

**BASELINE STUDY:
VERTEBRATE FAUNA AND FLORA ASSOCIATED
WITH THE QKR NAMIBIA NAVACHAB GOLD MINE
TAILINGS STORAGE FACILITY 3 (TSF3) PROJECT –
KARIBIB AREA**

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1 Introduction

A desktop study (i.e. literature review) was conducted between 18 and 22 April 2022 on the vertebrate fauna (e.g. reptiles, amphibians, mammals and birds) and flora (larger trees and shrubs (>1m in height), herbs and grasses) expected to occur in the general Karibib area. This was followed by a rapid site assessment between 30 April and 2 May 2022 to determine actual vertebrate fauna and flora (including unique habitats) associated with the proposed Tailings Storage Facility (TSF3) development area at the QKR Navachab Gold Mine. The aim was to determine the vertebrate fauna and flora potentially impacted should the proposed TSF3 development proceed (Figure 1).

This literature review was to determine the actual as well as potential vertebrate fauna and flora associated with the general Karibib area and commonly referred to as the Semi-desert Savannah and Transition Zone [Escarment area] (Giess 1971, Van der Merwe 1983) or the areas referred to by Mendelsohn *et al.* (2002) as the Western Highlands. This semi-desert and savannah transition zone as referred to by Giess (1971) is typified by shrubs (“fodder bushes”) such as *Blepharis pruinosa*, *Leucosphaera bainesii* and *Monechma genistifolia*. Larger woody species such as *Acacia erioloba* are confined to the drainage lines. The Karibib area is characterised by *A. senegal* shrubs while *Cyphostemma currorii* and *C. bainesii* also occur in this region. The trees common in the area are *Commiphora glaucescens*, *C. virgata* and *C. dinteri* as well as *Boscia albitrunca* and *B. foetida*. The grass cover is sparse and consists of the climax grasses *Stipagrostis obtusa* and *S. uniplumis* (Giess 1971).

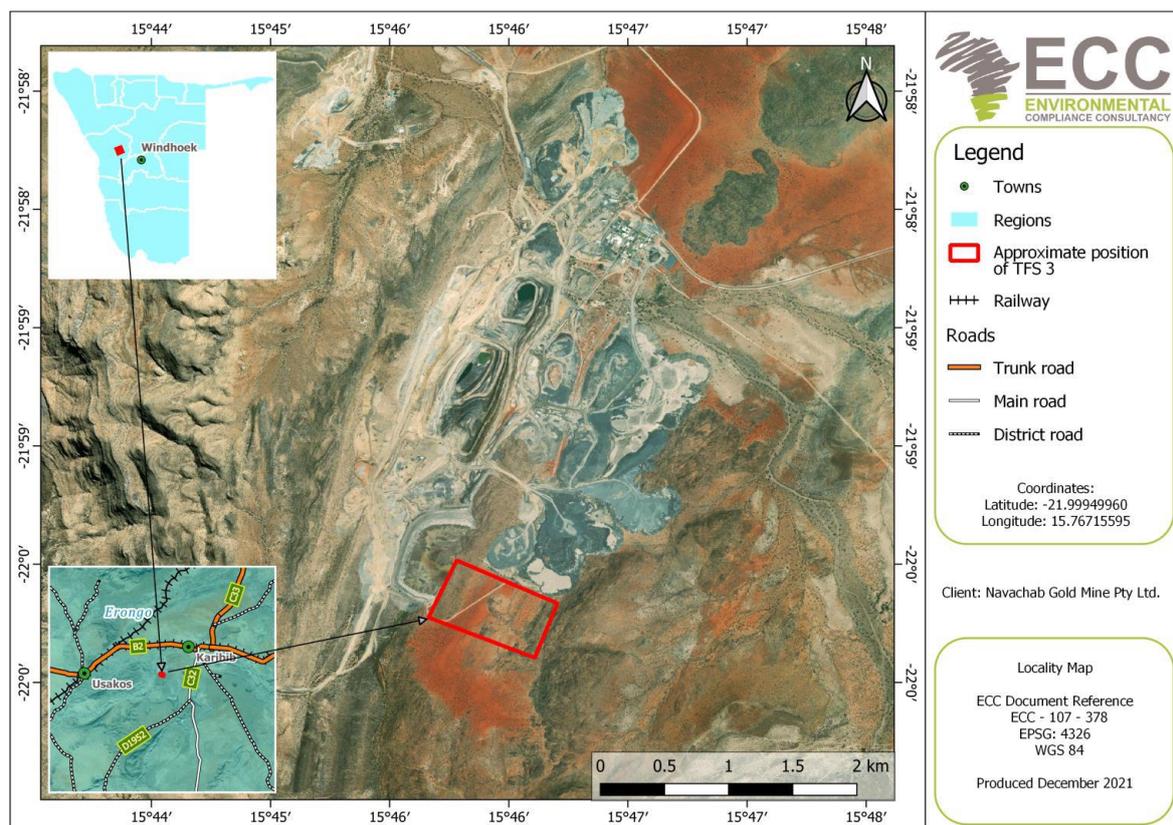


Figure 1. The proposed Tailings Storage Facility (TSF3) at the QKR Navachab Gold Mine southwest of Karibib in the Erongo Region (Source: ECC).

The Namib Desert biome is well protected with parks in this biome making up 69% of the network compared to only 7% of the Savannah biome being formally protected and the Mountain Savannah area being wholly under protected (Barnard 1998). Escarpments, mountains and inselbergs are generally considered as sites of special ecological importance with granite domes (Karibib and Omaruru districts) high in biotic richness and endemism (Curtis and Barnard 1998).

The Karibib area in general is regarded as “moderate” in overall (all terrestrial species) diversity while the overall terrestrial endemism in the area on the other hand is “high” (Mendelsohn *et al.* 2002). The overall diversity and abundance of large herbivorous mammals (big game) is viewed as “moderate” with 3-4 species expected – e.g. gemsbok, kudu, mountain zebra and springbok – while overall diversity and density of large carnivorous mammals (large predators) is viewed as “moderate” with 4 species expected – e.g. leopard, cheetah, spotted and brown hyena (Mendelsohn *et al.* 2002).

The generally Karibib area is viewed as an area of importance for local endemic plant species, especially the Erongo Mountains with between 26-35 endemic species (Mendelsohn *et al.* 2002). The overall plant diversity (all species) in the general Karibib area is estimated at between 150-299 species and the Erongo Mountain area between 400-499 species (Mendelsohn *et al.* 2002). These estimates are limited to “higher” plants as information regarding “lower” plants is sparse. The greatest variants affecting the diversity of plants are habitat and climate with the highest plant diversity generally associated with high rainfall areas. Pockets of high diversity are found throughout Namibia in “unique” habitat – often transition zones – e.g. mountains, inselbergs, etc. Plant endemism, other than the Erongo Mountains, is viewed as “medium to high” – with between 6-15 endemics expected from the general area (Mendelsohn *et al.* 2002). Furthermore, Mendelsohn *et al.* (2002) views the overall plant production as medium to low in the general Karibib area and high in the Erongo Mountains, the availability of hardwoods as medium and the grazing and browse as average in the general area.

Bush thickening (encroachment) is viewed as problematic between Karibib and Omaruru with *Acacia reficiens* (red-bark Acacia) the dominant problem species (Bester 1996, Cunningham 1998, Mendelsohn *et al.* 2002).

The carrying capacity for the general area is 10-20kg/ha (Mendelsohn *et al.* 2002) or 12-15LAU/ha (van der Merwe 1983) and the risk of farming is viewed as relatively high. Sheep farming is the dominant farming activity in the Karibib area with between 70-80% of stock farmed with being sheep and 20-30% goats and cattle, respectively (van der Merwe 1983). The stock density is estimated at <3sheep/km² (1.5% of total sheep in Namibia) and <1cattle/km² (1.3% of total cattle in Namibia) (van der Merwe 1983). There are numerous existing tourism ventures in the area with the tourism potential viewed as relatively high (Mendelsohn *et al.* 2002).

The area does not fall within a Communal Conservancy with the closest being †Gaingu located in the Spitskoppe area to the west of Karibib, neither within a Freehold (i.e. commercial) Conservancy with Okawi being the closest, east of Karibib (Mendelsohn *et al.* 2002, MEFT/NACSO 2021, See: www.nacso.org.na).

It is estimated that at least 75 species of reptile, 7 amphibian, 88 mammal, 217 birds, 74-101 larger trees and shrubs and up to 80 grass species occur in the general/immediate Karibib area of which a high proportion are endemics (e.g. reptiles – 45.3%).

2 Methods

2.1 Literature review

A comprehensive and intensive literature review (i.e. desktop study) regarding the reptiles, amphibians, mammals, birds, larger trees and shrubs (>1m in height), herbs and grasses that could potentially occur in the general Karibib area (including the Navachab Gold Mine area) was conducted using as many references as manageable. A list of the references consulted can be viewed in the Reference section (Page 65).

2.2 Field Survey

Vertebrate fauna

According to the original ToR, a rapid fieldwork assessment to determine the actual faunal diversity would include the following:

- Small mammal transects to determine small mammal diversity in the area
- Assess larger mammal presence in the area
- Reptile and amphibian transects to determine reptile and amphibian diversity in the area
- Bird transects to determine avian diversity in the area
- Tree/shrub transects to determine diversity in the area
- Grass transects to determine diversity in the area

Reptiles

Diurnal reptile transects were conducted along various transects throughout the proposed TSF3 area and were not conducted in rigid straight lines, but focused on the habitat viewed as most suitable for reptiles. Reptiles observed were either caught by hand or by using an active capture technique called 'reptile noosing' where an extendable fishing rod was fitted with a soft thread noose, positioned over the unsuspecting head of an individual and pulled tight. This technique does not result in the death or injury of the caught specimen. Species caught were identified *in situ*, photographed and released unharmed at the point of capture. No nocturnal observations were conducted due to the dense grass biomass encountered at the site. Not only would it have been virtually impossible to observe nocturnal reptiles under these conditions, but using a gas lantern would have posed a fire risk.

Amphibians

Amphibians were searched for in areas deemed suitable habitat – e.g. drainage lines, dams, etc. – with species encountered identified *in situ*.

Mammals

Small mammal trapping was conducted by active trapping using collapsible aluminium Sherman traps baited with peanut butter and oats. Traps were set at 1 site in the proposed TSF3 area with 20 traps placed 20m apart for 1 night (i.e. potential maximum of 20 captures).

Assessing larger mammals from the area was conducted by traversing the area on foot and included actual sightings, tracks, scats and other signs – e.g. burrows, scrapes, carcasses, etc.

Birds

Bird transects (variable lengths, directions and times) were conducted on foot and by vehicle following permissible tracks throughout the area (when in vehicle) during daylight hours using binoculars to identify and confirm species.

Flora

According to the original Terms of Reference (ToR), fieldwork to determine the actual floral diversity was to include the following:

- Trees and shrubs – species composition
- Grasses – species composition
- Other species (e.g. herbs, etc.)

Trees and shrubs

All the trees and shrubs encountered in the proposed development areas were identified whilst conducting the fieldwork in the area – i.e. identification was not only limited to transect only. Trees and shrubs species composition was quantified. The transect lengths varied according to the terrain and were conducted in the proposed TSF3 area.

Grasses

All the grasses encountered in the proposed development areas were identified whilst conducting the fieldwork in the area – i.e. identification was not only limited to transect only. Grass species composition was quantified. The transect lengths varied according to the terrain and were conducted in the proposed TSF3 area.

Other species

Other species – i.e. bulbs, herbs, etc. – were also identified whenever encountered.

3 Results

3.1 Reptile Diversity

Reptile diversity known and/or expected to occur in the Karibib area, including species confirmed during the fieldwork as well as the authors confirmed records during other studies from the general area (e.g. Cunningham 2011, 2013, 2017, 2021), is presented in Table 1.

Approximately 261 species of reptiles are known or expected to occur in Namibia thus supporting approximately 30% of the continents species diversity (Griffin 1998a). At least 22% or 55 species of Namibian lizards are classified as endemic. The occurrence of reptiles of “conservation concern” includes about 67% of Namibian reptiles (Griffin 1998a). Emergency grazing and large scale mineral extraction in critical habitats are some of the biggest problems facing reptiles in Namibia (Griffin 1998a). The overall reptile diversity and endemism in the general Karibib area is estimated at between 41-70 species and 21-28 species, respectively (Mendelsohn *et al.* 2002). Griffin (1998a) presents figures of between 21-30 and 7-8 for endemic lizards and snakes, respectively, from the general area, while the closest protected areas, the Skeleton Coast and Namib-Naukluft National Parks, have an estimated 77 and 100 species, respectively. There is currently no data for the !Dorob National Park.

At least 75 species of reptiles are expected to occur in the Karibib area with 34 species being endemic – i.e. 45.3% endemic. These consist of at least 30 snakes (1 blind snake, 2 thread snake, 2 python, 2 burrowing snakes and 23 typical snakes), 11 of which are endemic (33.3%) to Namibia, 2 tortoises, 1 terrapin, 42 lizards (1 worm lizard, 10 skinks, 6 Old World lizards, 2 plated lizards, 1 girdled lizard, 1 monitor lizard, 3 agamas, 1 chameleon and 17 geckos), 23 (54.8%) of which are endemic to Namibia. Skink's (10 species), Old World lizards (6 species) and gecko's (17 species) are the most numerous lizards expected from the general area. Namibia with approximately 129 species of lizards (Lacertilia) has one of the continents richest lizard fauna (Griffin 1998a). Geckos have the highest occurrence of endemics in the general area with 13 of the 17 species (76.5%) expected and/or known to occur in the area, being endemic to Namibia.

