whereas others produce a thick bark or wax layers. Some psammophilous species exhibit epidermal adaptations that allow them to fix a protective layer of sand grains to the leaf surface. Yet other species disappear seasonally below the sand surface by shrinking their succulent tissue during the dry summer months, and re-emerging during the rainy season. A unique set of psammophilous animals has also evolved in the Namib dunes, with sand moisture being the most important driver of their adaptations (Henschel & Jürgens, in press).

3.2.16 Climate change

Depending on the model parameterisation and climate scenarios used, widely divergent projections are produced for the Succulent Karoo Biome. The early projections predicted a substantial contraction of the Succulent Karoo (Midgley *et al.,* 2001), while more recent models suggest that the biome will be resilient to climate change and will not differ substantially in the future from its current distribution (Driver *et al.,* 2012). Studies by means of repeat photography suggest that modelled projections differ significantly from

observed measurements of vegetation change (Davis *et al*., 2016, Hoffman *et al.,* 2019). For most southern African biomes, there is little evidence yet of the catastrophic shifts in ecosystem structure and function that are predicted for the future due to climate change.

The Desert Biome has not yet expanded into large parts of the Succulent Karoo Biome nor has the Nama-Karoo Biome extended its range into the more mesic Grassland Biome. The 2018 National Biodiversity Assessment projected a limited switch from Succulent Karoo to Desert in its northern reaches and its expansion in the southern coastal region to replace parts of the Fynbos Biome (Skowno *et al.,* 2019). Some biomes are recovering from past over-exploitation and others are regenerating following a reduction in livestock numbers and the abandonment of agricultural land. Still others appear resilient to the warming trends that have been experienced thus far (Davis *et al.,* 2016).

A study by Broennimann *et al.* (2006) found that geophytes and succulents, were particularly vulnerable to climate change and Midgley & Thuiller (2007) also contended that succulents could be susceptible to the impacts of climate change. The risk to dwarf succulents, in particular *Conophytum* spp., was highlighted by Young *et al*. (2016).

4. SITE ASSESSMENT

According to the Terms of Reference received from the CSIR, a detailed field assessment of the vegetation was not necessary at the level required for the SEA and no field surveys were needed. However, a broad-scale, high-level, on-site reconnaissance and evaluation of the vegetation was deemed necessary to ground-truth the environmental and flora sensitivities listed by the Screening Tool (Screening Tool, 2024). The vegetation and flora assessment relied heavily on the expert knowledge of Pieter van Wyk, a Richtersveld botanical specialist, and was supported by available data. Although no surveys were required, a limited number of surveys were done during the site visit. Lists of the most prominent plant species were compiled at 37 sampling points and supplemented with data for the Telkom hill generated from the report by Todd (2011) (Figure 19).

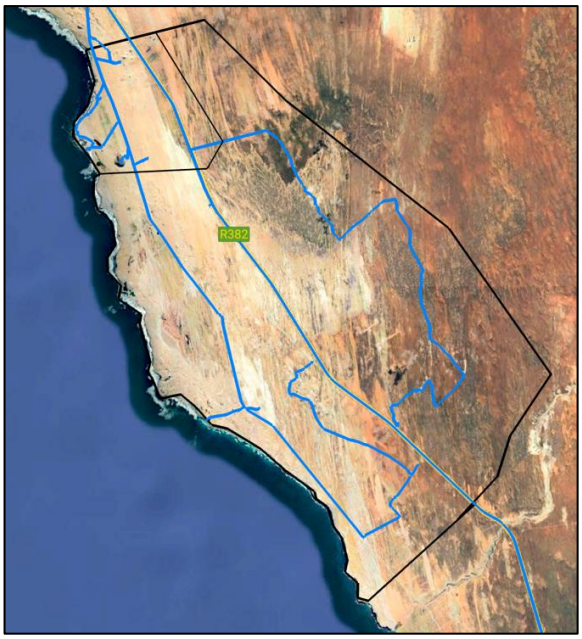

Figure 19: Tracks (blue line) followed during the site visit.

The vegetation data gathered during the site visit were classified following phytosociological procedures and plant communities (habitats) were identified (Appendix B). The vegetation could be subdivided into three distinct clusters:

- Cluster 1: Vegetation associated with the rocky outcrops (Plant Community 1);
- Cluster 2: Vegetation occurring on the coastal lowlands, i.e. predominantly to the west of the tar road (R382) (Plant Communities 2, 3 & 4);
- Cluster 3: Vegetation occurring on the uplands within the site, i.e. predominantly to the east of the tar road (R382) (Plant Communities 6, 7 & 8); and
- Additionally, there was a transitional Plant Community 5 and the wetland vegetation (Plant Community 9).

4.1 Description of plant communities

Plant Community / Habitat 1 (C1)

This plant community occurs where the basement geology is exposed, most notably on the outcrops such as the Boegoeberg Twins, Namakwakop (note this is the Namakwakop on site, there is another

Namakwakop to the north of the site on the topocadastral map in Figure 2) and around the Telkom tower (near Visagiesfonteinkop) (Figure 20). Small outcrops were not all mapped.

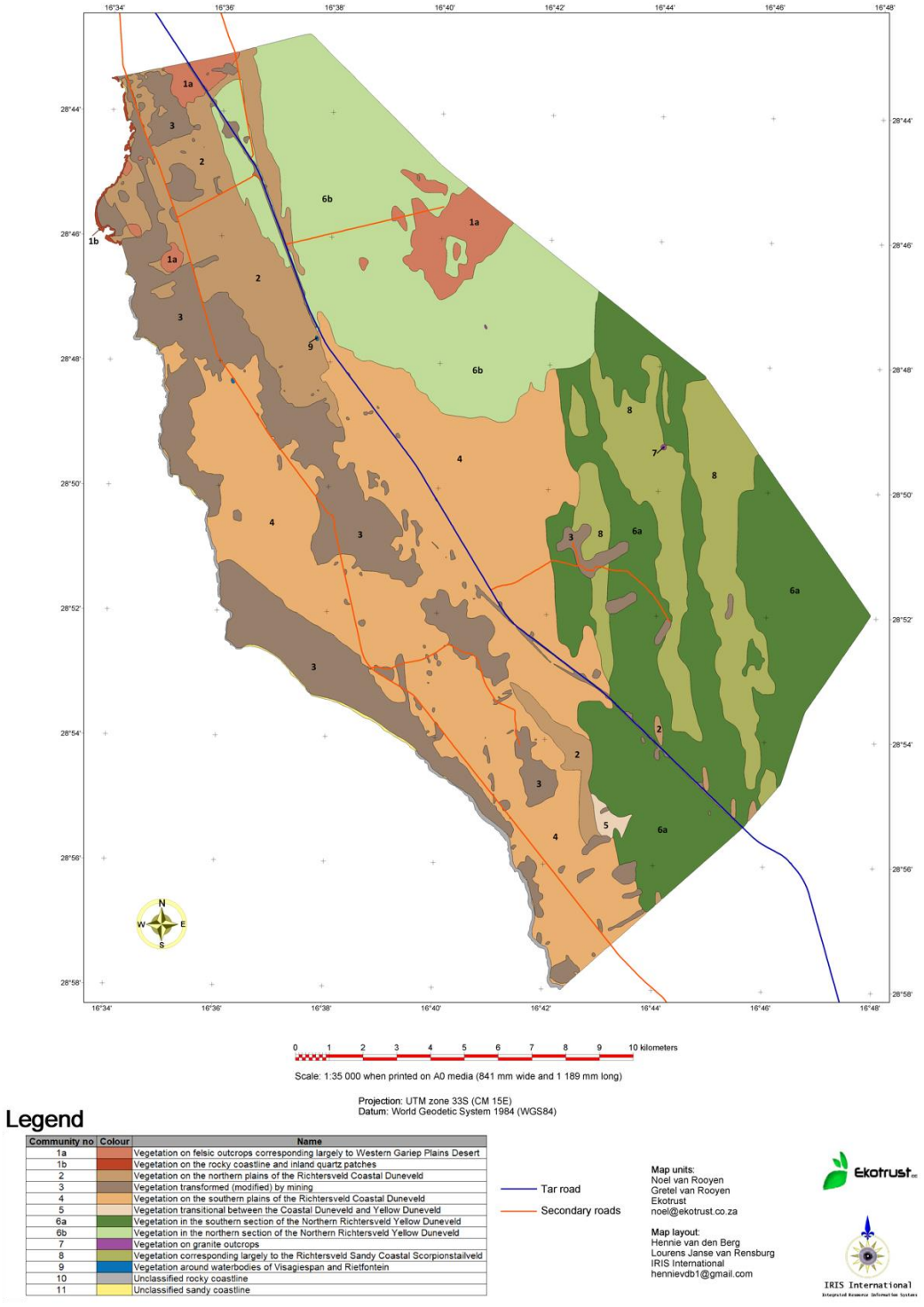

Figure 20: Broad-scale vegetation map indicating the location of the plant communities distinguished in this report.

Plant Community 1 also occupies the coastline from the northern site boundary to approximately Wreck Point (see Figure 2 for place names). The rocky shores in the south of the site were not visited and thus mapped as unclassified. Species that are diagnostic for Community 1 are listed in Species Group 2 (Appendix B), e.g. *Cephalophyllum ebracteatum* (VU), *Conophytum saxetanum* (EN), Sensitive species 305 (CR) and *Monsonia patersonii* (VU). Prominent species commonly found in this habitat include *Asparagus*

capensis, Crassothonna sedifolia, Mesembryanthemum crystallinum, Roepera cordifolia, Stoeberia beetzii and various *Salsola* spp. Two subcommunities (SC) were distinguished, with SC1a defined by Spesies group 1 and SC1b having no diagnostic species group. SC1b contains the highest concentration of Sensitive species 305 (CR) within the species' distribution and removal of this population will have a detrimental impact on this species.

Land use in Plant Community 1 falls partly within the mining area and to the east of the R382 the land is currently used for livestock farming. The Richtersveld Wind Energy Facility has been approved, and this proposed WEF will include sections of Plant Community 1.

- ***Presence of SCC:*** Plant Community / Habitat 1 contained a wealth of SCC:

Dregeochloa pumila	**CR**
Drimia barbata	**CR**
Gazania schenckii	**CR**
Anacampseros cf. *gariepensis*	**CR**
Bassia dinteri	**CR** (SANBI)
Sensitive species 305	**CR**
Calobota acanthoclada	EN
Conophytum saxetanum	EN
Adromischus montium-klinghardtii	VU
Sensitive species 720	VU
Monsonia patersonii	VU
Cephalophyllum ebracteatum	VU
Sensitive species 1187	VU
Lapeirousia macrospatha	VU (SANBI)
Crassula ammophila	NT
Crotalaria meyeriana	NT
Curio crassifolius	DDT
Curio sulcicalyx	DDT
Ifloga lerouxiae	Rare

- ***Occurrence of threatened ecosystems:*** Although C1 is typical of the Western Gariep Plains Desert, which has a Least Concern status sections of C1 occur in areas mapped as Namib Seashore Vegetation as well as in the Richtersveld Coastal Duneveld, both of which have a **Critically Endangered** status.

- ***Occurrence in a CBA (2016 CBA map):*** Large portions of Plant Community 1, e.g. the Boegoeberg Twins, Namakwakop, and Visagiesfonteinkop, have been mapped as part of a **CBA 1**.

- ***Located in a Focus Area of the NPAES:*** To the west of the tar road (R382) this plant community does not fall in the NPAES, however, to the east of the R382 (i.e. Visagiesfonteinkop) it has been included in the **NPAES**.

- ***Degree of disturbance versus intact vegetation:*** In some parts the vegetation is still fairly intact, although some areas are severely degraded, e.g. the wind-blown sand covering the northern footslopes of Boegoeberg South.

- ***Time needed for the vegetation to recover:*** Once disturbed the vegetation in Plant Community 1 will take very long (many decades) to recover.

Plant Community / Habitat 2 (C2)

This plant community occurs on level plains with some relief and covers large parts of the port section and the north-central part of the SEZ (Figure 20). The land use in Plant Community 2 has been mining. These wind-swept plains appear to be a degraded, species-poor variant of Plant Community 4, because it lacks

species in Species Groups 3, 7 and 14 (Appendix B). The floristic affinities between C2 & C3 are shown by the shared presence of Species Groups 4, 5, 8 and 15. Common species found in this plant community include *Cladoraphis cyperoides, Drosanthemum luederitzii, Mesembryanthemum crystallinum, Othonna furcata, Stoeberia beetzii* and *Tetraena clavata*.

- ***Presence of SCC:*** Plant community 2 contained the following SCC (some species from iNaturalist):

Dregeochloa pumila	**CR**
Lachenalia klinghardtiana	**CR**
Monsonia patersonii	VU

- ***Occurrence of threatened ecosystem:*** For the most part this plant community falls into the Richtersveld Coastal Duneveld, which has a **Critically Endangered** status.

- ***Occurrence in a CBA (2016 CBA map):*** The unit is largely mapped as a **CBA 1**.

- ***Located in a Focus Area of the NPAES:*** The area has not been included in the NPAES.

- ***Degree of disturbance versus intact vegetation:*** The vegetation is considered to be a degraded variant of the Richtersveld Coastal Duneveld.

- ***Time needed for the vegetation to recover:*** Without stabilising the sand and other rehabilitation measures, the vegetation in Plant Community 2 will take very long to recover after a major disturbance.

Plant Community / Habitat 3 (C3)

Plant Community 3 has been transformed by mining and currently represents modified habitat *sensu* IFC Performance Standard 6 (IFC, 2012, updated 2019) (Figure 20). It is floristically strongly related to C2, but differs in the level of transformation. C3 differs markedly from C4 due to the absence of species in Species Groups 3, 7 and 14, but shares Species Groups 4, 5 and 8 with C2 and C4. Prominent perennial dwarf shrubs in this plant community are *Amphibolia rupis-arcuatae, Didelta carnosa, Drosanthemum luederitzii, Lycium tetrandrum, Stoeberia beetzii* and *Tetraena clavata,* while some conspicuous short-lived species include *Oncosiphon* spp., *Mesembryanthemum crystallinum* and *Mesembryanthemum hypertrophicum*. The unit is located within the area mapped as Richtersveld Coastal Duneveld, but due to the level of disturbance might never return to its original state.

- ***Presence of SCC:*** No SCC were recorded during the site visit.

- ***Occurrence of threatened ecosystems:*** For the most part this unit falls into the Richtersveld Coastal Duneveld, which has a Critically Endangered status. However, due to the transformed nature of this unit, it does not warrant a threatened ecosystem status.

- ***Occurrence in a CBA (2016 CBA map):*** The habitat was not classified in the CBA map.

- ***Located in a Focus Area of the NPAES:*** The area has not been included in the NPAES.

- ***Degree of disturbance versus intact vegetation:*** The vegetation is entirely transformed.

- ***Time needed for the vegetation to recover:*** Considering the permanent transformation, C3 can return to its current transformed state, however, it might never return to its original state.

Plant Community / Habitat 4 (C4)

The species composition recorded in this plant community during the site visit agrees well with the description of the Richtersveld Coastal Duneveld provided in Mucina & Rutherford (2006). Plant Community 4 occupies plains with low hills and ridges. The portion of the community to the west of the tar

road is located in the mining area, whereas the section east or the tar road is used for livestock farming. Diagnostic species in this unit are listed in Species Group 3, e.g. *Atriplex vestita, Crassothonna cylindrica, Hebenstretia* sp., *Osteospermum oppositifolium* and *Ruschia* sp. Prominent species include *Amphibolia rupis-arcuatae*, *Crassothonna cylindrica*, *Didelta carnosa, Mesembryanthemum crystallinum, Oncosiphon* spp., *Roepera cordifolia, Stoeberia beetzii, Stoeberia utilis* and *Salsola* spp. This plant community shows floristic affinities with C1, C2 and C3 through the shared species in Species Groups 4 and 5, but also to the vegetation to the east of the R382 tar road *viz.* Community 6 through the shared species in Species Groups 7, 8, 14 and 15.

- ***Presence of SCC:*** Several SCC were recorded during the site visit, with some additional records obtained from iNaturalist:

Lachenalia klinghardtiana	**CR**
Sensitive species 305	**CR**
Sensitive species 293	EN
Sensitive species 734	VU
Monsonia patersonii	VU (SANBI)
Amphibolia succulenta	NT

- ***Occurrence of threatened ecosystems:*** This plant community falls mainly in the Richtersveld Coastal Duneveld, which has a **Critically Endangered** status.

- ***Occurrence in a CBA (2016 CBA map):*** The unit has for the most part been classified as **CBA 1**.

- ***Located in a Focus Area of the NPAES:*** Only a small section has been included in the NPAES.

- ***Degree of disturbance versus intact vegetation:*** C4 is interspersed with mine trenches, diggings and dumps. Although by no means pristine, there are some areas with intact vegetation and other areas that were disturbed a very long time ago.

- ***Time needed for the vegetation to recover:*** Considering the harsh environment, C4 will take a long time to recover after a major disturbance.

Plant Community / Habitat 5 (C5)

Plant Community 5 represents a transition from the vegetation characteristic of the Richtersveld Coastal Duneveld to the vegetation typically found in the Northern Richtersveld Yellow Duneveld and occurs in the south-central part of the SEZ around Duikerkop (Figures 20). A large colony of Brant's whistling rats was present in the plant community. The land use in Plant Community 5 has been mining. The unit has no diagnostic species, but its transitional nature is illustrated by the presence of Species Group 5 linking it to C1 – C4 (west of the R382) and Species Groups 7, 8 and 13 linking it to the vegetation units to the east of the tar road (R382) i.e. C6, C7 and C8. Common species in C5 include *Amphibolia rupis-arcuatae, Asparagus capensis, Cephalophyllum rigidum, Cheiridopsis robusta, Eberlanzia sedoides, Lycium tetrandrum, Oncosiphon* spp., *Mesembryanthemum crystallinum, Mesembryanthemum schlichtianum, Roepera cordifolia, Senecio aloides, Stoeberia beetzii* and *Tetraena clavata.*

- ***Presence of SCC:*** No SCC were recorded in Plant Community 5 during the site visit.

- ***Occurrence of threatened ecosystem:*** This habitat falls into the area mapped as Northern Richtersveld Yellow Duneveld, which has a Least Concern status.

- ***Occurrence in a CBA (2016 CBA map):*** Plant Community 5 has been mapped as **CBA 2**.

- ***Located in a Focus Area of the NPAES:*** The area has not been included in the NPAES.

- ***Degree of disturbance versus intact vegetation:*** C5 is largely intact vegetation.

- ***Time needed for the vegetation to recover:*** Considering the harsh environment, C5 will take a very long time to recover after a major disturbance.

Plant Community / Habitat 6 (C6)

This plant community as a whole is defined by the species in Species Group 9, e.g. *Asparagus graniticus, Asparagus undulatus, Babiana hirsuta, Calobota spinescens, Jordaaniella clavifolia* (VU) and *Ruschia* sp. The plant community can be subdivided into two subcommunities. SC6a is found in the southern part of the area mapped as Northern Richtersveld Yellow Duneveld in the Boegoeberg Port and SEZ site (SANBI, 2024), whereas SC6b is found in the northern part of the Northern Richtersveld Yellow Duneveld occurring on site (Figure 20). C6 is currently used for livestock grazing.

