BOTANICAL IMPACT ASSESSMENT FOR THE TAILINGS STORAGE FACILITY, RELOCATION CHANNEL AND ROAD DIVERSION AT THE PROPOSED NATAKA HEAVY MINERALS DEPOSIT, NAMPULA PROVINCE, MOZAMBIQUE

Prepared for:

Kenmare Moma Mining

(Mauritius) Limited and Kenmare Moma Processing (Mauritius) Limited
Mozambique Branch
Av. Marginal 4985, Prédio Zen,
4º Andar Esq.Maputo, Mozambique

Prepared by:

Biodiversity Africa

30 Chudleigh Road
Plumstead, 7800, Cape Town, Western Cape



In association with

CES
ENVIRONMENTAL AND SOCIAL ADVISORY SERVICES
www.cesnet.co.za

October 2022

Updated March 2023

Details of Company

Name of Company	Biodiversity Africa
Email	Tarryn@biodiversityafrica.com
Tel	+27 71 332 3994

Author

Tarryn Martin (Lead Botanical Specialist and Report Author) (*Pri. Sci. Nat* 008745)
Tarryn has over ten years of experience working as a botanist, nine of which are in the environmental sector. She has worked as a specialist and project manager on projects within South Africa, Mozambique, Lesotho, Zambia, Tanzania, Cameroon, Swaziland and Malawi. The majority of these projects required lender finance and consequently met both in-country and lender requirements.

Tarryn has extensive experience writing botanical impact assessments, critical habitat assessments, biodiversity management plans, biodiversity monitoring plans and Environmental Impact Assessments to International Standards, especially to those of the International Finance Corporation (IFC). Her experience includes working on large mining projects such as the Kenmare Heavy Minerals Mine, where she monitored forest health, undertook botanical impact assessments for their expansion projects and designed biodiversity management and monitoring plans. She has also project managed Environmental Impact Assessments for graphite mines in northern Mozambique and has a good understanding of the Mozambique Environmental legislation and processes.

Tarryn holds a BSc (Botany and Zoology), a BSc (Hons) in African Vertebrate Biodiversity and an MSc with distinction in Botany from Rhodes University. Tarryn's Master's thesis examined the impact of fire on the recovery of C3 and C4 Panicoid and non-Panicoid grasses within the context of climate change for which she won the Junior Captain Scott-Medal (Plant Science) for producing the top MSc of 2010 from the South African Academy of Science and Art as well as an Award for Outstanding Academic Achievement in Range and Forage Science from the Grassland Society of Southern Africa.
Tarryn is a professional member of the South African Council for Natural Scientific Professionals (since 2014).

Dr Alice Massingue (Botanical Specialist and Species ID)
Dr Alice Massingue is a leading botanical specialist on coastal vegetation in Mozambique. Her PhD from Nelson Mandela Metropolitan University in South Africa focused on the ecology and biogeography of coastal vegetation in Southern Mozambique Mambone (Save River) in Inhambane and Ponta de Ouro (SA border) in Maputo.

Alice has collaborated on various biodiversity projects such as Gorongosa Vegetation and Flora survey in Central Mozambique 2006-2007, Coastal Forest Vegetation and Flora survey in Cabo –Delgado 2009-2020, North of Mozambique. She also collaborated on the assessment of threatened plants in Mozambique, in coordination with SANBI, Pretoria South Africa and KEW GARDENS.

She has a broad academic background including impact assessments and characterization of vegetation and flora for environmental impact assessments in Mozambique.

Ms Nicole Wienand (Botanical Specialist) (*Pri. Sci. Nat* 130289)

Ms Nicole Wienand (SACNASP Reg No. 130289) is an Environmental Consultant with 3 and a half years' experience based in the Port Elizabeth branch. Nicole obtained her BSc Honours in Botany (Environmental Management) from Nelson Mandela University (NMU) in December 2018. She also holds a BSc Degree in Environmental Management (Cum Laude) from NMU. Nicole's honours project focused on the composition of subtidal marine benthic communities on warm temperate reefs off the coast of Port Elizabeth and for her undergraduate project she investigated dune movement in Sardinia Bay. Since her employment with CES in January 2019, Nicole has specialised in the field of ecology and botanical specialist assessments, ensuring that these specialist assessments are undertaken and prepared in accordance with the Protocols for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity (GN R. 320), Plant Species and Animal Species (GN R. 1150). Nicole has undertaken numerous Ecological Impact Assessments for a range of developments including Wind Energy Facilities (WEFs), Overhead Lines (OHL) and infrastructure, working closely with developers to ensure a development which is environmentally sustainable as well as financially and technically feasible.

Non-Technical Summary

The Nataka Project is located to the west of the existing Namalope Project and north-east of the Pilivilli Project within the catchment of the Larde River.

Of relevance to the terrestrial ecology is the clearance of vegetation and topsoil. Prior to mining, vegetation will be cleared and topsoil removed and stored adjacent to the mine path to assist in subsequent rehabilitation. Alternatively, and preferably, topsoil can be deposited immediately over the surface of mined and re-contoured areas to minimise loses and assist in rehabilitation of areas that have already been mined.

A field survey of the deposit and TSF was undertaken at the end of the rainy season from 18-29 April 2022. The purpose of the survey was to assess the site-specific botanical state of the project areas by recording the species present (both indigenous and alien invasive species), identifying sensitive ecosystems and areas with species of conservation concern, and identifying the current land use.

Twelve 100m, evenly spaced belt transects were overlaid on the project area; three within the TSF project Area of Influence and nine within the Nataka mine boundary. To eliminate sampling bias, random points were created within each transect using the ESRI ArcMap Random Points Tool. While generating the random points the minimum distance threshold between points was set to 50 m (i.e. every point is >50 m away from every other point). This report relates to the TSF and associated infrastructure only, however reference to the broader project area is made where relevant.

As there were 36 points within the sampling area, to ensure that there was adequate coverage of the sample area within the available time, points that occurred within natural and secondary vegetation were prioritised over points that fell within active machambas. The time available in the field was sufficient to provide enough data to characterise the vegetation types present.

At each point, the point centre quarter (PCQ) method was used to determine species density of dominant species. In addition, all species at each point were recorded to determine diversity. Each sample plot was sampled until no new species were recorded.

Vegetation communities were then described according to the dominant species recorded from each vegetation type, and these were mapped and assigned a sensitivity score.

Within the broad project area, 214 plant species were recorded from 59 families. Of these 214 species, 159 species from 57 families were recorded within the TSF project site. Despite the project site being comprised primarily of a mosaic of secondary woodland, twelve species of conservation concern were recorded. Of the twelve SCC, five are listed as threatened (CR, En and VU) species, three of which were recorded within the TSF project area, four as endemic species and two as near endemic species. Additionally, although not recorded within the TSF project area, four additional SCC were recorded within the broader Nataka Deposit project area and are therefore likely to occur within the TSF project area. The presence of these species within the project area suggests that they are able to persist in an area that is frequently disturbed by clearing and burning over long periods of time although it is unknown whether these activities have resulted in the steady decline of these species. Based on field

observations it is suspected that *Brachystegia oblonga* and *Blepharis dunensis* are more resilient to disturbance than *Warneckea sessilicarpa*. While these species are able to recover when cleared for machambas, likely due to the below ground biomass remaining intact and allowing individuals to coppice and regrow over time, they are unlikely to persist when cleared for mining activities as their root systems are completely removed, the seed bank is removed, and the soil structure is altered.

Sensitivity for the Forest Patch and Secondary Miombo Woodland was determined to be high due to the presence of CR, EN and VU plant species which contributes to the medium Biodiversity Importance (BI) of the habitat types, coupled with the low receptor resilience. In contrast, the machambas were determined to have a low sensitivity.

Seven impacts were identified to be associated with the construction and operation of the TSF and associated infrastructure. Before mitigation, one impact was rated as very high, three as high, two as moderate and one as negligible. This is due to the sensitive nature of the project site. However, if the mitigation and biodiversity offset measures identified in this report are successfully implemented and adhered to, the significance of these impact can be reduced to one high negative, three moderate negative, one low negative and two negligible. The resulting residual impacts are summarised below:

- Very High = 0 impacts
- High = 1 impact
- Moderate = 3 impacts
- Low = 1 impact
- Negligible = 2 impact

Project activities will result in the loss of Secondary Miombo Woodland and more importantly the loss of species of conservation concern that are listed as CR, EN,VU and NT. The loss of such species is considered significant as the impacts are permanent and globally significant for critically endangered and endangered species that are endemic and range restricted. In order to determine what percentage of the population will be lost due to project activities, a bioregional survey of these species is required. However, in accordance with the precautionary principle it is assumed that the further loss of these species as a result of project activities could impact on the survival of these species at a global level. Since these impacts can't be avoided and are difficult to mitigate, a restoration plan for SCC that are lost must be implemented.

Further to this, based on the directive issued under the Biodiversity Offset Decree (No. 55/2022), the project site will require biodiversity offsets for residual impacts as the following criteria are met by the project site:

- Project occurs within a nationally and internationally recognised Key Biodiversity Area
- Presence of threatened (CR, EN and VU) species
- Presence of endemic species with restricted geographical ranges
- Habitat of significant importance to endangered, endemic or geographically restricted species.

According to the directive (V.4.), a preliminary Biodiversity Offset Plan is a condition for the issuance of an environmental license for Category A and A+ projects.

It is recommended that the following conditions are included in the Final EMPr as well as the conditions of the Environmental Licence (EL), if granted

- The forest patch inclusive of a 50 buffer must be declared a no-go area to mining related activities and Kenmare staff and representatives.
- If any SCC are to be impacted, these must be relocated to nearest appropriate habitat. This may be possible for *Blepharis dunensis* (a low growing of shrub that is less than 0.5m high) and it is recommended that trials are undertaken prior to clearing to determine the likelihood of success.
- Seeds for *Brachystegia oblonga* and *Warneckea sessilicarpa* must be collected prior to clearing.
- Propagation success and rehabilitation trials for SCC, particularly for *Brachystegia oblonga (CR), Warneckea sessilicarpa (CR)* and *Blepharis dunensis* (EN) should commence immediately to determine the likelihood of success of restoration projects.
- Areas within the site must be identified for restoration of SCC to reduce the residual impact of mining activities. This must form part of the rehabilitation plan. However, it is noted that this may not be feasible since it is Kenmare's intention to mine the entire site without including any ecological corridors or set aside areas.
- Only indigenous plant species typical of the local vegetation and approved by a botanist should be used for the rehabilitation of natural habitat. A list of these species must be included in the rehabilitation plan.
- Topsoil (20 cm, where possible) must be collected and used to rehabilitate impacted areas behind the active mine path.
- Employees must be prohibited from collecting any plants.
- Alien invasive plant clearing should be undertaken in line with an Alien Vegetation Management plan, which should be compiled as part of the EMPr and implemented with immediate effect.
- Biodiversity Offsets will be required for the project site. A Biodiversity Offset specialist must be consulted and a draft Biodiversity Offset Plan developed as this will need to be submitted with the final Environmental Impact Assessment Report (Refer to Section V (4) of the Biodiversity Offset Decree (No. 55/2022)).

Table of Contents

List of Figures

List of Tables

Glossary of Terms

Alien Invasive Species refers to an exotic species that can spread rapidly and displace native species causing damage to the environment

Biodiversity is the term that is used to describe the variety of life on Earth and is defined as "*the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems*" (Secretariat of the Convention on Biological Diversity, 2005).

Critical Habitat are areas with high biodiversity value including the following criteria i) habitat of significant importance to Critically Endangered and/or Endangered species ii) habitat of significant importance to endemic and/or restricted-range species and 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.

Key Biodiversity Area (KBAs) are important sites for the global persistence of biodiversity. These sites are either important for a number of unique species or for just one species that is range restricted and endemic.

Habitat Fragmentation occurs when large expanses of habitat are transformed into smaller patches of discontinuous habitat units isolated from each other by transformed habitats such as farmland.

Natural Habitat refers to habitats composed of viable assemblages of plant and/or animal species of largely native origin and/or where human activity has not essentially modified an area's primary ecological function and species composition.

Protected Area is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values**.** *(IUCN Definition 2008).*

Acronyms

CBA	Critical Biodiversity Area
CR	Critically Endangered
ECO	Environmental Control Officer
EN	Endangered
EIA	Environmental Impact Assessment
EOO	Extent of Occupancy
GBIF	Global Biodiversity Information Facility
GIS	Geographical Information System
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
LC	Least Concern
SCC	Species of Conservation Concern
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
VU	Vulnerable

1. INTRODUCTION

1.1. Project Description and Location

The proposed TSF project is located directly west of Kenmare's existing Namalope Mine, within Kenmare's existing concession (Concession No. 735 C) (**Error! Reference source not found.**). The r elocation of the existing mining operations at Namalope is required to ensure that the provision of feedstock to maintain the current production rate of 1.2 million tonnes of ilmenite plus the co-products zircon and rutile can continue. In order to support the proposed mining operation, the following infrastructure is required:

- Tailings Storage Facility (TSF);
- Starter Pond
- Relocation Channel in order to move the Wet Concentrator Plant (WCP) - A to the new mining area at Nataka;
- Backfilling;
- Process Water Dam;
- Paddock Thickner;
- Water related infrastructure (i.e. channel, sump and pipeline)
- Road diversion; and
- Infrastructure Terrace.

A full project description is included in the Environmental, Social and Health Impact Assessment accompanying this Vegetation Assessment, and thus it has not been repeated here.

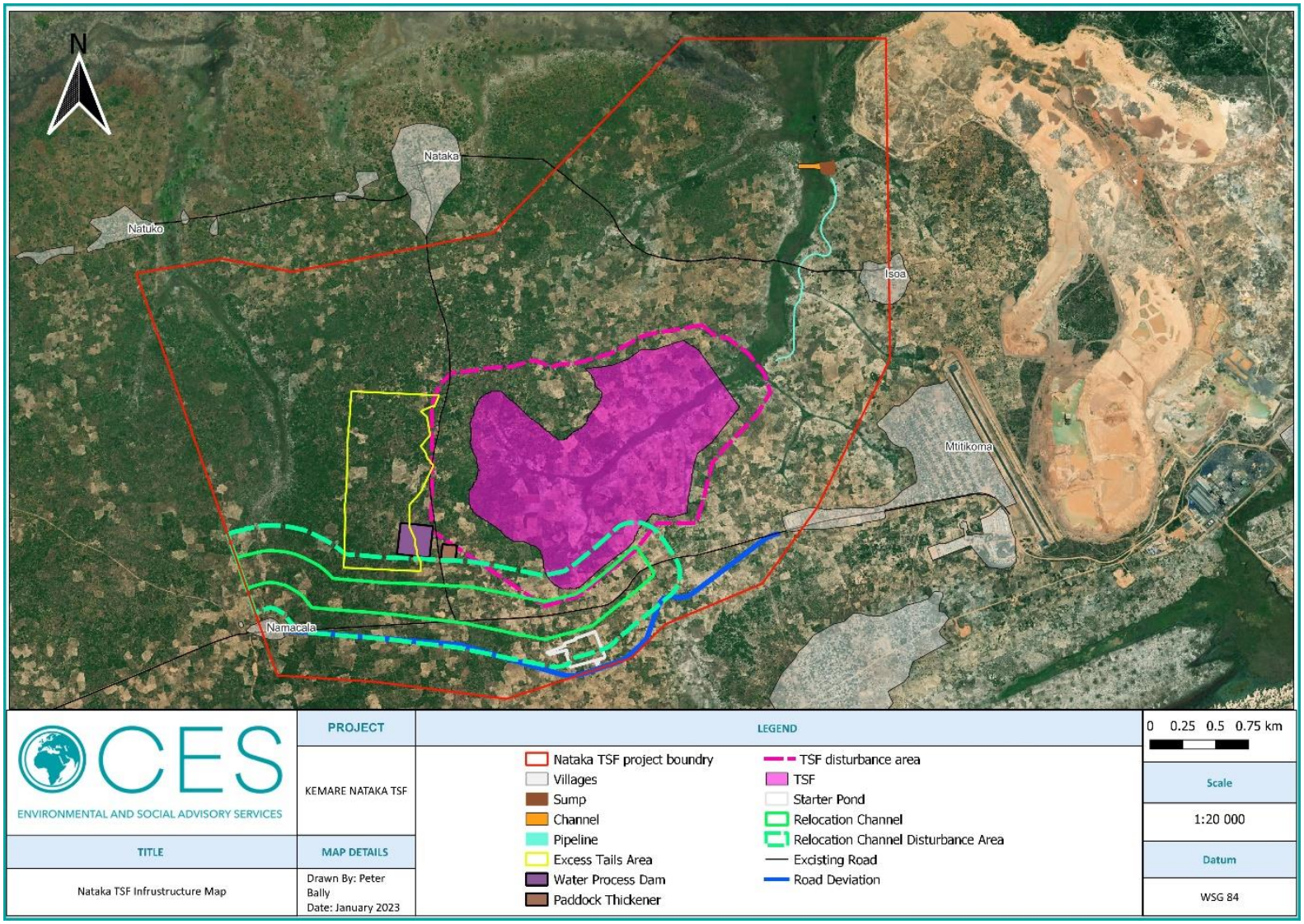

Figure 1.1: Locality of the proposed TSF, Relocation Channel, and Road Diversion at the proposed Nataka Heavy Minerals Deposit, Nampula Province, Mozambique.

1.1. Objectives

The objectives of the botanical assessment are as follows:

- To record the plant species that occur within the Nataka deposit area, based on field surveys.
- To identify any species of special concern, namely species with conservation status or which are endemic to the area.
- To comment on the conservation status of specific plant species.
- To compile a broad-scale vegetation or habitat map of the area. This vegetation map should indicate the extent that mining activities would affect each vegetation or habitat type, such as the impacts on wetlands located in the concession area.
- To identify alien invasive species and the levels of infestation, with particular focus on rehabilitation that would reduce the significance of this impact.
- To record as many plant species of ethnobotanical significance as possible, and to integrate this information into the Soils, Land & Natural Resource Use and Agricultural Assessment[1].
- To assess the level of dependence of the local inhabitants on the vegetation of the immediate and surrounding areas, and the impact that the removal of this vegetation would have on the community. Close liaison with the social scientists will be essential.
- To work in consultation with other specialists to ensure that the linkages between the various systems are understood.
- Assess the environmental significance of these impacts using a methodology compliant with international best practice.
- To provide practical and realistic recommendations to mitigate impacts with a particular focus on rehabilitation that would reduce the significance of vegetation loss.

1.2. Limitations and Assumptions

This report is based on current available information and, as a result, the following limitations and assumptions are implicit:

- Species of Conservation Concern (SCC) are difficult to find and may be difficult to identify, thus species described in this report do not comprise an exhaustive list. It is possible that additional SCCs are present.
- Sampling could only be carried out at one stage in the annual or seasonal cycle. The survey was conducted at the end of the rainy season when most plants were still in flower or fruiting but it is likely that some early flowering geophytes may have gone undetected. However, the time available in the field and information gathered during the survey was sufficient to provide enough information to determine the status of the affected area.

[1] Please note that a separate Land and Natural Resource Use Report has been drafted for the proposed project. As such, to prevent duplication, point 6 and 7 of the terms of reference have been omitted from the Botanical Assessment as it has already been incorporated into the Land and Natural Resource Use Assessment.

- This is a botanical assessment and does not include an assessment of faunal species likely to occur on site. A separate faunal assessment has been conducted for the project.

2. METHODOLOGY

2.1. Project Area

The “project area” or “project site” is defined as the area that will be directly impacted by TSF project infrastructure. This includes the Starter Pond, Relocation Channel, Process Water Dam; Paddock Thickner; Water related infrastructure (i.e. channel, sump and pipeline), Road diversion; and Infrastructure Terrace.

The project area of influence (PAOI) refers to the broader area around the project area that may be indirectly impacted by project activities.

2.2. Desktop Assessment

A desktop assessment was undertaken prior to the site visit to determine the vegetation types present, identify species of conservation concern that might occur on site and identify the conservation status of the project site. Key resources were consulted and include:

- The Nataka Terrestrial Ecological Screening Assessment (2021)
- The IUCN Red Data List
- iNaturalist

A species list was compiled for the site based on records obtained from the sources listed above.

2.3. Field Survey

A field survey of the deposit and TSF area was undertaken at the end of the rainy season from 18-29 April 2022. The purpose of the survey was to assess the site-specific botanical state of the project area by recording the species present (both indigenous and alien invasive species), identifying sensitive ecosystems and areas with species of conservation concern, and identifying the current land use. This report relates to the assessment undertaken for the TSF and associated infrastructure.

Three 100m, evenly spaced, belt transects were overlaid on the TSF project area. To eliminate sampling bias, random points were created along each transect using the ESRI ArcMap Random Points Tool. While generating the random points the minimum distance threshold between points was set to 50 m (i.e. every point is >50 m away from every other point). Figure 2.1 illustrates the location of the transects and sample plots.