According to the Namibian legislation 3 species are viewed as rare (*Rhinotyphlops lalandei*, *Limaformosa (Mehelya) vernayi*, *Afroedura africana*), 4 species as vulnerable (*Stigmochelys pardalis*, *Psammobates oculiferus*, *Python natalensis*, *Varanus albigularis*), 5 species as protected game, 4 species insufficiently known and 3 species as peripheral. The IUCN (2021) classifies 37 species as least concern although not all the reptiles have yet been assessed by the IUCN Red List. The SARDB (2004) classifies 1 species as vulnerable, 1 species as safe to vulnerable and 2 species as peripheral while CITES lists 7 species under Appendix 2 and 1 species under Appendix 3. Due to the fact that reptiles are an understudied group of animals, especially in Namibia, it is expected that more species may be located in the general area than presented above.

Reptile species observed and/or confirmed from the Navachab Gold Mine included 1 tortoise, 1 terrapin, 5 snakes, 9 lizards, 1 monitor lizard, 2 agamas and 8 geckos (i.e. 27 species) (Cunningham 2011); Helikon/Rubicon Lithium Mine area (approximately 25km southeast of the study area) include 2 skinks, 1 Old World lizard and 2 agamas (i.e. 5 species) (Cunningham 2013) and 1 python, 1 skink, 2 Old World lizards, 1 agama and 1 gecko (i.e. 6 species) (Cunningham (2017) and Osino Gold Mine area (approximately 25km northeast of the study area) include 1 tortoise, 1 terrapin, 1 python, 4 typical snakes, 4 skinks, 3 Old World lizards, 2 agamas, 1 monitor, 1 chameleon and 2 geckos (i.e. 20 species) (Cunningham 2021).

During the fieldwork only 4 species were confirmed from the TSF3 area which included 1 skink, 2 Old World lizards and 1 agama (Figures 2-3). A total of at least 28 species are confirmed from the general area if one includes species identified by Cunningham (2011, 2013, 2017 and 2021) – See Table 1.



Figure 2. *Heliobolus lugubris* (bushveld lizard) observed in TSF3 area.

Table 1. Reptile diversity expected (literature study) and confirmed (fieldwork - √) including author's confirmed records from other studies conducted from the general area (See: Cunningham 2011, 2013, 2017, 2021).

Species: Scientific name	Species: Common name	Species confirmed	Navachab Gold (2011)	Helikon Lithium (2013)	Helikon/Rubicon Lithium (2017)	Osino Gold (2021)	Namibian conservation and legal status	International status		
								SARDB	IUCN	CITES
TORTOISES AND TERRAPINS										
<i>Stigmochelys pardalis</i>	Leopard Tortoise					√	Vulnerable; Peripheral; Protected Game		LC	C2
<i>Psammobates oculiferus</i>	Kalahari Tent Tortoise						Vulnerable; Protected Game			C2
<i>Pelomedusa subrufa</i>	Marsh/Helmeted Terrapin		√			√	Secure			C3
SNAKES										
Blind Snakes										
<i>Rhinotyphlops lalandei</i>	Delalande's Beaked Blind Snake						Insufficiently known; Rare?			
Thread Snakes										
<i>Namibiana (Leptyphlops) occidentalis</i>	Western Thread Snake						Endemic; Secure	P		LC
<i>Namibiana (Leptyphlops) labialis</i>	Damara Thread Snake						Endemic; Secure			LC
Pythons										
<i>Python anchietae</i>	Dwarf Python						Endemic; Insufficiently known; Protected game			LC C2
<i>Python natalensis</i>	Southern African Python					√	Vulnerable; Peripheral; Protected Game	V		C2
Burrowing Snakes										
<i>Atractaspis bibronii</i>	Bibron's Burrowing Asp						Secure			
<i>Xenocalamus bicolor bicolor</i>	Bicoloured Quill-snouted Snake						Secure			
Typical Snakes										
<i>Boaedon (Lamprophis) fuliginosus</i>	Brown House Snake									
<i>Lycophidion capense</i>	Cape Wolf Snake									
<i>Lycophidion namibianum</i>	Namibian Wolf Snake						Endemic; Secure			LC
<i>Mehelya capensis</i>	Cape File Snake						Secure			
<i>Limaformosa (Mehelya) vernayi</i>	Angola File Snake						Insufficiently known; Rare?			LC
<i>Pseudaspis cana</i>	Mole Snake						Secure			

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<i>Pythonodipsas carinata</i>	Western Keeled Snake					Endemic; Secure		LC
<i>Prosymna frontalis</i>	South-western Shovel-snout					Endemic; Secure	P	LC
<i>Hemirhagerrhis viperinus</i>	Viperine Bark Snake					Endemic; Secure		
<i>Dipsina multimaculata</i>	Dwarf Beaked Snake					Endemic; Secure		
<i>Psammophis trigrammus</i>	Western Sand Snake					Endemic; Secure		LC
<i>Psammophis notostictus</i>	Karoo Sand Snake					Secure		
<i>Psammophis leightoni namibensis</i>	Namib Sand Snake					Secure		LC
<i>Psammophis brevirostris leopardinus</i>	Leopard Grass Snake					Endemic; Secure		
<i>Philothamnus semivariiegatus</i>	Spotted Bush Snake					Secure		
<i>Dasypeltis scabra</i>	Common/Rhombic Egg Eater					Secure		LC
<i>Telescopus semiannulatus polystrictus</i>	Eastern Tiger Snake					Secure		
<i>Aspidelaps lubricus infuscatus</i>	Coral Snake					Secure		
<i>Aspidelaps scutatus scutatus</i>	Shield-nose Snake					Secure		
<i>Naja nivea</i>	Cape Cobra					Secure		
<i>Naya nigricincta</i>	Black-necked Spitting Cobra				√	Endemic; Secure		
<i>Dendroaspis polylepis</i>	Black Mamba				√	Secure		LC
<i>Bitis arietans</i>	Puff Adder				√	Secure		
<i>Bitis caudalis</i>	Horned Adder				√	Secure		
WORM LIZARDS								
<i>Zygaspis quadrifrons</i>	Kalahari Round-headed Worm Lizard					Secure		
LIZARDS								
Skinks								
<i>Typhlosaurus braini</i>	Brain's Blind Legless Skink					Endemic; Secure		LC
<i>Typhlacontias brevipes</i>	FitzSimon's Burrowing Skink					Endemic; Secure		LC
<i>Trachylepis acutilabris</i>	Wedge-snouted Skink		√	√		Secure		LC
<i>Trachylepis capensis</i>	Cape Skink					Secure		
<i>Trachylepis hoeschi</i>	Hoesch's Skink					Endemic; Secure		LC
<i>Trachylepis occidentalis</i>	Western Three-striped Skink					Secure		
<i>Trachylepis spilogaster</i>	Kalahari Tree Skink					Endemic; Secure		
<i>Trachylepis striata wahlbergi</i>	Striped Skink					Secure		
<i>Trachylepis sulcata</i>	Western Rock Skink		√	√	√	Secure		

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<i>Trachylepis variegata variegata</i>	Variegated Skink	√			√	Secure			
Old World Lizards									
<i>Heliobolus lugubris</i>	Bushveld Lizard	√				Secure			
<i>Meroles suborbitalis</i>	Spotted Desert Lizard		√			Secure		LC	
<i>Pedioplanis breviceps</i>	Short-headed Sand Lizard					Endemic; Secure		LC	
<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard		√		√	Secure			
<i>Pedioplanis undata</i>	Western Sand Lizard		√		√	Endemic; Secure		LC	
<i>Pedioplanis inornata</i>	Plain Sand Lizard	√		√		Endemic; Secure		LC	
Plated Lizards									
<i>Cordylosaurus subtessellatus</i>	Dwarf Plated Lizard					Endemic; Secure		LC	
<i>Matabosaurus maltzahani</i> (<i>Gerrhosaurus validus</i>)	Giant Plated Lizard		√			Secure		LC	
Girdled Lizards									
<i>Karusasaurus (Cordylus) jordani</i>	Jordan's Girdled Lizard					Endemic; Secure		LC C2	
Monitors									
<i>Varanus albigularis</i>	Rock or White-throated Monitor		√			Vulnerable; Peripheral; Protected Game	S to V	C2	
Agamas									
<i>Agama achuleata</i>	Ground Agama		√	√		Secure			
<i>Agama anchietae</i>	Anchietae's Agama			√		Secure		LC	
<i>Agama planiceps</i>	Namibian Rock Agama	√	√	√	√	Endemic; Secure		LC	
Chameleons									
<i>Chamaeleo namaquensis</i>	Namaqua Chameleon					Secure		LC C2	
Geckos									
<i>Afroedura africana</i>	African Flat Gecko					Endemic; Insufficiently known; Rare		LC	
<i>Chondrodactylus angulifer</i>	Giant Ground Gecko					Endemic; Secure		LC	
<i>Lygodactylus bradfieldi</i>	Bradfield's Dwarf Gecko				√	Endemic; Secure			
<i>Narudasia festiva</i>	Festive Gecko					Endemic; Secure		LC	
<i>Pachydactylus bicolour</i>	Velvety Thick-toed Gecko					Endemic; Secure			
<i>Pachydactylus capensis</i>	Cape Thick-toed Gecko					Endemic; Secure			
<i>Pachydactylus fasciatus</i>	Banded Thick-toed Gecko		√			Endemic; Secure		LC	
<i>Pachydactylus kochii</i>	Koch's Thick-toed Gecko					Endemic; Secure		LC	
<i>Pachydactylus turneri</i>	Turner's Thick-toed Gecko		√			Secure			
<i>Pachydactylus punctatus</i>	Speckled Thick-toed Gecko				√	Secure			
<i>Pachydactylus rugosus</i>	Rough Thick-toed Gecko					Endemic; Secure		LC	
<i>Pachydactylus scherzi</i>	Namib Variable Gecko					Endemic; Secure		LC	

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<i>Pachydactylus weberi</i>	Weber's Thick-toed Gecko			Secure	LC
<i>Ptenopus garrulus</i>	Common Barking Gecko			Secure	LC
<i>Rhoptropus afer</i>	Common Namib Day Gecko			Endemic; Secure	LC
<i>Rhoptropus boultoni</i>	Boulton's Namib Day Gecko	√	√	Endemic; Secure	LC
<i>Rhoptropus bradfieldi</i>	Bradfield's Namib Day Gecko			Endemic; Secure	LC

Namibian conservation and legal status according to the Nature Conservation Ordinance No 4 of 1975

Endemic – includes Southern African Status (Branch 1998)

SARDB (2004): S to V – Safe to Vulnerable; V – Vulnerable; P – Peripheral

IUCN (2021): LC – Least Concern [All other species not yet assessed]

CITES: CITES Appendix 2/3 species

Source for literature review: Alexander and Marais (2007), Branch (1998), Branch (2008), Bonin *et al.* (2006), Boycott and Bourquin (2000), Broadley (1983), Buys and Buys (1983), Cunningham (2006), Cunningham (2011), Cunningham (2013), Cunningham (2017), Cunningham (2021), Griffin (2003), Hebbard (n.d.), IUCN (2021), Marais (1992), SARDB (2004), Schleicher (2020), Tolley and Burger (2007)



Figure 3. *Pedioplanis inornata* (plain sand lizard) – endemic, secure, LC – confirmed from the TSF3 area.



Figure 4. *Agama planiceps* (Namibian rock agama) male – endemic, secure, LC – observed in rocky outcrops in TSF3 area.

The most important species expected to occur in the general area (See Table 1) are viewed as the tortoises *Stigmochelys pardalis* and *Psammobates oculiferus*; pythons – *P. anchietae* and *P. natalensis*; Namibian wolf snake (*Lycophidion namibianum*) – *Varanus albigularis* and some of the endemic and little known gecko species – e.g. *Pachydactylus* species. Tortoises, snakes and monitor lizards are routinely killed for food or as perceived threats. Other important species are those viewed as “rare” – i.e. *Rhinotyphlops lalandei*, *Mehelya vernayi* and *Afroedura africana* – although very little is known about these species.

The Navachab Gold Mine project area has been heavily impacted due to current/past mining activities and none of the unique reptiles are expected to be exclusively associated with the TSF3 area. The proposed mitigations – See Section 4 – are expected to minimise the overall effect on reptiles potentially occurring in the area.

3.2 Amphibian Diversity

Amphibian diversity known and/or expected to occur in the Karibib area, including species confirmed during the authors records during other studies from the general area, is presented in Table 2.

Amphibians are declining throughout the world due to various factors of which much has been ascribed to habitat destruction. Basic species lists for various habitats are not always available with Namibia being no exception in this regard while the basic ecology of most species is also unknown. Approximately 4,000 species of amphibians are known worldwide with just over 200 species known from southern Africa and at least 57 species expected to occur in Namibia. Griffin (1998b) puts this figure at 50 recorded species and a final species richness of approximately 65 species, 6 of which are endemic to Namibia. This “low” number of amphibians from Namibia is not only as a result of the generally marginal desert habitat, but also due to Namibia being under studied and under collected. Most amphibians require water to breed and are therefore associated with the permanent water bodies, mainly in northeast Namibia.