SC6a is floristically related to C2 to C5 through the shared species in Species Group 8, whereas SC6b is not as closely related to C2 and C3 but shares some species with C5 (Species Group 13) and C4 (Species group 14). SC6a was the only subcommunity characterised by a diagnostic species group (Species Group 6) containing species such as *Euphorbia burmannii, Euphorbia ephedroides, Heliophila lactea, Othonna undulata, Ruschia* sp., *Pelargonium* sp. nov. *and Veltheimia capensis*. Prominent species for the community as a whole included *Amphibolia succulenta* (NT), *Asparagus capensis, Cephalophyllum rigidum, Cheiridopsis robusta, Crassothonna sedifolia, Didelta carnosa, Euphorbia mauritanica, Euphorbia rhombifolia, Foveolina dichotoma, Jordaaniella cuprea, Jordaaniella spongiosa, Lampranthus otzenianus, Lampranthus stipulaceus, Mesembryanthemum crystallinum, Mesembryanthemum schlichtianum, Pteronia glabrata, Roepera cordifolia, Roepera morgsana, Senecio aloides, Stoeberia utilis* and *Trachyandra falcata.*

- ***Presence of SCC:***

Lachenalia klinghardtiana	**CR**
Dregeochloa pumila	**CR** (Todd, 2011)
Sensitive species 305	**CR** (SANBI)
Sensitive species 720	VU
Jordaaniella clavifolia	VU
Sensitive species 734	VU
Monsonia patersonii	VU
Adromischus montium-klinghardtii	VU (SANB)
Schlechteranthus holgatensis	VU (SANBI)
Cephalophyllum ebracteatum	VU
Amphibolia succulenta	NT
Crassula ammophila	NT
Aloe framesii	NT

- ***Occurrence of threatened ecosystem:*** This plant community falls into the area mapped as Northern Richtersveld Coastal Duneveld with a Least Concern status.

- ***Occurrence in a CBA (2016 CBA map):*** C6 has been mapped partly as **CBA 1** and partly as **CBA 2**.

- ***Located in a Focus Area of the NPAES:*** The area has largely been included in the **NPAES**.

- ***Degree of disturbance versus intact vegetation:*** C6 is largely intact vegetation. It is used for livestock grazing.

- ***Time needed for the vegetation to recover:*** Considering the harsh environment, C6 will take a long time to recover after a major disturbance.

Plant Community / Habitat 7 (C7)

Plant Community 7 is a small plant community representing a unique habitat, occurring on and around outcrops of granite boulders. It is embedded in either the Northern Richtersveld Yellow Duneveld or the

Richtersveld Sandy Coastal Scorpionstailveld (Figure 20). During the rainy season, the hollows in the granite boulders are filled with water providing an important source of water for wildlife. Plant community 7 is currently used for livestock grazing. The diagnostic species for this unit are listed in Species Group 10 and include *Antimima varians, Cotula coronopifolia, Colchicum albomarginatum, Cynodon dactylon, Drosanthemum inornatum, Opuntia ficus-indica, Gladiolus arcuatus, Lachenalia punctata, Lessertia frutescens, Manochlamys albicans, Melolobium adenodes* and *Oxalis inconspicua.*

- ***Presence of SCC:*** The following SCC were recorded during the site visit:

Adromischus montium-klinghardtii	VU
Sensitive species 734	VU
Amphibolia succulenta	NT

- ***Occurrence of threatened ecosystems:*** This unit falls into both the Northern Richtersveld Yellow Duneveld and Richtersveld Sandy Coastal Scorpionstailveld, both of which have a Least Concern status.

- ***Occurrence in a CBA (2016 CBA map):*** The unit has been mapped as **CBA 2**.

- ***Located in a Focus Area of the NPAES:*** The area has been included in the **NPAES**.

- ***Degree of disturbance versus intact vegetation:*** C7 represents natural habitat and shows signs of disturbance by humans as well as livestock.

- ***Time needed for the vegetation to recover:*** C7 will take a very long time to recover after a major disturbance.

Plant Community / Habitat 8 (C8)

Plant Community 8 (Figure 20) agrees with the area mapped as Richtersveld Sandy Coastal Scorpionstailveld and was characterised by the heuweltjies occurring in the unit. In the study site, the heuweltjies lack the typical surface mounding and appear as flat, rather barren patches (see McAuliffe *et al.,* 2019). In the arid extremes of the distribution of heuweltjies, the central soils also have an elevated N and P content, but the vegetation cover and height in the surrounding areas are often substantially reduced and perennial plants may be entirely absent. Termites play an important role in the carbon cycle and their activities could be assisting carbon sequestration (Francis *et al.,* 2024). When a heuweltjie landscape is overgrazed, the heuweltjies are typically the first places to be denuded of vegetation. Plant Community 8 is currently used for livestock grazing.

C8 had a weak diagnostic Species Group (Species Group 12). Prominent species in this plant community included *Amphibolia succulenta* (NT)*, Asparagus capensis, Cheiridopsis robusta, Euphorbia* spp.*, Foveolina dichotoma, Lampranthus otzenianus, Mesembryanthemum crystallinum, Mesembryanthemum schlichtianum, Pteronia glabrata, Roepera cordifolia, Senecio aloides* and *Stoeberia beetzii.* C8 is floristically related to C5 and C6 through the shared species in Species Group 13. It also shares some species with C4 (Species Group 14).

- ***Presence of SCC:*** The following SCC was recorded during the site visit:

Amphibolia succulenta	NT

- ***Occurrence of threatened ecosystems:*** This unit falls into the Richtersveld Sandy Coastal Scorpionstailveld with a Least Concern status.

- ***Occurrence in a CBA (2016 CBA map):*** The unit is mostly mapped as **CBA 2**, with sections within a **CBA 1.**

- ***Located in a Focus Area of the NPAES:*** Most of C8 has been included in the **NPAES**.

- ***Degree of disturbance versus intact vegetation:*** Plant Community 8 represents natural habitat and shows signs of disturbance by humans and livestock.

- ***Time needed for the vegetation to recover:*** C8 will take a very long time to recover after a major disturbance.

Plant Community / Habitat 9 (C9)

Plant Community 9 represents the vegetation around the waterbodies on Visagiespan and Rietfonteinpan (Figure 20). These waterbodies fall in the mining lease area and are embedded in the **CR** Richtersveld Coastal Duneveld. The most prominent species were *Atriplex vestita, Drosanthemum luederitzii, Juncus* sp., *Phragmites australis* and *Salicornia natalensis*.

- ***Presence of SCC:*** No SCC were recorded in Plant Community 9 during the site visit.

- ***Occurrence of threatened ecosystems:*** This unit falls in the Richtersveld Coastal Duneveld which has a **Critically Endangered** status.

- ***Occurrence in a CBA (2016 CBA map):*** While Rietfontein's waterbody was mapped as **CBA 1**, the waterbody at Visagiespan was not classified.

- ***Located in a Focus Area of the NPAES:*** The area has not been included in the NPAES.

- ***Degree of disturbance versus intact vegetation:*** The waterbody at Visagiesfontein is apparently man made, however, Rietfonteinpan appears to be a natural wetland.

- ***Time needed for the vegetation to recover:*** Plant Community 9 will take a very long time to recover after a major disturbance.

5. SITE SENSITIVITY

The first environmental screening for the Boegoebaai Port area was undertaken in 2018 (MDT, 2018 https://publishedetenders.blob.core.windows.net/publishedetenderscontainer/9083/Annexure%20C%20-%20Environmental %20Screening%20Report%20Rev%201%20-%202018%2004%2024%20-%20Final.pdf). The report mentioned various sensitive features e.g. the presence of the Endangered Namib Seashore Vegetation and that any impact on this ecosystem should be avoided. The report also mentioned the occurrence of CBA 1s, 'Vulnerable and Rare plants species on the Boegoeberg Inselbergs, an ancient hyaena lair site and grave sites' as well as the seal and cormorant colonies in the port site. Since the MDT report the Namib Seashore Vegetation has been upscaled to Critically Endangered and the Richtersveld Coastal Duneveld has been upscaled from Least Concern to Critically Endangered.

The Terms of Reference for the vegetation and flora component of the SEA required the ground-truthing of the environmental sensitivities indicated by DFFE's Screening Tool (Screening Tool, 2024). The available information used to produce the sensitivity maps for the current assessment of the Boegoebaai SEA is at a coarse scale. Sensitivity ratings relied on an assessment of various features within each plant community that was distinguished e.g. presence of CR ecosystems, SCC, CBAs, and NPAES. Ratings were applied per plant community, based on the occurrence of a feature. Because many of the plant communities are large, the current analysis and mapping of sensitive features is at a broad scale and many small or localised features may not have been mapped. This highlights the importance of conducting an in-depth, fine-scale analysis of the vegetation for a detailed sensitivity and ecological impact analyses.

5.1 Screening Tool

5.1.1 Plant Theme

The Screening Tool rated the sensitivity of the Plant Theme as **Medium** and provided a list of 19 plant species with all species rated as of medium sensitivity (Table 1, Figure 21a). The Screening Tool's **Medium** sensitivity refers to the presence of model-derived suitable habitat for threatened and/or rare species. The areas in green in Figure 21a correspond to areas that were transformed by mining.

Table 1: Species of Conservation Concern (SCC) listed for the proposed Boegoebaai Port and SEZ site in the Screening Tool and whether their presence could be confirmed on site

Sensitivity	Feature(s)	IUCN Status	Confirmed on site
Medium	*Bassia dinteri*	CR	Yes (SANBI)
Medium	Sensitive species 305	Was VU; now CR	Yes
Medium	*Mesembryanthemum occidentale (= Aridaria vespertina)*	EN	
Medium	Sensitive species 282	EN	
Medium	Sensitive species 407	Was VU; now EN	Yes
Medium	Sensitive species 293	EN	Yes
Medium	Sensitive species 1110	EN	Yes
Medium	*Calobota acanthoclada*	EN	Yes
Medium	Sensitive species 827	VU	Yes
Medium	Sensitive species 435	VU	
Medium	Sensitive species 734	VU	Yes
Medium	Sensitive species 1187	VU	Yes
Medium	Sensitive species 720	VU	Yes
Medium	*Adromischus montium-klinghardtii*	VU	Yes
Medium	*Nemesia saccata*	VU	Yes
Medium	*Helichrysum dunense*	VU	Yes
Medium	Sensitive species 744	VU	
Medium	*Manulea cinerea*	VU	
Medium	Sensitive species 1090	RARE	

The presence of 13 of these species were confirmed on site either during the current site visit or from records provided by P. van Wyk, iNaturalist or SANBI (2024) for the site. An additional 33 SCC were confirmed for the site (Appendix A). In total, there are thus **46 confirmed SCC on site**. Moreover, 163 Northern Cape provincially protected/specially protected and 20 CITES-listed species are also present on site.

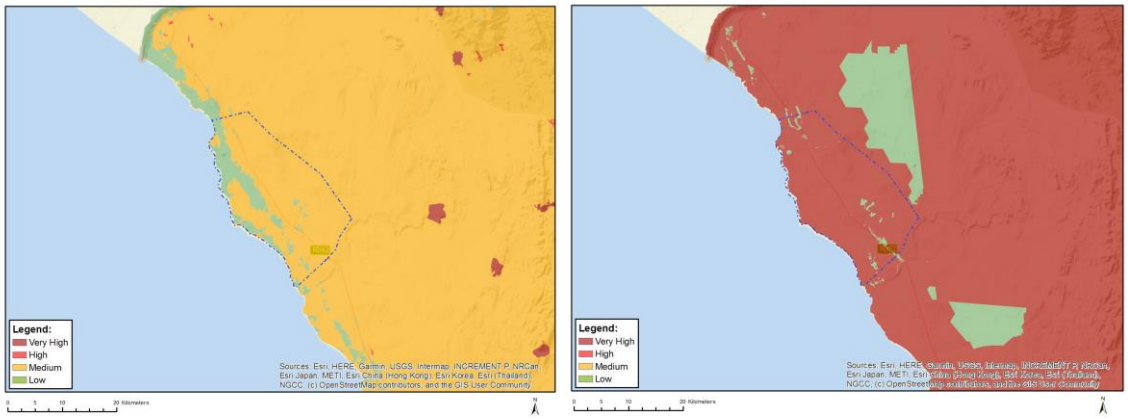

Figure 21: Site sensitivity of the (a) Plant Theme; and (b) Relative Terrestrial Biodiversity Theme as provided by the Screening Tool.

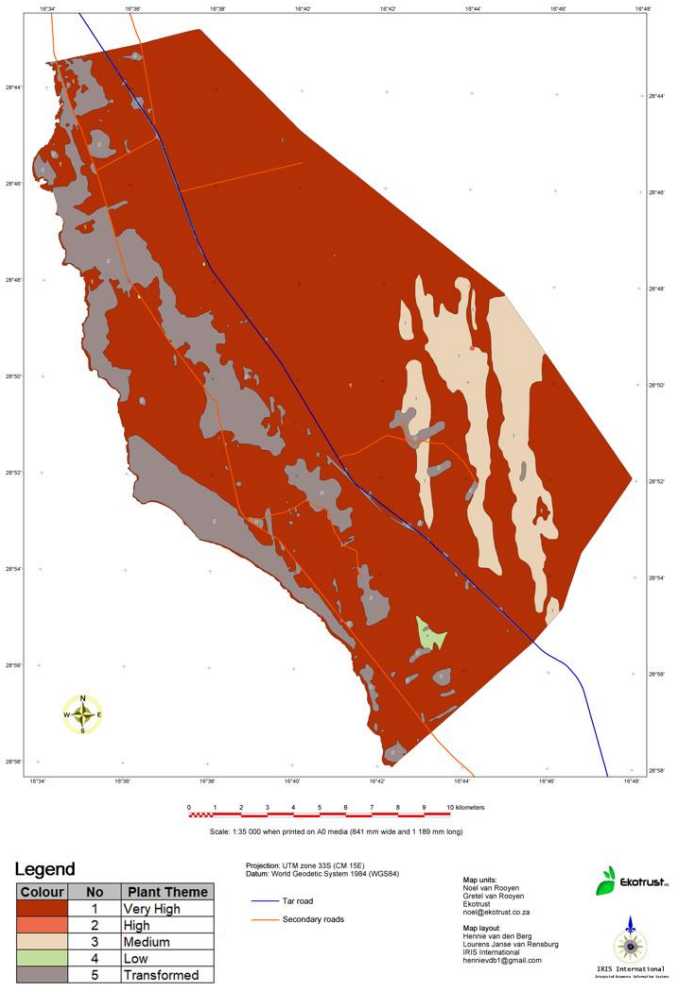

Figure 22: Site sensitivity of the Plant Theme as assessed during the site visit. Areas in grey correspond to areas that have been transformed by mining.

The criteria used for the current site sensitivity assessment per plant community were as follow:

- A plant community was rated as **Very High** if it was habitat for a Critically Endangered species
- A plant community was rated as **High** if it was habitat for an Endangered or Vulnerable species
- A plant community was rated as **Medium** if it was habitat for a Near Threatened, Data Deficient or Rare species
- A plant community was rated as **Low** if it was not habitat for any SCC.

On the basis of these criteria it is recommended that the sensitivity of the Plant Theme should be upscaled to **Very High** (Figure 22). Plant Community 3, representing the areas transformed by mining, was rated as modified or transformed habitat and no SCC were reported for this unit.

5.1.2 Relative Terrestrial Biodiversity Theme

The Screening Tool rated the sensitivity of the Relative Terrestrial Biodiversity Theme as **Very High** based on the features listed in Table 2 (Figure 21b). Because the 2016 CBA map was used in the Screening Tool the same version was used for the current comparison. The desktop evaluation confirmed the presence of all these features listed by the Screening Tool and **if the same sensitivity ratings as the Screening Tool were applied and the same CBA map (2016) is used, the current assessment would confirm the rating of Very High.**

Table 2: Features used by the Screening Tool to assess the Relative Terrestrial Biodiversity Theme and the sensitivity rating used by the Screening Tool as well as the adjusted ratings used in the current assessment

Feature(s)	Sensitivity (Screening Tool)	Sensitivity used in the current assessment
Low Sensitivity	Low	
CBA 1	Very High	Very High
CBA 2	Very High	High
ESA	Very High	Medium
National Protected Area Expansion Strategy (NPAES)	Very High	High
CR Namib Seashore Vegetation	Very High	Very High
CR_Richtersveld Coastal Duneveld	Very High	Very High
CR plant species	-	Very High

To compare the Screening Tool's site sensitivity with the assessment made during the current study (Figure 23), the sensitivity ratings were modified to correspond more closely with the 'Best Practice Guidelines for Implementing the Mitigation Hierarchy in South Africa' (EWT, 2023) which agree well with the National Biodiversity Offset Guideline of DFFE (2023). These guidelines use the principles of Limits of Acceptable Change/Threshold of Concern. These limits for changes in environmental quality define the ceiling that would be considered to be acceptable.

It has to be emphasized that the current assessment represents a site sensitivity, whereas the EWT guidelines refer to impact significance, where significance is a combination of the (i) extent (scale); (ii) duration; (iii) intensity; and (iv) likelihood of an impact. In this study sensitivity was regarded as equivalent to impact. If the current assessment confirmed the presence of a feature in a plant community, the following ratings were applied.

Sensitivity is considered **Very High** if it would include:

- a **Critically Endangered ecosystem**;
- an irreplaceable Critical Biodiversity Area (**CBA 1**);

- confirmed habitat of a **Critically Endangered species**;
- impacts on **range-restricted species** which are **nationally listed as Rare or Extremely Rare**;
- a natural or near-natural part of a **formally protected area**; and
- loss of **key ecological corridors** recognised as important for evolutionary processes and climate change adaptation where no spatial options to safeguard these processes exist. Key ecological corridors for evolutionary processes and climate change adaptations are generally incorporated into CBA 1 classifications.

According to the mitigation hierarchy (EWT, 2023) a **Very High** impact rating would indicate that the proposed development must be avoided/prevented, since these changes cannot be remedied and offsets or compensation would not be feasible because of the high threat status or irreplaceability of the affected biodiversity or ecosystem services.

Sensitivity is considered **High** if it would include:

- an optimal Critical Biodiversity Area (**CBA 2**);
- an **Endangered ecosystem**;
- presence of the **National Protected Area Expansion Strategy** (NPAES) or buffer zones around protected areas;
- confirmed habitat of an **Endangered species**, or impacts leading to an increase in their threat status; and
- impacts on **range-restricted endemic** species that are not nationally listed as Rare, Extremely or Critically Rare.

Where residual negative impacts of **High** significance remain, biodiversity offsets/compensation can be considered.