As there were 36 points within the sampling area, to ensure that there was adequate coverage of the sample area within the available time, points that occurred within natural and secondary vegetation were prioritised over points that fell within active machambas.

At each point, the point centre quarter (PCQ) method was used to determine species density of dominant species. In addition, all species at each point were recorded to determine diversity. Each sample plot was sampled until no new species were recorded.

Vegetation communities were then described according to the dominant species recorded from each vegetation type, and these were mapped and assigned a sensitivity score.

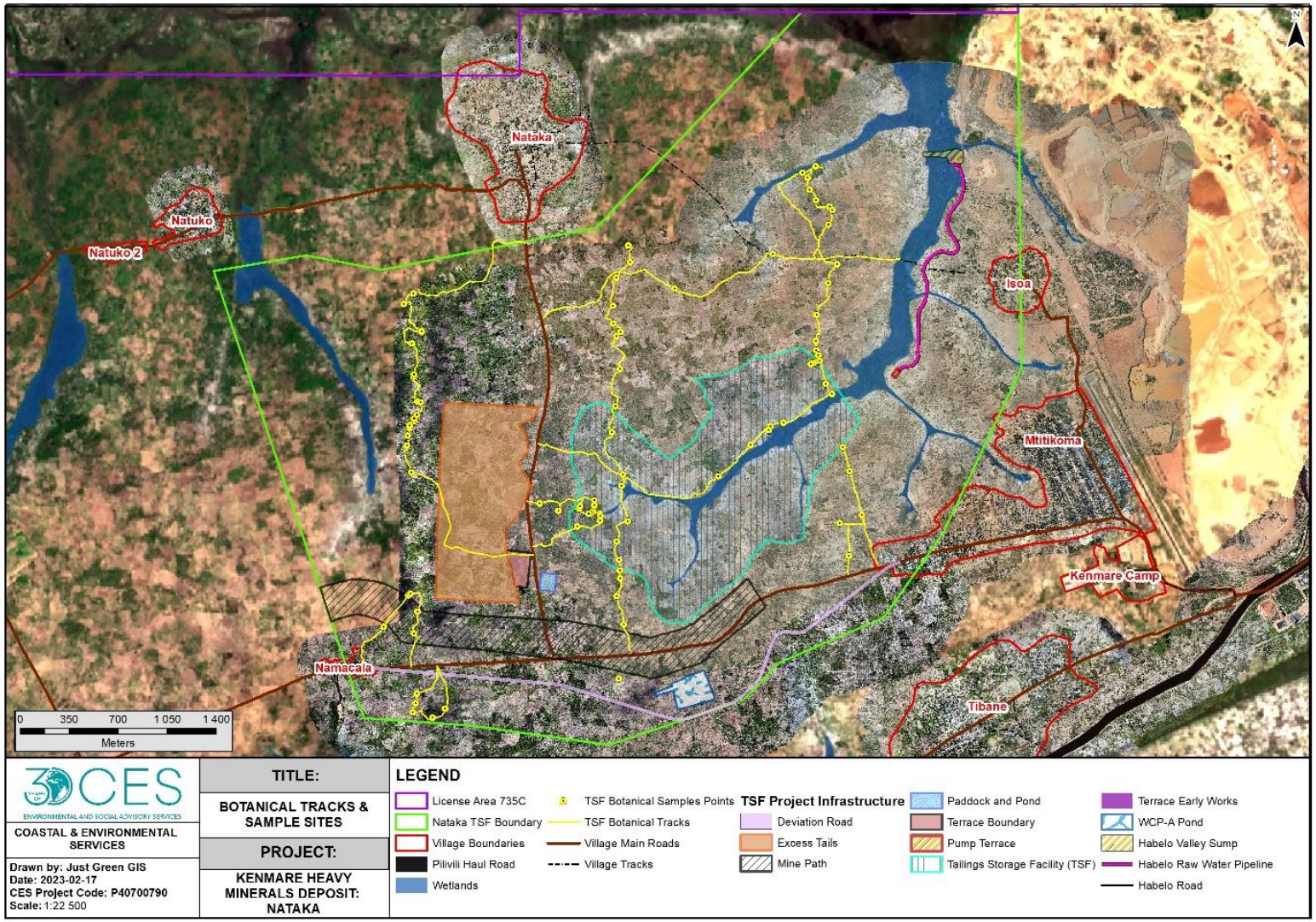

Figure 2.1: Map showing sample sites and tracks within the project area

2.4. Species of Conservation Concern

The GPS locations and number of individuals of Species of Conservation Concern (SCC) encountered within the site, were recorded and have been included on the vegetation map (Figure 4.5).

2.5. Site Sensitivity Assessment

The Species Environmental Assessment Guideline (SANBI, 2021) was applied to assess the Site Ecological Importance (SEI) of the project area. The habitats and the species of conservation concern in the project area were assessed based on their conservation importance, functional integrity and receptor resilience (Table 2.1). The combination of these resulted in a rating of SEI and interpretation of mitigation requirements based on the ratings.

Table 2.1: Criteria for establishing Site Ecological Importance.

Criteria	Description
Conservation Importance (CI)	*The importance of a site for supporting biodiversity features of conservation concern present e.g. populations of Threatened and Near-Threatened species (CR, EN, VU & NT), Rare, range-restricted species, globally significant populations of congregatory species, and areas of threatened ecosystem types, through predominantly natural processes.*
Functional Integrity (FI)	*A measure of the ecological condition of the impact receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts.*
Biodiversity Importance (BI) is a function of Conservation Importance (CI) and the Functional Integrity (FI) of a receptor.	
Receptor Resilience (RR)	*The intrinsic capacity of the receptor to resist major damage from disturbance and/or to recover to its original state with limited or no human intervention.*
Site Ecological Importance (SEI) is a function of Biodiversity Importance (BI) and Receptor Resilience (RR)	

2.6. Description of impact analysis methodology

To ensure a balanced and objective approach to assessing the significance of potential impacts, a rating scale developed by CES was used to assess the impacts of the project on the receiving environment. Factors that are taken into account include six key factors to determine the overall significance of the impact prior to mitigation[2]:

- **Nature of impact:** Defines whether the impact has a negative or positive effect on the receiving environment.
- **Type of impact:** Defines whether the impact has a direct, indirect or cumulative effect on the environment.

[2] A more detailed description of the impact methodology is provided in the Environmental Impact Assessment Report

- **Duration:** Defines the relationship of the impact to temporal scales. The temporal scale defines the significance of the impact at various time scales as an indication of the duration of the impact. This may extend from the short-term (less than 5 years, equivalent to the construction phase) to permanent. Generally, the longer the impact occurs the greater the significance of any given impact.
- **Extent:** Describes the relationship of the impact to spatial scales i.e. the physical extent of the impact. This may extend from the local area to an impact that crosses international boundaries. The wider the spatial scale the impact extends, the more significant the impact is considered to be.
- **Probability:** Refers to the likelihood (risk or chance) of the impact occurring. While many impacts generally do occur, there is considerable uncertainty in terms of others. The scale varies from unlikely to definite, with the overall impact significance increasing as the likelihood increases.
- **Severity or benefits:** The severity/beneficial scale is used in order to scientifically evaluate how severe negative impacts would be, or how beneficial positive impacts would be on the receiving environment. The severity of an impact can be evaluated prior and post mitigation to demonstrate the seriousness of the impact if it is not mitigated, as well as the effectiveness of the mitigation measures. The word 'mitigation' does not only refer to 'compensation', but also includes concepts of containment and remedy. For beneficial impacts, optimization refers to any measure that can enhance the benefits. Mitigation or optimisation should be practical, technically feasible and economically viable.

For each impact, the duration, extent and probability are ranked and assigned a score. These scores are combined and used to determine the overall impact significance prior to mitigation. They must then be considered against the severity rating to determine the overall significance of an activity. This is because the severity of the impact is far more important than the other three criteria. The overall significance is either negative or positive (Criterion 1) and direct, indirect or cumulative (Criterion 2).

Once mitigation measures are proposed, the following three factors are then considered to determine the overall significance of the impact after mitigation.

- **Reversibility Scale**: This scale defines the degree to which an environment can be returned to its original/partially original state.
- **Irreplaceable Loss Scale:** This scale defines the degree of loss which an impact may cause.
- **Mitigation Potential Scale:** This scale defines the degree of difficulty of reversing and/or mitigating the various impacts. This ranges from very difficult to easily achievable. Both the practical feasibility of the measure, the potential cost and the potential effectiveness is taken into consideration when determining the appropriate degree of difficulty.

The following assumptions and limitations are inherent in the rating methodology:

- Value Judgements: Although this scale attempts to provide a balance and rigor to assessing the significance of impacts, the evaluation relies heavily on the values of the person making the judgment.
- Cumulative Impacts: These affect the significance ranking of an impact because it considers the impact in terms of both on-site and off-site sources. This is particularly problematic in terms of

impacts beyond the scope of the proposed development. For this reason, it is important to consider impacts in terms of their cumulative nature.

- Seasonality: Certain impacts will vary in significance based on seasonal change. Thus, it is difficult to provide a static assessment. Seasonality will need to be implicit in the temporal scale, with management measures being imposed accordingly (e.g. dust suppression measures being implemented during the dry season).

3. DESCRIPTION OF THE RECEIVING ENVIRONMENT

3.1. Biophysical Environment

The project site is located within the Mozambique coastal plain and is characterised by a warm tropical climate with two distinct seasons (Parker, 2017). The wet season typically occurs from December to March/April and the dry season from May to November with a mean annual rainfall of 1176 mm. Average annual temperatures for the region are 25.4°C with the warmest months being December (with an average temperature of 28.1°C) and the coolest month being July (with an average temperature of 21.7°C) (www.climatedata.eu. Accessed: 8-08-2021).

The Nataka deposit is a large accumulation of heavy minerals in the aeolian sediments of the Old Red Dune, centred approximately 15km west of the Namalope Project. The mineralisation consists of thick, uniform zones of orange to red-brown silty sand. The underlying geology has given rise to the following soils within the project site: Fernwood soils (grey and pale brown sands) on the lower slopes, Hutton (red sands) and Clovelly (brown sands with yellow subsoil) on mid and top slopes, where the soil is sandy. The drainage areas have slightly heavier (mainly silt, but with some clay) soils. Clay lamellae (bands in which clay has accumulated) in the subsoil are likely to occur in areas which are wet for most of the year.

The sandy texture of the soils (particularly in the upper, rooting zone) influences the following physical properties of the soils:

- Low water holding capacity
- Low cation exchange capacity (which in turn imparts a low fertility to the soils)
- Rapid permeability
- Poor cohesion between grains which makes the soils susceptible to erosion.

The climate, geology and soils associated with this region have given rise to a complex of woodland, wetlands and forest. In addition to the biophysical features, the current land use has also influenced the structure and composition of the vegetation at the site. Activities such as harvesting woody species for fuelwood, construction and charcoaling, clearing of vegetation for machambas and burning to increase soil nutrition, all of which were noted to occur on site, play a major role in species composition and structure.

3.2. Mozambique's Eco regions and Centres of Endemism

There are thirteen ecoregions in Mozambique and four main Centres of Endemism. The project site falls within the Southern Zanzibar-Inhambane Coastal Forest Mosaic which runs along the coast of Mozambique (Figure 3.1) (Burgess *et al.,* 2004; Odorico *et al.*, 2022). It also occurs within the Zambezian Regional Centre of Endemism within which there are four more restricted phytogeographical units including the recently extended Rovumo Centre of Endemism (Figure 3.2) (Darbyshire *et al.*, 2019). Previously, this Centre of Endemism was restricted to southeast Tanzania but has been extended to include the coastal area of Cabo Delgado, Nampula and Zambezia Provinces (Darbyshire, 2019; Odorico *et al.*, 2022). The Rovumo Centre of Endemism is noted as having a high number of strict-endemics with many species often restricted to a few or even single forest block (Darbyshire *et al.,* 2019). Also of interest is that Nampula and Zambezia Provinces

register the highest number of strict-endemics. The project site occurs within Nampula Province and the Rovuma Centre of Endemism.

Plant endemism in Mozambique is relatively high and was assessed at 9.59% and includes 278 strict-endemic taxa and 403 near-endemic taxa (Darbyshire *et. al.,* 2019; Odorico *et al.*, 2022). Of the known indigenous species, 4.9% are listed as Species of Conservation Concern (24 taxa are listed as Critically Endangered, 119 as Endangered and 158 as Vulnerable). Odorico *et al.* (2022) attribute the "*increase in the number of strict-endemic and near-endemic taxa compared to previous studies (Darbyshire et al. 2019) to the continuous progress in the knowledge of the Mozambique's flora"* suggesting that areas have been previously undersampled.

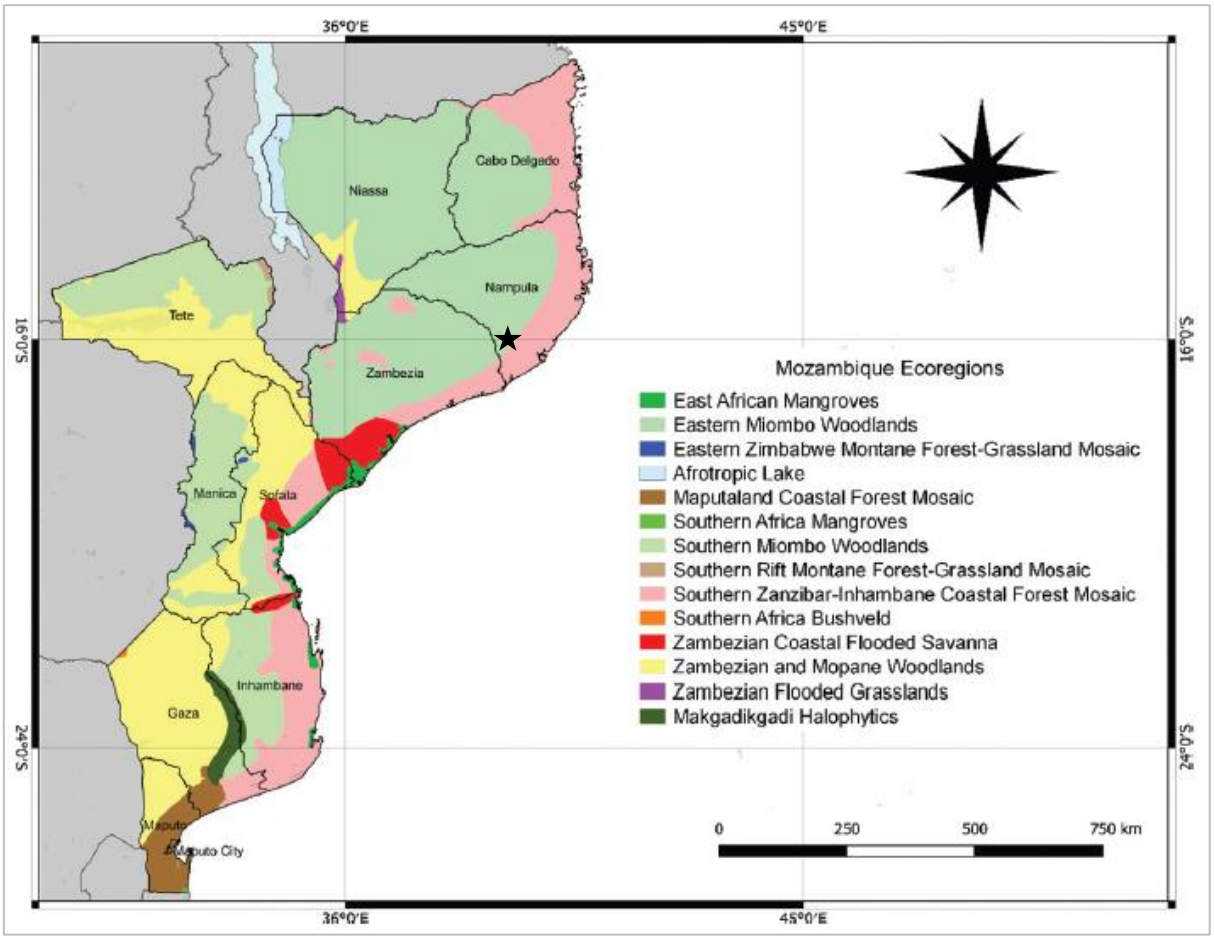

Figure 3.1: Ecoregions in Mozambique (Source: Odorico *et al.*, 2022). Black star indicates approximate location of project site.

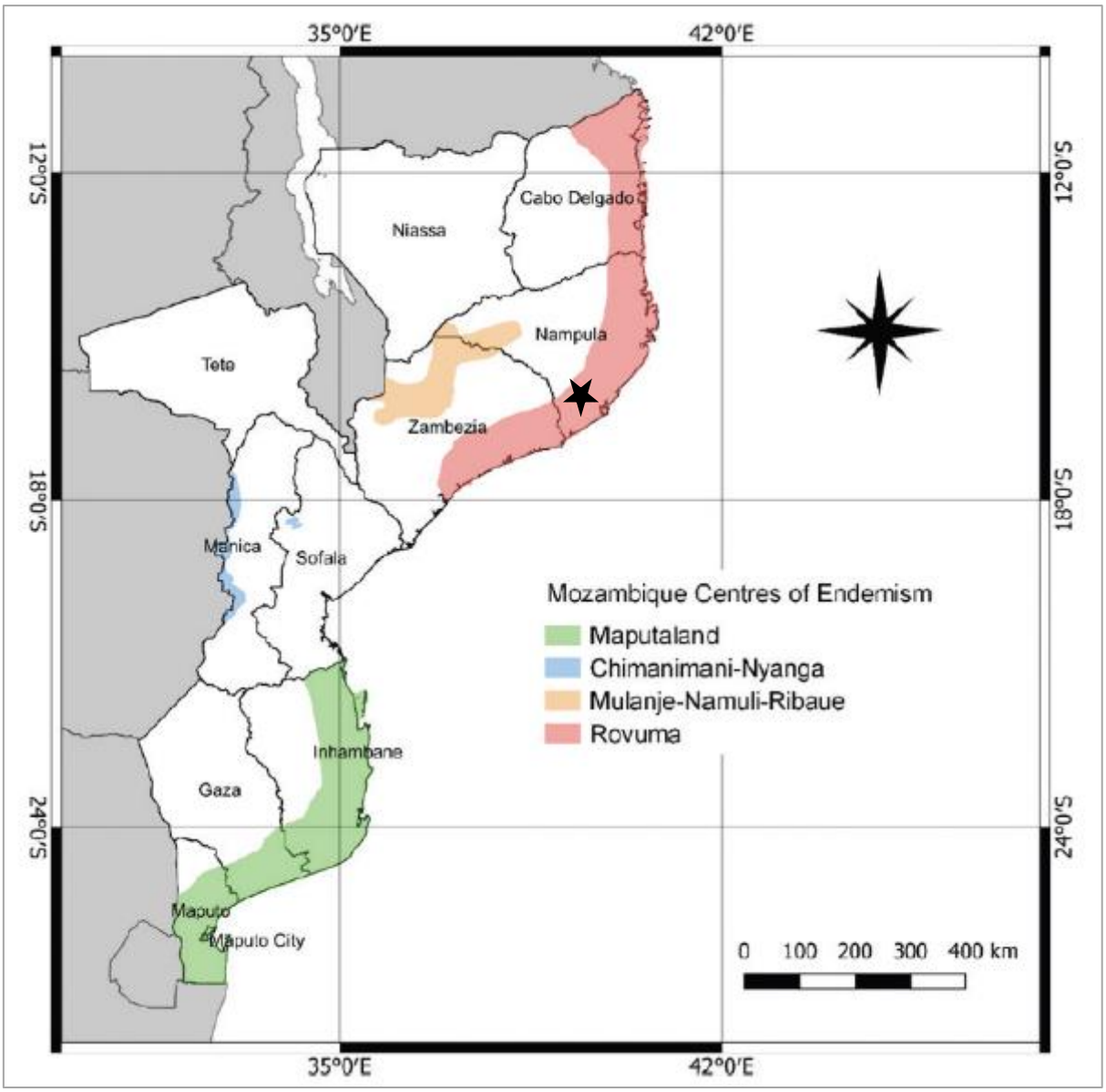

Figure 3.2: Mozambique's Centres of Endemism (Source: Odorico *et al.*, 2022). Black star indicates approximate location of project site.

3.3. Key Biodiversity Areas and Protected Areas

All protected areas, including National Parks, Forest Reserves and Trans-frontier Conservation Areas are the responsibility of ANAC. The Forest Reserves were created to safeguard timber reserves from advancing agriculture for future sustainable utilization, and hence not specifically for conservation. The possibility that these reserves can make a significant contribution towards biodiversity conservation has now been recognized, and studies are being conducted to gain an understanding of the vegetation and ecosystem condition within these reserves. Over the last ten years, Mozambique has actively been increasing the number of conservation areas to include ecosystems that were not previously represented. Currently, 26% of the country's surface (21 million hectares) is classified as a gazetted conservation or protected area (MITADER, 2015 and National Biodiversity Offset System, 2016). Two thirds of these areas are managed by the private sector and the remaining third is managed by the public sector with support and technical assistance from local NGOs.