According to Mendelsohn *et al.* (2002), the overall frog diversity in the general Karibib area is estimated at between 4-7 species. Griffin (1998b) puts the species richness in the general area at 10 species, while the closest protected areas, the Skeleton Coast and Namib-Naukluft National Parks, have an estimated 10 and 9 species, respectively. There is currently no data for the !Dorob National Park.

At least 7 species of amphibians are expected to occur in suitable habitat in the Karibib area. The area is under represented, with 2 toads, and 1 species each for rubber, puddle, bullfrog, sand and platanna known and/or expected (i.e. potentially could be found in the area) to occur in the area. Of these, 2 species are endemic (*Poyntonophrynus (Bufo) hoeschi* and *Phrynomantis annectens*) (Griffin 1998b) and 1 species is classified as “near threatened” (*Pyxicephalus adspersus*) (Du Preez and Carruthers 2009) – i.e. high level (42.9%) of amphibians of conservation value from the general area.

Amphibian species observed and/or confirmed from the Navachab Gold Mine included 1 toad and 1 rubber frog (Cunningham 2011); no amphibians were confirmed from the Helikon/Rubicon Lithium Mine areas (approximately 25km southeast of the study area) (Cunningham 2013, 2017) and 1 rubber frog was confirmed from the Osino Gold Mine area (approximately 25km northeast of the study area) (Cunningham 2021).

During the fieldwork no open surface water was observed in the TSF3 area – i.e. no likely amphibian breeding habitat observed (Figure 5).



Figure 5. The TSF3 area does not have any open surface water and/or any other suitable amphibian habitats.

Table 2. Amphibian diversity expected (literature study) and confirmed (fieldwork - ✓) including author's confirmed records from other studies conducted from the general area (See: Cunningham 2011, 2013, 2017, 2021).

Species: Scientific name	Species: Common name	Species confirmed	Navachab Gold (2011)	Helikon Lithium (2013)	Helikon/Rubicon Lithium (2017)	Osino Gold (2021)	Namibian conservation and legal status	International Status: IUCN
Toads								
<i>Amietophrynus poweri</i>	Western Olive Toad							LC
<i>Poyntonophrynus hoeschi</i>	Hoesch's Pygmy Toad		✓				End	LC
Rubber Frog								
<i>Phrynomantis annectens</i>	Marbled Rubber Frog		✓			✓	End	LC
Puddle Frog								
<i>Phrynobatrachus mababiensis</i>	Dwarf Puddle Frog							LC
Bullfrogs								
<i>Pyxicephalus adspersus</i>	Giant Bullfrog						NT	LC
Sand Frogs								
<i>Tomopterna tandyi</i>	Tandy's Sand Frog							LC
Platannas								
<i>Xenopus laevis</i>	Common Platanna							LC

End: Endemic – (Griffin 1998b)

NT: Near threatened – (Du Preez and Carruthers 2009)

LC: Least Concern (IUCN (2021))

Source for literature review: Carruthers (2001), Channing (2001), Channing and Griffin (1993), Cunningham (2011), Cunningham (2013), Cunningham (2017), Cunningham (2021), Du Preez and Carruthers (2009), IUCN (2021), Passmore and Carruthers (1995), SARDB (2004)

Important species include the 2 endemics – *Poyntonophrynus hoeschi* and *Phrynomantis annectens* and *Pyxicephalus adspersus* which are classified as “near threatened” in southern Africa (Du Preez and Carruthers 2009). The latter species numbers are decreasing throughout its range in Namibia mainly due to being targeted as food (Griffin *pers. com*). Although *Poyntonophrynus hoeschi* and *Phrynomantis annectens* were previously observed in the Navachab Mine area (Cunningham 2011), they occur widespread throughout Namibia and are not exclusively associated with the Navachab Mine and/or the TSF3 area.

The Navachab Gold Mine project area has been heavily impacted due to current/past mining activities and none of the unique amphibians are expected to be exclusively associated with the TSF3 area. The proposed mitigations – See Section 4 – are expected to minimise the overall effect on amphibians potentially occurring in the area.

3.3 Mammal Diversity

Mammal diversity known and/or expected to occur in the Karibib area, including species confirmed during the fieldwork as well as the authors confirmed records during other studies from the general area (e.g. Cunningham 2011, 2013, 2017, 2021), is presented in Table 3.

Namibia is well endowed with mammal diversity with at least 250 species occurring in the country. These include the well known big and hairy as well as a legion of smaller and lesser-known species. Currently 14 mammal species are considered endemic to Namibia of which 11 species are rodents and small carnivores of which very little is known. Most endemic mammals are associated with the Namib and escarpment with 60% of these rock-dwelling (Griffin 1998c). According to Griffin (1998c) the endemic mammal fauna is best characterized by the endemic rodent family *Petromuridae* (Dassie rat) and the rodent genera *Gerbillurus* and *Petromyscus*.

Overall terrestrial diversity and endemism – all species – is classified as “average” and “high” respectively in the general Karibib area (Mendelsohn *et al.* 2002). The overall diversity (5-6 species) and abundance of large herbivorous mammals is “high” in the general area with kudu, mountain zebra and oryx having the highest densities of the larger species (Mendelsohn *et al.* 2002). The overall abundance and diversity of large carnivorous mammals is “average” (4 species) in the general area with leopard and cheetah having the highest densities of the larger species (Mendelsohn *et al.* 2002). The overall mammal diversity in the general Karibib area is estimated at between 61-75 species with 5-6 species being endemic to the area (Mendelsohn *et al.* 2002). Griffin (1998c) puts the species richness distribution of endemic mammals between 7-8 species in the general area, while the closest protected areas, the Skeleton Coast and Namib-Naukluft National Parks, at 87 and 80 species, respectively. There is currently no data for the !Dorob National Park.

According to the literature at least 87 species of mammals are known and/or expected to occur in the general Karibib area of which 10 species (11.5%) are classified as endemic. The Namibian legislation classifies 2 species as “rare”, 5 species as “vulnerable”, 3 species as “specially protected game”, 9 species as “protected game”, 5 species as “insufficiently known”, 4 species as “hunnable game” and 4 species as “problem animals”. Five species of bat are not listed – i.e. according to Monadjem *et al.* (2010) these bats potentially could occur in the general Karibib area according to a habitat modelling programme although not yet actually confirmed.

At least 31% (27 species) of the mammalian fauna that occur or are expected to occur in the general Karibib area are represented by rodents of which 5 species (18.5%) are endemic. This is followed by bats 27.6% (24 species) of which 1 species is classified as “rare”. Twenty nine species (33.3%) have IUCN, CITES and SARDB international conservation status (some species have more than one conservation status). The IUCN (2021) classifies 4 species each as vulnerable (cheetah, leopard, Hartmann’s mountain zebra, giraffe) and near

threatened (African straw-coloured fruit bat, Commerson's roundleaf bat, striped leaf-nosed bat, brown hyena). The SARDB (2004) classifies 1 species as rare, 1 species as endangered, 2 species as vulnerable, 12 species as near threatened and 6 species as data deficient while CITES lists 2 species as Appendix 1 and 5 species as Appendix 2. The House Mouse (*Mus musculus*) is viewed as an invasive alien species to the area. *Mus musculus* are generally known as casual pests and not viewed as problematic although they are known carriers of "plague" and can cause economic losses.

Of the 87 species of mammals known and/or expected to occur in the general Karibib area, 9 species (10.3%) are classified as endemic. Rodents (of which 5 species – 18.5% – are endemic) and bats (of which 1 species is classified as rare) are the groups least studied. Species of greatest concern in the general area are those viewed as rare in Namibia – i.e. Namibian wing-gland bat and Southern African hedgehog – and species classified as vulnerable (cheetah, leopard, Hartmann's mountain zebra, giraffe) and near threatened (African straw-coloured fruit bat, Commerson's roundleaf bat, striped leaf-nosed bat, brown hyena) by the IUCN (2021). Another important and unique species, although not observed, but known to occur in the general area, is the endemic Kaokoland slender or black mongoose (See: Cowley and Cunningham 2004, Warren *et al.* 2009).

Mammal species observed and/or confirmed from the Navachab Gold Mine area included 27 species (Cunningham 2011); 12 species from the Helikon and 11 species from the Rubicon Lithium Mine areas (approximately 25km southeast of the study area) (Cunningham (2013, 2017) and 24 species from the Osino Gold Mine area (approximately 25km northeast of the study area) (Cunningham 2021).

During the fieldwork only 8 species of mammals were confirmed (i.e. actually captured, observed and or other evidence – e.g. tracks, scats, etc.) to occur in the TSF3 area. A total of at least 35 species are confirmed from the general area if one includes species identified by Cunningham (2011, 2013, 2017, 2021) – See Table 3. Some species were confirmed from tracks and/or scats located throughout the area surveyed – e.g. Cape hare, Cape fox, chacma baboon, black-backed jackal, rock hyrax (Figures 6-8).



Figure 6. Cape hare (*Lepus capensis*) tracks in the TSF3 area.



Figure 7. Black-backed jackal (*Canis mesomelas*) faeces encountered in area.



Figure 8. Rock hyrax (*Procavia capensis*) hyracium – i.e. white uric acid stains – typical of their latrines.

Table 3. Mammal diversity expected (literature study) and confirmed (fieldwork - ✓) including author's confirmed records from other studies conducted from the general area (See: Cunningham 2011, 2013, 2017, 2021).

Species: Scientific name	Species: Common name	Species confirmed	Navachab Gold (2011)	Helikon Lithium (2013)	Helikon/Rubicon Lithium (2013)	Osino Gold (2021)	Namibian conservation and legal status	International status		
								SARDB	IUCN	CITES
Elephant Shrews										
<i>Macroscelides proboscideus</i>	Round-eared Elephant-shrew						Endemic; Secure			
<i>Elephantulus rupestris</i>	Western Rock Elephant-shrew						Secure			
<i>Elephantulus intufi</i>	Bushveld Elephant-shrew	✓	✓	✓	✓	✓	Secure	DD		
Aardvark										
<i>Orycteropus afer</i>	Aardvark		✓				Secure; Protected Game			
Shrews										
<i>Crocidura fuscomurina</i>	Tiny Musk Shrew						Secure	DD		
<i>Crocidura cyanea</i>	Reddish-grey Musk Shrew						Secure	DD		
Hyrax										
<i>Procavia capensis</i>	Rock Hyrax	✓	✓	✓	✓	✓	Secure; Problem animal			
Bats										
<i>Eidolon helvum</i>	African Straw-coloured Fruit Bat						Secure (Migrant)	NT	NT	
<i>Mops midas</i>	Midas Free-tailed Bat						Secure			
<i>Miniopterus natalensis</i>	Natal Long-fingered Bat						Secure	NT		
<i>Mimetillus thomasi</i>	Thomas's Flat-headed Bat						Not listed			
<i>Sauromys petrophilus</i>	Flat-headed Free-tailed Bat						Secure			
<i>Tadarida aegyptiaca</i>	Egyptian Free-tailed Bat						Secure			
<i>Neoromicia capensis</i>	Cape Serotine Bat						Secure			
<i>Neoromicia zuluensis</i>	Zulu Serotine Bat						Secure			
<i>Nycticeinops schlieffeni</i>	Schlieffen's Twilight Bat						Secure			
<i>Pipistrellus rueppellii</i>	Rüppell's Pipistrelle						Insufficiently known; Peripheral			
<i>Pipistrellus rusticus</i>	Rusty Pipistrelle						Not listed			
<i>Cistugo seabrai</i>	Namibian Wing-gland Bat						Endemic; Rare	V		
<i>Eptesicus hottentotus</i>	Long-tailed Serotine Bat						Secure			
<i>Scotophilus dinganii</i>	African Yellow Bat						Secure			
<i>Nycteris thebaica</i>	Egyptian Slit-faced Bat						Secure			