Sensitivity is considered **Medium** if it would include:

- an Ecological Support Area (**ESA**);
- irreversible impacts on Priority Focus Areas in the **National Protected Areas Expansion Strategy (NPAES);**
- **Strategic Water Source Areas** (see Aquatic report);
- areas within **32 meters of a watercourse** (see Aquatic report);
- **Vulnerable ecosystems and/or species**, or endemic (but not range-restricted) or protected species;
- or impacts on ecosystems or species which would result in them being listed as threatened;
- degradation of ecological infrastructure providing highly valued or important ecosystem services; and
- loss of, or reduction in important ecological process areas or landscape corridors.

Avoidance or minimisation of impacts is essential and restoration of degraded areas must be undertaken when the impact rating is **Medium**. Should significant negative impacts of medium significance remain, biodiversity offsets/compensation can be considered.

Sensitivity is considered **Low** if it would include:

- loss of vegetation in an **ONA** or biodiversity of **Least Concern** supporting no threatened ecosystems or species, and not constituting important ecological process areas or corridors, or providing important ecosystem services.

Should the impact have a **Low** rating, impacts should as far as possible be avoided and minimised and rehabilitation/ restoration would minimise residual negative impacts and biodiversity offsets or compensation would not be required.

Should any features be present in a plant community, the feature with the highest status overrides the lesser status, a principle that agrees with the viewpoint applied by the Screening Tool. Using these criteria the current sensitivity would be **Very High** for most of the site with Plant Community 8 rated as **High**. Plant Community 3 representing the habitat that has been transformed/modified by mining could be used for development.

The **Very High** sensitivity of the Relative Terrestrial Biodiversity Theme found using the criteria in the current assessment agrees well with the sensitivity generated by the Screening Tool. It does however point out a weakness in scoring the environmental sensitivity of the Boegoebaai Port during the port selection stage (MDT, 2018; Transnet National Ports Authority, 2024; https://www.csir.co.za/sites/default/files/Documents/Appendix%20C_Overview%20of%20Boegoebaai%20Site%20Selection%20process.pdf).

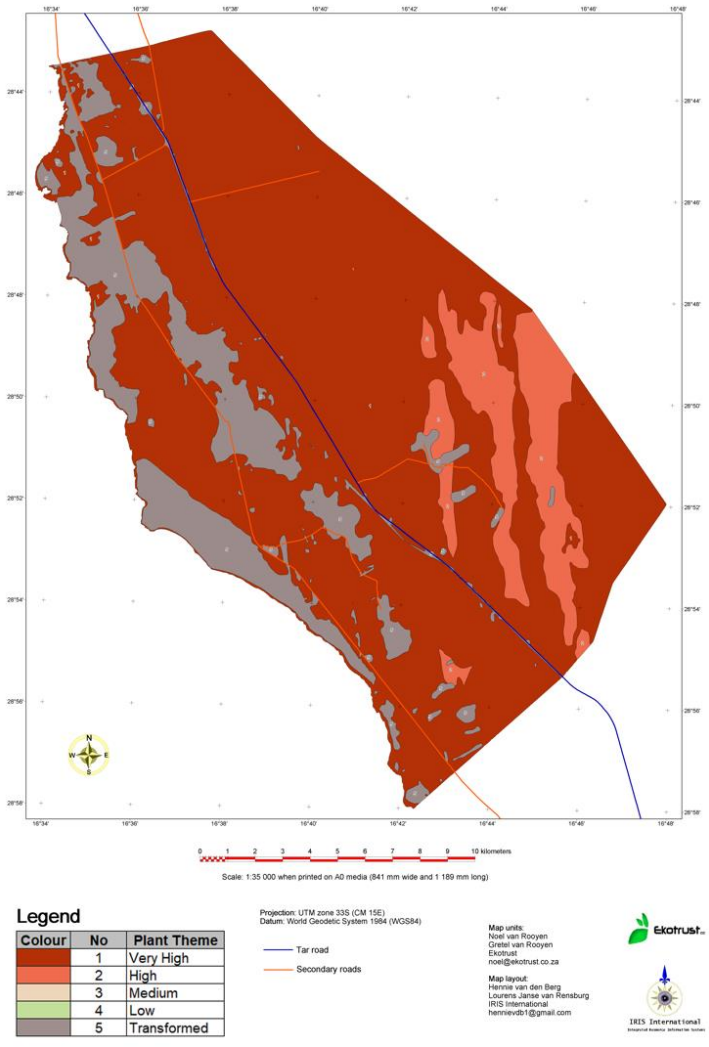

Figure 23: Sensitivity of the Relative Terrestrial Biodiversity Theme as assessed during the site visit.

5.2 International Finance Corporation (IFC)

The following section is a brief outline of the Guidance Notes of the IFC (IFS PS6, 2019), to compare the principle of Limits of Acceptable Change/Threshold of Concern proposed in the mitigation hierarchy by the Endangered Wildlife Trust (EWT, 2023) to those provided by the IFC. The IFC Performance Standards provide guidance to clients on how to avoid, mitigate and manage risks and impacts in a sustainable way. In Guidance Note 6 of the 'Biodiversity Conservation and Sustainable Management of Living Natural Resources' the concept of '**Critical habitat'** is introduced. Critical habitats are areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes. These habitats would therefore have a **Very High** sensitivity. The critical habitat definition as applied by the IFC is in line with criteria used to identify priority habitat for biodiversity conservation. These habitats must include one or more of the criteria referred to as critical habitat criteria. Each of these criteria are established based on some features.

Criterion 1: Critically Endangered (CR) and Endangered (EN) Species

Thresholds for Criterion 1:

- Areas that support globally important concentrations of an IUCN Red-listed CR or EN species (≥0.5% of the global population and ≥5 reproductive units.
- Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR.
- As appropriate, areas containing important concentrations of a **nationally or regionally listed CR or EN species**.

Criterion 2: Endemic and Restricted-range Species (i.e. Extent of Occurrence (EOO) less than 50,000 km^2)

Threshold for Criterion 2:

- Areas that regularly hold ≥10% of the global population size and ≥10 reproductive units of a species.

Criterion 3: Migratory and Congregatory Species

This criterion is not applicable to plant species.

Criterion 4: Highly Threatened or Unique Ecosystems

Thresholds for Criterion 4:

- Areas representing ≥5% of the global extent of an ecosystem type meeting criteria for IUCN status of CR or EN.
- Other areas not assessed by IUCN but determined to be of **high priority for conservation by regional or national systematic conservation planning**.

Criterion 5: Key Evolutionary Processes:

Examples:

- Landscapes with high spatial heterogeneity are a driving force in speciation, as species are naturally selected based on their ability to adapt and diversify.

- Environmental gradients producing transitional habitat, which has been associated with the process of speciation and high species and genetic diversity.
- Edaphic interfaces are specific juxtapositions of soil types, which have led to the formation of unique plant communities characterized by both rarity and endemism.
- Connectivity between habitats (corridors) ensures species migration and gene flow, which is important in fragmented habitats and for conserving metapopulations.
- Sites of demonstrated importance to climate change adaptation for either species or ecosystems.

The IFC Performance Standards stipulates that in areas of critical habitat, the client will not implement any project activities unless all of the following can be demonstrated:

- No other viable alternative within the region exists for development of the project on modified or natural habitats that are not critical;
- The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values;
- The project does not lead to a net reduction in the global and/or national/regional populations of any CR or EN species over a reasonable period of time;
- A robust, appropriately designed and long-term biodiversity monitoring and evaluation program is integrated into the client's management program.

Should a client be able to meet the requirements above, the project's mitigation strategy must be described in a Biodiversity Action Plan and be designed to achieve net gains of those biodiversity values for which the critical habitat was designated. In instances where biodiversity offsets are proposed as part of the mitigation strategy, the client must demonstrate through an assessment that the project's significant residual impacts on biodiversity will be adequately mitigated to meet the requirements.

6. ASPECTS AND IMPACTS REGISTER

An aspects and impacts register (Table 3) was compiled based on the project description provided by the CSIR (Schreiner *et al*., 2024).

Table 3: Aspects and impacts register applicable to the vegetation in the proposed Boegoebaai Port and SEZ

PORT INFRASTRUCTURE ASPECT / SEZ SUBZONE	POTENTIAL IMPACT	RECEIVING ENVIRONMENT OF CONCERN
PORT		
Zone 1: Infrastructure *Any structure to be built or covering land related to the port facility e.g.:* • buildings; • bulk material stockpiles, warehouses & handling facilities; • ship loaders; • conveyor belt structures; • water reservoirs; • sewage systems; • stormwater drainage systems; • electrical substations; • fuel storage facilities; and • roads.	***Infrastructure:*** ***Vegetation clearance:*** Natural vegetation will be cleared for various structures related to the port facility. Vegetation clearance will cause a loss of a portion of (i) a **CR ecosystem**; (ii) an **irreplaceable CBA 1** or **optimal CBA 2**; or (iii) the **NPAES** if the structure is located in such an area. The removal of indigenous vegetation will likely cause a loss of individuals of threatened, protected and/or endemic plant species since several CR, EN, VU, protected and endemic species are present in the port precinct. Vegetation clearance will cause a loss of parts of a Key Biodiversity Area (KBA) because almost the entire port is located in a KBA. Vegetation clearance is also accompanied by a loss of faunal habitat. Vegetation clearance will also be associated with increased sand movement and erosion of topsoil material. Transported sand may accumulate and smother adjacent vegetation, affecting in particular small plant species. Sand storms may intensify as a result of vegetation clearance and the effects of sandblasting on the vegetation may increase. Vegetation clearance will decrease ecosystem services supplied by the botanical component.	Except for areas that have been mapped as transformed habitat, the rest of the Port area has been assigned a **Very High** sensitivity and should thus be avoided (Figure 23). In support of the avoidance as the only option, are the presence of the following: • **CR Namib Seashore Vegetation** as well as **Richtersveld Coastal Duneveld** which are irreplaceable and cannot be offset (Figure 9); • irreplaceable **CBA 1s** (Figure 10); • **CR plant species** (Plant Community 1 & 2, Figure 20); • optimal **CBAs 2s**; • focus areas of the **NPAES** (Figure 12); and • a **Key Biodiversity Area** (Figure 13).
Zone 1: Dry bulk material handling ***Manganese:*** Manganese will be stored in closed stockpiles, with dust suppression using water spraying.	***Dry bulk material handling:*** ***Manganese:*** Manganese is an essential micronutrient for plants but in excess it can be toxic. The type of closed stockpile was not specified. It is recommended to store manganese in a warehouse or specialised silo and move via piped conveyor. Wind can disperse fine particles from stockpiles leading to contamination of the soil, which can affect the vegetation. Water is such a scarce commodity in the area that an alternative method for dust suppression must be sought. Using water for dust suppression is expensive and inefficient and the water will become contaminated. No indication has been given of how the impurities will be extracted or how the water will be disposed of or reused.	Location of the manganese stockpile can impact vegetation and species negatively and all areas listed for **Zone 1: Infrastructure** must be avoided. The stockpile can only be located in habitat that has been intensively modified by mining i.e. Plant Community 3 (Figure 20). Implement an Air Quality Monitoring Plan to monitor and manage atmospheric emissions around stockpiles and warehouses and ensure that monitoring equipment is adequately maintained.

PORT INFRASTRUCTURE ASPECT / SEZ SUBZONE	POTENTIAL IMPACT	RECEIVING ENVIRONMENT OF CONCERN
Lead and zinc: Lead and zinc will be stored in enclosed warehouses.	***Zinc and lead:*** Zinc is an essential micronutrient for plants but in excess it can be toxic. Lead is a toxic heavy metal which negatively affects plant growth. The bulk storage warehouses need to be fully contained to protect against chemical spillage.	
Zone 1: Conveyor belts Systems handling zinc and lead must be fully enclosed, while those handling manganese require arched coverage. Elevated belt conveyors are designed with handrailed walkways for safe access and maintenance.	***Conveyor belts:*** ***Manganese:*** In faulty systems dust can contain manganese particles and other pollutants which may affect plant life if they enter the soil in large amounts. ***Lead and zinc:*** Runoff from the conveyor can lead to leaching of lead/zinc into groundwater.	Implement an Air, Soil and Water Quality Monitoring Plan to monitor and manage atmospheric emissions around the conveyor system and ensure that monitoring equipment is adequately maintained.
Zone 1: Dust control Dust suppression and collection systems are incorporated with all material handling equipment designed to prevent material accumulation outside the dust collection system.	***Dust control:*** It has not been specified how and where the material accumulated in the dust collection system will be discarded.	Dust control systems should avoid the areas mentioned in ***Zone 1: Infrastructure.*** Material collected in the dust suppression system should be disposed of at a registered waste facility.
Zone 1: Bulk services – Water Option 1: Pipeline from Alexander Bay with water treatment plant. It has been assumed that the water treatment plant for this option would be at Alexander Bay. Option 2 (preferred): On-site desalination plant with 1 ML capacity. Elevated reservoirs will provide pressure for fire suppression discharge.	***Desalination of water:*** Vegetation clearance - **see Zone 1: Infrastructure** ***Option 1: Pipeline:*** Pipeline from Alexander Bay is not assessed since no on-site route was provided. ***Option 2: Desalination:*** Reverse osmosis will be used to desalinate seawater. See the Marine Ecology Report to discuss negative effects. In summary: (i) the intake of seawater can harm marine life by impingement and entrainment; (ii) concentrated brine produced can harm marine ecosystems when discharged into the ocean, especially if done without the necessary diffusion; (iii) chemicals used in the desalination process can enter the marine environment; and (iv) brine should also not be discharged at temperatures that are too high for the ecosystem. The possibility to use the brine solution to produce salt can be investigated. The salt needs to be purified to achieve the desired quality. Careful management of the process is required to minimise ecological disruption to surrounding areas. New advances in technology may allow for a nearly waste-free zero liquid discharge desalination which crystalises salt and chemicals.	Desalination plants may not be located in any of the areas mentioned in ***Zone 1: Infrastructure.*** ***Option 2: Desalination:*** Marine ecologists should assist with the site of the seawater intake. Brine discharge demands careful selection of the site and method of discharge. Discharge points must be located away from sensitive marine ecosystems – see Marine Ecology report. Continuous monitoring of the discharge site is needed to allow for adjustment if unacceptable negative impacts are found. Observe compliance with local and international regulations to ensure that discharge practices meet environmental standards.
Zone 1: Bulk services – Sewage The site will be divided into separate drainage areas with isolated reticulation systems, on-site treatment and disposal. Drainage areas will use a combination of waste-water treatment plants, septic tanks and soak-away systems.	***Bulk services – Sewage:*** For vegetation clearance - see ***Zone 1: infrastructure*** Positive impacts could arise if nutrients are recovered and used as fertilizers. Investigate if wastewater could be used for industrial purposes. Negative impacts include the use of chemicals for disinfection that can lead to residual pollutants in	Waste water treatment plants, septic tanks and soak-away systems may not be located in any of the areas mentioned in ***Zone 1: Infrastructure.*** Groundwater contamination by these sewage systems must be avoided.

PORT INFRASTRUCTURE ASPECT / SEZ SUBZONE	POTENTIAL IMPACT	RECEIVING ENVIRONMENT OF CONCERN
	treated water; sludge disposal can lead to soil and water contamination; and inadequate treatment of sewage water leaves pathogens that pose health risks.	
Zone 1: Stormwater drainage systems The drainage system will separate clean and dirty water, with clean water runoff diverted around the site. High-risk dirty runoff water will flow into concrete-lined channels to the pollution control pond and low-risk dirty runoff water will flow into block and vegetated channels. Pollution control ponds will be lined with HDPE (high density polyethylene), attenuated to the 1:50 year pre-development condition and discharged to the receiving natural environment.	***Stormwater drainage systems:*** For vegetation clearance - see ***Zone 1: Infrastructure*** Changing the natural water flow could affect aquatic habitats and diversion of water can concentrate pollutants into some areas. Favourable habitat for invasive species could be created. Poorly maintained systems become clogged and ineffective, possibly causing flooding. Positive impacts could result if (i) diverting stormwater can minimise runoff of pollutants into water bodies; (ii) controlling water flow can reduce soil erosion; and (iii) floods are prevented.	The storm water treatment structures, may not be located in any of the areas mentioned in ***Zone 1: Infrastructure.*** Pollutants may not enter the groundwater.
Zone 1: Electrical: The internal network will include an intake substation, primary and secondary substations and distribution substations.	***Electrical:*** For vegetation clearance - see ***Zone 1: Infrastructure.*** Electrical infrastructure will not be limited to substations. Powerlines need to carry electricity from the renewable source to the intake substation and from there to the other substations. Some lines may be buried which will add to the vegetation clearance. A lifecycle assessment must include all emissions associated with the construction of renewable energy structures, generation and transport. A life cycle assessment clearly indicates the use of carbon during infrastructure manufacturing, thus the renewable energy is not entirely carbon free.	None of the substations may be located in any of the areas mentioned in ***Zone 1: Infrastructure.***
Zone 1: Fuel storage (Phase 1) A liquid bulk storage facility with two 35 000 m^3 tanks and tanker loading facilities is included. Tanker vessels will discharge into storage tanks via pipeline.	***Fuel storage (Phase 1):*** For vegetation clearance - see ***Zone 1: Infrastructure*** Fuel spills can contaminate soil or water bodies and potentially enter the groundwater which will affect plant life and aquatic systems. Volatile organic compounds, other pollutants and strong odours are emitted, reducing air quality. Inadequate management and monitoring will lead to increased risks of contamination and pollution. Flammable fuels pose a risk of fire and explosions.	The bulk fuel storage structures and loading facilities, may not be located in any of the areas mentioned in ***Zone 1: Infrastructure.*** Lichens are particularly sensitive to pollution. A study needs to be conducted on the dominant movement of air from the planned port and SEZ site, to ensure that pollutants from the port and SEZ are not carried onto the Namib Lichen Fields or the Boegoeberg Twins that are also rich in lichens.
Zone 1: Internal port roads and bridges: Port Access Interchange for large volumes of heavy vehicles Port Access Control: access gateways and weighbridge Truck Offloading Area: Three offloading terminals	***Internal port roads and bridges:*** For vegetation clearance - see ***Zone 1: Infrastructure*** Roads can (i) cause habitat fragmentation and disrupt movement of wildlife; (ii) lead to soil erosion; (iii) facilitate the spread of alien invasive species; (iv) change natural water flow patterns; and (v) runoff can carry pollutants affecting water quality. Vehicle emissions degrade air quality and	The internal port roads and bridges should avoid the areas mentioned in ***Zone 1: Infrastructure*** wherever possible. A study needs to be conducted on the dominant movement of air from the planned port and SEZ site, to ensure that pollutants from the vehicle emissions are not carried onto the Namib Lichen Fields or the Boegoeberg Twins that are also rich in lichens.