The term "Protected area" in Mozambique is comprised of various categories which are broadly divided into a) total conservation areas and b) conservation areas for sustainable use. These are briefly described in Table 3.1. Articles 13-25 of the Conservation Law (16/2014 of 20 June as amended 5/2017 of 11 May) provides further details on the activities associated with each type of protected area. Although 26% of the country is considered a protected area within Mozambique based on the legislation, not all of these areas are afforded the same level of protection, which can be misleading.

Table 3.1: List of legislated protected areas.

Name	Function
Total Conservation Area	
Full Natural Reserve	Total conservation area in the public domain of the State, delimited, designated for the preservation of nature, the maintenance of ecological processes, the functioning of ecosystems and of rare or endangered species.
National Parks	Total conservation area in the public domain of the State, delimited and designated for the propagation, protection, conservation, preservation and management of flora and wildlife, and for the protection of sites, landscapes or geological formations of particular scientific, cultural or aesthetic value, in the public interest and for public recreation, representative of the national heritage.
Cultural and Natural Monument	Monuments are total conservation areas in the public domain of the State, municipality or community or private, containing one or more elements with unusual or unique natural, aesthetic, geological, religious, historical or cultural value, in an area of less than 100 hectares, which due to its uniqueness and rarity, requires the preservation and maintenance of its integrity.
Conservation Areas for Sustainable Use	
Special Reserve	Designated for the protection of a particular species of rare, endemic, endangered or declining fauna or flora, or with recognized cultural and economic value.
Environmental Protection Area (*Primeiras and Segundas Archipelago Protected Area)*	**Interaction between human activity and nature endows the landscape with aesthetic, ecological or culturally specific and unique qualities and offers important ecological services for its residents and its neighbours. Additionally, it allows for mining to occur within the area.**
Official Hunting Preserve	Delimited and designated for hunting activities and the protection of species and ecosystems, in which the right to hunt is only recognized by means of the concession contract between the State and the operator.
Community Conservation Area	Conservation area for sustainable use in the public domain of the community, delimited and managed by one or more local communities who have the right to use and benefit from land, designated for the conservation of fauna and flora and the sustainable use of natural resources.
Sanctuary	Designated for the reproduction, shelter, food and research of certain species of fauna and flora.
Game Farm	Fenced area of private domain, designated for the conservation of fauna and flora where the right to hunt is limited to the holder of the land use rights (DUAT) or to those who have been authorized by that holder, provided that both acquire the respective license issued by the competent authority.
Municipal Ecological Park	Conservation area for sustainable use in the municipal public domain for the conservation of sensitive ecosystems within an urban/populated context.

An understandable challenge facing the protected areas in Mozambique is that although they are recognised on paper as being areas of conservation, the reality is that there is a general lack of staff, equipment and budgets necessary to adequately implement conservation measures to prevent biodiversity loss (National Biodiversity Offset System, 2016). It is estimated by the National Administration of Conservation Areas

(ANAC) that the protected area network only receives 19% of its current funding from reliable and sustainable resources. Studies show that to bring the level of management up to a standard that will result in meaningful protection and an increase in biodiversity, a once off fee of 120 million USD would need to be invested followed by an annual budget to fund operations of 70 million USD. Currently only 19M USD is spent per annum on protecting the biodiversity within protected areas. Additional funding is required to improve the on-the-ground management of existing parks to allow them to move beyond the goal of simple maintenance as well as assist with the protection of unique biodiversity that occurs outside of protected areas. These challenges are common in developing countries, where the revenue from a small tax base is simply insufficient for meaningful and effective conservation strategies to be implemented.

All project infrastructure associated with the TSF occurs in the Primeiras and Segundas Archipelago Protected Area (Figure 3.3) which was established in 2012 and is cited as the largest marine protected area in Africa, extending over 200 km of coastline and comprising of 10,500km^2 (about 1.5 million hectares) of terrestrial and marine environments (Teixeira, 2015). This reserve is listed as an IUCN Management V Protected Area. This IUCN category is defined as "*A protected area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values".*

The reserve is also recognised as a Key Biodiversity Area (KBAs) (Figure 3.4) (SIBMOZ, 2022). KBAs are important sites for the global persistence of biodiversity. These sites are either important for a number of unique species or for just one species that is range restricted and endemic. KBAs are recognised by the IFC and financial institutions that adhere to the Equator Principles as areas of internationally and/or nationally significant biodiversity value that may require a critical habitat assessment (GN54 PS 6 Guidance Notes).

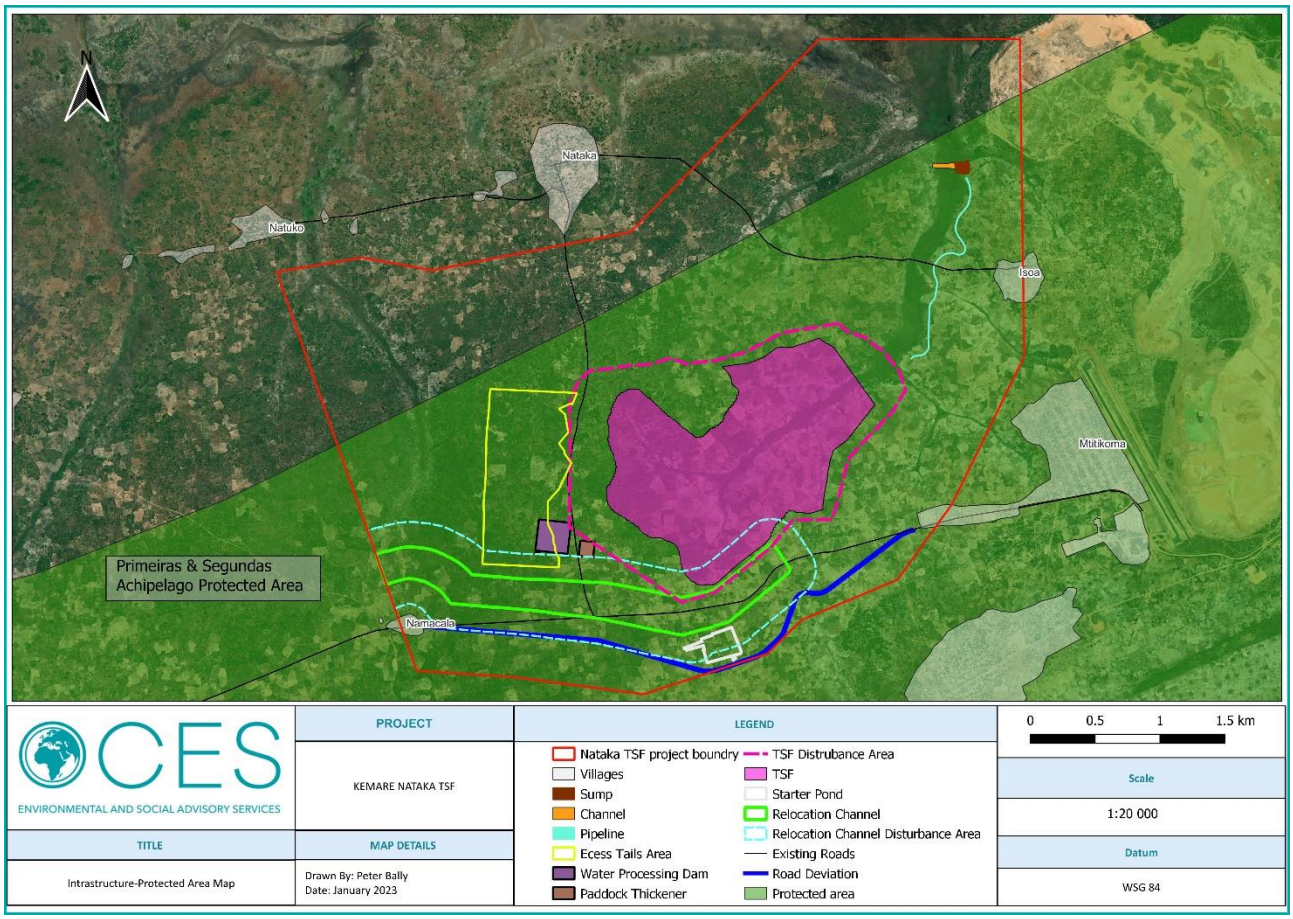

Figure 3.3: Map showing a portion of the Nataka Project Site occurring in the Primieras and Segundas Archipelago Protected Area

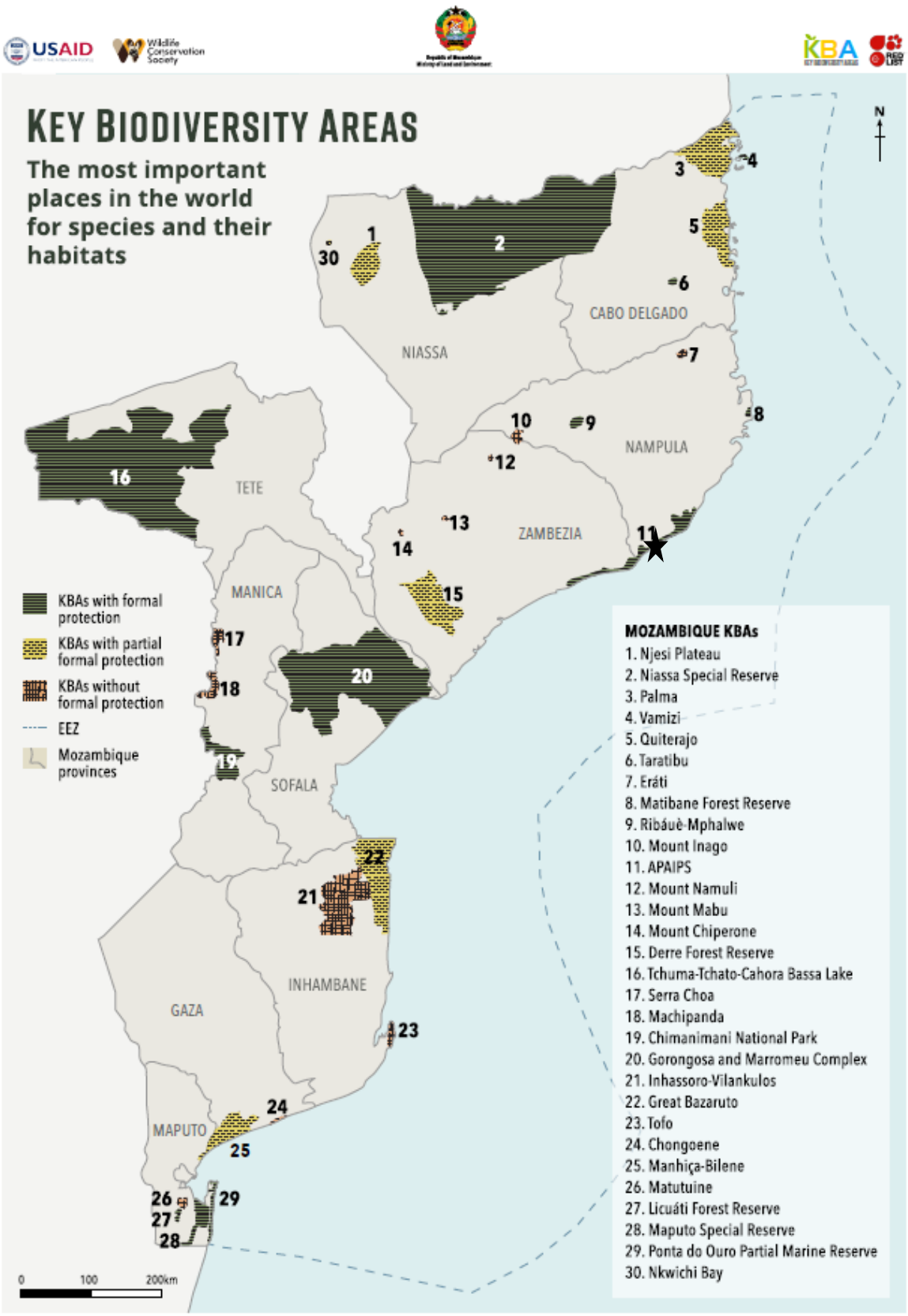

Figure 3.4: Key Biodiversity Areas in Mozambique. The project site occurs within the Primieras and Segundas Protected Area (APAIPS which is number 11 on the map). (Source: SIBMOZ, 2022). Black star indicates approximate location of project site.

3.4. Miombo Woodland

The vegetation found within the TSF Project Site is characteristic of the broad vegetation unit described as Miombo Woodland. The Miombo Ecoregion is defined by Byers (2001) as comprising of multiple vegetation types that reflect differences in species composition and ecological processes, but which are all dominated by one or more species of the Caesalpinioideae family. It is estimated that this ecoregion covers approximately 3.6 million km^2 across eleven countries in central and southern Africa (Figure 3.5) (Timberlake and Chidumayo, 2011) and contains around 8,500 plant species of which 54% are endemic (White, 1984). It also supports a number of faunal species that are endemic or near endemic to the ecoregion. Due to this high level of endemicity and because it is an important habitat for several threatened species[3], it has been identified as one of five global wilderness areas that should be prioritised for conservation (Mittermeier *et al*., 2003) (Table 3.2). However, compared to other global ecoregions, to date, this ecoregion has received little conservation and research attention (Jew *et al.,* 2016).

Table 3.2: The number of species and endemic/near endemic species in the Miombo Ecoregion.

Group	No. Species in ecoregion	No. endemic/near endemic species	% Endemics
Plants	8500	4590	54%
Mammals	318	35	11%
Birds	938	53	6%
Reptiles	284	83	29%
Amphibians	130	36	28%
Fish	200	30	15%
Butterflies	1300	90	7%
Total	11,670	4,915	42%

Although there is a high species diversity and a number of endemic and near endemic species associated with this ecoregion, according to the Miombo Ecoregion Vision Report (2011), the conservation of the Miombo Ecoregion is more about "*conservation of processes operating at a landscape scale across thousands of square kilometres than about conservation of species or individual habitats*" (Timberlake and Chidumayo, 2011).

It is estimated that over 100 million people are directly or indirectly dependent on this ecoregion to meet their daily needs (Syampungani *et al.,* 2009). Given that the population of sub-Sahara Africa has grown from 186 million to 856 million people from 1950-2010 and it's estimated that by 2060, the population of sub-Sahara Africa could be as large as 2.7 billion people (The World Bank, 2015). As such, pressure on this ecoregion is steadily increasing (Cabral et al., 2011; Dewees et al., 2010). However, these woodlands have historically been inhabited by people and the ecological dynamics have therefore been largely shaped by humans (e.g. burning these woodlands during the dry season for agricultural purposes) (Jew et. al. 2016). This interdependence between humans living in this ecoregion and the impact they have in shaping it led to Campbell (1996) describing the miombo ecoregion as a "social forest". However, despite these links, little is

[3] It is estimated that 100 threatened species are thought to occur in the ecoregion, of which nine are Endangered or Vulnerable

known about the present-day response of biodiversity to land-use change, such as the clearing of land for agriculture and the utilisation of natural resources in the remaining woodland.

In Mozambique, disturbance such as clearing for agriculture and harvesting of trees for charcoal has resulted in the ongoing degradation of Miombo Woodland, with a significant loss of vegetation outside of protected areas.

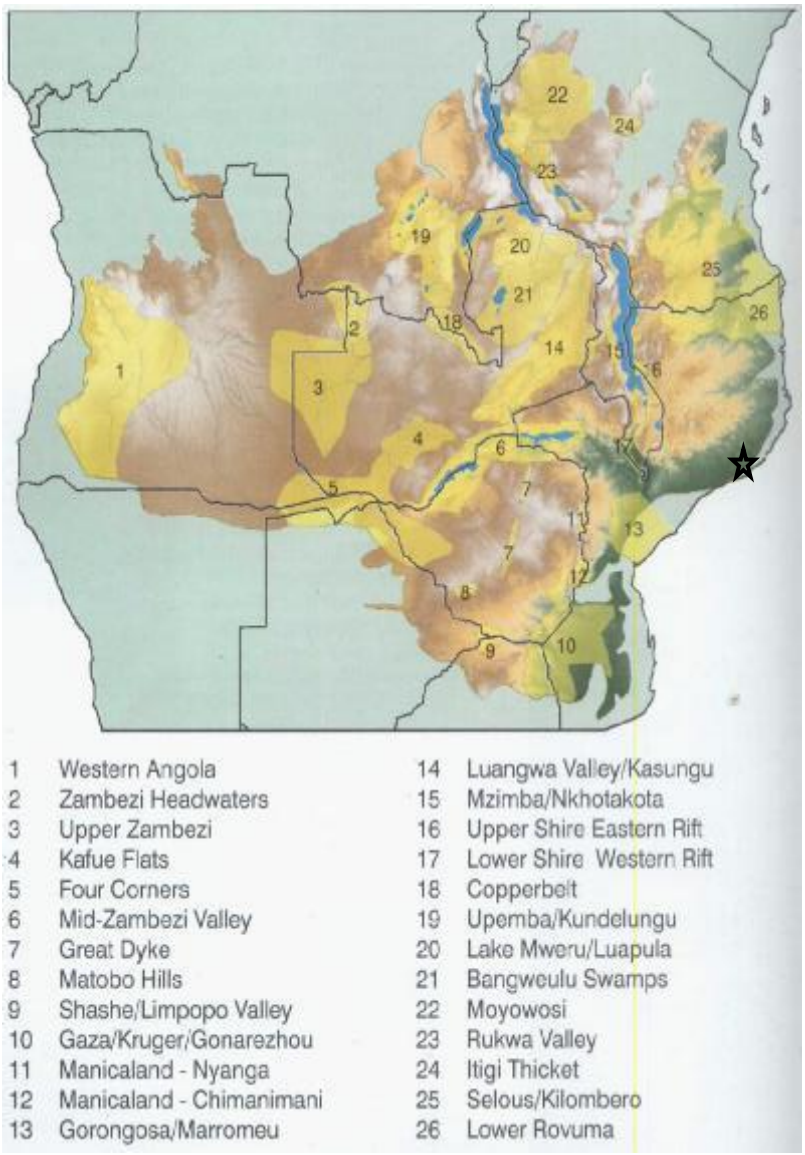

Figure 3.5: The Miombo Ecoregion (from WWF SARPO 2003) in relation to the project area (star).

3.5. Current and Historical Land Use

Historical imagery indicates that the site has been used for shifting agriculture since at least 1986 and likely dating back even further (Figure 3.6), which shows changes since 2013, when reliable imagery became available.

Typically, areas are cleared through a combination of mechanical means and burning. Crops (mainly cassava interspersed with ground nuts, rice in wetlands) are planted for a few seasons after which the land becomes infertile and are thus left fallow to regenerate. Areas that are left fallow within the project site generally

return to a secondary woodland for a small period of time (3-5 years) before they are cleared again for crop cultivation.

In addition, secondary woodland is used as a source of fuel wood, raw materials for charcoaling, construction materials and harvesting of wild food and for medicinal purposes.

An NDVI analysis was undertaken using sentinel imagery for 2019, 2020, 2021 and 2022 for the TSF project area (Table 3.3 and Figure 3.7). The analysis identified four vegetation classes:

- Barren rock and sand
- Machambas and grassland
- Secondary Miombo Woodland
- Forests
- Wetlands

The findings indicate that by 2022, the Machambas and grassland vegetation type had increased from 47.36% of the assessed area to 80.87% of the assessed area. Machambas and grassland therefore increased by 33.5% between 2019 and 2022 and Secondary Woodland showed a decrease of 30.29% between 2019 and 2022, as Secondary Woodland has been cleared to make way for Mashambas.

Table 3.3: NDVI analysis showing the change in each vegetation class between 2019 and 2021.

Class	2019	2020	2021	2022	Change between 2019 and 2022	% change
Barren Rock & Sand	0.1 ha 0.01%	0.4 ha 0.02%	4.3 ha 0.23%	17.7 ha 0.97%	+17.6 ha	0.96%
Machambas and Grassland	829.9 ha 45.38%	1102.2 ha 60.28%	963.5 ha 52.7%	1401 ha 76.6%	+351 ha	19.2%
Secondary Miombo Woodland	790.7 ha 43.28%	568.4 ha 31.11%	685.1 ha 37.5%	268.9 ha 14.72%	-521.8 ha	-40.7%
Forests	70.4 ha 3.85%	20.0 ha 1.09%	37.9 ha 2.07%	2.5 ha 0.13%	-67.9 ha	-3.72%
Wetlands	136 ha 7.44%	136.0 ha 7.44%	136.0 ha 7.44%	136.0 ha 7.44%	0ha	0%

It is also evident from Figure 3.7 that there has been a significant increase in the rate of vegetation clearing between 2021 and 2022. This is attributed to increased pressure on the land for crops, due partly to in-migration of job seekers, the current land-take by Kenmare, and possibly speculative land clearing in the hope of obtaining compensation through the RP process. These are therefore induced secondary impacts arising from Kenmare's activities in the broader area.