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<i>Rhinolophus fumigatus</i>	Rüppell's Horseshoe Bat						Secure	NT	
<i>Rhinolophus clivosus</i>	Geoffroy's Horseshoe Bat						Secure	NT	
<i>Rhinolophus darlingi</i>	Darling's Horseshoe Bat						Secure	NT	
<i>Rhinolophus denti</i>	Dent's Horseshoe Bat						Secure	NT	
<i>Rhinolophus hildebrandtii</i>	Hildebrandt's Horseshoe Bat						Not listed		
<i>Macronycteris (Hipposideros) commersoni</i>	Commerson's Roundleaf Bat						Secure		NT
<i>Hipposideros caffer</i>	Sundevall's Roundleaf Bat						Secure	DD	
<i>Macronycteris (Hipposideros) gigas*</i>	Giant Leaf-nosed Bat						Not listed		
<i>Macronycteris (Hipposideros) vittatus</i>	Striped Leaf-nosed Bat						Not listed		NT
Hares and Rabbits									
<i>Lepus capensis</i>	Cape Hare	√	√	√		√	Secure		
<i>Lepus saxatilis</i>	Scrub Hare						Secure		
<i>Pronolagus randensis</i>	Jameson's Red Rock Rabbit						Secure		
Rodents									
Porcupine									
<i>Hystrix africaeaustralis</i>	Cape Porcupine		√	√	√	√	Secure		
Rats and Mice									
<i>Petromys typicus</i>	Dassie Rat		√	√		√	Endemic; Secure	NT	
<i>Pedetes capensis</i>	Springhare						Secure		
<i>Xerus inaurus</i>	South African Ground Squirrel		√				Secure		
<i>Xerus princeps</i>	Damara Ground Squirrel						Endemic	NT	
<i>Graphiurus rupicola/platyops</i>	Western Rock Dormouse						Endemic; Secure	DD	
<i>Graphiurus murinus</i>	Woodland Dormouse						Secure		
<i>Rhabdomys pumilio</i>	Four-striped Grass Mouse		√				Secure		
<i>Mus indutus</i>	Desert Pygmy Mouse		√				Secure		
<i>Mastomys natalensis</i>	Natal Multimammate Mouse						Secure		
<i>Mastomys coucha</i>	Southern Multimammate Mouse						Secure		
<i>Thallomys paedulcus</i>	Acacia Rat						Secure		
<i>Thallomys nigricauda</i>	Black-tailed Tree Rat						Secure		
<i>Aethomys chrysophilus</i>	Red Veld Rat						Secure		
<i>Micaelamys namaquensis</i>	Namaqua Rock Mouse	√	√			√	Secure		
<i>Desmodillus auricularis</i>	Cape Short-tailed Gerbil						Secure		
<i>Gerbillurus paeba</i>	Hairy-footed Gerbil						Secure		
<i>Gerbillurus setzeri</i>	Setzer's Hairy-footed Gerbil						Endemic		

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<i>Tatera leucogaster</i>	Bushveld Gerbil	√	√		√	√	Secure	DD		
<i>Saccostomus campestris</i>	Pouched Mouse					√	Secure			
<i>Malacothrix typica</i>	Gerbil Mouse						Secure			
<i>Petromyscus collinus</i>	Pygmy Rock Mouse						Endemic; Secure			
<i>Mus musculus</i>	House Mouse						Invasive alien			
Primates										
<i>Galago moholi</i>	South African Galago						Vulnerable; Protected Game			C2
<i>Papio ursinus</i>	Chacma Baboon	√	√	√		√	Secure; Problem animal			C2
Hedgehog										
<i>Atelerix frontalis angolae</i>	Southern African Hedgehog		√				Insufficiently Known; Rare; Protected Game	NT; R		
Carnivores										
<i>Proteles cristatus</i>	Aardwolf					√	Insufficiently known; (Vulnerable?) Peripheral			
<i>Parahyaena (Hyaena) brunnea</i>	Brown Hyena					√	Insufficiently known; (Vulnerable?) Peripheral	NT	NT	
<i>Crocuta crocuta</i>	Spotted Hyena						Secure?; Peripheral	NT		
<i>Acinonyx jubatus</i>	Cheetah		√	√			Vulnerable; Protected Game	V	V	C1
<i>Panthera pardus</i>	Leopard					√	Secure?; Peripheral; Protected Game		V	C1
<i>Caracal caracal</i>	Caracal						Secure; Problem Animal			C2
<i>Felis silvestris</i>	African Wild Cat		√	√		√	Vulnerable			C2
<i>Genetta genetta</i>	Small Spotted Genet					√	Secure			
<i>Suricata suricatta marjoriae</i>	Suricate						Endemic; Secure			
<i>Cynictis penicillata</i>	Yellow Mongoose		√			√	Secure			
<i>Galerella sanguinea</i>	Slender Mongoose					√	Secure			
<i>Galerella flavescens (nigrata)</i>	Kaokoland/Black Slender Mongoose						Endemic; Secure			
<i>Otocyon megalotis</i>	Bat-eared Fox					√	Vulnerable?; Peripheral			
<i>Vulpes chama</i>	Cape Fox	√					Vulnerable?			
<i>Canis mesomelas</i>	Black-backed Jackal	√	√		√	√	Secure; Problem animal			
<i>Mellivora capensis</i>	Honey Badger/Ratel		√				Secure; Protected Game	NT		
<i>Ictonyx striatus</i>	Striped Polecat						Secure			

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Equidae									
<i>Equus zebra hartmannae</i>	Hartmann's Mountain Zebra	√	√			Endemic; Secure; Specially Protected Game	E	V	C2
Suidae									
<i>Phacochoerus africanus</i>	Common Warthog	√			√	Secure; Huntable Game			
Antelopes									
<i>Giraffa camelopardalis</i>	Giraffe	√			√	Vulnerable; Peripheral; Specially Protected Game		V	
<i>Tragelaphus strepsiceros</i>	Greater Kudu	√	√	√	√	Secure; Huntable Game			
<i>Oryx gazella</i>	Gemsbok	√			√	Secure; Huntable game			
<i>Sylvicapra grimmia</i>	Common Duiker	√			√	Secure			
<i>Antidorcas marsupialis</i>	Springbok	√			√	Secure; Huntable game			
<i>Madoqua damarensis</i>	Damara Dik-dik					Insufficiently Known; Protected Game			
<i>Raphicerus campestris</i>	Steenbok	√	√	√	√	Secure; Protected Game			
<i>Oreotragus oreotragus</i>	Klipspringer	√	√	√		Secure; Specially Protected Game			

SARDB (2004): R – Rare, E – Endangered, V – Vulnerable, NT – Near Threatened, DD – Data Deficient

IUCN (2021): V – Vulnerable, NT – Near Threatened. All other species not listed are viewed as “Least Concern” by IUCN (2021)

CITES: CITES Appendix 1/2 species

*Monadjem *et al.* (2010)

Source for literature review: Cunningham (2011), Cunningham (2013), Cunningham (2017), Cunningham (2021), De Graaff (1981), Griffin and Coetzee (2005), Estes (1995), IUCN (2021), Joubert and Mostert (1975), Monadjem *et al.* (2010), SARDB (2004), Skinner and Smithers (1990), Skinner and Chimimba (2005), Stander and Hanssen (2003) and Taylor (2000)

A total of 20 Sherman small mammal traps were set for 1 night in the TSF3 area (Table 4). This resulted in 4 captures of 3 species – *Elephantulus intufi*, *Tatera leucogaster* and *Micaelamys namaquensis* – i.e. 20% capture success (Figures 9-11).

Table 4. Small mammals trap sites.

	Number	Traps	Area	Habitat	Coordinates	Captures	Species
Summer	1	20	TSF3	Gravel/rocky	21 59 5085 15 46 03.8	1	<i>Elephantulus intufi</i>
						1	<i>Tatera leucogaster</i>
						2	<i>Micaelamys namaquensis</i>



Figure 9. *Elephantulus intufi* (bushveld elephant-shrew) captured in the TSF3 area.



Figure 10. *Tatera leucogaster* (bushveld gerbil).



Figure 11. *Micaelamys namaquensis* (Namaqua rock mouse).

The Navachab Gold Mine project area has been heavily impacted due to current/past mining activities and none of the unique mammals are expected to be exclusively associated with the TSF3 area. The proposed mitigations – See Section 4 – are expected to minimise the overall effect on mammals potentially occurring in the area.

3.4 Avian Diversity

Bird diversity known and/or expected to occur in the Karibib area, including species confirmed during the fieldwork as well as the authors confirmed records during other studies from the general area (e.g. Cunningham 2011, 2013, 2017, 2021), is presented in Table 5.

Although Namibia's avifauna is comparatively sparse compared to the high rainfall equatorial areas elsewhere in Africa, approximately 658 species have already been recorded with a diverse and unique group of arid endemics (Brown *et al.* 1998, Maclean 1985). Fourteen species of birds are endemic or near endemic to Namibia with the majority of Namibian endemics occurring in the savannas (30%) of which ten species occur in a north-south belt of dry savannah in central Namibia (Brown *et al.* 1998).

Bird diversity and endemism is viewed as “high” in the general Karibib area with 171-200 species, of which 8 species being endemic (Mendelsohn *et al.* 2000). Simmons (1998a) suggests 7-9 endemic species and a “high” ranking for southern African endemics and “average” ranking for red data birds expected from the general area. Although the Karibib area is not classified as an Important Birding Area (IBA) in Namibia (Simmons 1998a) the closest such sites are located to the west at the coast – i.e. Walvis Bay, Sandwich and Mile 4 Saltworks – while the closest inland IBA's are Brandberg and Naukluft.

According to the literature at least 217 bird species [mainly terrestrial “breeding residents”] occur and/or could occur in the general Karibib area at any time (Hockey *et al.* 2006, Maclean 1985, Tarboton 2001). Twelve of the 14 Namibian endemics are expected to occur in the general area (85.7% of all Namibian endemic species or 5.6% of all the species expected to occur in the area). Eight species are classified as endangered (violet wood-hoopoe, Ludwig's bustard, white-backed vulture, black harrier, tawny eagle, booted eagle, martial eagle, black stork), 2 species as vulnerable (lappet-faced vulture, secretarybird) and 5 species as near threatened (Rüppel's parrot, kori bustard, Verreaux's eagle, peregrine falcon, marabou stork) (Simmons *et al.* 2015). Fifty seven species have a southern African conservation rating with 8 species classified as endemic (14% of southern African endemics

Table 5. Avian diversity expected (literature study) and confirmed (fieldwork - ✓) including author's confirmed records from other studies conducted from the general area (See: Cunningham 2011, 2013, 2017, 2021).

Species: Scientific name	Species: Common name	Species confirmed	Navachab Gold (2011)	Helikon Lithium (2013)	Helikon/Rubicon Lithium (2017)	Osino Gold (2021)	Namibian conservation and legal status	International status	
								Southern African status	IUCN
<i>Struthio camelus</i>	Common Ostrich		✓						
<i>Scleroptila levaillantoides</i>	Orange River Francolin								Near endemic
<i>Pternistis hartlaubi</i>	Hartlaub's Spurfowl						Endemic		Near endemic
<i>Pternistis adspersus</i>	Red-billed Spurfowl		✓			✓			Near endemic
<i>Pternistis swainsonii</i>	Swainson's Spurfowl								
<i>Coturnix coturnix</i>	Common Quail	✓				✓			
<i>Coturnix delegorguei</i>	Harlequin Quail								
<i>Numida meleagris</i>	Helmeted Guinea fowl		✓	✓	✓	✓			
<i>Turnix sylvaticus</i>	Kurrichane Buttonquail								
<i>Indicator minor</i>	Lesser Honeyguide								
<i>Campethera abingoni</i>	Golden-tailed Woodpecker								
<i>Dendropicus fuscescens</i>	Cardinal Woodpecker								
<i>Dendropicus namaquus</i>	Bearded Woodpecker								
<i>Tricholaema leucomelas</i>	Acacia Pied Barbet		✓		✓				Near endemic
<i>Tockus monteiri</i>	Monteiro's Hornbill		✓	✓	✓	✓	Endemic		
<i>Tockus damarensis</i>	Damara Hornbill						Endemic		Near endemic
<i>Tockus leucomelas</i>	Southern yellow-billed Hornbill		✓		✓				Near endemic
<i>Tockus nasutus</i>	African Grey Hornbill		✓						
<i>Upupa africana</i>	African Hoopoe		✓		✓	✓			
<i>Phoeniculus purpureus</i>	Green Wood-Hoopoe								
<i>Phoeniculus damarensis</i>	Violet Wood-Hoopoe						E; Endemic		
<i>Rhinopomastus cyanomelas</i>	Common Scimitarbill		✓	✓	✓	✓			
<i>Coracias caudatus</i>	Lilac-breasted Roller		✓			✓			
<i>Coracias naevius</i>	Purple Roller		✓			✓			
<i>Merops hirundineus</i>	Swallow-tailed Bee-eater		✓		✓	✓			
<i>Merops apiaster</i>	European Bee-eater								