PORT INFRASTRUCTURE ASPECT / SEZ SUBZONE	POTENTIAL IMPACT	RECEIVING ENVIRONMENT OF CONCERN
	negatively affect lichens and some plant species. Gravel roads lead to the production of dust.	
Zone 1: External roads: In the short-term mining ore will be transported by trucks along the R382, until rail transport viability is considered and established.	***External roads:*** For vegetation clearance - see ***Zone 1: Infrastructure and Zone 1: Internal port roads.*** The R382 will have to be widened to accommodate traffic volumes. This will increase the area where vegetation is cleared.	The external port roads and bridges should avoid the areas mentioned in ***Zone 1: Infrastructure.***
Zone 2: Conservancy area: An conservancy area (ca. 1 170 ha) has been set aside based on conservation priorities such as the presence of the Boegoeberg Twins and seal colony. There is also an archaeological site *viz.* the Boegoebaai cave/ lair.	***Conservancy area:*** Air pollution from the neighbouring SEZ could negatively affect the lichens in the Conservation Area.	**The boundary of the conservation area must be revised to include the entire Boegoeberg North. The Cape fur seal colony should also be included in the Conservancy area. The CSIR will provide a new delineation of the Conservation area.** All development must avoid the Conservancy area. A study needs to be conducted on the dominant movement of air from the planned port and SEZ site, to ensure that pollutants are not carried onto the Boegoeberg Twins that are rich in lichens.
SPECIAL ECONOMIC ZONE (SEZ)		
Zones 3 – 10: Infrastructure *Any structure to be built or covering land related to the SEZ e.g.:* • Offices, warehouses, ammonia facilities, desalination plants & electrolyser; • Manufacturing infrastructure; • Gas storage facilities; • Wastewater treatment plants; • Firewater tanks; and • Lye solution purges	For vegetation clearance - see ***Zone 1: Infrastructure***	The SEZ infrastructure should avoid the areas mentioned in ***Zone 1: Infrastructure.***
Zone 3: Desalination plant: Desalination plant and associated infrastructure (including seawater intake infrastructure and discharge pipeline) Water reservoirs	***Desalination plant:*** For vegetation clearance - see ***Zone 1: Infrastructure.*** See discussion on desalination in ***Zone 1: Bulk services - water***	Desalination plants may not be located in any of the areas mentioned in ***Zone 1: Infrastructure.***
Zone 3: Electrolyser: Electrolyser will split water into hydrogen and oxygen to produce green H_2. Hydrogen and oxygen storage Lye solution purge from the GH_2 plant will be discharged with the other return streams to the sea.	**Electrolyser:** For vegetation clearance for electrolyser unit and associated infrastructure - see ***Zone 1: Infrastructure*** Electrolysers require large amounts of demineralised water to produce hydrogen; Desalination of seawater is costly and discharge of the brine is environmentally harmful; Some electrolysis processes involve the use of chemicals, which need to be managed to avoid further risks. Large areas of land are needed to generate renewable power by wind and solar for the desalination of seawater and subsequent electrolysis. The alternative would be to use small nuclear power reactors as carbon-free source, however these systems are expensive and also come with risks.	The electrolyser may not be located in any of the areas mentioned in ***Zone 1: Infrastructure.***

PORT INFRASTRUCTURE ASPECT / SEZ SUBZONE	POTENTIAL IMPACT	RECEIVING ENVIRONMENT OF CONCERN
	In many systems the lye solution can be recycled. If the lye solution is to be discharged it must be treated to neutralise its alkalinity and remove contaminants before releasing it. Hydrogen is a very light, non-toxic, flammable gas. When released into the atmosphere and it is not dispersed it will probably ignite. Because hydrogen is colourless and odourless, sensors must be appropriately positioned to detect leakages. It burns with a pale blue flame that is nearly invisible in daylight, so detection by human senses is difficult.	
Zone 3: Ammonia facility: The green ammonia facility will be located near the TNPA port and adjacent to the coast and desalination plant. ***Associated infrastructure:*** Air separation unit Liquid air energy system (LAES) for nitrogen storage Ammonia processing unit and liquid ammonia storage tank Pipelines required for hydrogen, its derivatives and by-products, and a control room Cooling tower blowdown Gasses (oxygen and small quantities of other gas) expected to be safe to vent to the atmosphere	***Ammonia facility:*** For vegetation clearance - *see* ***Zone 1: Infrastructure & Zone 3: Electrolyser*** for hazards associated with hydrogen. Positive impacts of the ammonia facility include: (i) a reduction in fossil fuel use; (ii) production of green ammonia as fertiliser without contributing to greenhouse gas emissions; (iii) ammonia is an energy carrier enabling storage and transport of renewable energy; (iv) production from GH_2 produces less harmful pollutants than traditional ammonia production. Negative impacts of the ammonia facility include: (i) electrolysis and ammonia production require substantial energy from renewable resources; (ii) large areas of land are used to generate renewable energy by wind and solar; (iii) large amounts of water are needed for electrolysis; (iv) ammonia is toxic and poses risks during handling and transportation; (v) strict safety measure to prevent leaks and accidents are essential. Ammonia is a hazardous substance and leaks can cause air pollution and can pose serious health risks. Ammonia can contaminate groundwater. Although the production of ammonia using renewable energy is cleaner that using fossil fuel, a lifecycle assessment must include all emissions associated with the construction of renewable energy infrastructure, generation and transport. Cooling tower blowdown may contain dissolved solids (minerals) that accumulate due to evaporation. Proper treatment of blowdown prior to release is thus essential. Ammonia can contaminate the soil, although it would act as fertiliser to plants.	The ammonia facility and associated infrastructure may not be located in any of the areas mentioned in ***Zone 1: Infrastructure.*** It is essential to monitor the atmospheric emissions around the ammonia facility. A study needs to be conducted on the dominant movement of air from the planned SEZ, to ensure that pollutants from the SEZ are not carried onto the Namib Lichen Fields or the Boegoeberg Twins that are also rich in lichens.
Zone 3: Firewater: Firewater will be stored in firewater tanks. There is an opportunity to combine firewater and desalinated water storage on site. Seawater will be used as backup source when stored firewater is not adequate.	***Firewater:*** Firewater (i) runoff can introduce pollutants into the soil and water bodies and could potentially disrupt habitats; (ii) if firefighting foams are used, toxic substances can persist in the environment; (iii) when using seawater, the discharge will have a high salinity and increased pollutant load; and (iv) intake of seawater can harm marine life by impingement and entrainment.	Firewater infrastructure may not be located in any of the areas mentioned in ***Zone 1: Infrastructure.*** The location of the point of seawater intake needs to be carefully selected – see Marine Ecology report.
Zone 4 – 6: Industrial Park The Industrial Park will be designated for	For vegetation clearance for the Industrial Park - see ***Zone 1: Infrastructure***	The Industrial Park may not be located in any of the areas mentioned in ***Zone 1: Infrastructure.***

PORT INFRASTRUCTURE ASPECT / SEZ SUBZONE	POTENTIAL IMPACT	RECEIVING ENVIRONMENT OF CONCERN
mixed-use purposes; a manufacturing cluster; logistics; warehousing; and offices. It will also include a desalination plant, pump station, supply pipelines, feeder pipelines.	See discussion on desalination in ***Zone 1: Bulk services - water***	
Zone 7. Future GH_2 facility: *Replication of Green Ammonia Facilities*	***See Zone 3: Ammonia facility***	The future GH_2 facility may not be located in any areas mentioned in ***Zone 1: Infrastructure.***
Zone 8. Future GH_2 facility: *Replication of Green Ammonia Facilities*	***See Zone 3: Ammonia facility***	The future GH_2 facility may not be located in any areas mentioned in ***Zone 1: Infrastructure.***
Zone 9. Future GH2 facility: *Replication of Green Ammonia Facilities*	***See Zone 3: Ammonia facility***	The future GH_2 facility may not be located in any areas mentioned in ***Zone 1: Infrastructure.***
Zone 10. Future tank storage: Proposed area of approximately 1 704 ha inland of the R382 road.	***See Zone 1: Fuel storage***	The bulk fuel storage structures and loading facilities, may not be located in any of the areas mentioned in ***Zone 1: Infrastructure.***

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7. CONCLUSIONS AND RECOMMENDATIONS

The potential benefits of the Boegoebaai development must be evaluated against the irreversible loss of plant and vegetation diversity and ecosystem services. The current high-level evaluation of the botanical component demonstrated a **Very High** sensitivity and consequently the proposed development requires a cautious approach with a strong emphasis on the conservation of botanical diversity. Mitigation measures cannot eliminate irreversible losses of critical habitats and species and in such instances avoidance will be the only option. Therefore, the proposed development will need to revisit alternative sites where impacts on the receiving environment have lower sensitivities.

The Boegoebaai Port and SEZ site is located in the Desert and Succulent Karoo Biomes. Compared to other deserts with the same level of aridity globally, the Desert Biome in South Africa is exceptionally rich in plant species and also hosts a large number of endemic plant species. The Succulent Karoo Biome is recognised as one of the IUCN global hotspots of biodiversity and one of only two global hotspots that are entirely arid. To qualify as a hotspot, the area must contain a high level of species diversity, a high percentage of endemic species and a substantial number of species that are threatened. Due to the high levels of biodiversity in both the Succulent Karoo and Desert vegetation, the proposed Boegoebaai Port and SEZ site encompasses many features of **High** or **Very High** sensitivity.

The provisional checklist for the Boegoebaai Port and SEZ site contains 390 plant species that have been confirmed occurring on site. The confirmed on-site checklist includes eight plant species with a Critically Endangered IUCN status, nine plant species classified as Endangered, 15 as Vulnerable, seven as Near Threatened, six as Data Deficient and one as Rare. Thus, in total 46 species on site could be classified as SCC, representing 11.8% of all species on site. It is likely that this provisional checklist is not yet complete since the mined area to the west of the R382 has been poorly surveyed by plant collectors because of the historically restricted access to the area.

The receiving environment in the proposed Boegoebaai Port and SEZ site hosts many features that indicate priority habitat for biodiversity conservation, such as:

- Two **Critically Endangered ecosystems**, the Richtersveld Coastal Duneveld and the Namib Seashore Vegetation;
- Large areas classified as **irreplaceable CBA 1s** or as **optimal CBA 2s** (2016 Northern Cape CBA map);
- Habitat for **Critically Endangered plant species**;
- Portions included in the **National Protected Area Expansion Strategy** (NPAES);
- Inclusion into an internationally recognised Key **Biodiversity Area** (KBA); and
- The **Critically Endangered Namib Lichen Fields**, *ca* 13 km north of the site, is a small unique ecosystem at risk of collapse due to high rates of habitat loss in the past. Lichens are extremely sensitive to air pollution and sand movement. Care must be taken that the proposed development does not negatively impact this ecosystem.

On the positive side, the level of infestation by alien invasive plant species in the proposed Boegoebaai Port and SEZ is low. A large proportion of the site was previously mined and the vegetation in these areas is transformed (modified habitat *sensu* IFC). Furthermore, mine-induced sand plumes cover large sections of land. These transformed habitats could be used for development provided that areas of priority habitat are not negatively impacted by the development.

A broad-scale, high-level, on-site reconnaissance and evaluation of the vegetation was conducted. The field assessment relied heavily on the expert knowledge of a Richtersveld botanical specialist, and was supported by available data. A small number of surveys were done during the reconnaissance visit. These data were classified and nine plant communities identified, described and a broad-scale vegetation map produced.

From a vegetation ecology and flora perspective the major source of impacts of the proposed Boegoebaai Port and SEZ development will result directly or indirectly from vegetation clearance which will lead to habitat loss and transformation and loss of the priority diversity features mentioned above.

The ToR for the vegetation and flora component of the SEA required the ground-truthing of the environmental sensitivities indicated by the Screening Tool. Although the Screening Tool rated the sensitivity of the Plant Theme as Medium, the current assessment recorded 46 SCC on site and an upscaling of the Plant Theme to **Very High** is recommended. The Screening Tool rated the sensitivity of the Relative Terrestrial Biodiversity Theme as **Very High**. The current assessment supported a **Very High** sensitivity for most of the site. Although the plant community that was previously mined was located within the area mapped as a Critically Endangered ecosystem (Richtersveld Coastal Duneveld), it was classified as transformed in the current assessment and could be used for development.

The available information used to produce the sensitivity maps for the current assessment of the Boegoebaai SEA is at a coarse scale. The sensitivity ratings were applied per plant community and relied on the presence of various features within a plant community. The screening level sensitivity maps in this report therefore need to be improved over time when major revisions of the underlying data (e.g. national vegetation types, threatened ecosystems, CBA maps, NPAES or other fine-scale conservation planning products) are produced or when detailed studies of the site become available. **Considering the large areas with a Very High sensitivity rating, it would be prudent to conduct an in-depth, fine-scale analysis of the vegetation to produce a detailed vegetation map of the entire area as soon as possible, rather than conducting multiple EIAs at different levels of detail over a long period of time. Such a map will significantly contribute towards planning the layout of the port and SEZ and could potentially avoid placing footprints in areas that could possibly not receive Environmental Authorization.**

It is recommended that such detailed, fine-scale vegetation and sensitivity maps are used for planning purposes. During the planning phase, areas of **Very High** sensitivity should be avoided, and as far as possible areas of **High** sensitivity should also be avoided. Residual impacts on irreplaceable biodiversity cannot be offset since that would prevent national biodiversity targets from being met. Avoidance would in the first place imply revisiting the alternative site options. For possible alternative sites, consult Botha & Desmet (2022) or the presentation given by TNPA (meeting 10 October 2024), where a site approximately 18 km north of Port Nolloth was identified (p. 6) (https://www.csir.co.za/sites/default/files/Documents/Appendix%20C_Overview%20of%20Boegoebaai%20Site%20Selection%20process.pdf). Although offset options are not applicable to impacts of Very High sensitivity, offsets may be required for impacts of High or Medium sensitivity. Should offsets be required, biodiversity offset studies have to be conducted.

Should the proposed development proceed, it is strongly recommended to establish all planned infrastructure in the already transformed mining landscapes, west of the tar road, **provided adjacent areas of priority habitat are not negatively impacted by the development.** However, the impacts of such a large development such as the Boegoebaai Port and SEZ will generally not be limited to the site but will be more widespread and land adjoining the site will likely also be affected. Neighbouring areas could thus be targeted by plant poaching as a result of increased human activities due to the development.

Because hyper-arid areas are very difficult to rehabilitate successfully, a major risk would be that the site is not adequately rehabilitated to a functioning system and a degraded, vulnerable and disturbed ecosystem is left behind.

Practical recommendations for future EIA studies:

All EIA studies must adhere to the following legislation and guidelines, as relevant at the time of the assessments:

- National Environmental Management Act (NEMA) (Act No 107, 1998): NEMA requires that measures are taken to "prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development." The disturbance of ecosystems and loss of biological diversity should be avoided, or where they cannot be altogether avoided, are minimised and remedied.

- The National Environmental Management: Biodiversity Act (NEMBA) (Act 10 of 2004) (NEM:BA, 2004) provides for listing of endangered, threatened and otherwise controlled species (ToPS) and threatened or protected ecosystems.
- The National Protected Area Expansion Strategy falls under NEMBA and is South Africa's national strategy for expansion of the protected area network (NPAES, 2018).
- The National Biodiversity Assessment is the primary tool for monitoring and reporting on the state of biodiversity in South Africa. It is used to inform policies, strategies and actions in a range of sectors for managing and conserving biodiversity more effectively.
- The reports have to be prepared in terms of the Environmental Impact Assessment (EIA) Regulations under the National Environmental Management Act (Act No. 107 of 1998) (NEMA 2014, 2017) and the gazetted *Procedures for the assessment and minimum requirements for reporting on identified environmental themes in terms of Sections 24(5) (a) and (h) and 44 of the National Environmental Management Act, 1998,* when applying for environmental authorisation, specifically the *'Protocol for the Specialist Assessment and Minimum Report Content Requirements of Environmental Impacts on Terrestrial Biodiversity' (GG 43110 / GN R320, 20 March 2020; NEMA, 2020a and Government Gazette 43855, GN R1150, 30 October 2020; NEMA, 2020b).* Guidance for the implementation of the above-mentioned protocols must be followed according to SANBI (2020, as amended).

It is recommended that the specialist studies should provide:

- A description of the biodiversity at ecosystem level including (i) main vegetation types and environmental determinants; (ii) CBAs, ESAs and 'reasons' for CBA mapping; (iii) threatened ecosystems; (iv) NPAES Focus Areas; and (v) NFEPA Priority Catchments, rivers, wetlands and estuaries within the site.
- A fine-scale map of plant communities/habitats, wetlands, rivers and estuaries that occur on site.
- A description of the plant communities/habitats, including environmental features, common species and SCC.
- A fine-scale 4-tier sensitivity map with criteria for allocating units to the different sensitivity classes.
- A description of species biodiversity including (i) distribution of threatened fauna and flora; (ii) if possible, viability and estimated population size of threatened species; and (iii) the likelihood of other SCC occurring.
- If possible, the potential impact of the development on SCC in terms of the likely reduction in population size and viability.
- A description of other noteworthy landscape features such as (i) rocky outcrops; (ii) seasonal wetlands; (iii) quartz patches; (iv) lichen fields; (v) salt marshes; (vi) rare or important vegetation.
- An assessment of the level of alien invasive plant infestation.
- An assessment of site condition based on current or previous land uses.
- A description of biodiversity patterns and processes and the potential impacts of the proposed development and related activities on these patterns and processes.
- Recommendations to prevent, mitigate or restore disturbed vegetation, aquatic features, or ecological processes. Mitigation measures from the specialist studies are to be incorporated into the EMPr.
- Evidence of how the layout of the development incorporated biodiversity considerations.
- A list of all relevant legislation, permits and standards that would apply to the development.
- If applicable, list additional studies that should be conducted to avoid/ameliorate impacts to sensitive features.
- Recommendations on monitoring.

Recommendations to enhance positive impacts and reduce negative impacts

Rehabilitation: Rehabilitation aims to ensure the long-term stability of soils, landforms and hydrology required to establish and sustain a natural ecosystem that supports the approved future land use. Rehabilitation also aims to partially or fully repair the capacity of ecosystems to provide habitats for biota and services for people. Hyper-arid areas such as the Richtersveld are very difficult to rehabilitate successfully. A rehabilitation specialist, with expertise in the rehabilitation and ecological restoration along the West Coast of South Africa (e.g. Nurture, Restore, Innovate), should be consulted to advise on the possibilities of rehabilitating and potentially even restoring the vegetation. The rehabilitation specialist should be able to advise on setting rehabilitation targets and objectives and which locally occurring species of different functional types could be used in rehabilitation. Other topics to include in the rehabilitation recommendations are (i) landscaping; (ii) soil properties to consider; (iii) availability of topsoil and the presence of a seed bank; (iv) water erosion; (v) wind erosion; and (vi) whether the use of restoration packs or transplanting would be feasible (Desmet, 1996; De Villiers *et al.,* 2004; Carrick, 2022). The rehabilitation process should be initiated as soon as possible after an area has been disturbed. This can be done immediately after the construction phase of the Boegoebaai development has been completed, except if old mining scars are to be rehabilitated.

Sand stabilisation: Sand stabilisation should be addressed by biological, chemical or mechanical means or the use of geotextiles. The aim of the sand stabilisation would be to prevent sand from reaching priority habitat to the north of of the proposed development.