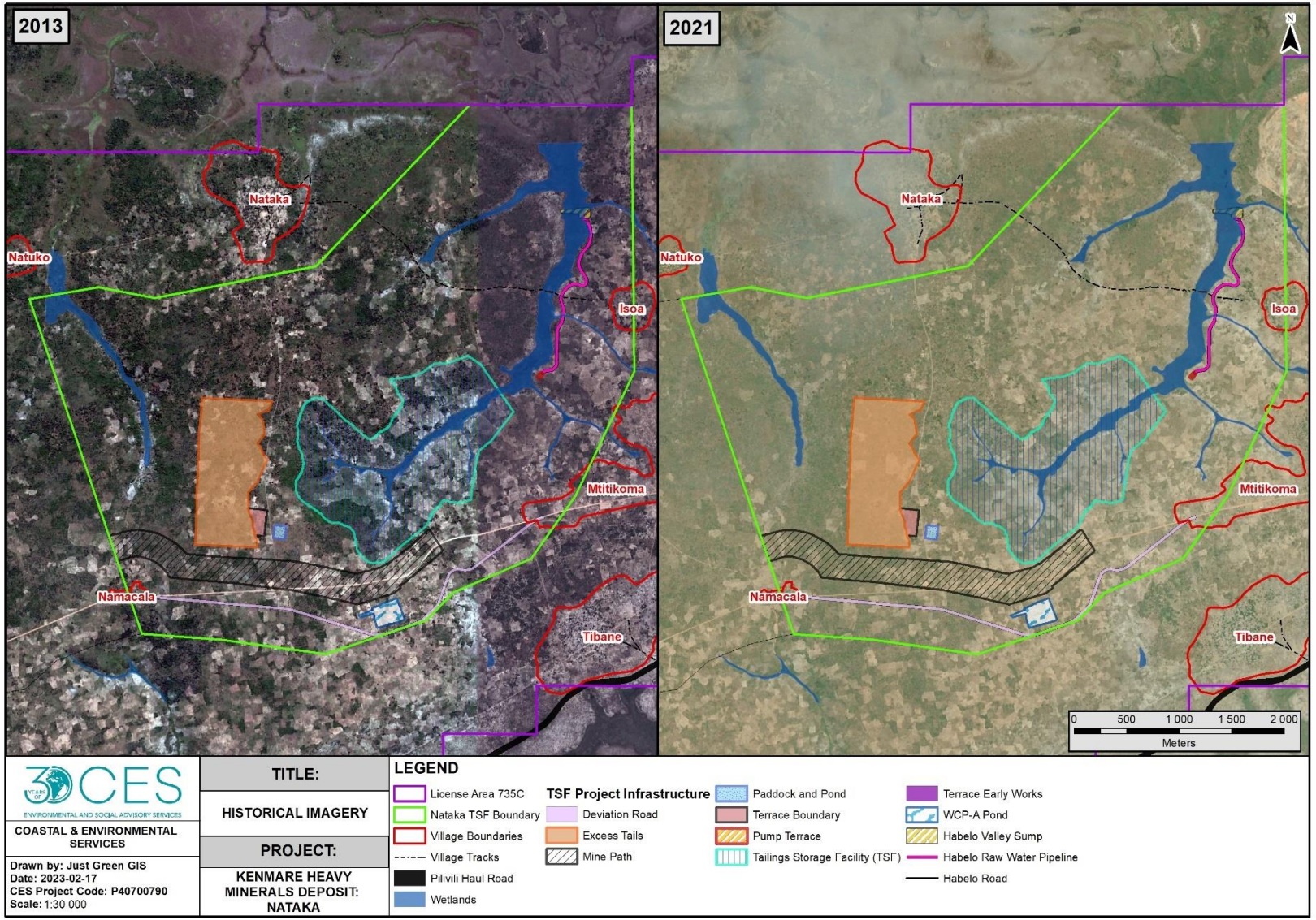

Figure 3.6: Historical imagery indicates that the majority of the site has been cultivated since at least 2013. Close up imagery dating back to earlier years is not available for this area. However, imagery that has been zoomed out indicates that this area has been under shifting cultivation since at least 1986.

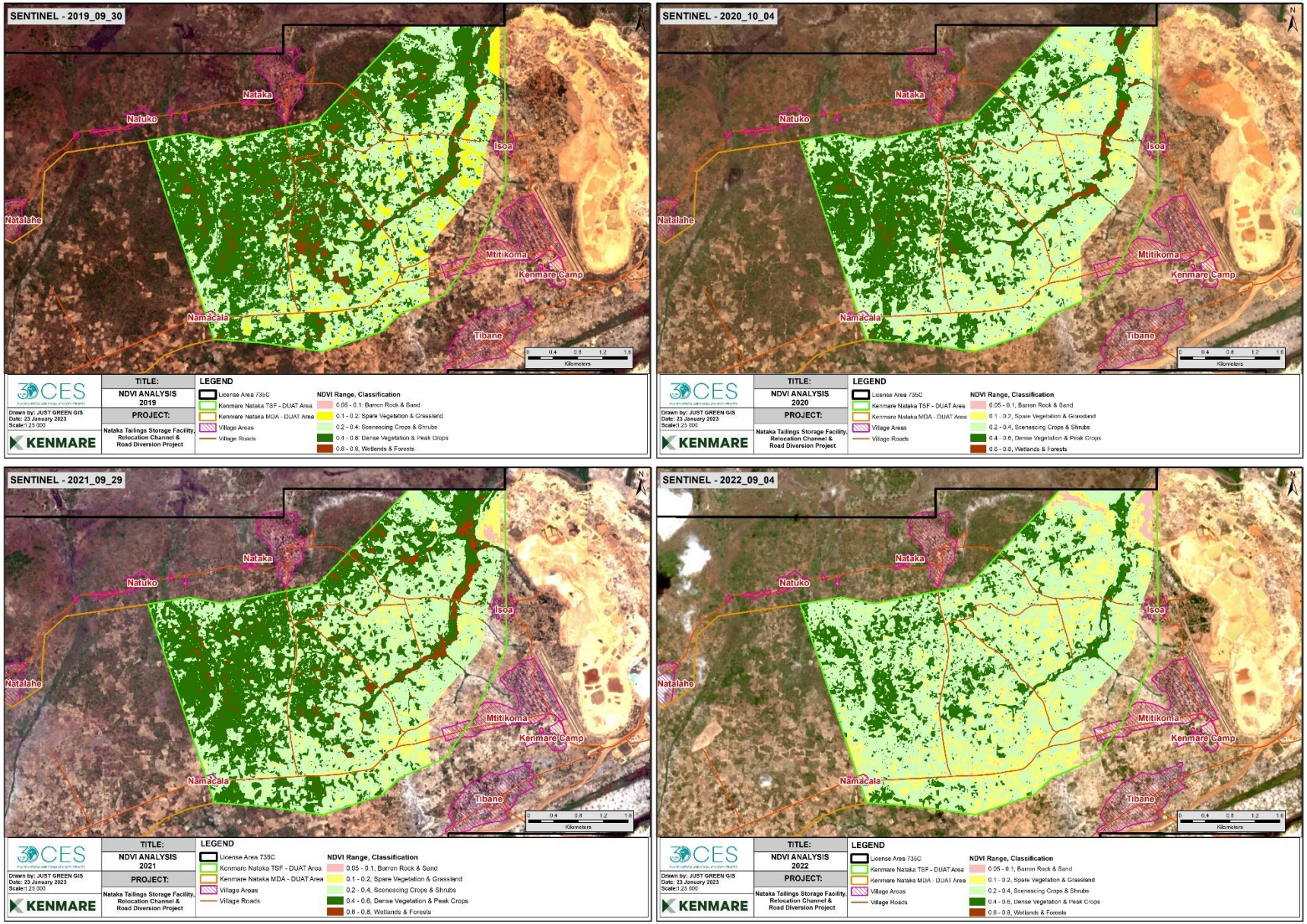

Figure 3.7: NDVI analysis of the site indicating change in land use and vegetation from 2019 to 2022. Kenmare started prospecting in 2021. Note the impact that occurred between 2021 and 2022.

4. RESULTS

4.1. Vegetation recorded on site

The vegetation present within the project area of influence (i.e. the broader project area) is comprised of a mosaic of Secondary Miombo Woodland and transformed land which includes machambas and villages. Interspersed within these areas are wetlands which are described in greater detail in the Wetland Impact Assessment Report. There is one forest patch to the north-east of the project area that is intact and has been described (refer to section 4.1.2). Areas that have been transformed have been mapped for the sake of completion, but no further descriptions are provided.

Within the project site itself (i.e. the area that will be directly impacted by TSF project infrastructure) only Secondary Miombo Woodland, Machambas and Wetlands are present.

4.1.1. Secondary Miombo Woodland

Secondary Miombo Woodland occurs as fragmented patches throughout the site (Figure 4.5). These areas were evident based on the structure of the vegetation and the coppicing trees and shrubs (Figure 4.1 and 4.2). Although this area is likely to have once been Closed Miombo Woodland or even forest, historical imagery indicates a long history of clearing dating back to 1986 in some areas with further clearing occurring in the early to mid-2000's (Figure 3.5 and 3.6). The vegetation present is therefore adapted to cycles of burning and clearing followed by periods where the land is "rested" and shrubs and trees are given the opportunity to recover. These areas are typically allowed to lay fallow for three to five years although in some areas within Nataka, it was observed that the secondary woodland had been left for longer periods as these areas had taller shrubs with a larger canopy cover.

Depending on how long an area has lain fallow will influence canopy cover. Some areas had open canopies of 25-50% while other areas that had not been cleared in some time indicated a canopy cover of 50-75%. Patches of woodland with an open canopy cover typically had an understory of grass and trees. Trees were between 2-3m in height with emergents of 4m. In contrast, areas with a closed canopy cover had an understory with more herbs and saplings (young trees) present rather than grass and trees were typically taller (between 3-5m) with emergents of 6m.

There are no clearly dominant species that characterise this vegetation type, however common species throughout the site include shrubs and trees such as *Xylotheca tettensis, Ozoroa obovata, Anonna senagalensis Xylopia gracilipes, Ancylobothrys petersiana, Carissa macrocarpa, Parinari curatellifolia, Commiphora serrata, Grewia sulcata, Pteleopsis myrtifolia, Rourea orientalis, Rourea coccinea subsp. boiviniana Tetracera boiviniana, Hymenocardia ulmoides, Euclea natalensis, Cassia afrofistula, MIllettia stuhlmanii, Phyllocosmus lemaireanus, Vitex doniana, Afzelia quanzensis, Albizia adianthifolia, Senna petersiana, Caloncoba welwitschia, Premna serratifolia Dalbergia nitidula, Strychnos madagascariensis, Strychnos spinosa, Grewia transzambezica, Ochna mossambicensis, Olax dissitiflora, Margaritaria discoidea Antidesma vernosum, Pavetta decumbens, Blighia unjugata, Deinbollia oblongifolia, Nesogordonia holtzii, Garcinia livingstonei, Merremia tridentata, Bosqueiopsis carvalhoana* and *Manilkara concolor.* A full species list has been included in Appendix 1.

Species of Conservation Concern such as *Brachystegia oblonga* (Critically Endangered) *Waernecka sessilicarpa* (Critically Endangered) and *Nesogordonia holtzii* (Near Threatened) were scattered throughout the project site, whilst some SCC such as *Blepharis dunensis* (Endangered), *Hexalobus mossambicensis* (Vulnerable) and *Vitellariopsis kirkii* (Vulnerable) were only recorded within a few sites. SSC are discussed in further detail in section 3.6.

Figure 4.1: Secondary woodland with an open canopy found within the project site.

Figure 4.2: Secondary woodland with a closed canopy found within the project site.

4.1.2. Forest

There is a near-intact forest patch situated to the north-east of the project site, north of the proposed TSF (Figure 4.3 and 4.5). Within clearings in the forest patch were a number of graves suggesting the site is a sacred site. Species present included *Euclea natalensis, Albizia versicolor, Rotheca sansibarensis subsp. sansibarensis var. eratensis, Hugonia orientalis, Flueggea virosa subsp. Virosa, Carpolobia goetzei, Paropsia braunii, Sphaerocorne gracilis subsp. Gracilis, Strychnos mytoides, Eugenia capensis, Brachystegia oblonga, Afzelia quanzensis, Millettia stuhlmanii* and *Bosqueiopsis carvalhoana.*

This forest was characterised by a closed canopy cover (90-100%) and trees were 6 to 7m in height with emergents of 8-10m. The understory was comprised of saplings and small shrubs of 1-2m in height.

Figure 4.3: Forest patch found within the project site.

4.1.3. Machambas

Machambas consists mostly of crops such as cassava interspersed with ground nuts, however there are scattered trees and shrubs throughout these areas including species of consvervation concern such as *Brachystegia oblonga, Waerneckea sessilicarpa* and *Blepharis dunensis.* Machambas are often not fully cleared. Larger trees with estbalished root systems are cut down to stumps and then during the growing season, these individuals coppice and grow back (Figure 4.4).

Figure 4.4: Active machambas in the foreground (planted with Cassava) and secondary woodland in the background.

4.2. Vegetation loss

The project infrastructure will result in the eventual direct loss of approximately 29.5 ha of secondary woodland, 16.8 ha of riparian vegetation and 371 ha of machambas.

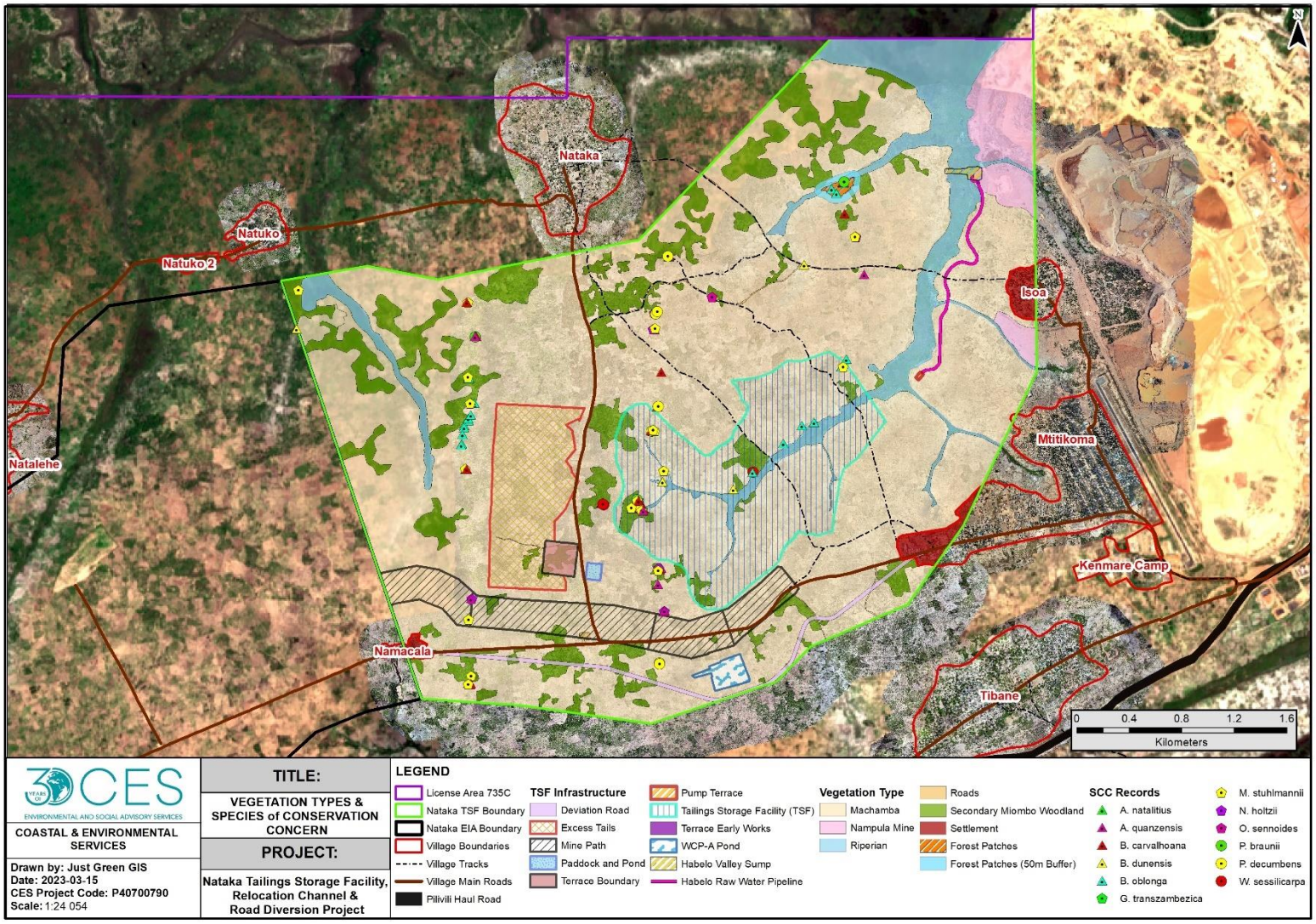

Figure 4.5: Vegetation map for the project site and the location of confirmed threatened species encountered during the survey. There are likely to be more individuals present than those recorded.

4.3. Floristics

Within the broad project area, 214 plant species were recorded from 59 families. Of these 214 species, 159 species from 57 families were recorded within the TSF project site. (Table 4.1) (a full species list has been included in Appendix 1). The Fabaceae family had the highest number of species (21 species) followed by Poaceae (14 species), Lamiaceae (7 species), and Apocynaceae, Malvaceae, Rubiaceae (each with six species). The remaining families have five or less species. Of the 159 recorded species, fifteen are considered to be species of conservation concern (refer to section 4.3.1 for further details).

Table 4.1: Number of families and species recorded within the project site.

FAMILY	No. of Species	FAMILY	No. of species
Acanthaceae	2	Lamiaceae	7
Achariaceae	2	Lauraceae	1
Anacardiaceae	5	Linaceae	1
Annonaceae	4	Loganiaceae	3
Apocynaceae	6	Melastomataceae	1
Araceae	1	Malpighiaceae	1
Arecaceae	2	Malvaceae	6
Asparagaceae	1	Menispermaceae	2
Asteraceae	1	Moraceae	4
Bignoniaceae	3	Myrtaceae	1
Burseraceae	2	Ochnaceae	3
Capparaceae	1	Olacaceae	2
Caprifoliaceae	1	Orchidaceae	1
Celastraceae	2	Passifloraceae	2
Celtidaceae	1	Phyllanthaceae	5
Chrysobalanaceae	1	Plantaginaceae	1
Clusiaceae	1	Poaceae	14
Colchicaceae	2	Polygalaceae	2
Combretaceae	4	Putranjivaceae	1
Commelinaceae	1	Rubiaceae	6
Connaraceae	2	Rutaceae	1
Convolvulaceae	2	Salicaceae	1
Cyperaceae	1	Sapindaceae	3
DILLENIACEAE	1	Sapotaceae	4
Ebenaceae	3	Solanacea	1
Euphorbiaceae	4	Thymelaeaceae	1
Fabaceae	21	Typhaceae	1
Flagellariaceae	1	Vitaceae	1
Ixonanthaceae	1		

4.3.1. Species of Conservation Concern

Species of Conservation Concern (SCC) are defined as species listed on the IUCN and Mozambique Red Data List as Critically Endangered, Endangered, Vulnerable, Near Threatened, Critically Rare, Rare, Declining or Data Deficient. A subgroup of SCC are Threatened Species comprised of Critically Endangered, Endangered and Vulnerable species (Figure 4.6). In addition to this, endemic and near endemic species are also considered species of conservation concern.

Twelve SCC were recorded within the project area of influence. Of these, five are listed as threatened (CR, En and VU) species, three of which were recorded within the TSF project area, four as endemic species and two as near endemic species.

Table 4.2 lists SCC recorded in the TSF site and Table 4.3 lists the additional SCC recorded within the broader Nataka Deposit project area. Below the tables is a brief description of each species' range and status and its significance to the project.