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<i>Colius colius</i>	White-backed Mousebird	√				√			Endemic
<i>Urocolius indicus</i>	Red-faced Mousebird	√	√						
<i>Clamator jacobinus</i>	Jacobin Cuckoo					√			
<i>Clamator glandarius</i>	Great Spotted Cuckoo								
<i>Cuculus clamosus</i>	Black Cuckoo								
<i>Cuculus gularis</i>	African Cuckoo								
<i>Chrysococcyx klaas</i>	Klaas's Cuckoo								
<i>Chrysococcyz caprius</i>	Diderick Cuckoo		√						
<i>Poicephalus rueppellii</i>	Rüppell's Parrot							NT; Endemic	Near endemic
<i>Agapornis roseicollis</i>	Rosy-faced Lovebird			√	√			Endemic	Near endemic
<i>Cypsiurus parvus</i>	African Palm Swift		√						
<i>Tachymartus melba</i>	Alpine Swift		√				√		
<i>Apus bradfieldi</i>	Bradfield's Swift		√						Near endemic
<i>Apus affinis</i>	Little Swift	√	√						
<i>Apus caffer</i>	White-rumped Swift								
<i>Corythaixoides concolor</i>	Grey Go-away Bird		√						√
<i>Tyto alba</i>	Barn Owl								
<i>Otus senegalensis</i>	African Scops Owl								
<i>Ptilopsis granti</i>	Southern White-faced Scops Owl								
<i>Bubo africanus</i>	Spotted Eagle Owl			√					√
<i>Bubo lacteus</i>	Verreaux's Eagle-Owl								
<i>Glaucidium perlatum</i>	Pearl-spotted Owlet								
<i>Caprimulgus pectoralis</i>	Fiery-necked Nightjar								
<i>Caprimulgus tristigma</i>	Freckled Nightjar		√						√
<i>Caprimulgus rufigena</i>	Rufous-cheeked Nightjar								
<i>Caprimulgus europaeus</i>	European Nightjar								
<i>Columba livia</i>	Rock Dove								
<i>Columba guinea</i>	Speckled Pigeon		√	√					
<i>Streptopelia capicola</i>	Cape Turtle Dove		√	√	√		√		
<i>Streptopelia senegalensis</i>	Laughing Dove		√				√		
<i>Oena capensis</i>	Namaqua Dove		√			√	√		
<i>Neotis ludwigii</i>	Ludwig's Bustard		√					E	Near endemic
<i>Ardeotis kori</i>	Kori Bustard		√					NT	
<i>Lophotis ruficrista</i>	Red-crested Korhaan		√			√	√		Near endemic
<i>Afrotis afraoides</i>	Northern Black Korhaan						√		Endemic
<i>Eupodotis rueppellii</i>	Rüppell's Korhaan		√					Endemic	Near endemic

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<i>Pterocles namaqua</i>	Namaqua Sandgrouse	√	√	√				Near endemic
<i>Pterocles bicinctus</i>	Double-banded Sandgrouse			√				Near endemic
<i>Burhinus capensis</i>	Spotted Thick-knee							
<i>Charadrius tricollaris</i>	Three-banded Plover	√						
<i>Vanellus armatus</i>	Blacksmith Lapwing						√	
<i>Vanellus coronatus</i>	Crowned Lapwing						√	
<i>Rhinoptilus africanus</i>	Double-banded Courser							
<i>Rhinoptilus chalcopterus</i>	Bronze-winged Courser							
<i>Cursorius rufus</i>	Burchell's Courser						√	Near endemic
<i>Cursorius temminckii</i>	Temminck's Courser	√					√	
<i>Elanus caeruleus</i>	Black-shouldered Kite							
<i>Milvus migrans</i>	Black Kite	√					√	
<i>Gyps africanus</i>	White-backed Vulture	√					√	E
<i>Aegypius tracheliotos</i>	Lappet-faced Vulture	√					√	V
<i>Circaetus pectoralis</i>	Black-chested Snake-Eagle	√					√	
<i>Circaetus cinereus</i>	Brown Snake-Eagle							
<i>Melierax canorus</i>	Southern Pale Chanting Goshawk						√	√
<i>Melierax gabar</i>	Gabar Goshawk							Near endemic
<i>Accipiter badius</i>	Shikra	√						
<i>Accipiter minullus</i>	Little Sparrowhawk							
<i>Accipiter ovampensis</i>	Owambo Sparrowhawk							
<i>Buteo vulpinus</i>	Steppe Buzzard	√						
<i>Buteo augur</i>	Augur Buzzard							
<i>Buteo rufofuscus</i>	Jackal Buzzard							
<i>Aquila nipalensis</i>	Steppe Eagle							
<i>Circus maurus</i>	Black Harrier							E
<i>Aquila rapax</i>	Tawny Eagle	√						E
<i>Aquila verreauxii</i>	Verreaux's Eagle	√	√				√	NT
<i>Aquila spilogaster</i>	African Hawk-Eagle							
<i>Aquila pennatus</i>	Booted Eagle							E
<i>Polemaetus bellicosus</i>	Martial Eagle							E
<i>Sagittarius serpentarius</i>	Secretarybird						√	V
<i>Polhierax semitorquatus</i>	Pygmy Falcon						√	
<i>Falco rupicolus</i>	Rock Kestrel	√	√				√	
<i>Falco rupicoloides</i>	Greater Kestrel							
<i>Falco chicquera</i>	Red-necked Falcon							

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<i>Falco biarmicus</i>	Lanner Falcon	√							
<i>Falco peregrinus</i>	Peregrine Falcon							NT	
<i>Egretta garzetta</i>	Little Egret								
<i>Egretta intermedia</i>	Yellow-billed Egret								
<i>Ardea cinerea</i>	Grey Heron								
<i>Ardea melanocephala</i>	Black-headed Heron								
<i>Bubulcus ibis</i>	Cattle Egret								
<i>Scopus umbretta</i>	Hamerkop								
<i>Ciconia nigra</i>	Black Stork							E	
<i>Ciconia abdimii</i>	Abdim's Stork								
<i>Leptoptilos crumeniferus</i>	Marabou Stork							NT	
<i>Dicrurus adsimilis</i>	Fork-tailed Drongo	√			√		√		
<i>Terpsiphone viridis</i>	African Paradise-Flycatcher								
<i>Nilaus afer</i>	Brubru								
<i>Dryoscopus cubla</i>	Black-backed Puffback								
<i>Tchagra australis</i>	Brown-crowned Tchagra								
<i>Laniarius atrococcineus</i>	Crimson-breasted Shrike				√		√		Near endemic
<i>Telophorus zeylonus</i>	Bokmakierie								Near endemic
<i>Prionops plumatus</i>	White-crested Helmet-Shrike								
<i>Lanioturdus torquatus</i>	White-tailed Shrike	√			√		√	Endemic	Near endemic
<i>Batis pririt</i>	Priort Batis	√			√				Near endemic
<i>Corvus capensis</i>	Cape Crow								
<i>Corvus albus</i>	Pied Crow								
<i>Lanius collurio</i>	Red-backed Shrike	√							
<i>Lanius minor</i>	Lesser Grey Shrike	√					√		
<i>Lanius collaris</i>	Common Fiscal	√			√		√		
<i>Eurocephalus anguitimens</i>	Southern White-crowned Shrike								Near endemic
<i>Anthoscopus minutus</i>	Cape Penduline Tit								Near endemic
<i>Parus carpi</i>	Carp's Tit							Endemic	Near endemic
<i>Parus cinerascens</i>	Ashy Tit				√				Endemic
<i>Riparia paludicola</i>	Brown-throated Martin						√		
<i>Hirundo rustica</i>	Barn Swallow	√							
<i>Hirundo dimidiata</i>	Pearl-breasted Swallow								
<i>Hirundo cucullata</i>	Greater Striped Swallow								
<i>Hirundo spilodera</i>	South African Cliff-Swallow								
<i>Hirundo fuligula</i>	Rock Martin	√	√	√	√	√	√		

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<i>Delichon urbicum</i>	Common House Martin							
<i>Pycnonotus nigricans</i>	African Red-eyed Bulbul	√	√	√	√	√		Near endemic
<i>Achaetps pycnopygius</i>	Rockrunner		√				Endemic	Near endemic
<i>Sylvietta rufescens</i>	Long-billed Crombec		√					
<i>Eremomela icteropygialis</i>	Yellow-bellied Eremomela							
<i>Eremomela gregalis</i>	Karoo Eremomela							
<i>Eremomela usticollis</i>	Burnt-necked Eremomela							
<i>Acrocephalus baeticatus</i>	African Reed Warbler							
<i>Turdoides bicolor</i>	Southern Pied Babbler							Endemic
<i>Parisoma layardi</i>	Layard's Tit-Babbler							Endemic
<i>Parisoma subcaeruleum</i>	Chestnut-vented Tit-Babbler		√				√	Near endemic
<i>Zosterops pallidus</i>	Orange River White-eye							
<i>Cisticola subruficapilla</i>	Grey-backed Cisticola							Near endemic
<i>Cisticola jaridulus</i>	Desert Cisticola		√					
<i>Prinia flavicans</i>	Black-chested Prinia	√	√	√	√	√		
<i>Malcorus pectoralis</i>	Rufous-eared Warbler							
<i>Camaroptera brevicaudata</i>	Grey-backed Camaroptera							
<i>Calamonastes fasciolatus</i>	Barren Wren-Warbler							
<i>Mirafra passerina</i>	Monotonous Lark							
<i>Mirafra fasciolata</i>	Eastern Clapper Lark						√	Near endemic
<i>Mirafra sabota</i>	Sabota Lark		√	√				
<i>Calendulauda africanoides</i>	Fawn-coloured Lark						√	Near endemic
<i>Pinarocorys nigricans</i>	Dusky Lark							
<i>Ammomanopsis grayi</i>	Gray's Lark						Endemic	
<i>Chersomanes albofasciata</i>	Spike-heeled Lark					√		Near endemic
<i>Certhilauda subcoronata</i>	Karoo Long-billed Lark							Near endemic
<i>Eremopterix leucotis</i>	Chestnut-backed Sparrowlark							
<i>Eremopterix verticalis</i>	Grey-backed Sparrowlark					√		Near endemic
<i>Calandrella cinerea</i>	Red-capped Lark		√					
<i>Alauda starki</i>	Stark's Lark		√					Near endemic
<i>Monticola brevipes</i>	Short-toed Rock Thrush		√					
<i>Psophocichla litsitsirupa</i>	Groundscraper Thrush							
<i>Bradornis infuscatus</i>	Chat Flycatcher						√	Near endemic
<i>Melaenornis mariquensis</i>	Marico Flycatcher		√	√	√	√		Near endemic
<i>Muscicapa striata</i>	Spotted Flycatcher							
<i>Cercotrichas leucophrys</i>	White-browed Scrub-Robin							

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<i>Cercotrichas paena</i>	Kalahari Scrub-Robin		√		√	√		
<i>Namibornis herero</i>	Herero Chat						Endemic	Near endemic
<i>Oenanthe monticola</i>	Mountain Wheatear	√	√	√	√			Near endemic
<i>Oenanthe pileata</i>	Capped Wheatear		√		√	√		
<i>Cercomela schlegelii</i>	Karoo Chat							Near endemic
<i>Cercomela tracter</i>	Tracter Chat		√		√	√		Near endemic
<i>Cercomela familiaris</i>	Familiar Chat		√					
<i>Myrmecocichla formicivora</i>	Ant-eating Chat		√		√			Endemic
<i>Onychognathus naboroup</i>	Pale-winged Starling	√	√	√	√	√		Near endemic
<i>Lamprotornis nitens</i>	Cape Glossy Starling		√		√	√		
<i>Lamprotornis australis</i>	Burchell's Starling							
<i>Cinnyricinclus leucogaster</i>	Violet-backed Starling		√					
<i>Creatorhina cinerea</i>	Wattled Starling		√					
<i>Chalcomitra senegalensis</i>	Scarlet-chested Sunbird		√					
<i>Nectarinia fusca</i>	Dusky Sunbird	√	√	√	√	√		Near endemic
<i>Cinnyris mariquensis</i>	Marico Sunbird							
<i>Bualornis niger</i>	Red-billed Buffalo-Weaver		√		√			
<i>Sporopipes squamifrons</i>	Scaly-feathered Finch							Near endemic
<i>Plocepasser mahali</i>	White-browed Sparrow-Weaver	√	√	√	√	√		
<i>Philetairus socius</i>	Sociable Weaver							Endemic
<i>Ploceus intermedius</i>	Lesser Masked-Weaver							
<i>Ploceus velatus</i>	Southern Masked-Weaver	√	√	√	√	√		
<i>Ploceus rubiginosus</i>	Chestnut Weaver		√		√			
<i>Quelea quelea</i>	Red-billed Quelea							
<i>Amadina erythrocephala</i>	Red-headed Finch							Near endemic
<i>Estrilda erythronotos</i>	Black-faced Waxbill		√					
<i>Estrilda astrild</i>	Common Waxbill							
<i>Granatina granatina</i>	Violet-eared Waxbill		√					√
<i>Pytilia melba</i>	Green-winged Pytilia							
<i>Vidua paradisaea</i>	Long-tailed Paradise-Whydah							
<i>Vidua regia</i>	Shaft-tailed Whydah		√		√			
<i>Passer domesticus</i>	House Sparrow		√					
<i>Passer motitensis</i>	Great Sparrow							√
<i>Passer melanurus</i>	Cape Sparrow							Near endemic
<i>Passer griseus</i>	Southern Grey-headed Sparrow							Near endemic
<i>Motacilla capensis</i>	Cape Wagtail		√					

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<i>Anthus cinnamomeus</i>	African Pipit						
<i>Anthus vaalensis</i>	Buffy Pipit						
<i>Anthus similes</i>	Long-billed Pipit						
<i>Serinus alario</i>	Black-headed Canary						Endemic
<i>Crithagra atrogulariis</i>	Black-throated Canary						
<i>Serinus flaviventris</i>	Yellow Canary		√			√	Near endemic
<i>Serinus albogularis</i>	White-throated Canary		√	√			Near endemic
<i>Emberiza impetuani</i>	Lark-like Bunting	√	√		√	√	Near endemic
<i>Emberiza tahapisi</i>	Cinnamon-breasted Bunting						
<i>Emberiza capensis</i>	Cape Bunting		√				Near endemic
<i>Emberiza flaviventris</i>	Golden-breasted Bunting						

This table excludes migratory birds (e.g. Petrel, Albatross, Skua, etc.), aquatic species (e.g. ducks, etc.) and species breeding extralimital (e.g. stints, sandpipers, etc.) and rather focuses on birds that are breeding residents or can be found in the area during any time of the year. This would imply that many more birds (e.g. Palaearctic migrants) could occur in the area depending on “favourable” environmental conditions.