Monitoring requirements: The monitoring protocol must be developed during the EIA phase. (i) Populations of key plant SCC, that could potentially be impacted by the proposed development, should be monitored throughout construction and operation to ensure that these SCC are not negatively impacted by the development or being poached. Should negative impacts due to the development be identified, they must be mitigated.

Monitoring frequency will depend on the phenology and life cycle of the particular species. The rehabilitation progress should be monitored annually. A monitoring program for the early detection of alien invasive plant species should also be implemented and a control program to combat declared alien invasive plant species must be employed.

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Appendix A: Provisional checklist of plant species in the Boegoebaai Port and SEZ site and close environs

National criteria for allocation the IUCN status given to those SCC confirmed on site are given below the table.
**Plant names provided in Desmet (1996) could not be confirmed as occurring on site.
***NCNCA (Northern Cape Nature Conservation Act) Protected and Specially Protected species.

Species are colour coded according to their IUCN status listed in the Threatened Species Programme of SANBI (marked with #) or SANBI (2024).

Family	Species	IUCN#	**Study area combined**	Study area P van Wyk	2024 Site visit	Study area iNaturalist	SANBI: NewPOSA	Van Wyk: Larger area	Desmet (1996)**		NCNCA ***	CITES	ToPS-listed species	Alien invasive species
Acanthaceae	*Justicia crassiuscula*	VU	x				x							
Acanthaceae	*Justicia incana*	LC	x				x							
Aizoaceae	*Aizoon africanum*	LC	x				x				x			
Aizoaceae	*Aizoon collinum*	LC							x		x			
Aizoaceae	*Aizoon crystalinum*	LC	x	x	x		x	x	x		x			
Aizoaceae	*Aizoon fruticosum*	LC	x	x			x	x			x			
Aizoaceae	*Aizoon pruinosum*	LC	x	x	x			x			x			
Aizoaceae	*Aizoon sarcophyllum*	LC	x	x	x			x			x			
Aizoaceae	*Aizoon squamulosum*	LC							x		x			
Aizoaceae	*Amphibolia rupis-arcuatae*	LC	x	x	x	x	x	x	x		x			
Aizoaceae	*Amphibolia succulenta*	NT	x	x	x		x	x			x			
Aizoaceae	*Antimima buchubergensis*	-						x			x			
Aizoaceae	*Antimima maleolens*	LC							x		x			
Aizoaceae	*Antimima paripetala*	LC	x	x		x	x		x		x			
Aizoaceae	*Antimima perforata*	-	x	x	x			x	x		x			
Aizoaceae	*Antimima* sp. nov.	-	x	x	x				x		x			
Aizoaceae	*Antimima cf. varians*	LC	x		x						x			
Aizoaceae	*Astridia lutata = Astridia velutina*	DDD						x			x			
Aizoaceae	*Cephalophyllum ebracteatum*	VU	x	x	x	x	x	x	x		x			
Aizoaceae	*Cephalophyllum rigidum*	LC	x	x	x	x					x			
Aizoaceae	*Cheiridopsis brownii*	EN						x			x			
Aizoaceae	*Cheiridopsis robusta*	LC	x	x	x	x		x	x		x			
Aizoaceae	*Cheiridopsis verrucosa*	CR						x	x		x			
Aizoaceae	*Conicosia elongata*	LC	x	x	x			x	x		x			
Aizoaceae	*Conicosia pugioniformis* subsp. *alborosea*	LC	x	x				x			x			
Aizoaceae	*Conophytum saxetanum*	EN	x	x	x	x		x	x		x	iii		
Aizoaceae	*Dicrocaulon spissum*	LC					x				x			
Aizoaceae	*Dracophilus dealbatus*	CR				x		x	x		x			
Aizoaceae	*Drosanthemum curtophyllum*	LC	x	x					x		x			
Aizoaceae	*Drosanthemum hispidum*	LC	x	x							x			
Aizoaceae	*Drosanthemum inornatum*	LC	x	x	x			x			x			
Aizoaceae	*Drosanthemum luederitzii*	LC	x	x	x	x	x				x			
Aizoaceae	*Drosanthemum salicola*	LC						x			x			
Aizoaceae	*Eberlanzia cyathiformis*	LC	x	x	x				x		x			
Aizoaceae	*Eberlanzia ebracteata*	LC							x		x			
Aizoaceae	*Eberlanzia sedoides*	LC	x	x	x	x		x			x			
Aizoaceae	*Enarganthe octonaria*	EN						x			x			
Aizoaceae	*Fenestraria rhopalophylla* subsp. *aurantiaca*	LC	x	x	x	x	x	x	x		x			
Aizoaceae	*Jordaaniella clavifolia*	VU	x	x	x						x			
Aizoaceae	*Jordaaniella cuprea*	LC	x	x	x	x	x	x	x		x			
Aizoaceae	*Jordaaniella spongiosa*	LC	x	x	x	x		x	x		x			
Aizoaceae	*Jordaaniella uniflora*	EN	x	x				x			x			
Aizoaceae	*Juttadinteria deserticola*	CR						x	x		x			
Aizoaceae	*Lampranthus godmaniae*	LC						x			x			
Aizoaceae	*Lampranthus hoerleinianus*	LC							x		x			
Aizoaceae	*Lampranthus otzenianus*	LC	x	x	x	x		x			x			
Aizoaceae	*Lampranthus stipulaceus*	LC	x	x	x		x				x			
Aizoaceae	*Leipoldtia frutescens*	VU					x				x			

Family	Species	IUCN#	**Study area combined**	Study area P van Wyk	2024 Site visit	Study area iNaturalist	SANBI: NewPOSA	Van Wyk: Larger area	Desmet (1996)**		NCNCA ***	CITES	ToPS-listed species	Alien invasive species
Aizoaceae	*Leipoldtia uniflora*	LC	x	x		x		x	x		x			
Aizoaceae	*Lithops herrei*	VU				x		x	x		x			
Aizoaceae	*Malephora purpureo-crocea*	LC				x					x			
Aizoaceae	*Mesembryanthemum barklyi*	LC	x	x	x	x		x	x		x			
Aizoaceae	*Mesembryanthemum brevicarpum*	LC	x	x				x			x			
Aizoaceae	*Mesembryanthemum cf. coriarium*	LC	x		x						x			
Aizoaceae	*Mesembryanthemum crystallinum*	LC	x	x	x	x			x		x			
Aizoaceae	*Mesembryanthemum deciduum*	LC	x	x				x			x			
Aizoaceae	*Mesembryanthemum dinteri*	LC	x	x	x	x	x	x	x		x			
Aizoaceae	*Mesembryanthemum guerichianum*	LC						x			x			
Aizoaceae	*Mesembryanthemum hypertrophicum*	LC	x	x	x			x	x		x			
Aizoaceae	*Mesembryanthemum marlothii*	LC	x	x	x			x	x		x			
Aizoaceae	*Mesembryanthemum noctiflorum*	LC	x	x	x			x	x		x			
Aizoaceae	*Mesembryanthemum occidentale*	EN						x			x			
Aizoaceae	*Mesembryanthemum oculatum*	LC	x	x	x			x	x		x			
Aizoaceae	*Mesembryanthemum pseudoschlichtianum*	LC	x	x				x			x			
Aizoaceae	*Mesembryanthemum quartziticola*	LC	x	x					x		x			
Aizoaceae	*Mesembryanthemum schlichtianum = M. arenosum = Brownanthus arenosus*	LC	x	x	x			x	x		x			
Aizoaceae	*Mesembryanthemum serotinum*	LC	x	x				x			x			
Aizoaceae	*Mesembryanthemum spinuliferum*	LC							x		x			
Aizoaceae	*Mesembryanthemum subnodosum*	LC	x	x	x				x		x			
Aizoaceae	*Mesembryanthemum tetragonum*	LC	x	x										
Aizoaceae	*Meyerophytum meyeri*	LC				x			x		x			
Aizoaceae	*Psammophora modesta*	VU						x	x		x			
Aizoaceae	*Ruschia crassa*	LC					x				x			
Aizoaceae	*Ruschia fugitans*	DDT	x	x				x	x		x			
Aizoaceae	*Ruschia pallens*	LC	x	x	x	x		x			x			
Aizoaceae	*Ruschia pollardii*	-	x	x		x					x			
Aizoaceae	*Ruschia senaria*	LC						x			x			
Aizoaceae	*Ruschia* sp. 1 (possibly new)	-	x	x							x			
Aizoaceae	*Ruschia* sp. 2	-	x	x	x						x			
Aizoaceae	*Ruschia cf. variabilis*	-	x	x										
Aizoaceae	*Ruschia cf. viridifolia*	LC	x		x						x			
Aizoaceae	*Schlechteranthus diutinus*	LC					x				x			
Aizoaceae	*Schlechteranthus holgatensis*	VU	x	x		x		x			x			
Aizoaceae	*Stoeberia beetzii*	LC	x	x	x	x		x	x		x			
Aizoaceae	*Stoeberia frutescens*	LC	x	x	x	x		x			x			
Aizoaceae	*Stoeberia gigas*	CR						x	x		x			
Aizoaceae	*Stoeberia utilis*	LC	x	x	x	x	x	x	x		x			
Aizoaceae	*Tetragonia echinata*	LC	x	x	x			x			x			
Aizoaceae	*Tetragonia fruticosa*	LC	x	x			x	x	x		x			
Aizoaceae	*Tetragonia glauca*	LC	x				x				x			
Aizoaceae	*Tetragonia microptera*	LC							x		x			
Aizoaceae	*Tetragonia namaquensis*	LC	x				x				x			
Aizoaceae	*Tetragonia robusta*	LC							x		x			
Amaranthaceae	*Atriplex cinerea* subsp. *bolusii*	NE							x					
Amaranthaceae	*Atriplex eardleyae*	NE							x					
Amaranthaceae	*Atriplex lindleyi* subsp. *inflata*	NE							x					1b
Amaranthaceae	*Atriplex vestita* var. *appendiculata*	NE	x	x	x		x	x						
Amaranthaceae	*Atriplex vestita* var. *inappendiculata*	NE					x							
Amaranthaceae	*Bassia dinteri*	CR	x				x	x						
Amaranthaceae	*Chenopodiastrum murale = Chenopodium murale*	NE	x	x				x						
Amaranthaceae	*Manochlamys albicans*	LC	x	x	x			x						
Amaranthaceae	*Salsola angolensis*	LC	x				x							
Amaranthaceae	*Salsola aphylla (= Caroxylon aphyllum)*	LC	x	x			x							
Amaranthaceae	*Salsola merxmuelleri*	DDD	x				x							
Amaranthaceae	*Salsola nollothensis*	LC	x	x	x		x		x					

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Amaranthaceae	*Salsola* sp.	-	x	x				x						
Amaranthaceae	*Salsola zeyheri = Caroxylon zeyeri*	LC	x	x			x	x	x					
Amaranthaceae	*Sarcocornia natalensis* var. *affinis*	LC	x	x	x			x						
Amaranthaceae	*Sarcocornia pillansii*	LC	x				x							
Amaranthaceae	*Suaeda fruticosa*	LC							x					
Amaranthaceae	*Suaeda plumosa*	?	x	x				x						
Amaryllidaceae	*Ammocharis longifolia*	LC						x			x			
Amaryllidaceae	*Boophone* sp.	-							x		x			
Amaryllidaceae	*Gethyllis grandiflora*	LC	x	x		x			x		x			
Amaryllidaceae	*Gethyllis linearis*	LC	x	x				x			x			
Amaryllidaceae	*Gethyllis* sp.	-	x		x						x			
Amaryllidaceae	*Haemanthus pubescens* subsp. *arenicola*	EN							x		x			
Amaryllidaceae	*Strumaria bidentata*	CR						x	x		x			
Anacampserotaceae	*Anacampseros albissima*	LC					x		x		x	ii		
Anacampserotaceae	*Anacampseros filamentosa* ssp. *namaquensis = A. namaquensis*	LC	x	x	x	x		x			x	ii		
Anacampserotaceae	*Anacampseros cf. gariepensis*	CR	x		x			x			x	ii		
Anacampserotaceae	*Anacampseros retusa*	LC	x	x		x		x			x	ii		
Anacardiaceae	*Searsia longispina*	LC	x	x	x			x						
Anacardiaceae	*Searsia undulata*	LC				x			x					
Apiaceae	*Anginon* sp.	-	x		x						x			
Apiaceae	*Capnophyllum leiocarpon*	LC	x	x				x			x			
Apiaceae	*Cynorhiza typica*	LC	x	x	x	x			x		x			
Apiaceae	*Dasispermum hispidum*	LC	x	x	x			x			x			
Apiaceae	*Dasispermum tenue*	LC							x		x			
Apiaceae	*Deverra denudata* subsp. *aphylla*	LC	x	x			x	x	x		x			
Apocynaceae	*Ceropegia herrei = Huernia namaquensis*	LC				x	x		x		x			
Apocynaceae	*Ceropegia marlothii = Larryleachia marlothii*	NT					x	x	x		x			
Apocynaceae	*Ceropegia pachyrrhiza*	LC						x	x		x			
Apocynaceae	*Ceropegia pulvinata = Stapelia pulvinata*	-	x	x										
Apocynaceae	*Cynanchum meyeri*	VU						x			x			
Apocynaceae	*Cynanchum viminale* subsp. *thunbergii*	LC						x			x			
Apocynaceae	*Ectadium virgatum*	NT						x			x			
Apocynaceae	*Gomphocarpus fruticosus*	LC						x			x			
Apocynaceae	*Microloma sagittatum*	LC	x	x		x		x	x		x			
Apocynaceae	*Quaqua armata* subsp. *maritima*	LC	x	x			x		x		x			
Apocynaceae	*Quaqua inversa = Ceropegia inversa*	LC	x	x							x			
Apocynaceae	*Quaqua parviflora* subsp. *parviflora*	LC	x		x			x			x			
Apocynaceae	*Rhyssolobium dumosum*	EN						x	x		x			
Apocynaceae	*Stapelia hirsuta* var. *gariepensis*	CR						x			x			
Apocynaceae	*Stapelia similis*	LC						x			x			
Apocynaceae	*Tridentea pachyrrhiza*	LC	x	x	x	x					x			
Asparagaceae	*Asparagus acocksii*	LC							x					
Asparagaceae	*Asparagus asparagoides*	LC							x					
Asparagaceae	*Asparagus capensis*	LC	x	x	x	x	x	x	x					
Asparagaceae	*Asparagus declinatus*	LC	x	x				x						
Asparagaceae	*Asparagus exuvialis*	LC	x	x				x						
Asparagaceae	*Asparagus fasciculatus*	LC							x					
Asparagaceae	*Asparagus graniticus*	LC	x	x	x			x						
Asparagaceae	*Asparagus juniperoides*	LC	x	x	x			x	x					
Asparagaceae	*Asparagus* sp.	LC	x		x		x							
Asparagaceae	*Asparagus retrofractus*	LC							x					
Asparagaceae	*Asparagus undulatus*	LC	x	x	x			x	x					
Asphodelaceae	*Aloe arenicola*	EN	x	x				x	x		x	ii		
Asphodelaceae	*Aloe framesii*	NT	x	x	x	x			x		x	ii		
Asphodelaceae	*Aloe gariepensis*	VU						x			x	ii		
Asphodelaceae	*Aloe krapholiana*	LC						x			x	ii	prot	
Asphodelaceae	*Aloe microstigma*	LC									x	ii		
Asphodelaceae	*Aloidendron ramosissimum*	EN						x			x			

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Asphodelaceae	*Bulbine abyssinica*	LC	x	x	x			x			x			
Asphodelaceae	*Bulbine* aff. *succulenta*	-							x		x			
Asphodelaceae	*Bulbine frutescens*	LC				x			x		x			
Asphodelaceae	Sensitive species 1110	EN	x	x				x			x			
Asphodelaceae	Sensitive species 407	EN	x	x				x			x			
Asphodelaceae	*Bulbine sedifolia*	LC				x								
Asphodelaceae	*Chlorophytum* sp.	-							x		x			
Asphodelaceae	*Chlorophytum viscosum*	LC	x	x	x			x			x			
Asphodelaceae	*Trachyandra bulbinifolia*	LC	x	x	x			x			x			
Asphodelaceae	*Trachyandra ciliata*	LC	x	x				x			x			
Asphodelaceae	*Trachyandra falcata*	LC	x	x	x	x		x	x		x			
Asteraceae	*Amellus epaleaceus*	LC							x					
Asteraceae	*Amellus flosculosus*	LC							x					
Asteraceae	*Amellus microglossus*	LC							x					
Asteraceae	*Amellus nanus*	LC	x	x			x	x						
Asteraceae	*Amellus tenuifolius*	LC	x	x					x					
Asteraceae	*Arctotheca calendula*	LC						x						
Asteraceae	*Arctotis canaliculata*	-	x	x	x	x								
Asteraceae	*Arctotis decurrens*	DDT							x					
Asteraceae	*Arctotis diffusa*	LC							x					
Asteraceae	*Arctotis fastuosa*	LC	x	x		x		x						
Asteraceae	*Arctotis hirsuta*	LC							x					
Asteraceae	*Arctotis* sp. nov.	-	x	x	x			x						
Asteraceae	*Arctotis stoechadifolia*	LC	x			x								
Asteraceae	*Berkheya fruticosa*	LC				x			x					
Asteraceae	*Chrysocoma ciliata*	LC	x	x				x						
Asteraceae	*Chrysocoma microphylla*	LC	x			x								
Asteraceae	*Cotula anthemoides*	LC	x	x										
Asteraceae	*Cotula coronopifolia*	LC	x		x									
Asteraceae	*Crassothonna clavifolia*	EN						x	x			iii		
Asteraceae	*Crassothonna cylindrica*	LC	x	x	x	x	x	x	x					
Asteraceae	*Crassothonna opima*	CR							x					
Asteraceae	*Crassothonna sedifolia*	LC	x	x	x	x	x	x	x					
Asteraceae	*Crassothonna sparsiflora*	-	x	x										
Asteraceae	*Curio citriformis*	DDT							x					
Asteraceae	*Curio corymbifer = Senecio sarcoides*	LC	x	x		x	x	x						
Asteraceae	*Curio crassulifolius*	DDT	x	x	x			x						
Asteraceae	*Curio pinguifolius = Kleinia pinguifolia*	DDT							x					
Asteraceae	*Curio radicans*	LC	x	x	x			x	x					
Asteraceae	*Curio sulcicalyx*	DDT	x	x	x			x						
Asteraceae	*Didelta carnosa* var. *tomentosa*	LC	x	x	x	x	x	x	x					
Asteraceae	*Dimorphotheca polyptera*	LC	x	x				x						
Asteraceae	*Dimorphotheca sinuata*	LC	x	x				x						
Asteraceae	*Eriocephalus brevifolius*	LC	x	x				x	x					
Asteraceae	*Eriocephalus racemosus*	LC							x					
Asteraceae	*Felicia microsperma*	LC	x	x				x						
Asteraceae	*Felicia muricata*	LC						x						
Asteraceae	*Felicia namaquana*	LC	x	x				x						
Asteraceae	*Felicia* sp.	-	x	x	x									
Asteraceae	*Foveolina dichotoma*	LC	x	x	x			x	x					
Asteraceae	*Gazania* aff. *heterochaeta*	-							x					
Asteraceae	*Gazania lichtensteinii*	LC						x	x					
Asteraceae	*Gazania schenckii*	CR	x	x	x	x	x	x	x					
Asteraceae	*Gazania tenuifolia*	LC	x	x				x	x					
Asteraceae	*Gorteria diffusa* var. *diffusa*	LC						x						
Asteraceae	*Helichrysum* aff. *oxybelium /asperum*	-							x					
Asteraceae	*Helichrysum dunense*	VU	x	x			x	x						
Asteraceae	*Helichrysum gariepinum*	LC						x						
Asteraceae	*Helichrysum hebelepis*	LC	x	x				x						