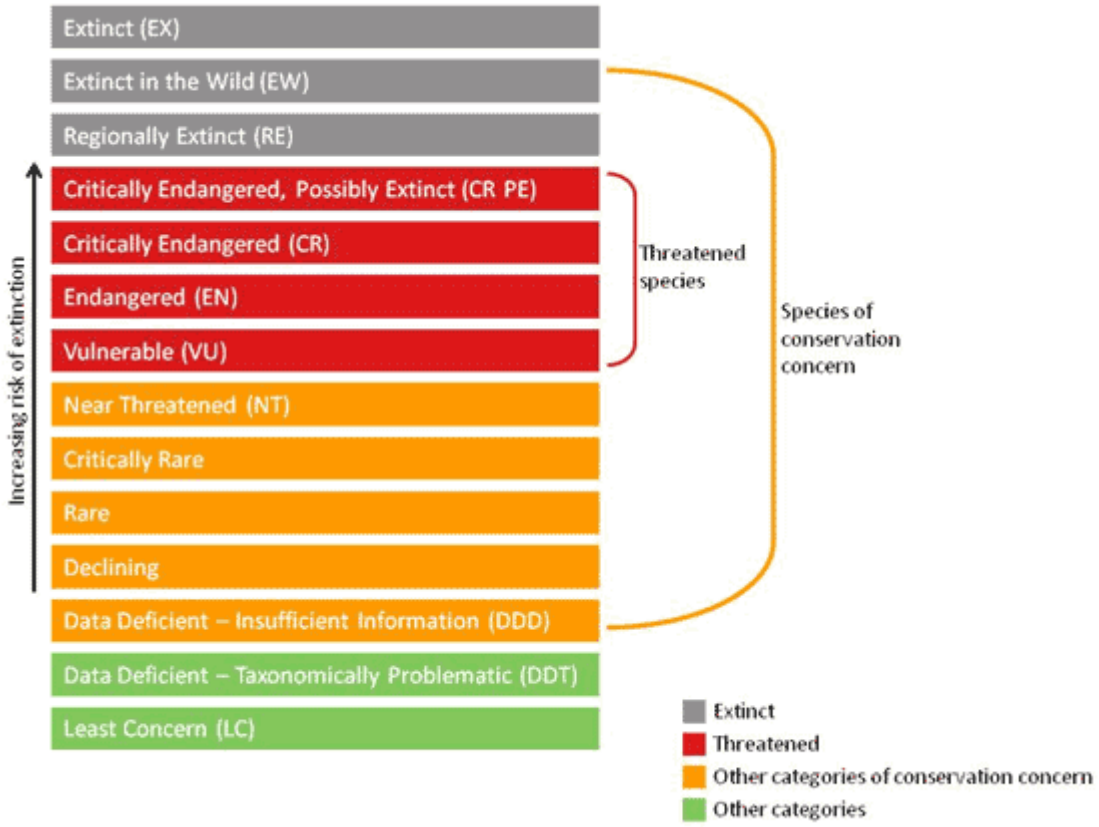

Figure 4.6: Illustration showing SCC and the subgroup of Threatened Species (Source: SANBI, 2021)

Table 4.2: Confirmed species of conservation recorded within the TSF project site.

Family	Name	IUCN	Moz Red Data List	Endemic	Possible trigger for critical habitat
Fabaceae	*Afzelia quanzensis*	Least Concern	Lower Risk- Near Threatened	-	
Acanthaceae	*Blepharis dunensis*	Endangered	Vulnerable	Endemic	X
Moraceae	*Bosqueiopsis carvalhoana*	-	-	Near Endemic	
Fabaceae	*Brachystegia oblonga*	Critically Endangered	-	Endemic	X
Malvaceae	*Grewia transzambesica*	-	-	Endemic	
Fabaceae	*Millettia stuhlmanii*	-	Lower Risk- least concern	-	
Sterculiaceae	*Nesogordonia holtzii*	Near threatened	-	-	
Melastomataceae	*Warneckea sessilicarpa*	Critically Endangered	-	Endemic	X
Fabaceae	*Ormocarpum sennoides subsp zanzibaricum*	Vulnerable	-	-	
Malpighiaceae	*Acridocarpus natalitius var.natalitius*	Least Concern	Near Endemic 1	Near Endemic	
Passifloraceae	*Paropsia braunii*	Near Threatened	-	-	
Rubiaceae	*Pavetta decumbens*	Vulnerable	-	-	

Table 4.3: SCC recorded within the broader Nataka Deposit project area that could occur within the TSF.

Family	Name	IUCN	Moz Red Data List	Endemic	Possible trigger for critical habitat
Malvaceae	*Glyphaea tomentosa*	Least Concern	Lower Risk- Near Threatened	Endemic	
Anacardiaceae	*Ozoroa obovata*	Least Concern	-	Near Endemic	
Anacardiaceae	*Ozoroa reticulata*	Least Concern	Lower Risk- Near Threatened	-	
Sterculiaceae	*Sterculia quinqueloba*	-	Vulnerable	-	

Critically Endangered Species:

- ***Brachystegia oblonga*** (Endemic) is listed as Critically Endangered on the IUCN red data list and is endemic to the region, with occurrences noted between Moma and Maganja da Costa. It has an extent of occurrence of 82km^2 and an area of occupancy of 9km^2. There are only two known sub-populations[4], one of which is extinct and the other is degraded and limited to 50 individuals (Burrows et. al., 2018; Alves et. al., 2014, Darbyshire et.al., 2019, Hyde et. al., 2021) (Figure 4.3). However, this species was also found within the coastal dune thicket and coastal forest at the Pilivili

[4] A subpopulation refers to breeding groups within a larger population of species, between which migration is restricted to a significant degree.

Mining area and this would thus constitute a 3rd subpopulation of this species. This species was recorded at 8 out of the 36 sample sites (15 individuals) surveyed within the TSF project area within the Secondary Miombo Woodland at the project site and has also been recorded within the coastal vegetation at the Pilivilli Project site. Based on available information (as included above), this species could potentially be a trigger for critical habitat (refer to section 5.2 below).

- ***Warneckea sessilicarpa*** is listed as Critically Endangered on the IUCN red data list. It is a deciduous shrub or small tree occurring in woodland and thicket on coastal dunes. This species is only known from three localities around Angoche town and has an Extent of Occurrence of 20km^2 and Area of Occupancy of 12km^2 (Darbyshire et. al., 2019). This species was recorded at one locality within the coastal dunes at Pilivilli and at three localities within the mine footprint and one within the TSF Project site (Figure 4.4). As with *Brachystegia oblonga,* this species could be a trigger for Critical Habitat (refer to section 5.2 below).

Endangered Species:

- ***Blepharis dunensis*** is endemic to Mozambique and listed as an Endangered species on the IUCN red data list and Vulnerable on the Mozambique Red Data List. It is found along the coastline from Quinga to Pebane and is typically restricted to coastal dunes and beach sands. Given its small AOO of 16km^2 and its listed status, this species could be a trigger for Critical Habitat. There are 20 records of this species recorded within the Pilivilli site, one within the Nataka mine site and five within the TSF project site (Figure 4.4). This species occurs in small clumps, so each record represents more than one individual.

Vulnerable Species:

- ***Hexalobus mossambicensis*** is listed as Vulnerable on the IUCN red data list and on the Mozambique red data list. This species is endemic to the north-eastern part of Mozambique occurring in Nampula and Cabo Delgado Provinces. It has an extent of occurrence of 37,965km^2 with a small AOO of 52km^2 although it is noted that this could be as a result of this species being under collected. Criterion 1 of the guidance notes on PS6 of the IFC Performance Standards states that "*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 and meet the thresholds in GN72(a*)" may also be a trigger for critical habitat. Although *Hexalobus mossambicensis* is listed as VU on the IUCN red data list, it seems unlikely that the loss of these individuals at the Nataka site will result in a change of the IUCN Red List Category and as such this species is unlikely to be a trigger for critical habitat.
- ***Sterculia quinqueloba*** is listed as Vulnerable on the Mozambique Red Data List and is not listed on the IUCN red data list. It occurs in Gaza, Inhambane, Manhica and Sofala Provinces as well as Congo, Tanzania, Malawi, Zimbabwe, Namibia and Angola. It is associated with woodland areas and on rocky hillsides. Given its distribution in other countries, this species is unlikely to be a trigger for critical habitat.
- ***Vitellariopsis kirkii*** is only known from a few localities from south-east Kenya to eastern Tanzania (Lovett and Clarke, 1998) and northern Mozambique (Burrows et al., 2018, Kew Plants of the World, 2021). This species is listed as vulnerable on the IUCN red data list and is associated with the coastal belt. It should be noted that the IUCN red data list for this species is outdated as it was last updated in 1998 and that Burrows *et al.* (2018) indicates that this species is confirmed to occur in northern Mozambique. Criterion 1 of the guidance notes on PS6 of the IFC Performance

Standards states that "*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 and meet the thresholds in GN72(a*)" may also be a trigger for critical habitat. Although *Vitellariopsis kirkii* is listed as VU on the IUCN red data list, it seems unlikely that the loss of these individuals at the TSF site will result in a change of the IUCN Red List Category, as this species appears to be more widespread than previously thought. The IUCN status was last assessed in 1998 and only mentions this species occurring in Kenya and Tanzania however there are subsequent records that show this species also occurs in Mozambique. This species is unlikely to be a trigger for critical habitat.

- ***Ormocarpum sennoides* subsp *zanzibaricum*** occurs from Kenya to Mozambique and typically occurs in dry coastal forest. The EOO and number of locations is not specified as there is a lack of information available for this subspecies. This species is listed as Vulnerable on the IUCN Red Data List (Lovett and Clarke, 1998). Given this species relatively wide distribution, it is unlikely to be a trigger for critical habitat.
- ***Pavetta decumbens*** occurs from Tanzania to Mozambique (EOO 56439.1 km^2) and is known from nine locations, but 7 to 8 of these locations are threatened. This species is listed as Vulnerable on the IUCN Red Data List (Amano *et al.,* 2022) This species typically occurs in Savanna and woodland (40-750 m elevation) in association with *Brachystegia* or *Julbernardia.* Given this species relatively wide distribution, it is unlikely to be a trigger for critical habitat.

Near Threatened Species:

- ***Afzelia quanzensis*** occurs from Somalia down to KwaZulu Natal in South Africa and is widespread throughout Mozambique (Hills, 2019) with a global extent of occurrence of 6 million km^2. It is listed as Lower Risk/Near threatened on the Mozambique Red Data List and as Least Concern on the IUCN Red Data List. The main threat to this species survival is the illegal harvesting of wood to make wood carvings and for construction. This species is not a trigger for critical habitat but should be considered as a species to be planted during rehabilitation of the site.
- ***Nesogordonia holtzii*** is listed as Near Threatened on the IUCN red data list and occurs in Kenya, Tanzania and Mozambique from sea level to 500m asl. This species has an extent of occurrence of 335,197km^2 and an area of occupancy of 104km^2 and is associated with evergreen coastal forest. This species is unlikely to be a trigger for critical habitat.
- ***Paropsia braunii*** is a shrub or small tree and occurs in dry forest, deciduous thicket, coastal woodland and coastal bushland in Tanzania and Mozambique (IUCN SSC East African Plants Red List Authority, 2013). It has an extent of occurrence of 437,518km^2 and area of occupancy of 180km^2. It is listed as Near Threatened on the IUCN red data list and is known from 18 localities. This species is unlikely to be a trigger for critical habitat.
- ***Ozoroa reticulata*** is listed as Lower Risk-Near Threatened on the Mozambique Red Data List and is not yet listed on the IUCN red data list. It occurs in Nampula, Niassa, Cabo Delgado and Tete provinces in Mozambique as well as Zambia, Malawi, Zimbabwe, Botswana and Tanzania. It is associated with a wide variety of woodland habitats. This species has not yet been listed on the IUCN Red Data List and as such the extent of occurrence is unavailable. This species is unlikely to be a trigger for critical habitat due to its extended range.
- ***Glyphaea tomentosa*** is endemic to central and northern Mozambique (Nampula, Zambezia and Sofala Provinces) and just extends into southeast Malawi in the Litchenya Forest Reserve and Ruo River with an extent of occurrence of 140 972km2 (Darbyshire, and Rokni, 2019). This species is widely spread within its area of occupancy and is threatened by the transformation of land,

although it does show some resilience to disturbance. It is listed as Least Concern on the IUCN Red Data List as it is locally common and is listed as Lower Risk Least Concern on the Mozambican Red Data List. This species is unlikely to be a trigger for critical habitat due to its extended range.

Endemic Species:

- ***Grewia transzambesica*** is listed as Least Concern on the IUCN red data list and is an endemic to Mozambique (Darbyshire *et al.*, 2019b). It is widespread in the northern parts of Mozambique (Cabo Delgado, Nampula, Zambezia and Sofala Provinces) and has an extent of occurrence of 220,538 km^2. This shrub (sometimes small tree) is associated with miombo woodland, coastal dune thicket, the fringes of dry coastal forest and has also on occasion been recorded in open savanna and along the edge of watercourses. This species is unlikely to be a trigger for critical habitat due to its extended range.

Near Endemic Species:

- ***Bosqueiopsis carvalhoana*** is a near endemic with the majority of its range occurring in Mozambique (Darbyshire *et. al.*, 2019). It is associated with the Rovuma Centre of Endemism and occurs in coastal forest and thicket. It has been recorded in the Quirimbas National Park, Pemba Quiterajo, Nangade, Mocimboa da Praia, Metoro, Mecufi, Mossuril, Itoculo, Matibane Forest. This species has not yet been listed on the IUCN Red Data List and as such the extent of occurrence is unavailable. This species is unlikely to be a trigger for critical habitat due to its extended range.
- ***Catunaregam stenocarpa*** is a shrub or small tree that is near endemic with the majority of its range occurring in Mozambique (Darbyshire *et. al.*, 2019). It is associated with sandy soils and occurs in open mixed woodland, coastal woodland and thicket. Within Mozambique it has been recorded at Manjamba, Marrupa, Macomia, Ancuabe, Montepuez, Mutuali, Ribaue Mountains, Mongincual and Gurue. This species has not yet been listed on the IUCN Red Data List and as such the extent of occurrence is unavailable. This species is unlikely to be a trigger for critical habitat due to its extended range.
- ***Millettia stuhlmanii*** is listed as Lower Risk-least concern on the Mozambique Red Data List, and as a near endemic. This species occurs in Mozambique, southern Tanzania and Zimbabwe and is associated with riverine forest, forest and woodland areas (Hyde *et al.*, 2022). This species has not yet been listed on the IUCN Red Data List and as such the extent of occurrence is unavailable. This species is unlikely to be a trigger for critical habitat.
- ***Ozoroa obovata*** is a shrub or small tree that is listed as Least Concern on the IUCN red data list and is a near endemic with the majority of its range occurring in Mozambique with some of its range extending into Zimbabwe (BGCI, 2020). It has an extent of occurrence of 1,528,714 km^2. It is associated with woodland, bushland and wooded grassland. This species is unlikely to be a trigger for critical habitat due to its extended range.
- ***Acridocarpus natalitius var.natalitius*** occurs in Eswatini, Mozambique, and South Africa (EOO 197,890.6 km^2). There are approximately 20,000-100,000 mature individuals. Its habitat includes forest, savanna and shrubland. This species is unlikely to be a trigger for critical habitat due to its extended range.

4.3.2. Alien Invasive plant Species

Weedy species such as *Ricinus communis, Galinsoga parviflora* and *Striga asiatica* were noted to occur in disturbed areas. The level of infestation of alien invasive plant species within the site and broader PAOI is low. Should alien invasive plant species establish themselves within the project area, the rehabilitation potential will be easy.

When the rehabilitated sites are monitored to determine the success of the rehabilitation plan, it is recommended that the site is also monitored for the presence of alien[5] invasive species. If these are recorded, they must be removed. . Records of *Opuntia stricta* at the MOMA site and within the mine camp indicate that this species could become established within the Nataka and TSF site. The monitoring plan must include monitoring for alien species within the rehabilitated areas and within any biodiversity areas of significance that will not be mined (e.g. the forest patch). It is also recommended that the prickly pear *(Opuntia)* that has been planted around the mine camp is removed.

[5] A plant introduced from elsewhere and now more or less naturalised.

Figure 4.7: Photographs of Threatened species recorded within the project area

5. SENSITIVITY ASSESSMENT

5.1. Sensitivity Assessment

The Species Environmental Assessment Guideline (SANBI, 2021) was applied to assess the Site Ecological Importance (SEI) of the project area. The habitats and the species of conservation concern in the project area were assessed based on their conservation importance, functional integrity and receptor resilience (Table 5.1). The combination of these resulted in a rating of SEI (Figure 5.1).

The conservation importance for the Forest Patch and Secondary Miomobo Woodland has been rated as high due to the presence of *Brachystegia oblonga* (CR), *Blepharis dunensis* (EN), *Warneckea sessilicarpa* (CR) and *Vitellariopsis kirkii* (VU) and *Hexalobus mossambicensis* (VU) within the project site. Functional integrity for the forest patch and machambas was low due to the small size of the forest patch and the transformed nature of the machambas.

Receptor resilience is linked to the activity that will take place and the vegetation types ability to recover after the activity. Heavy mineral mining results in the removal of the vegetation and also changes the soil structure through the removal of minerals that are being mined. As a result, recovery of indigenous species within the site is usually slower than if the site had been cleared for machambas through slash and burn practices. Receptor resilience for the forest patch and the secondary woodland was low as it is unlikely that habitat will recover to more than 50% of the original species composition within 15 years. Receptor resilience for the machambas was high.

Based on the above criteria, the overall sensitivity for the forest patch and secondary woodland was high and for the machambas it was low (Table 5.1). Although the sensitivity of the Forest Patch and Secondary Miombo Woodland is high, the impact of the project's activities on these vegetation types must be assessed to determine whether the significance is high, moderate or low. This is done in Chapter 6 below.

Table 5.1: Sensitivity assessment for each vegetation type within the project site.

Habitat / Species	Conservation Importance (CI)	Functional Integrity (FI)	BI	Receptor Resilience	SEI
Forest Patch	High	Low	Medium	Low	**High**
	Confirmed presences of *Brachystegia oblonga* (Critically Endangered) which is listed on the IUCN has having an AOO of 9km^2. However, given that it has been found at Pilivilli and Nataka the AOO is likely to	Small, semi-intact patch of forest (>3ha) with minor ecological impacts and few signs of past disturbance.		Receptor Resilience is based on the recovery of the habitat after mining. Habitat is unlikely to be able to recover fully after a relatively long period (>15 years to restore less than 50% of the original species composition) and functionality of the receptor is therefore low.	

Habitat / Species	Conservation Importance (CI)	Functional Integrity (FI)	BI	Receptor Resilience	SEI
	be more than 10km^2 and as such the CI is rated as High rather than Very High.				
Secondary Miombo Woodland	High	Medium	Medium	Low	**High**
	Confirmed presence of *Brachystegia oblonga* (CR) (refer to comment above), *Blepharis dunensis* (EN), *Warneckea sessilicarpa* (CR), *Vitellariopsis kirkii* (VU) and *Hexalobus mossambicensis (VU)* within the project site.	Vegetation is mostly secondary in nature however it still provides ecological corridors and thus habitat connectivity between the wetlands to the north and the coastal plain to the south.		Receptor Resilience is based on the recovery of the habitat after mining. Habitat is unlikely to be able to recover fully after a relatively long period (>15 years to restore less than 50% of the original species composition) and functionality of the receptor is thus low.	
Machambas	High	Low	Medium	High	**Low**
	Confirmed presence of *Brachystegia oblonga* (CR), *Blepharis dunensis* (EN) within active machambas.	Transformed areas. Migrations are still possible across these areas.		These areas will recover quickly possibly taking less than 10 years to restore 70% of the species composition.	

5.2. Suggested additional work to be conducted on SCC which could be possible triggers for Critical Habitat

As stated in the Sections above, the following species could potentially be triggers for Critical Habitat:

- *Brachystegia oblonga*
- *Warneckea sessilicarpa*
- *Blepharis dunensis*

It is recommended that additional work is conducted to determine the extent of the distribution of these species. As discussed in Section 5.3 below, Ministerial Decree No 55 of 2022, states that biodiversity offsets are required for any threatened species or ecosystems, thus the loss of these three species as a minimum would require an offset in terms of Mozambique Legislation. Critically Endangered and Endangered species are very difficult to offset, as they have a small area of occupancy and are only known from a few small populations. As such the only effective way to do this is by doing a bioregional survey to establish presence of these species in areas which could then be used as

offsets. This would also then assist in determining whether these species would trigger critical habitat as defined in the Ministerial Decree No 55 of 2022 and PS6 of the IFC Performance Standards.

It is highly recommended that a biodiversity offset specialist is appointed as soon as possible to provide further input on this matter.

5.3. Biodiversity Offsets

The Ministerial Decree No 55 of 2022 was issued on the 19th of May 2022. The purpose of this decree is to establish principles, methodologies, and requirements for the implementation of biodiversity offsets and integration of these into the environmental impact assessment process.

The Ministerial Decree No 55 of 2022 states that biodiversity offsets, that provides a net gain of 15% in biodiversity, are required when residual impacts on the project area and project area of influence (PAOI) occur in any of the following environments:

- *Key Biodiversity Areas, provided that they do not have the requirements to be considered fatal issues in accordance with the Environmental Impact Assessment Regulation;*
- *Critical habitats according to International Finance Corporation (IFC) criteria or High Conservation Value areas according to the Forest Stewardship Council (FSC); and*
- *Any threatened species or ecosystems.*

This means that the Mozambique legislation under this decree is adopting the criteria set out by the IFC and FSC for critical habitat and High Conservation Areas respectively and as such these criteria must be applied to studies at a local level to determine if offsets are required.