Namibian status: E – Endangered, V- Vulnerable, NT – Near Threatened (Simmons *et al.* 2015)

Southern African status: Hockey *et al.* (2006)

IUCN (2021): CE – Critically Endangered, E – Endangered, V- Vulnerable, NT – Near Threatened. All other species not listed are viewed as “Least Concern” by IUCN (2021)

Source for literature review: Brown *et al.* (1998), Cunningham (2011), Cunningham (2013), Cunningham (2017), Cunningham (2021), Hockey *et al.* (2006), IUCN (2021), Komen (n.d.), Little and Crowe (2011), Maclean (1985), Peacock (2015), Simmons *et al.* (2015), Tarboton (2001)

or 3.7% of all the birds expected) and 49 species classified as near endemic (86% of southern African endemics or 22.7% of all the birds expected) (Hockey *et al.* 2006). The IUCN (2021) classifies 1 species as critically endangered (white-backed vulture), 5 species as endangered (Ludwig's bustard, lack harrier, lappet-faced vulture, martial secretarybird), 1 species as vulnerable (tawny eagle) and 1 species as near threatened (kori bustard).

Bird species observed and/or confirmed from the Navachab Gold Mine area included 85 species (Cunningham 2011); 20 species from the Helikon and 44 species from the Rubicon Lithium Mine areas (approximately 25km southeast of the study area) (Cunningham (2013, 2017) and 58 species from the Osino Gold Mine area (approximately 25km northeast of the study area) (Cunningham 2021).

The most important bird species from the general area are those classified as endemic to Namibia of which the Damara hornbill and Herero chat are viewed as the most important due to the overall lack of knowledge of these species. Although also viewed as important, Rüppels korhaan is migratory throughout its range while the rockrunner inhabits inaccessible terrain and is widespread throughout mountainous areas in Namibia. Other species of concern are those classified as endangered (violet wood-hoopoe, Ludwig's bustard, black harrier, tawny eagle, booted eagle, martial eagle, black stork) and near threatened (Rüppel's parrot, Verreaux's eagle, peregrine falcon, marabou stork) (Simmons *et al.* 2015) and those species classified by the IUCN (2021) as critically endangered (white-backed vulture), endangered (Ludwig's bustard, lack harrier, lappet-faced vulture, martial secretarybird), vulnerable (tawny eagle) and near threatened (kori bustard).

During the fieldwork only 15 species of birds were confirmed (i.e. actually observed) to occur in the general TSF3 area (e.g. Figure 12). Another species (common swift) was also confirmed, but excluded from Table 4 as it is a migrant species. A total of at least 106 species are confirmed from the general area if one includes species identified by Cunningham (2011, 2013, 2017, 2021) – See Table 5. The most important species confirmed from the area during the fieldwork was Verreaux's Eagle (NT).



Figure 12. White-browed sparrow-weaver nests in the area.

The Navachab Gold Mine project area has been heavily impacted due to current/past mining activities and none of the unique birds are expected to be exclusively associated with the TSF3 area. The proposed mitigations – See Section 4 – are expected to minimise the overall effect on birds potentially occurring in the area.

3.5 Tree and Shrub Diversity

It is estimated that at least 74-101 species of larger trees and shrubs (>1m) (Coats Palgrave 1983 [85spp.], Curtis and Mannheimer 2005 [101spp.], Mannheimer and Curtis 2009 [91spp.], Mannheimer and Curtis 2018 [101spp.], Van Wyk and Van Wyk 1997 [62spp. and 12spp. endemic]) occur in the general Karibib area.

The trees and shrubs known, and/or expected to occur in the general area (derived from Mannheimer and Curtis 2018) is presented in Table 6 below. Species indicated are known from the quarter-degree square distribution principle used and don't necessarily occur throughout the entire area. Some species indicated to possibly occur in the area according to Coats Palgrave (1983) and Van Wyk and Van Wyk (1997) is excluded here.

Eight species of trees and shrubs (7.9%) expected to occur in the general Karibib area are classified as endemic, 4 species as near endemic (4%), 21 species (20.8%) are protected by the Forest Act No 12. of 2001, 5 species (5%) are protected under the Nature Conservation Ordinance No. 4 of 1975 while 6 species (5.9%) are classified as CITES Appendix 2 species. The IUCN (2021) classifies 19 species as least concern although not all tree/shrub species have yet been assessed by the IUCN Red List. All the trees with some kind of conservation and/or protected status are viewed as important in the general Karibib area. The most important species are viewed as *Commiphora dinteri*, *Commiphora saxicola*, *Commiphora virgata*, *Cyphostemma bainesii*, *Cyphostemma currorii* and *Erythrina decora* (See Table 6).

Although between 74 and 101 larger species of trees and shrubs are known and/or expected to occur in the general area only 12 and 9 species were identified in the following habitats – plains and hills – throughout the TSF3 area, respectively.

A total of 19 species of larger trees and shrubs were identified throughout the TSF3 area. A total of at least 59 species are confirmed from the general area if one includes species identified by Cunningham (2013, 2017, 2021) (See Table 6).

The most important protected species confirmed throughout the TSF3 area (including endemic/near endemic, etc.) are viewed as:

Plains

- *Acacia erioloba*, *Albizia anthelmintica*, *Boscia albitrunca* (Figure 13)

Hills

- *Boscia albitrunca*, *Commiphora glaucescens*, *Moringa ovalifolia* and *Sterculia africana* (Figures 14-16)

Table 6. Tree and shrub diversity expected (literature study) and confirmed (fieldwork - ✓) including author's confirmed records from other studies conducted from the general area (See: Cunningham 2013, 2017, 2021). The trees and shrubs known, and/or expected to occur in the general area (derived from Mannheimer and Curtis 2018).

Species Expected: Scientific name	Species confirmed		Helikon Lithium (2013)	Helikon/Rubicon Lithium (2017)	Osino Gold (2021)	Namibian conservation and legal status	International status (IUCN)
	Plains	Hills					
<i>Acacia erioloba</i>	✓		✓	✓	✓	Protected (F)	LC
<i>Acacia erubescens</i>	✓	✓		✓	✓		
<i>Acacia hebeclada</i>			✓	✓			
<i>Acacia hereroensis</i>							
<i>Acacia karroo</i>				✓			
<i>Acacia mellifera</i>	✓		✓	✓	✓		
<i>Acacia reficiens</i>	✓		✓	✓	✓		
<i>Acacia Senegal</i>				✓			
<i>Acacia tortilis</i>	✓		✓	✓	✓		
<i>Adenia pechuelii</i>						End	LC
<i>Adenolobus garipensis</i>				✓	✓		
<i>Adenolobus pechuelii</i>							
<i>Albizia anthelmintica</i>	✓		✓	✓	✓	Protected (F)	LC
<i>Aloe dichotoma</i>						Protected (F), NC, C2, N-end NC, C2	LC
<i>Aloe litoralis</i>				✓	✓		
<i>Azima tetraacantha</i>			✓	✓	✓		
<i>Boscia albitrunca</i>	✓	✓		✓	✓	Protected (F)	LC
<i>Boscia foetida</i>	✓		✓	✓	✓		
<i>Cadaba aphylla</i>							
<i>Caesalpinia rubra</i>							
<i>Catophractes alexandri</i>	✓		✓	✓	✓		
<i>Combretum apiculatum</i>				✓	✓		
<i>Combretum hereroense</i>							
<i>Combretum imberbe</i>					✓	Protected (F)	LC
<i>Commiphora Africana</i>					✓		
<i>Commiphora dinteri</i>						Protected (F), End	
<i>Commiphora glandulosa</i>				✓	✓		
<i>Commiphora glaucescens</i>		✓		✓	✓	N-end	LC

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<i>Commiphora pyracanthoides</i>					Protected (F), End	
<i>Commiphora saxicola</i>						
<i>Commiphora tenuipetiolata</i>	√		√	√		
<i>Commiphora virgata</i>				√	Protected (F), End	LC
<i>Cordia sinensis</i>						
<i>Croton gratissimus</i>	√			√		
<i>Cyphostemma bainesii</i>					Protected (F), End, NC	LC
<i>Cyphostemma currorii</i>				√	Protected (F), NC	
<i>Dichrostachys cinerea</i>	√	√	√	√		
<i>Diospyros lycioides</i>			√	√		
<i>Dombeya rotundifolia</i>			√	√		
<i>Ehretia alba</i>			√	√		
<i>Erythrina decora</i>					Protected (F), End	
<i>Elephantorrhiza suffruticosa</i>	√		√	√		
<i>Euclea pseudebenus</i>		√	√	√	Protected (F)	LC
<i>Euclea undulata</i>			√			
<i>Euphorbia avasmontana</i>				√	C2	
<i>Euphorbia damarana</i>					End, C2	
<i>Euphorbia guerichiana</i>			√	√	C2	
<i>Euphorbia virosa</i>					C2	
<i>Faidherbia albida</i>		√	√	√	Protected (F)	LC
<i>Flueggea virosa</i>				√		
<i>Ficus cordata</i>			√	√	Protected (F)	LC
<i>Ficus ilicina</i>						
<i>Ficus sycomorus</i>					Protected (F)	LC
<i>Gossypium anomalum</i>						
<i>Gossypium triphyllum</i>						
<i>Grewia avellana</i>						
<i>Grewia bicolor</i>			√	√		
<i>Grewia flava</i>		√	√	√		
<i>Grewia flavescens</i>	√		√	√		
<i>Grewia tenax</i>						
<i>Grewia villosa</i>				√		
<i>Gymnosporia senegalensis</i>				√		
<i>Ipomoea adeniodes</i>				√		
<i>Laggera decurrens</i>						
<i>Lycium bosciifolium</i>	√		√			
<i>Lycium cinereum</i>						
<i>Lycium eenii</i>		√	√	√		

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<i>Maerua juncea</i>						
<i>Maerua parvifolia</i>						
<i>Maerua schinzii</i>			√	√	Protected (F)	LC
<i>Manuleopsis dinteri</i>					End	
<i>Montinia caryophyllacea</i>			√	√		
<i>Moringa ovalifolia</i>	√			√	Protected (F), NC, N-end	LC
<i>Mundulea sericea</i>			√			
<i>Obetia carruthersiana</i>					N-end	
<i>Olea europaea</i>						
<i>Ozoroa crassinervia</i>						
<i>Parkinsonia africana</i>		√	√	√		
<i>Pechuel-Loeschea leubnitziae</i>	√		√	√		
<i>Phaeoptilum spinosum</i>				√		
<i>Rothea myricoides</i>						
<i>Rhigozum trichotomum</i>			√	√		
<i>Salsola</i> spp.						
<i>Salvadora persica</i>				√		
<i>Searsia ciliata</i>						
<i>Searsia lancea</i>					Protected (F)	LC
<i>Searsia marlothii</i>			√	√		
<i>Searsia pyroides</i>						
<i>Steganotaenia araliacea</i>						
<i>Sterculia africana</i>	√		√	√	Protected (F)	LC
<i>Strophanthus amboensis</i>						
<i>Tamarix usneoides</i>					Protected (F)	LC
<i>Tarchonanthus camphoratus</i>						
<i>Tetradenia riparia</i>						
<i>Tinnea rhodesiana</i>						
<i>Terminalia pruniodes</i>				√		
<i>Vangueria cyanescens</i>						
<i>Vangueria infausta</i>						
<i>Vernonia cinerascens</i>						
<i>Ximenia americana</i>		√	√	√		
<i>Ziziphus mucronata</i>		√	√	√	Protected (F)	LC

End: Endemic; **N-end:** Near-endemic (Mannheimer and Curtis 2018)

F: Forest Act No. 12 of 2001

NC: Nature Conservation Ordinance No. 4 of 1975

LC: Least Concern (IUCN 2021)

C2: CITES Appendix 2 species

Source for literature review: Coats Palgrave (1983), Cunningham (2013), Cunningham (2017), Cunningham (2021), Curtis and Mannheimer (2005), IUCN (2021), Loots (2005), Mannheimer and Curtis (2009), Mannheimer and Curtis (2018), Rothmann (2004), Steyn (2003), Van Wyk and Van Wyk (1997)



Figure 13. *Albizia anthelmintica* (worm-cure Albizia) – Protected F – observed on the plains.



Figure 14. *Commiphora glaucescens* (blue-leaved corkwood) – Near endemic – associated with rocky areas.



Figure 15. *Moringa ovalifolia* (bottle tree) – Protected F, NC, near endemic – only observed in rocky areas.



Figure 16. *Sterculia africana* (African star chestnut) – Protected F- on rocky areas.

Plains

Seven species of larger trees and shrubs were encountered along various transects totalling 500m in the plains habitat in the TSF3 area. *Acacia erubescens* (48%), *Catophractes alexandri* (20%) and *Boscia foetida* (18%) were the most dominant tree/shrub species observed during the fieldwork in the plains habitat (Figure 17). *Acacia* species account for 48% of the tree/shrub species composition in the plains area while protected species – *Albizia anthelmintica* and *Boscia albitrunca* – account for only 5% although not exclusively associated with the TSF3 area and occur widespread throughout Namibia.