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Asteraceae	*Helichrysum herniarioides*	LC	x	x	x			x						
Asteraceae	*Helichrysum leontonyx*	LC	x	x				x						
Asteraceae	*Helichrysum marmarolepis*	LC	x	x			x	x	x					
Asteraceae	*Helichrysum micropoides*	LC	x				x		x					
Asteraceae	*Helichrysum obtusum*	LC	x	x			x	x						
Asteraceae	*Helichrysum pumilio* subsp. *pumilio*	LC							x					
Asteraceae	*Ifloga lerouxiae*	Rare	x		x									
Asteraceae	*Lasiospermum brachyglossum*	LC	x				x							
Asteraceae	*Myxopappus acutilobus*	LC	x	x										
Asteraceae	*Oncosiphon grandiflorum*	LC	x	x				x	x					
Asteraceae	*Oncosiphon piluliferum*	LC	x		x									
Asteraceae	*Oncosiphon sabulosus*	LC				x								
Asteraceae	*Oncosiphon* sp.	-	x		x									
Asteraceae	*Oncosiphon suffruticosum*	LC	x	x				x	x					
Asteraceae	*Osteospermum incanum*	LC	x	x	x			x	x					
Asteraceae	*Osteospermum microcarpum*	LC	x	x				x	x					
Asteraceae	*Osteospermum oppositifolium*	LC	x	x	x	x		x	x					
Asteraceae	*Osteospermum polycephalum*	LC	x	x	x			x	x					
Asteraceae	*Othonna arbuscula*	LC	x				x							
Asteraceae	*Othonna bulbosa*	LC							x					
Asteraceae	*Othonna cuneata*	LC							x					
Asteraceae	*Othonna furcata*	LC	x	x	x	x		x	x					
Asteraceae	*Othonna graveolens*	LC							x					
Asteraceae	*Othonna lasiocarpa*	LC	x				x		x					
Asteraceae	*Othonna lobata*	LC	x				x							
Asteraceae	*Othonna pachypoda*	DDT	x	x		x								
Asteraceae	*Othonna perfoliata*	LC				x								
Asteraceae	*Othonna quercifolia*	LC	x	x				x						
Asteraceae	*Othonna sp.*	LC	x		x									
Asteraceae	*Othonna undulosa*	LC	x	x	x			x						
Asteraceae	*Pteronia ciliata*	LC				x								
Asteraceae	*Pteronia divaricata*	LC							x					
Asteraceae	*Pteronia glabrata*	LC	x	x	x		x	x	x					
Asteraceae	*Pteronia onobromoides*	LC	x	x				x	x					
Asteraceae	*Pteronia paniculata*	LC	x	x				x	x					
Asteraceae	*Rhynchopsidium pumilum*	LC	x	x				x						
Asteraceae	*Senecio abruptus*	LC	x	x										
Asteraceae	*Senecio aloides*	LC	x	x	x	x	x	x	x					
Asteraceae	*Senecio arenarius*	LC							x					
Asteraceae	*Senecio cardaminifolius*	LC							x					
Asteraceae	*Senecio piptocoma*	LC	x				x							
Asteraceae	*Ursinia calenduliflora*	LC							x					
Asteraceae	*Ursinia speciosa*	LC	x			x								
Boraginaceae	*Heliotropium tubulosum*	LC						x						
Boraginaceae	*Trichodesma africanum*	LC							x					
Brassicaceae	*Heliophila carnosa*	LC	x				x		x					
Brassicaceae	*Heliophila cornuta* var. *squamata*	NE	x	x				x						
Brassicaceae	*Heliophila lactea*	LC	x	x	x	x	x	x	x					
Brassicaceae	*Lepidium africanum*	LC							x					
Cactaceae	*Opuntia ficus-indica*	NE	x		x	x								1b
Campanulaceae	*Wahlenbergia androsacea*	LC	x	x				x						
Campanulaceae	*Wahlenbergia annularis*	LC	x	x			x	x						
Campanulaceae	*Wahlenbergia asparagoides*	NT	x	x				x						
Campanulaceae	*Wahlenbergia erophiloides*	-						x						
Campanulaceae	*Wahlenbergia prostrata*	LC	x	x				x						
Campanulaceae	*Wahlenbergia psammophila*	LC							x					
Caryophyllaceae	*Dianthus namaensis*	LC	x	x	x		x	x	x		x			
Caryophyllaceae	*Pollichia campestris*	LC							x					
Caryophyllaceae	*Spergularia bocconi*	LC	x	x	x	x		x						

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Caryophyllaceae	*Spergularia media*	NE	x	x	x			x						
Colchicaceae	*Colchicum albomarginatum*	LC				x					x			
Colchicaceae	*Colchicum irroratum*	LC	x	x	x			x			x			
Colchicaceae	*Hexacyrtis dickiana*	EN						x						
Colchicaceae	*Ornithoglossum dinteri*	LC	x	x				x						
Colchicaceae	*Ornithoglossum parviflorum* var. *parviflorum*	NE	x	x	x			x						
Colchicaceae	*Ornithoglossum vulgare*	LC	x	x				x	x					
Crassulaceae	*Adromischus marianiae* var. *hallii*	NE	x	x		x	x		x		x			
Crassulaceae	*Adromischus montium-klinghardtii*	VU	x	x	x	x		x	x		x			
Crassulaceae	*Cotyledon orbiculata* var. *orbiculata*	LC	x	x	x			x	x		x			
Crassulaceae	*Crassula ammophila*	NT	x	x	x	x		x			x			
Crassulaceae	*Crassula atropurpurea* var. *cultriformis*	LC	x	x	x	x	x	x	x		x			
Crassulaceae	Sensitive species 720	VU	x	x	x	x		x			x			
Crassulaceae	*Crassula columnaris*	LC				x		x	x		x			
Crassulaceae	*Crassula columnaris* subsp. *prolifera*	LC	x	x	x	x		x			x			
Crassulaceae	*Crassula corallina* subsp. *macrorrhiza*	LC						x			x			
Crassulaceae	*Crassula cotyledonis*	LC							x		x			
Crassulaceae	*Crassula deceptor*	LC	x	x		x		x	x		x			
Crassulaceae	*Crassula elegans*	LC	x	x	x	x		x	x		x			
Crassulaceae	*Crassula expansa*	LC	x		x		x	x	x		x			
Crassulaceae	*Crassula expansa* subsp. *pyrifolia*	LC	x	x				x			x			
Crassulaceae	*Crassula fusca*	NT						x			x			
Crassulaceae	*Crassula grisea*	LC	x				x	x			x			
Crassulaceae	*Crassula macowaniana*	LC							x		x			
Crassulaceae	*Crassula mesembrianthemopsis*	LC						x			x			
Crassulaceae	*Crassula muscosa* var. *muscosa*	NE	x	x		x		x			x			
Crassulaceae	*Crassula muscosa* var. *obtusifolia*	NE	x	x				x			x			
Crassulaceae	*Crassula natans*	LC	x	x							x			
Crassulaceae	*Crassula nudicaulis*	LC				x					x			
Crassulaceae	*Crassula pallens*	LC							x		x			
Crassulaceae	Sensitive species 305	CR	x	x	x	x		x	x		x			
Crassulaceae	*Crassula pseudohemisphaerica*	LC	x	x		x		x	x		x			
Crassulaceae	*Crassula rudolphii*	LC	x	x	x						x			
Crassulaceae	*Crassula sericea* var. *sericea*	NE	x		x			x			x			
Crassulaceae	*Crassula sladenii*	EN						x	x		x			
Crassulaceae	*Crassula subaphylla*	LC	x	x	x			x	x		x			
Crassulaceae	*Crassula tetragona*	LC	x	x							x			
Crassulaceae	*Crassula tomentosa* var. *tomentosa*	LC	x	x		x		x			x			
Crassulaceae	*Tylecodon buchholzianus* subsp. *fasciculatus*	DDT						x			x			
Crassulaceae	*Tylecodon decipiens*	RARE							x		x			
Crassulaceae	*Tylecodon fragilis*	EN							x		x			
Crassulaceae	*Tylecodon paniculatus*	LC	x	x	x			x	x		x			
Crassulaceae	*Tylecodon racemosus*	LC						x			x			
Crassulaceae	*Tylecodon reticulatus*	LC	x	x	x	x		x	x		x	iii		
Crassulaceae	Sensitive species 1187	VU	x	x	x	x		x	x		x			
Crassulaceae	*Tylecodon similis*	LC	x	x		x		x	x		x			
Crassulaceae	*Tylecodon wallichii* subsp. *ecklonianus*	LC	x	x	x			x			x			
Crassulaceae	*Tylecodon wallichii* subsp. *wallichii*	LC				x		x	x		x			
Curcurbitaceae	*Kedrostis psammophila*	LC	x	x	x			x	x		x			
Curcurbitaceae	*Kedrostis ramosissima*	-	x	x										
Cyperaceae	*Afroscirpoides dioeca*	LC				x								
Cyperaceae	*Cyperus marginatus*	LC	x	x										
Cyperaceae	*Isolepis marginata*	LC	x	x										
Didieriaceae	*Portulacaria fruticulosa*	LC						x				ii		
Didieriaceae	*Portulacaria pygmaea*	CR						x				iii		
Ebenaceae	*Diospyros lycioides* var. *lycioides*	LC						x						
Euphorbiaceae	*Euphorbia angrae**	LC	x	x	x						x	ii		
Euphorbiaceae	*Euphorbia burmannii*	LC	x	x	x	x			x		x	ii		
Euphorbiaceae	*Euphorbia caput-medusae*	LC	x	x	x			x	x		x	ii		

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Euphorbiaceae	*Euphorbia celata*	LC							x		x	ii		
Euphorbiaceae	*Euphorbia dregeana*	LC	x	x				x			x	ii		
Euphorbiaceae	*Euphorbia ephedroides*	LC	x		x	x	x	x	x		x	ii		
Euphorbiaceae	*Euphorbia ephedroides* var. *ephedroides*	NE	x	x				x			x	ii		
Euphorbiaceae	*Euphorbia ephedroides* var. *imminuta*	NE	x	x				x			x	ii		
Euphorbiaceae	*Euphorbia gummifera*	LC						x			x	ii		
Euphorbiaceae	*Euphorbia hamata*	LC	x	x				x			x	ii		
Euphorbiaceae	*Euphorbia mauritanica*	LC	x	x	x			x	x		x	ii		
Euphorbiaceae	*Euphorbia melanohydrata*	EN						x			x	ii		
Euphorbiaceae	*Euphorbia rhombifolia*	LC	x	x	x	x		x	x		x	ii		
Euphorbiaceae	*Euphorbia stapelioides*	LC	x	x	x	x		x	x		x	ii		
Fabaceae	*Calobota acanthoclada*	EN	x		x			x						
Fabaceae	*Calobota angustifolia*	LC	x	x					x					
Fabaceae	*Calobota cinerea*	LC	x	x				x	x					
Fabaceae	*Calobota halenbergensis*	LC	x	x	x			x						
Fabaceae	*Calobota sericea*	LC							x					
Fabaceae	*Crotalaria meyeriana*	NT	x	x	x		x	x	x					
Fabaceae	*Cullen* sp. nov.	-						x						
Fabaceae	*Indigofera exigua*	LC							x					
Fabaceae	*Lessertia candida*	LC	x	x				x	x		x			
Fabaceae	*Lessertia diffusa*	LC							x		x			
Fabaceae	*Lessertia frutescens* subsp. *frutescens*	LC	x	x	x	x		x			x			
Fabaceae	*Lotononis strigillosa*	NT						x						
Fabaceae	*Lotonotis falcata*	LC	x	x				x	x					
Fabaceae	*Medicago polymorpha*	NE							x					
Fabaceae	*Melolobium adenodes*	LC	x	x	x	x		x						
Frankeniaceae	*Frankenia pomonensis*	-	x	x										
Frankeniaceae	*Frankenia pulverulenta*	LC	x	x			x	x						
Geraniaceae	*Monsonia ciliata*	LC	x	x										
Geraniaceae	*Monsonia crassicaulis*	LC							x					
Geraniaceae	*Monsonia flavescens*	VU	x					x						
Geraniaceae	*Monsonia luederitziana*	LC	x	x				x						
Geraniaceae	*Monsonia multifida*	CR						x	x			ii		
Geraniaceae	*Monsonia patersonii*	VU	x	x	x	x	x	x	x			ii		
Geraniaceae	*Monsonia salmoniflora*	LC	x	x										
Geraniaceae	Sensitive species 734	VU	x	x	x	x								
Geraniaceae	*Pelargonium albersii*	CR						x						
Geraniaceae	*Pelargonium carnosum*	LC				x		x	x					
Geraniaceae	*Pelargonium carnosum = Pelargonium parviflorum*	LC	x	x		x								
Geraniaceae	*Pelargonium ceratophyllum*	LC							x					
Geraniaceae	*Pelargonium crithmifolium*	LC				x			x					
Geraniaceae	*Pelargonium echinatum*	LC	x	x		x		x	x					
Geraniaceae	*Pelargonium fulgidum*	LC	x	x	x	x	x	x	x					
Geraniaceae	*Pelargonium grandicalcaratum*	LC	x	x	x	x			x					
Geraniaceae	*Pelargonium klinghardtense*	LC						x						
Geraniaceae	*Pelargonium minimum*	LC	x	x	x			x						
Geraniaceae	*Pelargonium moniliforme*	LC	x	x				x						
Geraniaceae	*Pelargonium sibthorpiifolium*	CR	x	x				x	x					
Geraniaceae	*Pelargonium* sp. nov.	-	x	x	x			x						
Hyacinthaceae	*Albuca acuminata*	LC	x				x							
Hyacinthaceae	*Albuca canadensis*	LC	x	x					x					
Hyacinthaceae	*Albuca cooperi*	LC	x	x	x			x						
Hyacinthaceae	*Albuca flaccida*	LC	x	x				x						
Hyacinthaceae	*Albuca grandis*	LC	x	x	x			x						
Hyacinthaceae	*Albuca hallii*	LC	x			x		x						
Hyacinthaceae	*Albuca maxima*	LC	x	x										
Hyacinthaceae	*Albuca sabulosa*	LC						x						
Hyacinthaceae	*Albuca* sp. nov.	-	x	x					x					

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Hyacinthaceae	*Albuca suaveolens*	LC	x	x	x			x						
Hyacinthaceae	*Dipcadi cf. crispum*	LC	x	x			x	x						
Hyacinthaceae	*Drimia barbata*	CR	x	x	x	x		x						
Hyacinthaceae	*Drimia elata*	LC	x	x				x						
Hyacinthaceae	*Drimia occultans*	-	x	x	x			x						
Hyacinthaceae	*Drimia physodes*	LC						x						
Hyacinthaceae	*Lachenalia anguinea*	LC	x	x				x			x			
Hyacinthaceae	*Lachenalia buchubergensis*	LC						x			x			
Hyacinthaceae	*Lachenalia klinghardtiana*	CR	x	x	x	x	x	x	x		x			
Hyacinthaceae	*Lachenalia punctata*	LC	x		x	x					x			
Hyacinthaceae	*Lachenalia xerophila*	LC	x	x										
Hyacinthaceae	*Ledebouria undulata*	LC	x	x				x						
Hyacinthaceae	*Massonia sessiliflora*	LC						x						
Hyacinthaceae	*Massonia* sp.	-							x					
Hyacinthaceae	*Ornithogalum deltoideum*	LC						x			x			
Hyacinthaceae	*Ornithogalum falcatum*	-	x	x				x			x			
Hyacinthaceae	*Ornithogalum xanthochlorum*	LC							x		x			
Hyacinthaceae	*Trachyandra falcata*	LC	x	x		x								
Hyacinthaceae	*Veltheimia capensis*	LC	x	x	x			x	x		x			
Hydnoraceae	*Hydnora africana*	LC	x	x				x						
Hydnoraceae	*Hydnora triceps*	LC						x						
Iridaceae	*Babiana hirsuta*	LC	x	x	x		x	x	x		x			
Iridaceae	Sensitive species 827	VU	x	x					x		x			
Iridaceae	*Ferraria divaricata*	LC							x		x			
Iridaceae	*Ferraria schaeferi*	LC	x	x	x			x	x		x			
Iridaceae	*Ferraria variabilis*	LC	x	x	x			x			x			
Iridaceae	*Gladiolus orchidiflorus*	LC							x		x			
Iridaceae	*Gladiolus saccatus*	LC	x	x	x	x		x			x			
Iridaceae	*Gladiolus viridiflorus*	LC	x	x		x		x	x		x			
Iridaceae	*Lapeirousia arenicola*	LC	x	x				x			x			
Iridaceae	*Lapeirousia barklyi*	EN	x	x			x		x		x			
Iridaceae	*Lapeirousia macrospatha*	VU	x	x			x	x			x			
Iridaceae	*Moraea fugax*	LC							x		x			
Iridaceae	Sensitive species 293	EN	x	x	x			x			x			
Juncaceae	*Juncus acutus subsp. leopoldtii*	LC	x	x										
Juncaceae	*Juncus* sp.	-	x		x									
Kewaceae	*Hypertelis spergulacea*	LC						x						
Kewaceae	*Kewa angrae-pequenae*	LC	x	x	x				x					
Kewaceae	*Kewa salsoloides*	LC	x	x	x			x	x					
Labiatae	*Salvia aurea = Salvia africana-lutea*	LC	x	x				x						
Labiatae	*Salvia lanceolata*	LC							x					
Limeaceae	*Limeum africanum*	LC							x					
Limeaceae	*Limeum fenestratum*	LC	x	x				x						
Loranthaceae	*Septulina glauca*	LC	x	x				x						
Malvaceae	*Hermannia cf. cuneifolia*	LC	x		x									
Malvaceae	*Hermannia gariepina*	LC						x						
Malvaceae	*Hermannia heterophylla*	LC							x					
Malvaceae	*Hermannia macra*	LC	x	x				x						
Malvaceae	*Hermannia paucifolia*	LC	x	x				x						
Malvaceae	*Hermannia pfeilii*	LC	x	x				x	x					
Malvaceae	*Hermannia* sp. nov.	-	x	x				x						
Malvaceae	*Hermannia trifurca*	LC							x					
Malvaceae	*Lavatera arborea*	NE	x	x				x						
Malvaceae	*Malva* cf. *parviflora*	-	x		x									
Malvaceae	*Radyera urens*	LC	x	x				x						
Menispermaceae	*Antizoma miersiana*	LC	x	x				x						
Molluginaceae	*Adenogramma glomerata*	LC	x	x				x						
Molluginaceae	*Coelanthum semiquinquefidum*	LC	x	x				x						
Molluginaceae	*Pharnaceum albens*	LC	x				x							