Based on the above, the project will trigger the requirement for a biodiversity offset due to the presence of threatened species on site and the fact that a portion of the site falls within a key biodiversity area (i.e. Premieres and Secundas Protected Area) (Figure 3.3).

The Ministerial Decree goes on to state that biodiversity offsets must be applied to residual impacts on biodiversity in the following instances:

- *Legally protected species, ecosystems or habitat;*
- *Species or ecosystems/habitats that are threatened or vulnerable;*
- *Endemic Species or an endemic ecosystem/habitat with a restricted geographical range;*
- *Ecosystem/habitat which is of significant importance to endangered, endemic or geographically restricted species and/or protected species;*
- *Ecosystem/habitat that is important for the existence of significant concentrations of migratory and/or congregatory species;*
- *Location that corresponds to a Key Biodiversity Area; and*
- *Any other species/ecosystem/habitat that are considered important to conserve.*

The document indicates that the list of endangered species and ecosystems available on the new government portal (SIBMOZ) must be consulted. However, at the time of writing this report, the portal was not available as it is not yet complete (Pers. Comm. Dr Massingue, 2022). However, the contributors to the portal were able to provide us with a map indicating the location of recognised KBAs (Figure 3.3). Relevant to this project is the Premieres and Secundas KBA.

Based on sensitivity assessment undertaken for the project, and since the Ministerial Decree No 55 of 2022 indicates that it must be determined whether the site is critical habitat using the criteria for critical habitat set out in PS6 of the IFC, it is likely that the TSF project site meets the requirements for critical habitat (Table 5.3). However, as outlined in Section 5.2 above this can only be confirmed if a bioregional survey and associated critical habitat assessment is conducted for the proposed project.

Table 5.3: Likely triggers for critical habitat.

Trigger	Threshold	Comment
Criterion 1: Critically Endangered and Endangered Species	Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species).	Two critically endangered and range restricted species *(Brachystegia oblonga and Warneckea sessilicarpa*) and one endangered and range restricted species (*Blepharis dunensis*) have been recorded within the Nataka Project site.
Criterion 2: Endemic and Restricted-range Species *For terrestrial plants, restricted-range species are defined as those species that have an EOO less than 50,000 square kilometers (km^2).*	Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.	The following restricted range species have been recorded within the TSF Project site and are likely to be triggers for critical habitat: *Brachystegia oblonga* *Warneckea sessilicarpa* *Blepharis dunensis* Please note that the majority of these were mature trees, some of which were in flower at the time of sampling and would thus constitute reproductive units.

To summarise, the project site will require biodiversity offsets for residual impacts as the following criteria are met by the project site:

- Project occurs within a nationally and internationally recognised KBA.
- Highly likely that the project site is considered critical habitat based on the present of CR and EN range restricted species.
- Presence of threatened (CR, EN and VU) species.
- Presence of endemic species with restricted geographical ranges.

Habitat of significant importance to endangered, endemic or geographically restricted species .

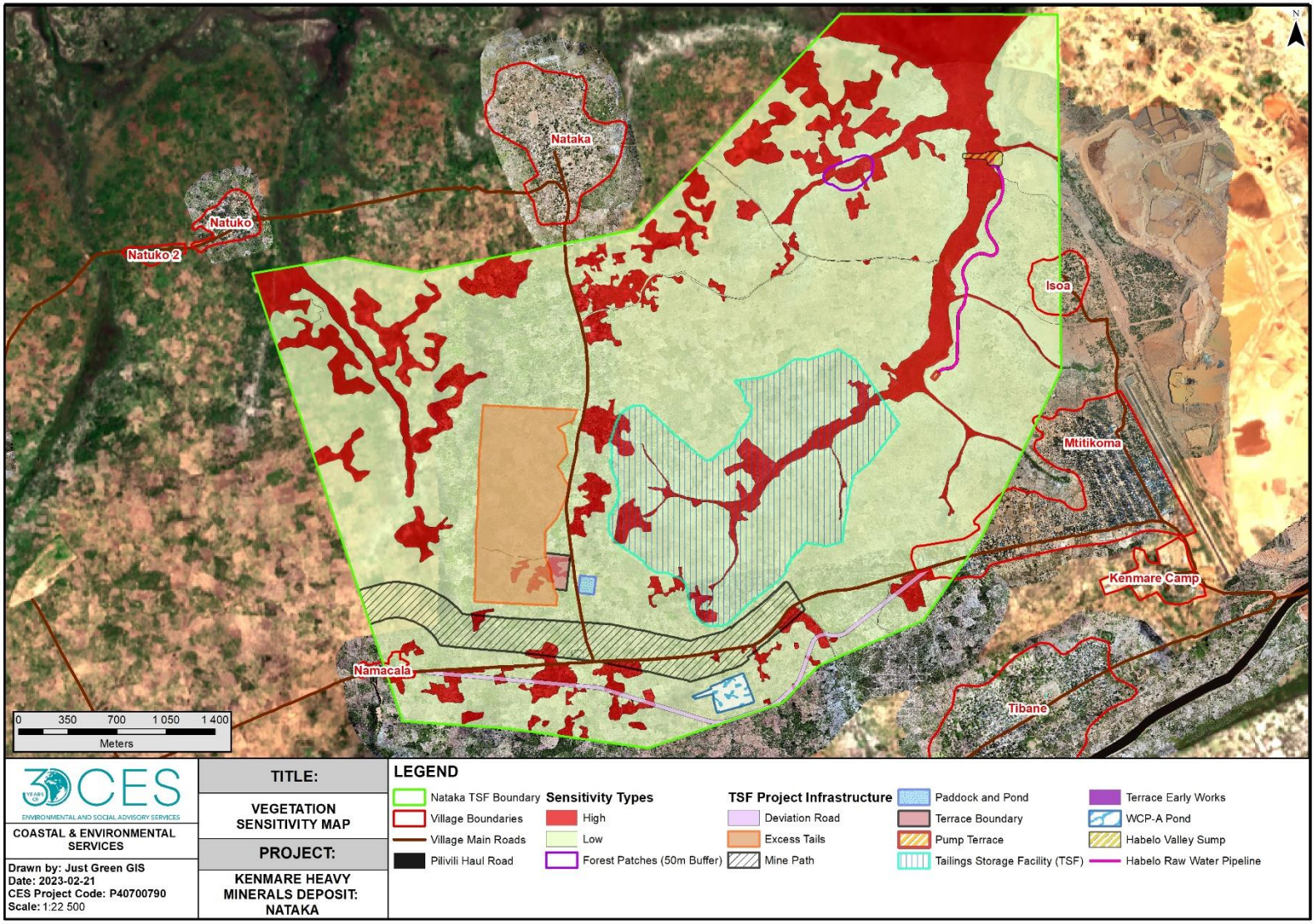

Figure: 5.1: Sensitivity map of the proposed project site showing areas of high, and low sensitivity.

6. IMPACT ASSESSMENT

6.1. The Current Impacts: The "No Go" or "Without Project Scenario"

To contextualise the potential impacts of the mining activities and associated infrastructure proposed by the proponent, the existing impacts (or status quo), associated with current land use and its effects on the ecological conditions needs to be described. Current land use has affected local biodiversity, vegetation patterns, structure and composition and as such this baseline or status quo should be used as the comparison against which project impacts are assessed. The identified impacts associated with the main issues that arise from current use are discussed below.

6.1.1. Impact 1: Removal of plant communities for farming practices

Cause and comment:
A large portion (1056.9 ha) of the study area has been cleared and planted with crops, specifically cassava over time. In the TSF project area, it is estimated from aerial imagery that 521 ha of natural vegetation has been cleared by local communities between 2019 and 2022. The impacts on each identified vegetation type have been assessed below.

Significance Statement:

Impact 1a: Clearing of Secondary Miombo Woodland
Secondary Miombo Woodland is cleared continuously for agricultural purposes as well as for natural resource use. However, clearing of large trees typically involves the removal of the canopy, leaving the stumps to coppice and regenerate. In addition, the seedbank is left relatively intact. A combination of these two factors has resulted in the persistence of a wide range of species, including SCC. The current impact on this vegetation type is therefore Moderate Negative and long-term, as the clearing has been ongoing since at least 1986, the earliest date that Google Earth images are available.

Impact 1b: Clearing of Forest
The forest patch contained a number of grave sites and as such appears to be protected by the local communities. Existing clearance within this vegetation type has been limited to the access paths and a few grave sites. As such, the current impact on this vegetation type is low.

Impact	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Impact 1a: Clearing of *Secondary Miombo Woodland*					
Without Mitigation	Long Term	Study Area	Moderate	Definite	MODERATE-
Impact 1b: Clearing of *Forest*					
Without Mitigation	Long Term	Localised	Slight	Probable	**Low**

6.1.2. Impact 2: Clearing of land has resulted in the loss of Species of Conservation Concern

Cause and comment:
Clearing of land for anthropogenic purposes has likely resulted in the loss of individuals of Species of Conservation Concern within the project site. Despite this, individual species of conservation concern have been recorded in the overall study site and individual trees have been recorded in some machambas and therefore they have persisted within the project area. This is probably because they are cut down and allowed to coppice rather than being completely removed, and the seed bank remains intact.

Significance Statement:

The current land use has resulted in the long term loss of some individual SCC throughout the site, as clearing has been ongoing since at least 1986. The current impact on Species of Conservation Concern is of Moderate significance.

Impact	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Impact 2: Clearing of land has resulted in the loss of Species of Conservation Concern					
Without Mitigation	Long Term	Study Area	Moderate	Definite	MODERATE-

6.1.3. Impact 3: Disruption of ecosystem function and processes as a result of habitat fragmentation and edge effects

Cause and comment:
Fragmentation is one of the most important impacts on vegetation, especially when this creates breaks in previously continuous vegetation, causing a reduction in the gene pool and a decrease in species richness and diversity. This impact occurs when large areas are cleared for agriculture or are burned to create green grass for grazing, or to establish crops. Fragmentation results in the isolation of functional ecosystems, and results in reduced biodiversity and reduced movement due to the absence of ecological corridors. It can also result in edge effects which occurs when the edge of the habitat is altered as a result of clearing. Edge effects favour some species, usually fast-growing opportunistic species, while other species may be more sensitive resulting in local extinctions.

Significance Statement:

The study area is highly fragmented as a result of the large expanses of land that have been cleared for agriculture. The impact of the current land use has had a High Negative impact on the fragmentation of the vegetation.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Impact 3: Disruption of ecosystem function and process as a result of habitat fragmentation and edge effects					
Without Mitigation	Permanent	Study Area	Severe	Definite	HIGH-

6.2. Impacts of the Mine project: Construction and Operational Phase

6.2.1. Impact 1: Loss of Plant Communities

Natural plant communities are dynamic ecosystems that provide habitats that support all forms of life. Different types of communities (and habitats) exist in the project area, and these occur within and around the project area. The TSF and associated infrastructure will result in the permanent loss of Secondary Miombo Woodland within the project area. The significance of this impact is discussed below.

Impact 1a: Loss of Secondary Miombo Woodland

Direct Impact: Although this vegetation is widespread throughout Mozambique, species assemblages differ between regions. For this specific site, there are 15 SCC, two of which are critically endangered (CR) and one of which is endangered (EN). Secondary Miombo Woodland, which occurs within the project area, currently provides a "home" for the SCC's that are listed as CR and EN. Without this vegetation type present, these species would not persist and as such this vegetation type, or habitat, in which they occur is of global significance as it is important to their survival.

However, when assessing impacts, it is important to account for the extent of vegetation that will be lost. Two scenarios are presented below. Under Scenario 1, only the loss of vegetation within the project infrastructure footprint has been assessed and under Scenario 2, the impact associated with the complete loss of Secondary Miombo Woodland within the project area has been assessed.

Scenario 1: Loss of Secondary Miombo Woodland within project infrastructure footprint

In this instance, 20ha of Secondary Miombo Woodland will be permanently lost and 9 ha will be lost over the long term. As such, the impacts have been separated to account for these differences.

Impact 1a i) Project infrastructure will definitely result in the permanent loss of approximately 20 ha of Secondary Miombo Woodland as a result of the construction and operation of the TSF. This is because it is unlikely that the TSF will be successfully rehabilitated back to Secondary Miombo Woodland. In addition, the Land and Natural Resource Use Report has recommended that this area be rehabilitated to serve community needs in terms of natural resource use. This would include, for example, the planting of woodlots with fast growing species such as *Eucalyptus,* which is not native to the area.

Impact 1a ii) The remainder of the infrastructure will result in the long-term loss of approximately 9 ha of Secondary Miombo Woodland as these areas can be rehabilitated back to this vegetation type upon closure.

Scenario 2: Loss of Secondary Miombo Woodland within entire project area

In this instance 214 ha of Secondary Miombo Woodland will be permanently lost. Rehabilitation back to indigenous vegetation with the same species assemblage is difficult in larger areas as natural recruitment from seeds and suckers becomes more difficult.

Cumulative Impact: Secondary Miombo Woodland has already been lost within the broader region due to slash and burn agriculture, fuel wood harvesting, village expansion and mining. The proposed project will therefore contribute to the cumulative loss of Secondary Miombo Woodland. As such, the cumulative impact is classified as high.

Impact 1 b and 1 c: Loss of the Forest Patch

Direct Impact: Project infrastructure will not impact the forest patch unless the TSF dam wall fails. Under the assumption that there is no TSF failure, the impact on this patch will be no effect. However, should the TSF fail, and the risk of this occurring is very low as many safeguards are in place, the forest will be inundated resulting in the permanent loss of this forest patch which contains Species of Conservation Concern.

Cumulative Impact: Portions of forest has already been lost within the broader project area. Should the TSF dam wall fail, the project will contribute to the cumulative loss of forest within the broader project area. As such, this impact is classified as very high.

Impact	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Scenario 1: Loss of Secondary Miombo Woodland within project infrastructure footprint					
Impact 1a i: Permanent Loss of Secondary Miombo Woodland (20ha) as a result of the TSF					
Without Mitigation	Permanent	Global	Moderate	Definite	HIGH-
With Mitigation	Permanent	Regional	Moderate	Definite	MODERATE-
Cumulative	Permanent	Global	Moderate	Definite	VERY HIGH-
Impact 1a ii: Long Term Loss of Secondary Miombo (9ha) Woodland as a result of other infrastructure					
Without Mitigation	Long Term	Regional	Moderate	Definite	HIGH-
With Mitigation	Long Term	Study Area	Low	Definite	MODERATE-
Cumulative	Long Term	Regional	Moderate	Definite	HIGH-
Scenario 2: Loss of secondary miombo woodland within entire project area					
Without Mitigation	Permanent	Global	Severe	Definite	VERY HIGH-
With Mitigation	Permanent	Regional	Severe	Definite	HIGH-
Cumulative	Permanent	Global	Severe	Definite	VERY HIGH-
Impact 1b: Loss of Forest					
Without Mitigation	Negligible				
With Mitigation	N/A				
Cumulative	N/A				
Impact 1c: Loss of Forest due to the TSF failure					

Without Mitigation	Permanent	Study Area	Severe	Unlikely	HIGH-
With Mitigation	Permanent	Study Area	Slight	May Occur	Negligible
Cumulative	Permanent	Study Area	Severe	May Occur	HIGH-

Mitigation and Management:

While the loss of vegetation communities within the footprint of the TSF can be considered as permanent, the potential for rehabilitation of the other project related infrastructure such the relocation channel, road diversion, paddock thickener, starter pond, water process dam, etc. does exist and therefore can be mitigated. The following mitigation actions are suggested:

- Where feasible, locate project infrastructure in areas which have already been disturbed.
- Increase the Area of Occupancy of SCC adjacent to the site via active planting of these species.
- Habitat clearance must be limited to areas required for the placement of identified infrastructure.
- The forest patch inclusive of a 50m buffer must be declared a no-go area to mining related activities and Kenmare staff and representatives (see Figure 6.1).
- The area must be subject to ongoing rehabilitation in line with the rehabilitation report drafted for this project.
- Align roads and pipelines within a single corridor where possible and keep this as narrow as feasible.
- The TSF must be designed and operated in accordance with both National and International Standards, in order to reduce the risk of failure.
- Ensure compliance with the Biodiversity Offset Regulations for Mozambique.
- Compile and implement a Biodiversity Management Plan for the project.

6.2.2. Impact 2: Loss of Species of Conservation Concern

Cause and Comment:

Direct Impact: Twelve species of conservation concern were identified within the TSF project area and will be negatively impacted by project activities. The impacts at a larger spatial scale will only be important in the case of species that have a globally restricted range (i.e. species listed as Critically Endangered and Endangered) or are otherwise in need of protection. In these cases, the project infrastructure may significantly reduce the *area of occupancy* of the species. A reduction of the area of occupancy in turn may threaten the chances of survival for these plant species of concern.

Cumulative Impact: The cumulative impact that will occur as a result of loss of habitat at the Pilivilli Mine site and Nataka Mine site. In addition to the TSF footprint will be permanent and of global significance for species listed as Critically Endangered. The overall cumulative impact will be Very High.

Significance Statement:

The construction and operation of the TSF and associated infrastructure will definitely result in the loss of Species of Conservation Concern and if mitigation measures are not successfully implemented, will have a permanent, **very severe** impact. The environmental significance of this unmitigated impact

would be VERY HIGH NEGATIVE. If the mitigation measures specified below are successful and include the recommended biodiversity offset that is able to protect new populations of the CR and EN species that will be affected, this impact could be reduced to high negative.

Impact	Effect			Risk or Likelihood	Overall Significance
	Temporal Scale	Spatial Scale	Severity of Impact		
Impact 2: Loss of Species of Conservation Concern					
Without Mitigation	Permanent	Global	Very Severe	Definite	VERY HIGH-
With Mitigation	Long Term	Global	Very Severe	Probable	HIGH-
Cumulative	Permanent	Global	Very Severe	Definite	VERY HIGH-

Mitigation and Management:

The following mitigation actions are suggested:

- Identify set aside areas that host the SCC identified in the project area that will be lost and manage these areas as conservation areas. This needs to form part of the Biodiversity Offset that is required;
- Identify areas within the above-mentioned set-aside area that must be rehabilitated back to its original state (restoration as the end goal) and where the densities of SCC's must be increased via active planting of these species. The size and locations within the set-aside area and the increase in the area of occupancy of identified SCC's must be determined prior to operational activities taking place. In addition, these areas must be cordoned off and protected by Kenmare from community harvesting;
- Viable seeds must be collected on an ongoing basis and propagated, grown and planted out into the proposed set aside areas and rehabilitated areas to increase the area of occupancy for each impacted species;
- Collect seeds from established trees and where feasible relocate saplings of species of special concern; and
- Implement a biodiversity offset in accordance with the Biodiversity Offset Regulations for Mozambique.

6.2.3. Impact 3: Increased habitat fragmentation, edge effects and disruption of ecological processes

Cause and Comment:

Direct Impact: The habitats that exist in the project area, together with those of the surrounding area that are linked, form part of a functional ecosystem. An ecosystem provides more than simply a 'home' for a set of organisms. It is a functional system where biological and biophysical processes such as nutrient cycling, soil formation, reproduction, migration, competition, predation, succession, evolution and migration take place. Destruction or modification of habitats causes disruption of ecosystem function and threatens the interplay of processes that ensure

environmental health and the survival of individual species. This issue deals with a collection of complex ecological impacts that are almost impossible to predict with certainty, but which are nonetheless important.

Fragmentation is one of the most important impacts on vegetation, especially when this creates breaks in previously continuous vegetation, causing a reduction in the gene pool and a decrease in species richness and diversity. Fragmentation results in the isolation of functional ecosystems, and results in reduced biodiversity and reduced seed dispersal due to the absence of ecological corridors. Although the project area already has large areas cleared for agriculture, the TSF and associated infrastructure, will severely increase fragmentation within the project area.

Habitat fragmentation and vegetation clearance can also disrupt ecological processes and drivers which are necessary for maintaining vegetation structure and diversity. The ecological drivers which influence the vegetation structure and composition of Miombo Woodland is a result of a complex interplay between climate (rainfall and temperature), variations in topography and lithology, soil moisture and depth, fire, herbivory, and anthropogenic disturbance (Frost, 1996). Other important ecological processes include pollination, dispersal, nutrient cycling, amongst others. The proposed construction and operation of the TSF and associated infrastructure will prevent ecological processes from occurring within the project area which could also in turn affect the surrounding remaining intact portions of vegetation. As such, the presence of ecological corridors are important to ensure connectivity within the broader landscape and the continuation of ecological processes.

Cumulative Impact: Habitat fragmentation and the disruption of ecological processes has already occurred within the project area, especially due to shifting cultivation, the establishment of roads, expanding settlements and other mining activities. The construction and operation of the TSF will therefore contribute to the cumulative fragmentation of habitats within the project area and therefore the disruption of ecological processes necessary for the maintenance of ecosystem functioning. The impact significance is classified as moderate negative.

Significance Statement:

The construction and operation of the TSF and associated infrastructure will definitely increase habitat fragmentation and the disruption of ecological process. This impact will have a moderate, long term impact. With mitigation, this will remain a MODERATE NEGATIVE impact.