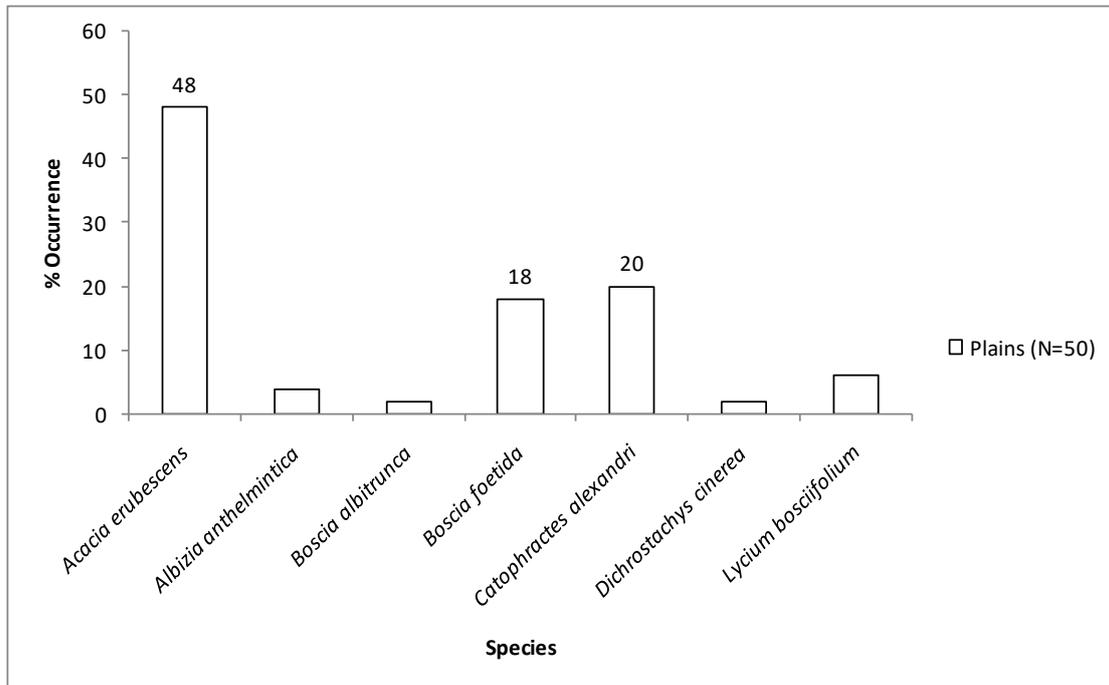


Figure 17. Tree and shrub species composition along various transects (total length – 500m @ 10m intervals) in the plains habitat (N=50 points).

Hills

Seven species of larger trees and shrubs were encountered along various transects totalling 500m in the hills habitat in the TSF3 area. *Acacia erubescens* (40%), *Croton gratissimus* (22%) and *Commiphora tenuipetiolata* (14%) were the most dominant species observed during the fieldwork in the hills habitat (Figure 18). *Acacia* species account for 40% of the tree/shrub species composition in this area while protected species – *Boscia albitrunca* (6%), *Commiphora glaucescens* (8%), *Moringa ovalifolia* (2%) and *Sterculia africana* (8%) – account for 24% although not exclusively associated with the TSF3 area and occur widespread throughout Namibia.

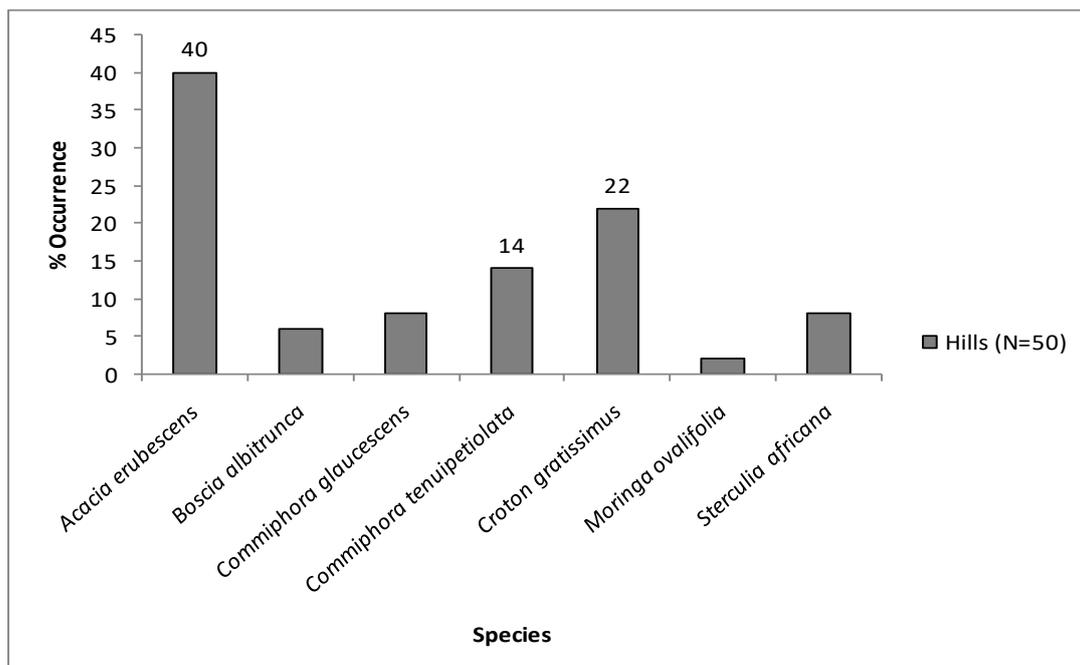


Figure 18. Tree and shrub species composition along various transects (total length – 500m @ 10m intervals) in the hills habitat (N=50 points).

The protected and/or unique species identified during the fieldwork throughout the proposed TSF3 development area occur widespread throughout Namibia and not limited to the Navachab Mine area. However, rocky/hill habitats have a large number of important (protected) tree species with *Moringa ovalifolia* (phantom tree) – Protected F, NC, near endemic – viewed as the most important. *M. ovalifolia* are relatively easily to transplant/relocate and could be relocated to other similar habitat prior to the TSF3 area being developed. However, as they grow in rocky areas in the TSF3 area, would make this extremely difficult to execute (See Figure 15).

The Navachab Gold Mine project area has been heavily impacted due to current/past mining activities and none of the unique trees/shrubs are expected to be exclusively associated with the TSF3 area. The proposed mitigations – See Section 4 – are expected to minimise the overall effect on trees/shrubs potentially occurring in the area.

3.6 Grass Diversity

It is estimated that at least 52-72 grasses (Müller 2007 [72spp.], Van Oudshoorn 1999 [52spp.]) – approximate total of 80 species – occur in the general Karibib area. The grasses known and/or expected to occur in the general area (¹Müller 2007 and ²Van Oudtshoorn 1999) is presented in Table 7 below.

Of the approximately 80 grasses that are expected in the general area, 1 species is viewed as endemic (*Eragrostis omahekensis*) (Table 7).

Although between 52 and 72 grasses are known and/or expected to occur in the general area only 5 and 11 species were identified in the following habitats – plains and hills – throughout the proposed TSF3 area, respectively. A total of 13 species of grasses were identified throughout the TSF3 area. A total of at least 27 species are confirmed from the general area if one includes species identified by Cunningham (2013, 2017, 2021) – See Table 7. The endemic *Pennisetum foermeranum* (false buffalo-grass) was also observed in the rocky/hill areas although not included in Table 7 (Figure 19).



Figure 19. The endemic *Pennisetum foermeranum* (false buffalo-grass) confirmed in rocky/hill habitats in the TSF3 area.

Table 7. Grass diversity expected (literature study) and confirmed (fieldwork - √) including author's confirmed records from other studies conducted from the general area (See: Cunningham 2013, 2017, 2021). The grasses known, and/or expected to occur in the general area (derived from ¹Müller 2007 and ²Van Oudtshoorn 2012).

Species: Scientific name	Species confirmed		Helikon Lithium (2013)	Helikon/ Rubicon Lithium (2013)	Osino Gold (2021)	Ecological Status *	Grazing Value *
	Plains	Hills					
^{1,2} <i>Andropogon chinensis</i>						Increaser 1	Average
² <i>Andropogon eucomus</i>						Increaser 2	Low
¹ <i>Antheophora argentea</i>						Decreaser	High
^{1,2} <i>Antheophora pubescens</i>		√		√	√	Decreaser	High
¹ <i>Antheophora schinzii</i>		√		√	√	Increaser 2	Low
^{1,2} <i>Aristida adscensionis</i>		√		√		Increaser 2	Low
^{1,2} <i>Aristida congesta</i>						Increaser 2	Low
¹ <i>Aristida effusa</i>						Increaser 2	Low
^{1,2} <i>Aristida meridionalis</i>						Increaser 2	Low
¹ <i>Aristida rhiniochloa</i>						Increaser 2	Low
^{1,2} <i>Bachiaria deflexa</i>						Increaser 2	Average
¹ <i>Brachiaria malacodes</i>						?	Low
¹ <i>Brachiaria glomerata</i>						Decreaser	Average
^{1,2} <i>Brachiaria nigropedata</i>		√				Decreaser	High
^{1,2} <i>Cenchrus ciliaris</i>			√	√	√	Decreaser	High
^{1,2} <i>Centropodia glauca</i>						Decreaser	High
^{1,2} <i>Chloris virgata</i>					√	Increaser 2	Average
² <i>Cladoraphis spinosa</i>						Increaser 1	Low
^{1,2} <i>Cynodon dactylon</i>						Increaser 2	High
^{1,2} <i>Dactyloctenium aegyptium</i>						Increaser 2	Low
¹ <i>Danthoniopsis ramosa</i>						?	High
^{1,2} <i>Dichanthium annulatum</i>						Decreaser	High
² <i>Diplachne fusca</i>						Decreaser	High
¹ <i>Echinochloa colona</i>						?	Low
² <i>Elionurus muticus</i>						Increaser 2	Low
^{1,2} <i>Enneapogon cenchroides</i>	√	√	√	√	√	Increaser 2	Low
^{1,2} <i>Enneapogon desvauxii</i>			√	√		Intermediate	Average
^{1,2} <i>Enneapogon scaber</i>						?	Low
^{1,2} <i>Enneapogon scoparius</i>						Increaser 2	Low

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¹ <i>Entoplocamia aristulata</i>	√		√		Intermediate	Low
^{1,2} <i>Eragrostis annulata</i>					Increaser 2	Low
¹ <i>Eragrostis cylindriflora</i>	√	√	√	√	?	Low
² <i>Eragrostis biflora</i>					Increaser 2	Low
² <i>Eragrostis cilianensis</i>					Increaser 2	Low
^{1,2} <i>Eragrostis echinochloidea</i>			√		Increaser 2	Average
¹ <i>Eragrostis homomalla</i>					?	Low
² <i>Eragrostis lehmanniana</i>					Increaser 2	Average
^{1,2} <i>Eragrostis nindensis</i>	√	√	√	√	Increaser 2	Average
¹ <i>Eragrostis omahekensis</i> [End]					?	Low
¹ <i>Eragrostis porosa</i>			√	√	Intermediate	Low
¹ <i>Eragrostis rigidior</i>					Increaser 2	Average
^{1,2} <i>Eragrostis rotifer</i>			√	√	Intermediate	Low
¹ <i>Eragrostis scopelophila</i>					?	High
^{1,2} <i>Eragrostis superba</i>			√		Increaser 2	Average
^{1,2} <i>Eragrostis trichophora</i>			√		Increaser 2	Average
^{1,2} <i>Eragrostis viscosa</i>					Increaser 2	Low
^{1,2} <i>Fingerhuthia africana</i>		√		√	Decreaser	Average
^{1,2} <i>Heteropogon contortus</i>					Increaser 2	Average
^{1,2} <i>Hyparrhenia hirta</i>					Increaser 1	Average
¹ <i>Leptochloa fusca</i>					?	Average
^{1,2} <i>Microchloa caffra</i>					Increaser 2	Low
¹ <i>Monelytrum luederitzianum</i>					?	Average
^{1,2} <i>Melinis repens</i>	√	√	√		Increaser 2	Low
¹ <i>Odyssea paucinervis</i>					?	Average
^{1,2} <i>Oropetium capense</i>					?	Low
^{1,2} <i>Panicum coloratum</i>					Decreaser	High
^{1,2} <i>Panicum maximum</i>					Decreaser	High
² <i>Panicum repens</i>				√	Decreaser	High
¹ <i>Pogonarthria fleckii</i>			√		Increaser 2	Low
² <i>Polypogon monspeliensis</i>					?	Average
^{1,2} <i>Schmidtia kalahariensis</i>	√		√		Increaser 2	Low
^{1,2} <i>Schmidtia pappophoroides</i>					Decreaser	High
¹ <i>Setaria appendiculata</i>					?	Average
^{1,2} <i>Setaria verticillata</i>			√		Increaser 2	Average
¹ <i>Sorghum bicolour</i>					?	Average
^{1,2} <i>Sporobolus festivus</i>					Increaser 2	Low
^{1,2} <i>Stipagrostis ciliata</i>				√	Decreaser	High
¹ <i>Stipagrostis giessii</i>					?	Average

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^{1,2} <i>Stipagrostis hirtigluma</i>						Increaser 2	Low
¹ <i>Stipagrostis hochstetteriana</i>	√			√	√	Decreaser	Average
^{1,2} <i>Stipagrostis namaquensis</i>				√	√	?	Average
^{1,2} <i>Stipagrostis obtusa</i>						Decreaser	High
^{1,2} <i>Stipagrostis uniplumis</i>	√	√	√	√	√	Increaser 2	Average
^{1,2} <i>Tricholaena monachne</i>						Increaser 2	Average
¹ <i>Triraphis purpurea</i>						?	Low
¹ <i>Triraphis ramosissima</i>		√	√	√		?	Average
^{1,2} <i>Tragus berteronianus</i>					√	Increaser 2	Low
¹ <i>Tragus racemosus</i>						Increaser 2	Low
¹ <i>Urochloa brachyura</i>						?	Average
¹ <i>Urochloa panicoides</i>						?	Low

End: Endemic (Müller 2007)

?: Not classified in literature, but often similar to other species within the genus

Source for literature review: Müller (2007), Van Oudtshoorn (2012)

Plains

Five species of grass were encountered along various transects totalling 200m in the proposed TSF3 area. *Enneapogon cenchroides* (48.5%) and *Eragrostis cylindriflora* (35%), were the most dominant grass species observed during the fieldwork (Figures 20-21).