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Molluginaceae	*Pharnaceum confertum* var. *brachyphyllum*	LC							x					
Molluginaceae	*Pharnaceum croceum*	LC	x	x	x				x					
Molluginaceae	*Pharnaceum exiguum*	LC	x	x					x					
Molluginaceae	*Pharnaceum lanatum*	LC	x				x		x					
Molluginaceae	*Pharnaceum microphyllum* var. *microphyllum*	LC	x	x			x	x	x					
Neuradaceae	*Grielum grandiflorum*	LC	x	x	x	x	x	x	x					
Neuradaceae	*Grielum humifusum*	LC	x	x	x	x		x						
Neuradaceae	*Grielum humifusum* var. *humifusum*	LC					x	x	x					
Neuradaceae	*Grielum humifusum* var. *parviflorum*	LC	x				x		x					
Ophioglossaceae	*Ophioglossum polyphyllum*	LC	x	x	x			x			x			
Orchidaceae	*Holothrix* cf. *schlechteriana* (possibly new sp.)	-	x	x							x			
Orchidaceae	*Holothrix filicornis*	LC	x	x							x			
Orchidaceae	*Holothrix grandiflora*	DDD	x			x					x	ii		
Orobanchaceae	*Harveya squamosa*	LC	x	x							x			
Orobanchaceae	*Hyobanche sanguinea*	LC	x	x				x	x		x			
Oxalidaceae	*Oxalis bullulata*	LC	x	x	x	x		x			x			
Oxalidaceae	*Oxalis copiosa*	LC	x	x		x		x			x			
Oxalidaceae	*Oxalis inconspicua*	LC	x		x	x					x			
Oxalidaceae	*Oxalis psammophila*	LC	x	x				x			x			
Oxalidaceae	*Oxalis pulchella*	LC					x				x			
Oxalidaceae	*Oxalis sonderiana*	LC	x	x										
Plumbaginaceae	*Limonium dregeanum*	LC							x					
Plumbaginaceae	*Limonium dyeri*	-	x	x	x			x						
Plumbaginaceae	*Limonium scabrum*	LC	x				x							
Plumbaginaceae	*Limonium* sp.	-	x		x									
Poaceae	*Centropodia glauca*	LC	x	x				x	x					
Poaceae	*Chaetobromus involucratus* subsp. *dregeanus*	LC	x	x	x									
Poaceae	*Chaetobromus involucratus* subsp. *involucratus*	LC						x	x					
Poaceae	*Chaetobromus involucratus* subsp. *sericeus*	LC	x				x							
Poaceae	*Cladoraphis cyperoides*	LC	x	x	x			x	x					
Poaceae	*Cladorapis spinosa*	LC	x	x				x						
Poaceae	*Cynodon dactylon*	LC	x	x	x			x						
Poaceae	*Dregeochloa pumila*	CR	x	x	x	x	x	x	x					
Poaceae	*Ehrharta brevifolia* var. *cuspidata*	LC							x					
Poaceae	*Ehrharta cf. calycina*	LC	x		x				x					
Poaceae	*Ehrharta cf. delicatula*	LC	x		x		x		x					
Poaceae	*Ehrharta* sp.	-	x		x									
Poaceae	*Enneapogon scaber*	LC	x	x				x						
Poaceae	*Hordeum geniculatum*	NE							x					
Poaceae	*Odyssea paucinervis*	LC	x	x	x									
Poaceae	*Phragmites australis*	LC	x	x	x				x					
Poaceae	*Schismus schismoides*	LC	x	x	x			x	x					
Poaceae	*Schmidtia kalahariensis*	LC							x					
Poaceae	*Stipagrostis ciliata*	LC						x	x					
Poaceae	*Stipagrostis ciliata* var. *capensis*	LC	x	x				x						
Poaceae	*Stipagrostis dregeana*	LC	x				x		x					
Poaceae	*Stipagrostis geminifolia*	CR						x	x					
Poaceae	*Stipagrostis lutescens*	LC						x	x					
Poaceae	*Stipagrostis obtusa*	LC	x	x			x	x	x					
Poaceae	*Stipagrostis schaeferi*	-	x	x				x						
Poaceae	*Stipagrostis subacaulis*	LC						x	x					
Polygalaceae	*Polygala leptophylla*	LC	x	x				x						
Polygalaceae	*Polygala mossii*	NT	x	x				x	x					
Rhamnaceae	*Ziziphus mucronata*	LC	x	x				x						
Rubiaceae	*Anthospermum dregei*	LC	x	x			x	x						
Rubiaceae	*Anthospermum spathulatum* subsp. *spathulatum*	LC	x	x				x						
Rubiaceae	*Kohautia caespitosa* subsp. *brachyloba*	LC						x						
Rubiaceae	*Kohautia cynanchica*	LC							x					

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Rubiaceae	*Kohautia ramosissima*	-	x	x				x						
Ruscaceae	*Eriospermum currorii = Eriospermum rautanenii*	-						x						
Ruscaceae	*Eriospermum namaquanum*	LC	x	x				x						
Ruscaceae	*Eriospermum* sp. (possible new)	-						x						
Santalaceae	*Thesium elatius*	LC							x					
Santalaceae	*Thesium lacinulatum*	LC						x						
Scrophulariaceae	*Aptosimum viscosum*	LC	x	x				x						
Scrophulariaceae	*Dischisma leptostachyum*	NT	x				x							
Scrophulariaceae	*Dischisma spicatum*	LC	x	x				x	x					
Scrophulariaceae	*Hebenstretia cordata*	LC							x					
Scrophulariaceae	*Hebenstretia integrifolia*	LC	x	x										
Scrophulariaceae	*Hebenstretia parviflora*	LC	x	x		x		x	x					
Scrophulariaceae	*Hebenstretia repens*	LC	x	x					x					
Scrophulariaceae	*Hebenstretia robusta*	LC	x	x	x	x			x					
Scrophulariaceae	*Jamesbrittenia fruticosa*	LC	x	x	x	x	x	x	x		x			
Scrophulariaceae	*Jamesbrittenia maxii*	LC									x			
Scrophulariaceae	*Jamesbrittenia merxmuelleri*	LC	x	x		x		x	x		x			
Scrophulariaceae	*Lyperia tristis*	LC	x	x	x			x	x					
Scrophulariaceae	*Manulea altissima*	LC	x	x				x			x			
Scrophulariaceae	*Manulea androsacea*	LC	x	x			x	x	x		x			
Scrophulariaceae	*Manulea aridicola*	VU							x		x			
Scrophulariaceae	*Manulea minuscula*	LC	x	x				x	x		x			
Scrophulariaceae	*Nemesia anisocarpa*	LC							x		x			
Scrophulariaceae	*Nemesia arenifera*	LC	x	x			x	x			x			
Scrophulariaceae	*Nemesia bicornis*	LC	x	x				x	x		x			
Scrophulariaceae	*Nemesia saccata*	VU	x	x			x	x			x			
Scrophulariaceae	*Nemesia viscosa*	LC							x		x			
Scrophulariaceae	*Peliostomum virgatum*	LC	x	x				x	x					
Scrophulariaceae	*Phyllopodium hispidulum*	EN	x	x				x			x			
Scrophulariaceae	*Phyllopodium namaense*	VU	x	x				x			x			
Scrophulariaceae	*Phyllopodium pumilum*	LC							x		x			
Scrophulariaceae	*Selago angustibractea*	LC	x	x										
Scrophulariaceae	*Selago centralis*	LC						x						
Scrophulariaceae	*Selago* cf. *dinteri*	LC	x		x									
Scrophulariaceae	*Selago namaquensis*	LC	x	x										
Scrophulariaceae	*Selago pinguicula*	LC							x					
Scrophulariaceae	*Zaluzianskya affinis*	LC	x	x	x	x		x	x					
Scrophulariaceae	*Zaluzianskya benthamiana*	LC	x	x	x			x	x					
Solanaceae	*Lycium bosciifolium*	LC	x	x				x						
Solanaceae	*Lycium cinereum*	LC							x					
Solanaceae	*Lycium decumbens*	-	x	x				x	x					
Solanaceae	*Lycium ferocissimum*	LC	x	x				x	x					
Solanaceae	*Lycium horridum*	LC				x								
Solanaceae	*Lycium tetrandrum*	LC	x	x	x	x	x	x						
Solanaceae	*Lycium villosum*	LC						x						
Solanaceae	*Nicotiana glauca*	NE	x			x								1b
Solanaceae	*Solanum burchellii*	LC	x	x				x						
Tecophilaeaceae	*Cyanella ramosissima*	VU						x	x		x			
Thymelaeaceae	*Gnidia* sp.	-							x					
Thymelaeaceae	*Lasiosiphon microphyllus =Gnidia suavissima*	LC	x	x				x						
Urticaceae	*Forsskaolea candida*	LC				x								
Zygophyllaceae	*Augea capensis*	LC						x	x					
Zygophyllaceae	*Roepera cordifolia*	LC	x	x	x	x	x	x	x					
Zygophyllaceae	*Roepera fusiforma*	?	x	x				x						
Zygophyllaceae	*Roepera morgsana*	LC	x	x	x		x	x	x					
ophyllaceae	*Roepera sp. nov.*	-	x	x										
Zygophyllaceae	*Tetraena clavata*	LC	x	x	x	x	x	x	x					
Zygophyllaceae	*Tetraena microcarpa*	LC						x						
Zygophyllaceae	*Tetraena patenticaula*	?	x	x	x			x						

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Zygophyllaceae	*Tetraena prismatocarpa*	LC	x				x	x	x					
Zygophyllaceae	*Tetraena simplex*	LC	x			x								
Zygophyllaceae	*Tetraena stapffii*	LC				x								

National criteria for allocation of the IUCN status given to those Species of Conservation Concern that were confirmed on site

Species	IUCN	National Criteria
Bassia dinteri	CR	B1ab(i,ii,iii,iv,v)
Anacampseros cf. gariepensis	CR	A3bc+4abc
Gazania schenckii	CR	C2a(i)
Sensitive species 305	CR	A3ce+4ace
Pelargonium sibthorpiifolium	CR	B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)
Drimia barbata	CR	A3ce+4ace
Lachenalia klinghardtiana	CR	A3c+4ac
Dregeochloa pumila	CR	A2ac+4ac
Conophytum saxetanum	EN	A4c
Jordaaniella uniflora	EN	B2ab(iii,v)
Aloe arenicola	EN	A2acd; B2ab(iii,v)
Sensitive species 1110	EN	A4ac; B1ab(iii,v)+2ab(iii,v)
Sensitive species 407	EN	A2ac
Calobota acanthoclada	EN	A4ac; B1ab(iii,v)+2ab(iii,v)
Lapeirousia barklyi	EN	A3c+4ac
Sensitive species 293	EN	B1ab(iii)+2b(iii)
Phyllopodium hispidulum	EN	B1ab(iii,v)+2ab(iii,v)
Justicia crassiuscula	VU	B1ab(iii,v)
Cephalophyllum ebracteatum	VU	A3ce+4ace
Jordaaniella clavifolia	VU	D2
Schlechteranthus holgatensis	VU	D1+2
Helichrysum dunense	VU	B1ab(ii,iii,v)
Adromischus montium-klinghardtii	VU	B1ab(iii,v)+2ab(iii,v)
Sensitive species 720	VU	B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)
Sensitive species 1187	VU	B1ab(iii,v)+2ab(iii,v)
Monsonia flavescens	VU	B1ab(i,ii,iii,iv,v)
Monsonia patersonii	VU	A4acde
Sensitive species 734	VU	B1ab(ii,iii,iv,v)
Sensitive species 827	VU	B1ab(ii,iii,v)+2ab(ii,iii,v)
Lapeirousia macrospatha	VU	A4c
Nemesia saccata	VU	B1ab(iii,v)
Phyllopodium namaense	VU	B1ab(iii,v)+2ab(iii,v)
Amphibolia succulenta	NT	B1ab(iii,v)+2ab(iii,v)
Aloe framesii	NT	A2ac+4ac; B2ab(i,ii,iii,iv,v)
Wahlenbergia asparagoides	NT	B1b(ii,iii)
Crotalaria meyeriana	NT	B1ab(iii,v)+2ab(iii,v)
Polygala mossii	NT	B1ab(iii,v)+2ab(iii,v)
Crassula ammophila	NT#	B1ab(ii,iii)
Dischisma leptostachyum	NT#	B1ab(ii,iii,iv,v)
Ifloga lerouxiae	Rare	-
Salsola merxmuelleri	DDD	-
Holothrix grandiflora	DDD#	-
Ruschia fugitans	DDT#	-
Curio crassulifolius	DDT#	-
Curio sulcicalyx	DDT#	-
Othonna pachypoda	DDT#	-

Lower taxa recorded on site

Acarospora gypsi-deserti
Acarospora luederitzensis
Acarospora ochrophaea
Arthothelium desertorum
Buellia follmannii
Buellia halonia
Buellia incrustans
Buellia inturgescens
Buellia procellarum
Buellia sipmanii
Buellia stellulata
Caloplaca bonae-spei
Caloplaca cinnabarina
Caloplaca elegantissima
Caloplaca gyalectoides
Caloplaca namibensis
Caloplaca renatae
Caloplaca rubelliana
Chrysothrix granulosa
Combea mollusca
Dimelaena radiata
Diploschistes actinostomus
Dploicia canescens
Ramalina melanothrix
Ramalina sp.
Ramalina sp.
Roccella montagnei
Santessonia hereroensis
Santessonia lagunebergii
Santessonia namibensis
Staurothele dendritica
Teloschistes capensis
Teloschistes chrysocarpoides
Teloschistes chrysophthalmus
Teloschistes puber
Tephromela austrolitoralis
Tephromela nashi
Toninia australis
Tornabea scutellifera
Flavoparmelia soredians
Gloeocapsa sp.
Grimmia laevigata
Heterodermia namaquana
Lecanographa subcaesioides
Lecanora panis-erucae
Lecanora sphaerospora
Lecanora substylosa
Lecidea sarcogynoides
Lecidella crystallina
Lecidella placodina
Niebla cephalota
Opegrapha culmigena
Parmotrema perlatum
Parmotrema reticulatum
Pertusaria pseudomelanospora
Pertusaria velata
Peterjamesia circumscripta
Placidium squamulosum
Polytrichum sp.
Ramalina angulosa
Ramalina canariensis
Ramalina fimbriata
Tortula atrovirens
Trentepohlia sp.
Xanthodactylon flammeum
Xanthodactylon inflatum
Xanthodactylon turbinatum
Xanthoparmelia arrecta
Xanthoparmelia dregeana
Xanthoparmelia equalis
Xanthoparmelia hottentotta
Xanthoparmelia hueana
Xanthoparmelia incomposita
Xanthoparmelia namibiensis
Xanthoparmelia tentaculina
Xanthoparmelia walteri
Xanthoria sipmanii

Appendix B: Synoptic table of broad-scale plant communities in the Boegoebaai Port and SEZ site

Numbers used in table:
1 indicates the species occurs in 1-20% of all sample plots in the (sub)community;
2 indicates the species occurs in 21-40% of all sample plots in the (sub)community;
3 indicates the species occurs in 41-60% of all sample plots in the (sub)community;
4 indicates the species occurs in 61-80% of all sample plots in the (sub)community;
5 indicates the species occurs in 81-100% of all sample plots in the (sub)community

Plant community/subcommunity		1a	1b	2	3	4	5	6a	6b	7	8	9
Species Group 1												
Sensitive species 1187	VU	4										
Sensitive species 720	VU	3						2				
Adromischus montium-klinghardtii	VU	2								3		
Cotyledon orbiculata var. *orbiculata*		2										
Albuca sp. nov.		2										
Crassula columnaris subsp. *prolifera*		3										
Crassula sericea		2										
Crassula atropurpurea var. *cultriformis*		3										
Euphorbia stapelioides		2										
Crassula muscosa		2								3		
Tetraena pterocaulis		2									3	
Drimia barbata	CR	1										
Crotalaria meyeriana	NT	1										
Calobota acanthoclada	EN	1										
Anacampseros cf. *gariepensis*	CR	1										
Curio sulcicalyx	DDT	1										
Crassula ammophila	NT	1						1				
Curio crassifolius	DDT	1										
Ifloga lerouxiae	RAR	1										
Species Group 2												
Sensitive species 305	CR	5	4									
Conophytum saxetanum	EN	4	4									
Monsonia patersonii	VU	4	2	2					3			
Cephalophyllum ebracteatum	VU	3	4						3			
Dregeochloa pumila	CR	2	2	2								
Gazania schenckii	CR	1	2									
Mesembryanthemum marlothii		2	2	2								
Crassula elegans		2	2					1				
Antimima perforata		1	1									
Euphorbia angrae		1	2									
Species Group 3												
Osteospermum oppositifolium			2			4		2		3		
Crassothonna cylindrica		1				4				3		
Atriplex vestita						3						3
Tetragonia sp. (narrow leaf)						3						
Ruschia pallens						2						
Hebenstretia sp.						2						
Sensitive species 293	EN					1						
Species Group 4												
Othonna furcata		4	4	4		1						
Mesembryanthemum hypertrophicum		1		2	3	2						
Cladoraphis cyperoides		2		5		3		1				
Ferraria schaeferi		2		3		1						
Euphorbia caput-medusae		1		2		2						
Chrysanthemoides incana				2		2						
Limonium sp.			2	2		1						
Species Group 5												
Lycium tetrandrum		3	2	3	3	4	5					
Tetraena clavata		3	2	4	3	2	5					
Fenestraria rhopalophylla subsp. *aurantiaca*		2	2	2		1	3					
Euphorbia hereroensis		1				1						
Species Group 6												
Aloe framesii	NT							2				
Lachenalia klinghardtiana	CR			2				1				