Impact	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Impact 3: Increased Habitat Fragmentation and Edge Effects					
Without Mitigation	Long Term	Study Area	Moderate	Definite	MODERATE -
With Mitigation	Long Term	Study Area	Moderate	Definite	MODERATE -
Cumulative	Permanent	Study Area	Moderate	Definite	MODERATE -

Mitigation and Management:

The following mitigation actions are suggested:

- Use existing access roads where feasible.
- Align roads and pipelines within a single corridor and keep this as narrow as feasible.
- Avoid locating linear infrastructure (such as roads and pipelines) through areas of high and moderate sensitivity. Where this is not feasible, the footprint of the infrastructure must be kept to a minimum.
- Habitat clearance must be limited to areas required for the placement of identified infrastructure.
- The area must be subject to ongoing rehabilitation in line with the rehabilitation report drafted for this project.

6.2.4. Impact 4: Infestation of Alien Invasive Plant Species

Cause and Comment:

Direct Impact: The removal of existing vegetation creates 'open' habitats that will inevitably be colonised by pioneer plant species. While this is part of a natural process of regeneration, which ultimately leads to the re-establishment of a secondary vegetation cover, it favours the establishment of undesirable species in the disturbed area, such as *Ricinus communis* (Castor Oil Bush) and *Opuntia monocantha*. These species are introduced along transport lines, and by human and animal movements in the area. Once established, they are typically very difficult to eradicate and may then invade undisturbed areas, posing a threat to the neighbouring ecosystem. This impact is likely to be exacerbated if the site is poorly managed.

Cumulative Impact: Alien and weedy plant species such as *Ricinus communis*, *Galinsoga parviflora* and *Striga asiatica* are already present within the broader project area, particularly within disturbed (i.e., machambas, areas frequented for wood harvesting, etc). Additionally, individuals of *Opuntia stricta* were also at the MOMA site and within the site camp. Currently, the level of infestation is low. However, should the construction and operation of the TSF and associated infrastructure result in establishment and spread of alien and weedy plant species, this could contribute to the cumulative spread of alien and weedy plant species within the broader project area.

Significance Statement:

The construction and operation of the TSF and associated infrastructure will probably result in the invasion of alien species into the project area and will have a **severe,** permanent effect. The environmental significance of this unmitigated impact would be HIGH NEGATIVE. Taking remedial action will reduce the impact to a LOW NEGATIVE.

Impact	Effect			**Risk or Likelihood**	**Overall Significance**
	Temporal Scale	Spatial Scale	Severity of Impact		
Impact 4: Infestation of Alien Invasive Plant Species					
Without Mitigation	Permanent	Study Area	Severe	Probable	MODERATE -
With Mitigation	Short Term	Localised	Low	May Occur	LOW -
Cumulative	Permanent	Regional	Severe	Probable	MODERATE

Mitigation and Management:

The following mitigation actions are suggested:

- Update the existing Alien Management Plan currently in place for Namalope and Pilivili to include the Nataka TSF site;
- Do not use exotic species that are known to be invasive for rehabilitation purposes but rather use indigenous species; and
- Monitor and remove alien vegetation as part of the monitoring programme for areas that have been rehabilitated.
- In other disturbed areas such as road verges conduct an annual survey for alien species if occurrences are low the frequency can be reduced to every second year.
- Alien species should be removed based on the results of the annual survey and their removal should be in accordance with the removal techniques incorporated in the existing alien management plan for Namalope.

6.3. Impacts of the Mine: Decommissioning Phase

Due to the slow consolidation, it will not be possible to rehabilitate the TSF in an acceptable time frame, with settlement continuing for decades after mining, leaving depressions that will need to be repeatedly filled and shaped. This means that land used for the TSF cannot be returned to the community for agricultural purposes and therefore results in a permanent loss of agricultural land.

Although it will eventually be possible to reinstate some natural vegetation and land use, due to the loss of the seed bank, change in soil properties and increases water holding capacity associated with the increased clay content of the soil, it is highly unlikely that the vegetation will ever resemble the Secondary Miombo Woodland of the site prior to mining activities. However, it is possible to rehabilitate the Starter Pond, Relocation Channel, Paddock Thickener and Infrastructure Terrace, especially if the Secondary Miombo Woodland surrounding these areas is kept intact. According to Godbless *et al* (2019), Miombo Woodland regenerates through sexual reproduction (seedlings) as well as vegetative reproduction (coppicing and root suckers). Therefore, if Secondary Miombo Woodland surrounding the Starter Pond, Relocation Channel, Paddock Thickener and Infrastructure Terrace is maintained, it is likely that this vegetation will re-establish and spread to disturbed areas through seed dispersal from nearby trees, coppicing and root suckers. The success of the regeneration and restoration of Secondary Miombo Woodland within these areas could be made more effective with active management interventions such as replanting of SCC.

The impacts on the natural vegetation and plant SCC as a result of the TSF and associated infrastructure will largely occur during the construction and operational phase. As such, these impacts have been dealt with under the construction and operational phase impacts (see Section 6.2 above). It is unlikely that the decommissioning phase activities will result in additional negative impacts on the natural vegetation of the project area. Rather, if the impacted areas are rehabilitated, decommissioning will have a slight positive impact on the status of the environment as seen during the construction and operational phase.

The only other minor negative impacts which could arise during the Decommissioning phase, provided decommissioning activities do not increase the development footprint, include:

- Increased dust levels due to the removal of infrastructure leaving exposed surfaces and vehicular access.

6.4. Summary of Impacts

Seven impacts were identified to be associated with the construction and operation of the TSF and associated infrastructure. Before mitigation, one impact was rated as very high, three as high, two as moderate and one as negligible. This is due to the sensitive nature of the project site. However, if the mitigation and biodiversity offset measures identified in this report are successfully implemented and adhered to, the significance of these impact can be reduced to one high negative, three moderate negative, one low negative and two negligible. The resulting residual impacts are summarised below:

- Very High = 0 impacts
- High = 1 impact
- Moderate = 3 impacts
- Low = 1 impact
- Negligible = 2 impact

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusions

Three vegetation communities were recorded within the broader TSF Project Site. These are Secondary Miombo Woodland, Forest and Machambas. The forest vegetation is limited to one small patch located in the north eastern section of the project site and the Secondary Miombo Woodland and Machambas are scattered throughout the site.

Within the project site, a total of 159 plant species from 57 families were recorded. Despite the project site being comprised primarily of a mosaic of secondary woodland and machambas, fifteen species of conservation concern were recorded. Of the fifteen SCC, eleven are listed as threatened species (CR, EN, VU and NT), five of the SCC are endemic species and three are near endemic species. Additionally, although not recorded within the TSF project area, four additional SCC were recorded within the broader Nataka Deposit project area. The presence of these species within the project area suggests that they are able to persist in an area that is frequently disturbed by clearing and burning over long periods of time although it is unknown whether these activities have resulted in the steady decline of these species. Based on field observations, it is suspected that *Brachystegia oblonga* and *Blepharis dunensis* are more resilient to disturbance than *Warneckea sessilicarpa.* While these species are able to recover when cleared for machambas, likely due to the below ground biomass remaining intact and allowing individuals to coppice and regrow over time, they are unlikely to persist when cleared for mining activities as their root systems are completely removed, the seed bank is removed, and the soil structure is altered.

Sensitivity for the Forest Patch and Secondary Miombo Woodland was determined to be high due to the presence of CR, EN and VU plant species. In contrast, the machambas were determined to have a low sensitivity.

Project activities will result in the loss of Secondary Miombo Woodland and more importantly the loss of species of conservation concern that are listed as CR, EN, VU and NT. The loss of such species is considered significant as the impacts are permanent and globally significant for critically endangered and endangered species that are endemic and range restricted. The further loss of these species as a result of project activities could impact on the survival of these species at a global level. In order to determine what percentage of the population will be lost due to project activities, a bioregional survey of these species is required. However, in accordance with the precautionary principle it is assumed that the further loss of these species as a result of project activities could impact on the survival of these species at a global level. Since these impacts can't be avoided and are difficult to mitigate, a restoration plan for SCC that are lost must be implemented. Furthermore, it is recommended that a research plan is developed for the SCC and implemented immediately. This plan must include a propagation research programme that is aimed at understanding the propagation strategy, out-planting success and ecological processes (pollination and dispersal) that are required for these species to persist. This programme will need to be run for at least three years to gain an understanding into each SCC.

Further to this, based on the directive issued under the Biodiversity Offset Decree (No. 55/2022), the project site will require biodiversity offsets for residual impacts as the following criteria is met by the project site:

- The project infrastructure occurs within a nationally and internationally recognised KBA.
- Presence of threatened (CR, EN and VU) species.
- Presence of endemic species with restricted geographical ranges.
- Habitat of significant importance to endangered, endemic or geographically restricted species.

According to the directive (V.4.), a preliminary Biodiversity Offset Plan is a condition for the issuance of an environmental license for Category A and A+ projects.

7.2. Recommendations

It is recommended that the following conditions are included in the Final EMPr as well as the conditions of the Environmental Authorisation (EA), if granted:

- The forest patch inclusive of a 50 buffer must be declared a no-go area to mining related activities and Kenmare staff and representatives.
- If any SCC are to be impacted, these must be relocated to nearest appropriate habitat. This may be possible for *Blepharis dunensis* (a low growing of shrub that is less than 0.5m high) and it is recommended that trials are undertaken prior to clearing to determine the likelihood of success.
- Seeds for *Brachystegia oblonga* and *Warneckea sessilicarpa* must be collected prior to clearing.
- Propagation success and rehabilitation trials for SCC, particularly for *Brachystegia oblonga (CR), Warneckea sessilicarpa (CR)* and *Blepharis dunensis* (EN) should commence immediately to determine the likelihood of success of restoration projects.
- Areas within the site must be identified for restoration of SCC to reduce the residual impact of mining activities. This must form part of the Biodiversity Management Plan as well as the rehabilitation plan.
- Only indigenous plant species typical of the local vegetation and approved by a botanist should be used for the rehabilitation of natural habitat. A list of these species must be included in the rehabilitation plan.
- Topsoil (20 cm, where possible) must be collected and used to rehabilitate impacted areas behind the active mine path.
- Employees must be prohibited from collecting any plants.
- Annual monitoring of alien species should take place. If alien invasive plant species are recorded, efforts should be made to remove them.
- Biodiversity Offsets will be required for the project site. A Biodiversity Offset specialist must be consulted and a draft Biodiversity Offset Plan developed as this will need to be submitted with the final Environmental Impact Assessment Report (Refer to Section V (4) of the Biodiversity Offset Decree (No. 55/2022)).

8. REFERENCES

Alves, M.T., Burrows, J.E., Timberlake, J., Coates Palgrave, F.M., Hyde, M.A., Massingue, A.O., Matimele, H.A., Raimondo, D., Hadj-Hammou, J. & Osborne, J. 2014. Brachystegia oblonga. The IUCN Red List of Threatened Species 2014: e.T62494198A62494201. https://dx.doi.org/10.2305/IUCN.UK.2014-3.RLTS.T62494198A62494201.en. Accessed on 15 June 2022.

Botanic Gardens Conservation International (BGCI) & IUCN SSC Global Tree Specialist Group. 2020. *Ozoroa obovata*. *The IUCN Red List of Threatened Species* 2020: e.T146450975A146450977. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T146450975A146450977.en. Accessed on 15 June 2022.

Burgess, N.; Negussie, G.; Bechtel, P and Doggart, N. 2003. Coastal Forests in Northern Mozambique. *The Arc Journal: Tanzania Forest Conservation Group.* 15: 7-11

Burgess, N.D. & Clarke, G.P. (eds.) (2000) *The coastal forests of eastern Africa*. IUCN Forest Programme, Gland and Cambridge.

Climate Data. www.climatedata.eu. Accessed: 8-08-2021.

Cosiaux, A., Couvreur, T.L.P. & Erkens, R.H.J. 2019. *Hexalobus mossambicensis*. *The IUCN Red List of Threatened Species* 2019: e.T32153A62473371. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T32153A62473371.en. Accessed on 15 June 2022.

Darbyshire I, Timberlake J, Osborne J, Rokni S, Matimele H, Langa C, Datizua C, de Sousa C, Alves T, Massingue A, Hadj-Hammou J, Dhanda S, Shah T, Wursten B. 2019. The endemic plants of Mozambique: diversity and conservation status. PhytoKeys 136: 45–96. https://doi.org/10.3897/phytokeys.136.39020

Darbyshire, I., Rokni, S., Alves, M.T., Burrows, J.E., Chelene, I., Datizua, C., De Sousa, C., Fijamo, V., Langa, C., Massingue, A.O., Massunde, J., Matimele, H.A., Mucaleque, P.A., Osborne, J. & Sitoe, P. 2019. *Memecylon sessilicarpum*. *The IUCN Red List of Threatened Species* 2019: e.T32162A136538253. https://dx.doi.org/10.2305/IUCN.UK.2019-2.RLTS.T32162A136538253.en. Accessed on 15 June 2022.

Darbyshire, I. & Rokni, S. 2019. *Glyphaea tomentosa*. *The IUCN Red List of Threatened Species* 2019: e.T32168A136537919. https://dx.doi.org/10.2305/IUCN.UK.2019-2.RLTS.T32168A136537919.en. Accessed on 15 June 2022.

Darbyshire, I., Alves, M.T., Burrows, J.E., Chelene, I., Datizua, C., De Sousa, C., Fijamo, V., Langa, C., Massingue, A.O., Massunde, J., Matimele, H.A., Mucaleque, P.A., Osborne, J., Rokni, S. & Sitoe, P. 2019. Blepharis dunensis. The IUCN Red List of Threatened Species 2019:

e.T120941013A120980068. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T120941013A120980068.en. Accessed on 15 June 2022.

Darbyshire, I., Burrows, J.E., Alves, M.T., Chelene, I., Datizua, C., De Sousa, C., Fijamo, V., Langa, C., Massingue, A.O., Massunde, J., Matimele, H.A., Mucaleque, P.A., Osborne, J., Rokni, S. & Sitoe, P. 2019. *Grewia transzambesica*. *The IUCN Red List of Threatened Species* 2019: e.T32170A136537949. https://dx.doi.org/10.2305/IUCN.UK.2019-2.RLTS.T32170A136537949.en. Accessed on 15 June 2022.

Frost, P. 1996. The Ecology of Miombo Woodlands. Available at: https://www.researchgate.net/publication/201997666_The_ecology_of_miombo_woodlands [Accessed February 2023].

Godbless, M., Anthony, S., Josiah, K. 2019. The regeneration dynamics of Miombo tree species in Sub-Saharan Africa. *African Journal of Ecology and Ecosystems* **6**(50), 1-16.

Hills, R. 2019. Afzelia quanzensis. The IUCN Red List of Threatened Species 2019: e.T60757666A60757681. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T60757666A60757681.en. Accessed on 15 June 2022.

Hyde, M.A., Wursten, B.T., Ballings, P. & Coates Palgrave, M. (2022). *Flora of Mozambique: Species information: Millettia stuhlmannii.* https://www.mozambiqueflora.com/speciesdata/species.php?species_id=130110, retrieved 15 June 2022

IFC Guidance Note 6. 2012. Biodiversity Conservation and Sustainable Management of Living Natural Resources. International Finance Corporation, World Bank Group.

IUCN SSC East African Plants Red List Authority. 2013. *Paropsia braunii*. *The IUCN Red List of Threatened Species* 2013: e.T179565A1582885. https://dx.doi.org/10.2305/IUCN.UK.2013-2.RLTS.T179565A1582885.en. Accessed on 15 June 2022.

Jew, E.; Dougill, A.J.; Sallu, S.M.; O'Connell, J.O.; Benton, T.G. 2016. Miombo Woodland under threat: Consequences for tree diversity and carbon storage. *Forest Ecology and Management.* 361: 144-153.

Lovett, J. & Clarke, G.P. 1998. *Vitellariopsis kirkii*. *The IUCN Red List of Threatened Species* 1998: e.T34446A9869155. https://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T34446A9869155.en. Accessed on 15 June 2022.

MITADER (2015). National Report on Implementation of the Convention on Biological Diversity in Mozambique. Maputo, Mozambique.

Mittermeier, R.A.; Mittermeier, C. G.; Brooks, T. M.; Pilgrim, J. D.; Konstant, W. R.; da Fonseca, G. A. B.; Kormos, C.. 2003. Wilderness and biodiversity conservation. Proceedings of the National Academy of Sciences. 100 (18) 10309-10313

Ndangalasi, H. 2021. Nesogordonia holtzii. The IUCN Red List of Threatened Species 2021: e.T174399898A202109402. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T174399898A202109402.en. Accessed on 15 June 2022.
LAS

Odorico, D.; Nicosia, E.; Datizua, C.; Langa, C.; Raiva, R.; Souane, J.; Nhalungo, S.; Banze, A.; Caetano, B.; Nhauando, V.; Ragu, H.; Machunguene, M.; Caminho, J.; Mutemba, L.; Matusse, E.; Osborne, J.; Wursten, B.; Burrows, J.; Cianciullo, S.; Malatesta, L. and Attorre, F. 2022. An updated checklist of Mozambiques vascular plants. *PhytoKeys.* 189: 61-80.

Parker, V. 2017. Important Bird Areas in Africa and associated islands – Mozambique. Biofund.
Syampungani, Stephen & Chirwa, Paxie & Akinnifesi, Festus & Sileshi, Gudeta & Ajayi, Oluyede Olu. (2009). The Miombo woodlands at the cross roads: Potential threats, sustainable livelihoods, policy gaps and challenges. *Natural Resources Forum*. 33. 150 - 159. 10.1111/j.1477-8947.2009.01218.x.

South African National Biodiversity Institute (SANBI). 2021. Species Environmental Assessment Guideline. South African National Biodiversity Institute, Pretoria.

SIBMOZ. 2022. https://sibmoz.gov.mz/

Timberlake, J and Chidumayo, E. 2011. Miombo Ecoregion Vision report. *Occasional Publications in Biodiversity No. 20.*

White, F. (1983). The Vegetation of Africa. Natural Resources Research No. 20. UNESCO, Paris.