Plant community/subcommunity		1a	1b	2	3	4	5	6a	6b	7	8	9
Heliophila lactea								4				
Euphorbia burmannii		1		2		1		5				
Othonna undulata								3				
Veltheimia capensis								3				
Ruschia sp. 1						1		3				
Euphorbia ephedroides		1						3				
Pelargonium sp. nov.								3				
Pelargonium grandicalcaratum								2				
Antimima sp.								2				
Calobota spinescens								2	3			
Lycium sp. 1								2				
Mesembryanthemum brevicarpum								2				
Tetragonia sp. 1								2				
Lyperia tristis								2				
Species Group 7												
Roepera morgsana						4	3	4				
Grielum humifusum		1				2		2				
Stoeberia utilis		1				3		4	3			
Tetragonia pillansii						1		1				
Ehrharta sp.						1		1				
Species Group 8												
Oncosiphon spp.				2	5	3	5	2				
Hermannia cuneifolia		1		2		3		1				
Amphibolia rupis-arcuatae		2			5	4	3	2				
Species Group 9												
Jordaaniella clavifolia	VU							1	3			
Euphorbia rhombifolia						1		3	3		3	
Euphorbia mauritanica						1		5	3	3	3	
Ruschia sp. 2 (white flower)						1		2	3			
Asparagus graniticus								2	3			
Babiana hirsuta								1	3			
Asparagus undulatus								2	3			
Species Group 10												
Cynodon dactylon										5		
Asparagus sp.								1		3		
Opuntia ficus-indica										3	3	
Manochlamys albicans										5		
Boraginaceae										3		
Arctotis sp.										3		
Cotula coronopifolia										3		
Drosanthemum inornatum										3		
Antimima varians										3		
Oxalis inconspicua										3		
Pelargonium minimum										3		
Malva parviflora										3		
Colchicum albomarginatum										3		
Gladiolus arcuatus										3		
Lachenalia punctata										3		
Lessertia frutescens										3		
Lycium sp. 2										3		
Melolobium adenodes										3		
Ophioglossum polyphyllum										3		
Species Group 11												
Sensitive species 734	VU							2	3	3		
Arctotis canaliculata								3	3	3		
Jordaaniella spongiosa								4		3		
Trachyandra falcata		1						3	3	5		
Lampranthus stipulaceus						1		3	3	3		
Mesembryanthemum barklyi								2	3	3		
Kedrostis psammophila								1	3	3		
Aizoon sarcophyllum								2		3		
Asparagus juniperoides								1		3		
Species Group 12												
Mesembryanthemum sp. (*Psilocaulon)*											3	
Ruschia viridifolia											3	
Eberlanzia cyathiformis											3	
Species Group 13												
Crassula expansa							3	1		3	3	

Plant community/subcommunity		1a	1b	2	3	4	5	6a	6b	7	8	9
Cheiridopsis robusta							5	2	3		5	
Foveolina dichotoma		1					3	2	3		5	
Lampranthus otzenianus							3	3		3	3	
Mesembryanthemum sp. *(Prenia)*							3	3	3			
Zaluzianskya affinis				2		1	3	1		3		
Cephalophyllum rigidum							5	3		3	3	
Species Group 14												
Amphibolia succulenta	NT					2		4	3	5	5	
Jordaaniella cuprea						3		4	3	3	3	
Aizoon crystallinum		1				3		1	3	3		
Pteronia glabrata		1				2	3	3	3	3	3	
Species Group 15												
Mesembryanthemum crystallinum		5	4	4	3	5	5	5	5	3	5	
Stoeberia beetzii		4	2	3	5	3	5	1	3	3	5	
Asparagus capensis		2	4	3		3	5	5	3	5	3	
Crassothonna sedifolia		3	2	2	3	2	3	5	3	3		
Didelta carnosa		3	2	3	3	3	3	4		3		
Roepera cordifolia		4	2			2	5	2	3		5	
Salsola spp. (incl *S. nollothensis)*		3	4	4		4	3	4	3		3	
Kewa salsoloides		3					3	1		3		
Calobota halenbergensis		1		2		2		3		3		
Antimima sp. nov.		2					3	1			3	
Mesembryanthemum dinteri		1	2	2		1		1	3		3	
Eberlanzia sedoides		2					5	1	3		3	
Mesembryanthemum subnodosum		1					3				3	
Albuca cooperi		1	2						3	3		
Grielum grandiflorum						1			3			
Jamesbrittenia merxmuelleri				2						3		
Kewa angrae-pequenae				2		1						
Searsia longispina						1				3		
Chaetobromus involucratus						1			3			
Species Group 16												
Limonium sp. (coastal type)												3
Phragmites australis												3
Juncus sp.												5
Salicornia natalensis												3
Species Group 17												
Drosanthemum luederitzii		2	4	4	3	1		1	3	3	3	5
Species Group 18												
Trachyandra bulbinifolia		2					3	1				
Pharnaceum sp.		1		2				1				
Mesembryanthemum oculatum				2				1				
Aizoon pruinosum						1						3
Spergularia sp.		1										3
Ornithoglossum parviflorum		1						1				
Pelargonium fulgidum		1								3		
Cynorhiza typica		1						1				
Osteospermum polycephalum		1										
Dianthus namaensis		1										
Selago cf. *dinteri*		1										
Albuca longipes		1										
Rubiaceae		1										
Bulbine abyssinica		1										
Anacampseros namaquensis		1										
Chlorophytum viscosum		1										
Drimia occultans		1										
Othonna retrofracta		1										
Tetragonia microptera		1										
Curio radicans		1										
Helichrysum sp.		1										
Oxalis bullulata		1										
Calobota sp. 1		1										
Tylecodon reticulatus		1										
Mesembryanthemum coriarium		1										
Jamesbrittenia maxii/fruticosa				2								
Tetragonia praemosa				2								
Tridentea pachyrrhiza				2								
Felicia sp.				2								
Dasispermum sp.					3							

Plant community/subcommunity	1a	1b	2	3	4	5	6a	6b	7	8	9
Crassula elegans hybrid	:	:	:	:	1	:	:	:	:	:	:
Odyssea paucinervis	:	:	:	:	1	:	:	:	:	:	:
Calobota sp. 3	:	:	:	:	1	:	:	:	:	:	:
Spergularia sp. (woolly)	:	:	:	:	1	:	:	:	:	:	:
Albuca grandis	:	:	:	:	1	:	:	:	:	:	:
Poaceae	:	:	:	:	1	:	:	:	:	:	:
Helichrysum herniarioides	:	:	:	:	1	:	:	:	:	:	:
Trachyandra laxa	:	:	:	:	:	3	:	:	:	:	:
Hebenstretia parviflora	:	:	:	:	:	:	1	:	:	:	:
Mesembryanthemum sp. (*Psilocaulon* high capsule)	:	:	:	:	:	:	1	:	:	:	:
Helichrysum sp. *(*annual)	:	:	:	:	:	:	1	:	:	:	:
Zaluzianskya benthamiana	:	:	:	:	:	:	1	:	:	:	:
Anginon sp.	:	:	:	:	:	:	1	:	:	:	:
Crassula sp. climbing	:	:	:	:	:	:	1	:	:	:	:
Gethyllis sp.	:	:	:	:	:	:	1	:	:	:	:
Stoeberia fruticosa	:	:	:	:	:	:	1	:	:	:	:
Tylecodon wallichii	:	:	:	:	:	:	1	:	:	:	:
Quaqua parviflora	:	:	:	:	:	:	1	:	:	:	:
Tylecodon paniculatus	:	:	:	:	:	:	1	:	:	:	:
Crassula rudolfii	:	:	:	:	:	:	1	:	:	:	:
Ehrharta calycina	:	:	:	:	:	:	1	:	:	:	:
Ehrharta delicatula	:	:	:	:	:	:	1	:	:	:	:
Schismus sp.	1	:	:	:	:	:	1	:	:	:	:
Conicosia elongata	:	:	:	:	:	:	:	3	:	:	:
Ferraria sp.	:	:	:	:	:	:	:	3	:	:	:

1
2

Appendix C: Photographic record of plant communities

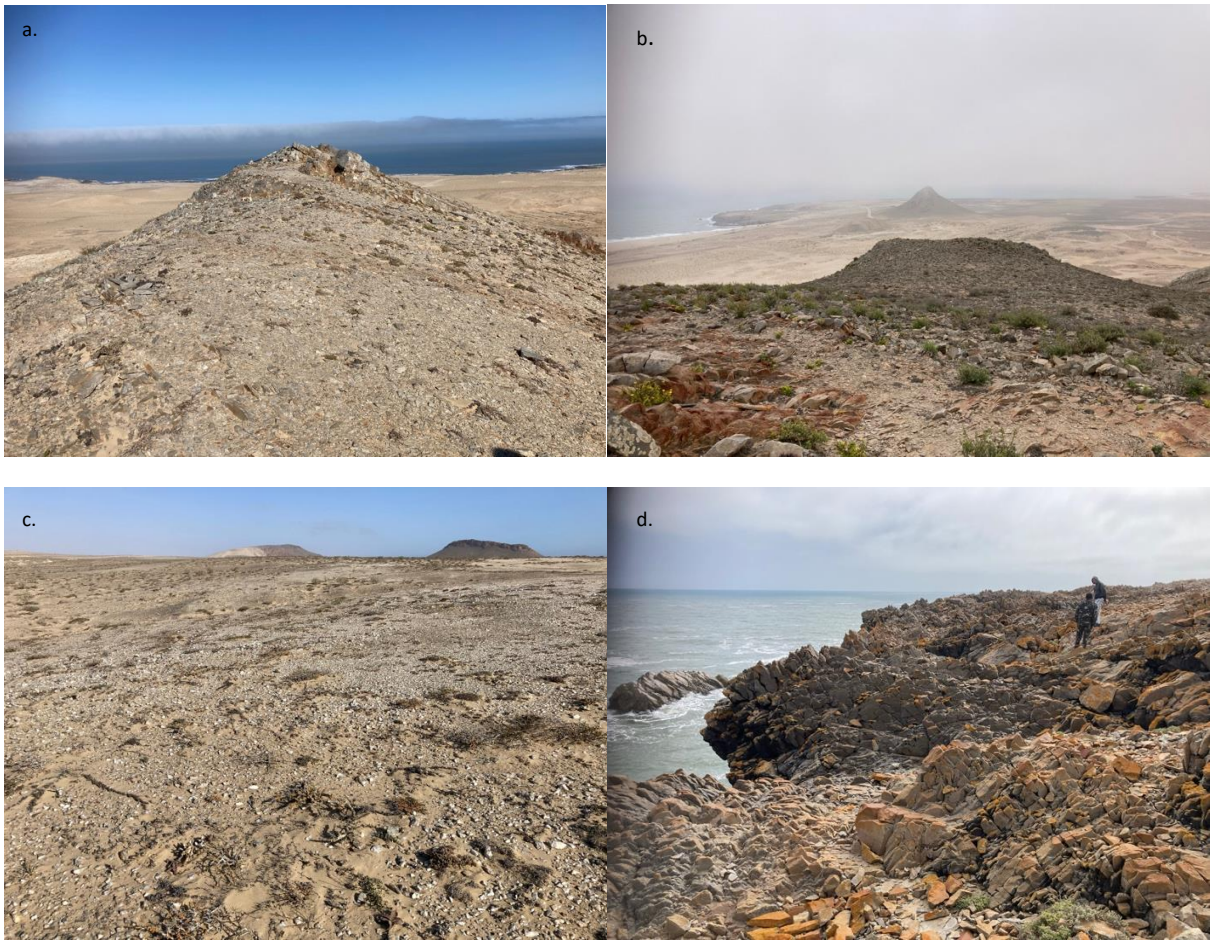

Figure C1: Plant Community 1. a. Namakwakop; b. Boegoeberg South; c. Quartz plains along the coast; and d. Rocky coastline.

Figure C2: Plant Community 2. a. Coastal vegetation; b. Near Visagiespan; c. Degraded sandy plains south of Boegoeberg South; and d. Visagiespan in the background.

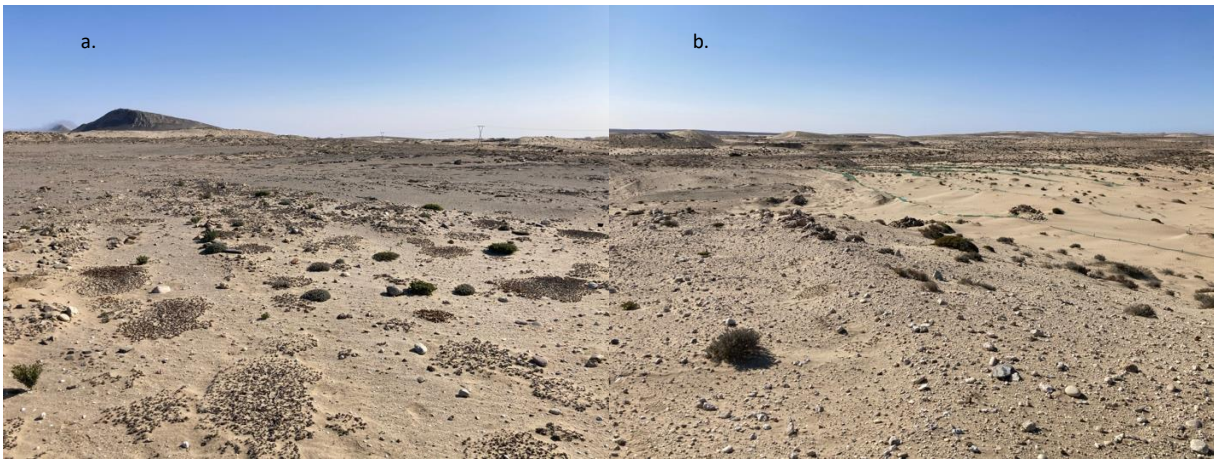

Figure C3: Plant Community 3. a. The modified mined habitat and b. shade nets almost buried by moving sand.

Figure C4: Plant Community 4. a. Around Rietfonteinpan; b. Area with intact vegetation; c. An area that was disturbed very many years ago; and d. Natural vegetation on yellow sand.

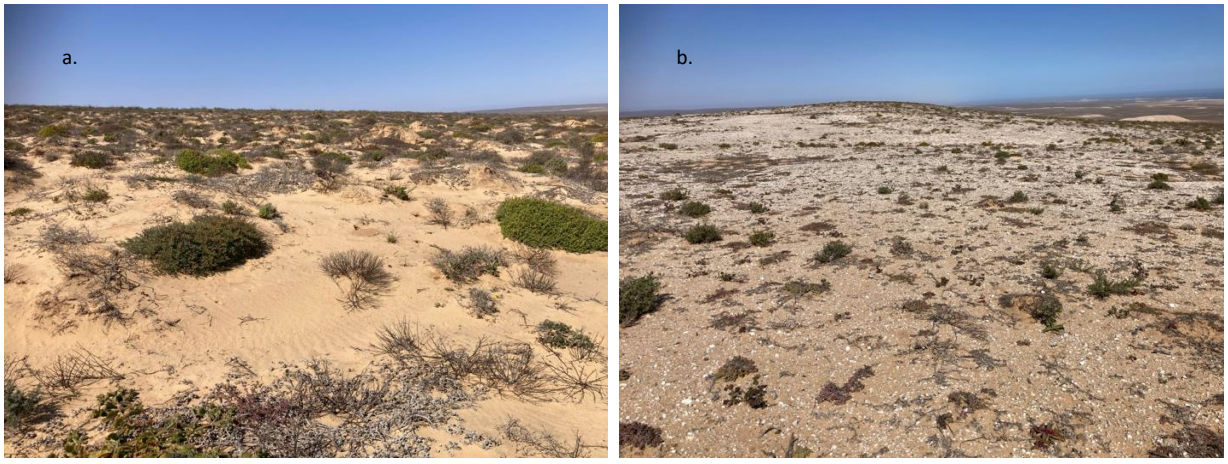

Figure C5: Plant Community 5. a. Vegetation at site with Brant's whistling rats; and b. Vegetation on quartz at Duikerkop.

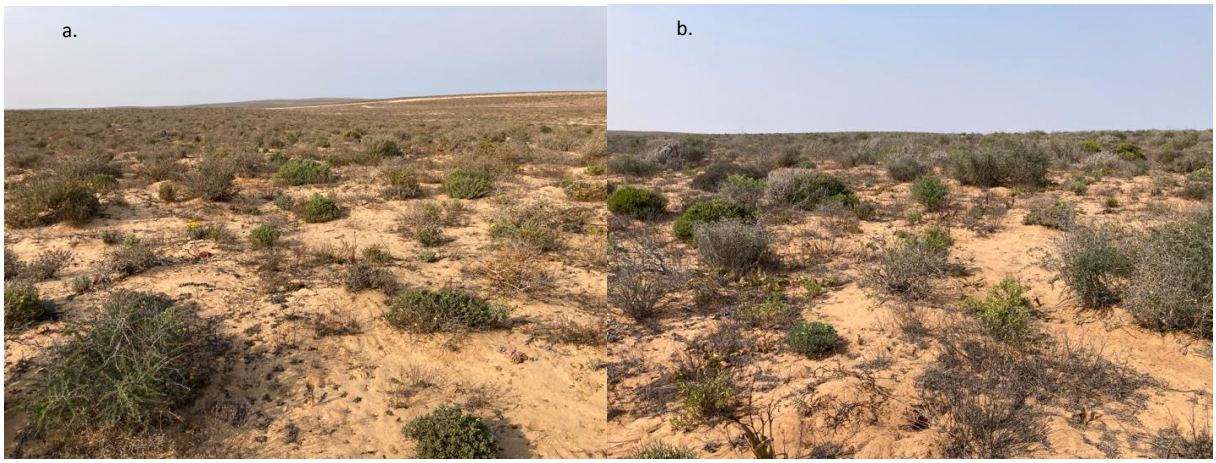

Figure C6: Plant Community 6. a. & b. Subcommunity 6a; and c. Subcommunity 6b.

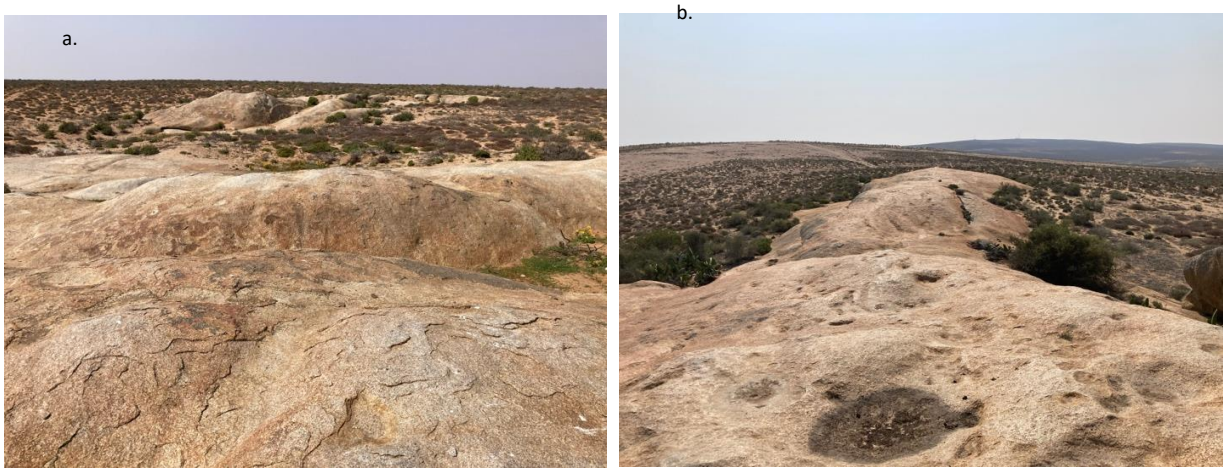

Figure C7: Plant Community 7. a. Granite outcrop at Swartbankkop; and b. Granite outcrop known at the Klipbakke.

Figure C8: Plant Community 8.

Figure C9: Plant Community 9. a. Visagiesfontein; and b. Rietfonteinpan.