APPENDIX 1: PLANT SPECIES RECORDED ON SITE

FAMILY	SPECIES	IUCN	MOZ RED LIST
Acanthaceae	*Blepharis sp*	Unknown	Unknown
Acanthaceae	*Blepharis dunensis*	Endangered	Vulnerable and Endemic
Achariaceae	*Caloncoba welwitschii*	Least Concern	
Achariaceae	*Xylotheca tettensis*	Least Concern	
Anacardiaceae	*Anacardium occidentale*	Exotic	
Anacardiaceae	*Mangifera indica*	Exotic	
Anacardiaceae	*Ozoroa sp.*	Unknown	
Anacardiaceae	*Sclerocarya birrea*		
Anacardiaceae	*Searsia natalensis*	Least Concern	
Annonaceae	*Annona senegalensis*	Least Concern	
Annonaceae	*Hexalobus mossambicensis*	Vulnerable	Vulnerable and Endemic
Annonaceae	*Xylopia gracilipes*	Least Concern	
Annonaceae	*Sphaerocoryne gracilis subsp. gracile*	Least Concern	
Apocynaceae	*Ancylobothrys petersiana*		
Apocynaceae	*Carissa macrocarpa*	Least Concern	
Apocynaceae	*Diplorhynchus condylocarpon*	Least Concern	
Apocynaceae	*Holarrhena pubescens*	Least Concern	
Apocynaceae	*Landolphia kirkii*		
Apocynaceae	*Tabernaemontana elegans*	Least Concern	
Araceae	*Araceae*	Unknown	
Arecaceae	*Cocos nucifera*		
Arecaceae	*Hyphaene coriacea*	Least Concern	
Asparagaceae	*Asparagus plumosus*		
Asteraceae	*Vernonia colorata*	Least Concern	
Bignoniaceae	*Fernandoa magnifica*	Least Concern	
Bignoniaceae	*Kigelia africana*	Least Concern	
Bignoniaceae	*Markhamia obtusifolia*	Least Concern	
Burseraceae	*Commiphora africana*	Least Concern	
Burseraceae	*Commiphora serrata*	Least Concern	
Capparaceae	*Capparis tomentosa*		
Caprifoliaceae	*Linnaea sp.*	Unknown	
Celastraceae	*Hyppocratea sp.*	Unknown	
Celastraceae	*Gymnosporia senegalensis*	Least Concern	
Celtidaceae	*Trema orientalis*	Least Concern	
Chrysobalanaceae	*Parinari curatellifolia*	Least Concern	
Clusiaceae	*Garcinia livingstonei*	Least Concern	
Colchicaceae	*Gloriosa superba*	Least Concern	
Colchicaceae.	*Grewia sulcata*		
Combretaceae	*Combretum sp.1*	Unknown	
Combretaceae	*Combretum sp. 2*	Unknown	
Combretaceae	*Pteleopsis myrtifolia*		

FAMILY	SPECIES	IUCN	MOZ RED LIST
Combretaceae	*Terminalia sericea*	Least Concern	
Commelinaceae	*Commelina sp.*	Unknown	
Connaraceae	*Rourea coccinea subsp. boiviniana*	Least Concern	
Connaraceae	*Rourea orientalis*	Least Concern	
Convolvulaceae	*Convolvulaceae*	Unknown	
Convolvulaceae	*Merremia tridentata*		
Cyperaceae	*Cyperus sp.*	Unknown	
DILLENIACEAE	*Tetracera boiviniana*	Least Concern	
Ebenaceae	*Diospyros squarosa*		
Ebenaceae	*Diospyros verrucosa*	Least Concern	
Ebenaceae	*Euclea natalensis*	Least Concern	
Euphorbiaceae	*Alchornea laxiflora*	Least Concern	
Euphorbeaceae	*Hymenocardia ulmoides*	Least Concern	
Euphorbiaceae	*Maprounea africana*		
Euphorbiaceae	*Manihot esculenta*		
Fabaceae	*Acacia sp.*		
Fabaceae	*Arachis hypogaea*		
Fabaceae	*Afzelia quanzensis Welw.*	Least Concern	Lower Risk- Near Threatened
Fabaceae	*Albizia adianthifolia*	Least Concern	
Fabaceae	*Albizia versicolor*	Least Concern	
Fabaceae	*Bauhinia petersiana*	Least Concern	
Fabaceae	*Brachystegia oblonga (endemic)*	Critically Endangered and an Endemic	Endemic
Fabaceae	*Cassia afrofistula*	Least Concern	
Fabaceae	*Chamaecrista spp.*		
Fabaceae	*Dalbergia nitidula*	Least Concern	
Fabaceae	*Dalbergia sp.*		
Fabaceae	*Indigofera sp.*		
Fabaceae	*Millettia stuhlmannii*		Lower Risk- Near Threatened
Fabaceae	*Senna petersiana*	Least Concern	
Fabaceae	*Tephrosia repens*		
Fabaceae	*Mundulea sericea*	Least Concern	
Fabaceae	*Ormocarpum sennoides subsp zanzibaricum*	Vulnerable	
Fabaceae	*Swartizia madagascariensis*		
Fabaceae	*Vigna sp.*		
Fabaceae	*Tephrosia purpurea*		
Fabaceae	*Xeroderris stuhlmannii*		
Flagellariaceae	*Flagellaria guineensis*		
Ixonanthaceae	*Phyllocosmus lemaireanus*		
Lamiaceae	*Clerodendrum robustum var robustum*	Least Concern	
Lamiaceae	*Hoslundia opposita*		

FAMILY	SPECIES	IUCN	MOZ RED LIST
Lamiaceae	*Premna serratifolia*	Least Concern	
Lamiaceae	*Rotheca sansibarensis subsp. sansibarensis var. eratensis*	Least Concern	
Lamiaceae	*Vitex sp. (small leaf)*		
Lamiaceae	*Vitex doniana*	Least Concern	
Lamiaceae	*Vitex mombassae*	Least Concern	
Lauraceae	*Cassytha filiformis L.*		
Linaceae	*Hugonia orientalis*	Least Concern	
Loganiaceae	*Strychnos madagascariensis*	Least Concern	
Loganiaceae	*Strychnos mytoides*		
Loganiaceae	*Strychnos spinosa*		
Melastomataceae	*Warneckea sessilicarpa*	Critically Endangered	Endemic
Malpighiaceae	*Acridocarpus natalitius var.natalitius*	Least Concern	Near Endemic 1
Malvaceae	*Melhania forbesii*		
Malvaceae	*Grewia bicolor*		
Malvaceae	*Grewia transzambesica*	LC	Endemic
Malvaceae	*Grewia sp.*		
Malvaceae	*Hibiscus sp.*		
Malvaceae	*Nesogordonia holtzii*	Near Threatened	
Menispermaceae	*Albertisia delagoensis*		
Menispermaceae	*Tiliacora funifera*		
Moraceae	*Bosqueiopsis carvalhoana*		Near Endemic 1
Moraceae	*Ficus trichopoda*	Least Concern	
Moraceae	*Maclura africana*	Least Concern	
Musaceae	*Musa sp.*		
Myrtaceae	*Eugenia capensis*		
Ochnaceae	*Ochna mossambicensis*	Least Concern	
Ochnaceae	*Ochna natalitia*	Least Concern	
Ochnaceae.	*Ochna sp.*		
Olacaceae	*Olax dissitiflora*	Least Concern	
Olacaceae	*Ximenia caffra var.caffra*	Least Concern	
Orchidaceae	*Orchid*		
Passifloraceae	*Paropsia braunii*	Near Threatened	
Passifloraceae	*Schlechterina mitostemmatoides*	Least Concern	
Phyllanthaceae	*Antidesma venosum*	Least Concern	
Phyllanthaceae	*Flueggea virosa subsp. virosa*	Least Concern	
Phyllanthaceae	*Margaritaria discoidea*	Least Concern	
Phyllanthaceae	*Margaritaria discoidea var triplosphaera*	Least Concern	
Phyllanthaceae	*Phyllanthus reticulatus*	Least Concern	
Plantaginaceae	*Linaria sp.*		
Poaceae	*Digitaria eriantha*		
Poaceae	*Digitaria sp.*		
Poaceae	*Eragrostis sp.*		
Poaceae	*Hyperthelia dissoluta*		
Poaceae	*Imperata cylindrica*	Least Concern	
Poaceae	*Melinis repens*		

FAMILY	SPECIES	IUCN	MOZ RED LIST
Poaceae	*Panicum coloratum*	Least Concern	
Poaceae	*Pennisetum purpureum*	Least Concern	
Poaceae	*Pogonarthria squarrosa*		
Poaceae	*Saccharum officinarum*		
Poaceae	*Setaria incrassata*		
Poaceae	*Spine grass*		
Poaceae	*Tall grass*		
Poaceae	*Themeda triandra*		
Polygalaceae	*Carpolobia goetzei*	Least Concern	
Polygalaceae	*Securidaca longepedunculata*	Least Concern	
Putranjivaceae	*Drypetes natalensis*	Least Concern	
Rubiaceae	*Catunaregam stenocarpa*		Near Endemic 1
Rubiaceae	*Oxyanthus zanguebaricus*	Least Concern	
Rubiaceae	*Pavetta decumbens*	Vulnerable	
Rubiaceae	*Psydrax moggii*	Least Concern	
Rubiaceae	*Rubiaceae*		
Rubiaceae	*Tarenna junodii*		
Rutaceae	*Vepris lanceolata*		
Salicaceae	*Casearia gladiiformis*	Least Concern	
Sapindaceae	*Blighia unijugata*	Least Concern	
Sapindaceae	*Deinbollia oblongifolia*	Least Concern	
Sapindaceae	*Haplocoelum foliosum var. mombasense*		
Sapotaceae	*Manilkara concolor*		
Sapotaceae	*Mimusops obtusifolia*		
Sapotaceae	*Vitellaria sp.*		
Sapotaceae	*Vitellariopsis kirkii*	Vulnerable	
Solanacea	*Solanacea*		
Thymelaeaceae	*Synaptolepis kirkii*		
Typhaceae	*Typha capensis*	Least Concern	
	Fern		
	Unknown species alternate Leave		
Vitaceae	*Cissus cactiformis*		
	Unknown sp.		

APPENDIX 2: CV

CONTACT DETAILS

Name	**Tarryn Martin**
Name of Company	**Biodiversity Africa**
Designation	Director
Profession	Botanical Specialist and Environmental Manager
E-mail	tarryn@biodiversityafrica.com
Office number	+27 (0)71 332 3994
Education	2010: Master of Science with distinction (Botany) 2004: Bachelor of Science (Hons) in African Terrestrial Vertebrate Biodiversity 2003: Bachelor of Science
Nationality	**South African**
Professional Body	**SACNASP**: South African Council for Natural Scientific Profession: Professional Natural Scientist (400018/14) **SAAB**: Member of the South African Association of Botanists **IAIASa**: Member of the International Association for Impact Assessments South Africa Member of Golden Key International Honour Society
Key areas of expertise	▪ Biodiversity Surveys and Impact Assessments ▪ Environmental Impact Assessments ▪ Critical Habitat Assessments ▪ Biodiversity Management and Monitoring Plans

PROFILE

Tarryn has over ten years of experience working as a botanist, nine of which are in the environmental sector. She has worked as a specialist and project manager on projects within South Africa, Mozambique, Lesotho, Zambia, Tanzania, Cameroon and Malawi.

She has extensive experience writing botanical impact assessments, critical habitat assessments, biodiversity management plans, biodiversity monitoring plans and Environmental Impact Assessments to International Standards, especially to those of the International Finance Corporation (IFC). Her experience includes working on large mining projects such as the Kenmare Heavy Minerals Mine, where she monitored forest health, undertook botanical impact assessments for their expansion projects and designed biodiversity management and monitoring plans. She has also project managed Environmental Impact Assessments for graphite mines in northern Mozambique and has a good understanding of the Mozambique Environmental legislation and processes.

Tarryn holds a BSc (Botany and Zoology), a BSc (Hons) in African Vertebrate Biodiversity and an MSc with distinction in Botany from Rhodes University. Tarryn's Master's thesis examined the impact of fire on the

recovery of C_3 and C_4 Panicoid and non-Panicoid grasses within the context of climate change for which she won the Junior Captain Scott-Medal (Plant Science) for producing the top MSc of 2010 from the South African Academy of Science and Art as well as an Award for Outstanding Academic Achievement in Range and Forage Science from the Grassland Society of Southern Africa. Tarryn is a professional member of the South African Council for Natural Scientific Professionals (since 2014).

EMPLOYMENT EXPERIENCE

Director and Botanical Specialist, Biodiversity Africa

July 2021 - present

- Botanical and ecological assessments for local and international EIAs in Southern Africa
- Identifying and mapping vegetation communities and sensitive areas
- Designing and implementing biodiversity management and monitoring plans
- Designing rehabilitation plans
- Designing alien management plans
- Critical Habitat Assessments
- Large ESIA studies
- Managing budgets

Principal Environmental Consultant, Branch Manager and Botanical Specialist, Coastal and Environmental Services

May 2012-June 2021

- Botanical and ecological assessments for local and international EIAs in Southern Africa
- Identifying and mapping vegetation communities and sensitive areas
- Designing and implementing biodiversity management and monitoring plans
- Designing rehabilitation and biodiversity offset plans
- Designing alien management plans
- Critical Habitat Assessments
- Large ESIA studies
- Managing budgets
- Cape Town branch manager
- Coordinating specialists and site visits

Accounts Manager, Green Route DMC

October 2011- January 2012

- Project and staff co-ordination
- Managing large budgets for incentive and conference groups travelling to southern Africa
- Creating tailor-made programs for clients
- Negotiating rates with vendors and assisting with the ground management of inbound groups to ensure client satisfaction.

Camp Administrator and Project Co-ordinator, Windsor Mountain International Summer Camp, USA

April 2011 - September 2012

- Co-ordinated staff and camper travel arrangements, main camp events and assisted with marketing the camp to prospective families.

Freelance Project Manager, Green Route DMC

November 2010 - April 2011

- Project and staff co-ordination

- Managing large budgets for incentive and conference groups travelling to southern Africa
- Creating tailor-made programs for clients
- Negotiating rates with vendors and assisting with the ground management of inbound groups to ensure client satisfaction.

Camp Counselor, Windsor Mountain Summer Camp, USA

June 2010 - October 2010

NERC Research Assistant, Botany Department, Rhodes University, Grahamstown in collaboration with Sheffield University, Sheffield, England

April 2009 - May 2010

- Set up and maintained experiments within a common garden plot experiment
- collected, collated and entered data
- Assisted with the analysis of the data and writing of journal articles

Head Demonstrator, Botany Department, Rhodes University

March 2007 - October 2008

Operations Assistant, Green Route DMC

September 2005 - February 2007

- Project and staff co-ordination
- Managing large budgets for incentive and conference groups travelling to southern Africa
- Creating tailor-made programs for clients
- Negotiating rates with vendors and assisting with the ground management of inbound groups to ensure client satisfaction

PUBLICATIONS

1. Ripley, B.; Visser, V.; Christin, PA.; Archibald, S.; Martin, T and Osborne, C. Fire ecology of C_3 and C_4 grasses depends on evolutionary history and frequency of burning but not photosynthetic type. *Ecology.* 96 (10): 2679-2691. 2015

2. Taylor, S.; Ripley, B.S.; Martin, T.; De Wet, L-A.; Woodward, F.I.; Osborne, C.P. Physiological advantages of C_4 grasses in the field: a comparative experiment demonstrating the importance of drought. *Global Change Biology*. 20 (6): 1992-2003. 2014

3. Ripley, B; Donald, G; Osborne, C; Abraham, T and Martin, T. Experimental investigation of fire ecology in the C3 and C4 subspecies of *Alloteropsis semialata. Journal of Ecology.* 98 (5): 1196 - 1203. 2010

4. South African Association of Botanists (SAAB) conference, Grahamstown. Title: Responses of C3 and C4 Panicoid and non-Panicoid grasses to fire. January 2010

5. South African Association of Botanists (SAAB) conference, Drakensberg. Title: Photosynthetic and Evolutionary determinants of the response of selected C3 and C4 (NADP-ME) grasses to fire. January 2008

COURSES

- Rhodes University and CES, Grahamstown
- EIA Short Course 2012
- Fynbos identification course, Kirstenbosch, 2015.
- Photography Short Course, Cape Town School of Photography, 2015.
- Using Organized Reasoning to Improve Environmental Impact Assessment, 2018, International IAIA conference, Durban

CONSULTING EXPERIENCE

International Projects

- 2020 – 2021: Project manager for the 2Africa subsea cable ESIA in Mozambique.
- 2020 – 2021: Project manager for the Category B EIA for the Wihinana Graphite Mine, Cabo delgado, Mozambique
- 2020 – 2021: Project manager for the category B exploration ESIA for Sofala Heavy Minerals Mine, Inhambane, Mozambique
- 2020: Critical Habitat Assessment for a graphite mine in Cabo Delgado, Mozambique. This assessment was to IFC standards.
- 2020: Analysed the botanical dataset for Lurio Green Resources and provided comment on the findings and gaps.
- 2020: Biodiversity Management Plan and Monitoring Plan for mine at Pilivilli in Nampula Province, Mozambique. This assessment was to IFC standards.
- 2019: Botanical Assessment for a cocoa plantation, Tanzania. This assessment was to IFC standards.
- 2019: Critical Habitat Assessment, Biodiversity Management Plan and Ecosystem Services Assessment for JCM Solar Farm in Cameroon. This assessment was to IFC standards.
- 2019: Undertook the Kenmare Road and Infrastructure Botanical Baseline Survey and Impact Assessment for an infrastructure corridor that will link the existing mine at Moma to the new proposed mine at Pillivilli in Nampula Province, Mozambique. This assessment was to IFC standards.
- 2012 – Present: Kenmare Terrestrial Monitoring Program Project Manager and Specialist Survey, Nampula Province, Mozambique.
- 2018: Conducted a field survey and wrote a botanical report to IFC standards for the proposed Balama Graphite Mine Environmental and Social Impact Assessment (ESIA) in Cabo Delgado Province, Mozambique.
- 2018: Co-authored the critical habitat assessment chapter for the proposed Kenmare Pilivilli Heavy Minerals Mine.
- 2018: Authored the Conservation Efforts chapter for the Kenmare Pilivilli Heavy Minerals Mine.
- 2017-2018: Co-authored and analysed data for the Kenmare Bioregional Survey of *Icuria dunensis* (species trigger for critical habitat) in Nampula Province, Mozambique. This was for a mining project that needed to be IFC compliant.
- 2017: Conducted a field survey and wrote a botanical report to IFC standards for the proposed Ancuabe Graphite Mine Environmental and Social Impact Assessment (ESIA) in Cabo Delgado Province, Mozambique.
- 2017-2018: Managed the Suni Resources Montepuez Graphite Mine Environmental Impact Assessment. This included the management of ten specialists, the co-ordination of their field surveys, regular client liaison and the writing of the Environmental Impact Assessment Report which summarised the specialists findings, assessed the impacts of the proposed mine on the environment and provided mitigation measures to reduce the impact.

I was also the lead botanist for this baseline survey and impact assessment and undertook the required field work and analysed the data and wrote the report.

- 2017: Undertook the botanical baseline survey and impact assessment for the proposed Kenmare Pilivili Heavy Mineral Mine in Nampula Province, Mozambique. This was to IFC Standards.
- 2017: Ecological Survey for the Megaruma Mining Limitada Ruby Mine Exploration License, Cabo Delgado, Mozambique.
- 2016: Undertook the botanical baseline survey and impact assessment, wrote an alien invasive management plan and co-authored the biodeiveristy monitoring plan for this farm. The project was located in Zambezia Province, Mozambique.
- 2015-2016: Conducted the Triton Minerals Nicanda Hills Graphite Mine Botanical Survey and Impact Assessment. Was also the project manager and

specialist co-ordinator for this project. The project was located in Cabo Delgado Province, Mozambique.

- 2015: Was part of the team that undertook a Critical Habitat Assessment for the Nhangonzo Coastal Stream site at Inhassora in Mozambique that Sasol intend to establish drill pads at. This project needed to meet the IFC standards.
- 2014: Lurio Green Resources Wood Chip Mill and Medium Density Fibre-board Plant, Project Manager and Ecological Specialist, Nampula Province, Mozambique. 2014-2015.
- 2013-2014: LHDA Botanical Survey, Baseline and Impact assessment, Lesotho.
- 2014: Biotherm Solar Voltaic Ecological Assessment, Zambia.
- 2013-2014: Lurio Green Resources Plantation Botanical Assessment, Vegetation and Sensitivity Mapping, Specialist Co-ordination, Nampula Province, Mozambique.
- 2013: Syrah Resources Botanical Baseline Survey and Ecological Assessment., Cabo Delgado Mozambique.
- 2013-2014: Baobab Mining Ecological Baseline Survey and Impact Assessment, Tete, Mozambique.

South African Projects

1. 2021 - Present: Project Manager for the Sturdee Energy Solar PV facility, Western Cape
2. 2021: Ecological Assessment for the Sturdee Energy Solar PV facility, Western Cape
3. 2021: Rehabilitation plan for a housing development (Hope Village)
4. 2020: Ecological Assessment for the Eskom Juno-Gromis Powerline deviation, Western Cape
5. 2020: Project Manager for the Basic Assessment for SANSA development at Matjiesfontein (Western Cape). Project received authorization in 2021.
6. 2020: Ecological Assessment for construction of satellite antennae, Matjiesfontein, Western Cape
7. 2019: Ecological Assessment for a wind farm EIA, Kleinzee, Northern Cape
8. 2019: Ecological Assessment for two housing developments in Zeerust, North West Province
9. 2019: Botanical Assessment in Retreat, Cape Town for the DRDLR land claim.
10. 2019: Cape Agulhas Municipality Botanical Assessment for the expansion of industrial zone, Western Cape, South Africa, 2019.
11. 2018: Ecological Assessment for the construction of a farm dam in Greyton, Western Cape.
12. 2018: Conducted the Ecological Survey for a housing development in Noordhoek, Cape Town
13. 2018: Conducted the field survey and developed an alien invasive management plan for the Swartland Municipality, Western Cape.
14. 2017: Undertook the field survey and co-authored a coastal dune study that assesses the impacts associated with the proposed rezoning and subdivision of Farm Bookram No. 30 to develop a resort.
15. 2017: Project managed and co-authored a risk assessment for the use of Marram Grass to stabilise dunes in the City of Cape Town.
16. 2015-2016: iGas Saldanha to Ankerlig Biodiversity Assessment Project Manager, Saldanha.
17. 2015: Innowind Ukomoleza Wind Energy Facility Alien Invasive Management Plan, Eastern Cape Province, South Africa.
18. 2015: Savannah Nxuba Wind Energy Facility Powerline Ecological Assessment, ground truthing and permit applications, Eastern Cape South Africa.
19. 2014: Cob Bay botanical groundtruthing assessment, Eastern Cape, South Africa.
20. 2013-2016: Dassiesridge Wind Energy Facility Project Manager, Eastern Cape, South Africa.

21. 2013: Harvestvale botanical groundtruthing assessment, Eastern Cape, South Africa.
22. 2012: Tsitsikamma Wind Energy Facility Community Power Line Ecological Assessment, Eastern Cape, South Africa.
23. 2012: Golden Valley Wind Energy Facility Power Line Ecological Assessment, Eastern Cape, South Africa.
24. 2012: Middleton Wind Energy Facility Ecological Assessment and Project Management, Eastern Cape, South Africa.
25. 2012: Mossel Bay Power Line Ecological Assessment, Western Cape, South Africa.
26. 2012: Groundtruthing the turbine sites for the Waainek Wind Energy Facility, Eastern Cape, South Africa.
27. 2012: Toliara Mineral Sands Rehabilitation and Offset Strategy Report, Madagascar.