Hills

Ten species of grass were encountered along various transects totalling 200m in the proposed TSF3 area. *Enneapogon cenchroides* (47.5%) and *Triraphis ramosissima* (20.5%), were the most dominant grass species observed during the fieldwork (Figures 20-21).

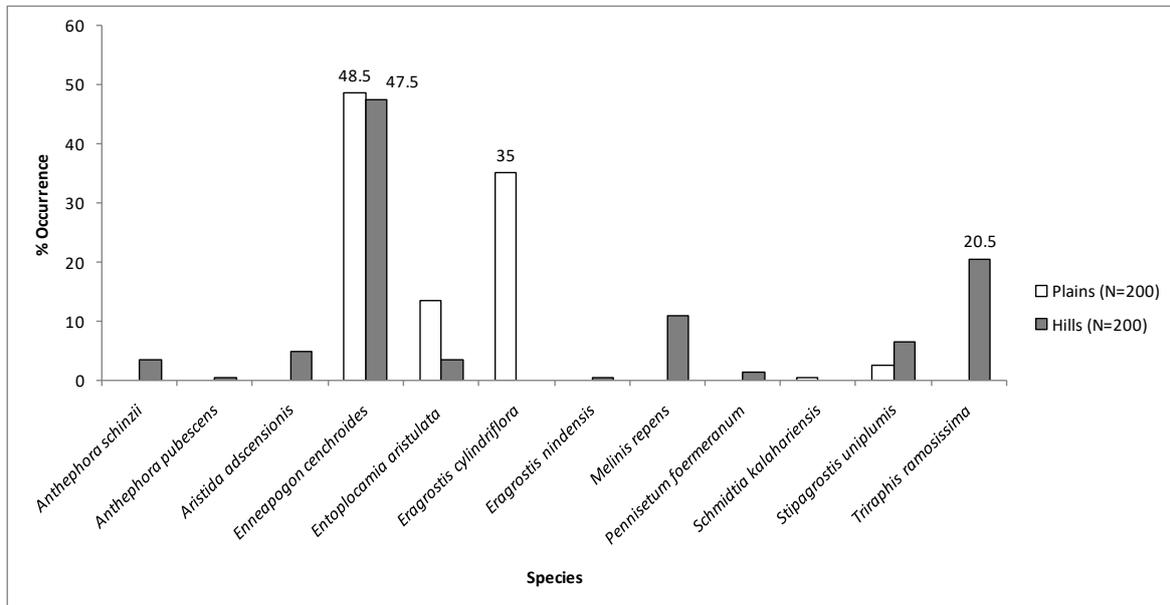


Figure 20. Grass species composition along various transects (total length - 200m @ 1m intervals) in the plains habitat (n=200 points).



Figure 21. A combination of *Entoplocamia aristulata*, *Enneapogon cenchroides* and *Stipagrostis uniplumis* grasses in the TSF3 area.

The Navachab Gold Mine project area has been heavily impacted due to current/past mining activities and none of the unique grasses are expected to be exclusively associated with the TSF3 area. The proposed mitigations – See Section 4 – are expected to minimise the overall effect on grasses potentially occurring in the area.

3.7 Other Species

Other species observed throughout the proposed development area included the following herbs, etc. (Table 8). This list is not comprehensive – i.e. many more species are known and/or expected to occur in the general area.

The most important species are viewed as the endemic species (*Aspilia eenii* and *Barleria lanceolata*) (Figures 22-23) (Mannheimer 2012).

Table 8. Other species – bulbs, herbs, etc. – confirmed in various habitats (i.e. H = Hills and P = Plains) during the fieldwork throughout the TSF3 area.

Species	Habitat	
	Winter	Status
<i>Acrotome inflata</i>	P	
<i>Aspilia eenii</i>	H,P	End
<i>Barleria lanceolata</i>	H	End
<i>Barleria lancifolia</i>	H	
<i>Blepharis obmitrata</i>	P,H	
<i>Calostephane divaricata</i>	P	
<i>Cleome elegantissima</i>	P,H	
<i>Convolvulus sagittatus</i>	P	
<i>Crotalaria damarensis</i>	P	
<i>Crotalaria</i> spp.	H	
<i>Cucumis africanus</i>	P	
<i>Cucumis sagittatus</i>	P	
<i>Dactyliandra welwitschii</i>	P	N-end
<i>Dicoma tomentosa</i>	P	
<i>Euphorbia glanduligera</i>	P	
<i>Forsskaolea candida</i>	H	
<i>Geigeria acaulis</i>	H	
<i>Gisekia africana</i>	P	
<i>Hermania modesta</i>	P	
<i>Hibiscus engleri</i>	H	
<i>Leucas pechuelii</i>	P	
<i>Leucasphaera bainesii</i>	P	
<i>Limeum fenestratum</i>	P	
<i>Limeum viscosum</i>	P	
<i>Momordica humilis</i>	P	
<i>Monsonia senegalensis</i>	P	
<i>Pergularia daemia</i>	P	
<i>Pupalea lappacea</i>	P	
<i>Sesamum triphyllum</i>	H	
<i>Sesbania sesban</i>	P	
<i>Sesamum triphyllum</i>	P,H	
<i>Tribulocarpus dimorphanthus</i>	P	
<i>Tribulus terrestris</i>	P,H	



Figure 22. *Aspilia eenii* (endemic) is an herb usually associated with rocky areas.



Figure 23. *Barleria lanceolata* (endemic) is widely distributed and mainly associated with rocky areas.

Invasive alien species

Only 1 invasive alien species – *Nicotiana glauca* – was observed and associated with mining activities – e.g. disturbed road verges, overburden sites, etc.

- *Nicotiana glauca* (wild tobacco) (Figure 24)



Figure 24. *Nicotiana glauca* (wild tobacco) observed in the TSF3 area.

3.8 Important Species

Reptiles

The high percentage of endemic reptile species (45.3%) associated with the rocky escarpment region of central western Namibia underscores the importance of this area without formal state protection. The most important species expected to occur in the general area (See Table 1) are viewed as the tortoises (*Stigmochelys pardalis* and *Psammobates oculiferus*); pythons (*Python anchietae* and *P. natalensis*); Namibian wolf snake (*Lycophidion namibianum*); monitor lizard (*Varanus albigularis*) and some of the endemic and little known gecko species – e.g. *Pachydactylus* species. Tortoises, snakes and monitor lizards are routinely killed for food or as perceived threats. Other important species are those viewed as “rare” – i.e. *Rhinotyphlops lalandei*, *Mehelya vernayi* and *Afroedura africana* – although very little is known about these species.

Amphibians

Of the 7 species of amphibians that potentially could occur in the general area, 2 species are endemic (*Poyntonophrynus hoeschi* and *Phrynomantis annectens*) (Griffin 1998b) and 1 species is classified as “near threatened” (*Pyxicephalus adspersus*) (Du Preez and Carruthers 2009) – i.e. high level (42.9%) of amphibians of conservation value from the general area (See Table 2). With the exception of these important species and due to the fact that there is no open permanent surface water in the area, amphibians are not viewed as very important in the general area.

Mammals

Of the 87 species of mammals known and/or expected to occur in the general Karibib area, 10 species (11.5%) are classified as endemic. At least 31% (27 species) of the mammalian fauna that occur or are expected to occur in the general Karibib area are represented by rodents of which 5 species (18.5%) are endemic. This is followed by bats 27.6% (24 species) of which 1 species is classified as “rare”. These are the mammal group’s least studied in Namibia. Species of greatest concern in the general area are those viewed as rare in Namibia – i.e. Namibian wing-gland bat and Southern African hedgehog – and species classified as vulnerable (cheetah, leopard, Hartmann’s mountain zebra, giraffe) and near threatened (African straw-coloured fruit bat, Commerson’s roundleaf bat, striped leaf-nosed bat, brown hyena) by the IUCN (2021) (See Table 3). Another important and unique species, although not observed, but known to occur in the general area, is the endemic

Kaokoland slender or black mongoose (See: Cowley and Cunningham 2004, Warren *et al.* 2009).

Birds

At least 217 bird species [mainly terrestrial “breeding residents”] occur and/or could occur in the general Karibib area at any time and include 12 of the 14 Namibian endemics (85.7% of all Namibian endemic species or 5.6% of all the species expected to occur in the area). The most important bird species from the general area are those classified as endemic to Namibia of which the Damara hornbill and Herero chat are viewed as the most important due to the overall lack of knowledge of these species. Although also viewed as important, Rüppels korhaan is migratory throughout its range while the rockrunner inhabits inaccessible terrain and is widespread throughout mountainous areas in Namibia. Other species of concern are those classified as endangered (violet wood-hoopoe, Ludwig’s bustard, black harrier, tawny eagle, booted eagle, martial eagle, black stork) and near threatened (Rüppel’s parrot, Verreaux’s eagle, peregrine falcon, marabou stork) (Simmons *et al.* 2015) and those species classified by the IUCN (2021) as critically endangered (white-backed vulture), endangered (Ludwig’s bustard, lack harrier, lappet-faced vulture, martial secretarybird), vulnerable (tawny eagle) and near threatened (kori bustard) (See Table 5).

Flora

Trees/shrubs and Grasses

At least 74 to 101 larger species of trees and shrubs are known and/or expected to occur in the general area of which 8 species (7.9%) expected to occur in the general Karibib area are classified as endemic, 4 species as near endemic (4%), 21 species (20.8%) are protected by the Forest Act No 12. of 2001, 5 species (5%) are protected under the Nature Conservation Ordinance No. 4 of 1975 while 6 species (5.9%) are classified as CITES Appendix 2 species. The IUCN (2021) classifies 19 species as least concern although not all tree/shrub species have yet been assessed by the IUCN Red List. Although all the trees with some kind of conservation and/or protected status (including endemic/near endemic species) are viewed as important in the general Karibib area, the most important species are viewed as *Commiphora dinteri*, *Commiphora saxicola*, *Commiphora virgata*, *Cyphostemma bainesii*, *Cyphostemma currorii* and *Erythrina decora* (See Table 6). The endemic grasses – *Eragrostis omahekensis* and *Pennisetum foermeranum* – are viewed as the most important species potentially occurring in the general area.

Important plant species known and/or expected from the general Karibib area and included in the Red Data Book for Namibia include at least 16 species of which 1 species is listed as rare (*Diclis tenuissima*), 1 species as vulnerable (*Lithops wernerii*) and 1 species as near threatened (*Adenia pechuellii*) (Table 9) (Loots 2005). All the species included in Table 9 are viewed as important.

Table 9. Important species – i.e. Red Data spp. – known to occur in the general Karibib area according to Loots (2004).

Species: Scientific name	Conservation status
<i>Adenia pechuellii</i>	End, NT
<i>Aloe dinteri</i>	End, NC, C2, LC
<i>Aloe namibensis</i>	End, NC, C2, LC
<i>Australluma peschii</i>	End, LC
<i>Chamaegigas intrepidus</i>	End, LC
<i>Crassula capitella</i> subsp. <i>nodulosa</i>	LC
<i>Cyphostemma bainesii</i>	End, LC
<i>Diclis tenuissima</i>	End, R
<i>Dombeya rotundifolia</i> var. <i>velutina</i>	End, LC
<i>Euphorbia monteiroi</i> subsp. <i>brandbergensis</i>	End, C2, LC
<i>Lithops gracilidelineata</i> subsp. <i>gracilidelineata</i>	NC, LC

<i>Lithops ruschiorum</i>	End, NC, LC
<i>Lithops wernerii</i>	End, NC, V
<i>Namacodon schinzianum</i>	End, LC
<i>Nicotiana africana</i>	End, LC
<i>Trema orientalis</i>	LC

End: Endemic (Loots 2005)

NC: Nature Conservation Ordinance No. 4 of 1975

R – Rare; **V** – Vulnerable; **NT** – Near Threatened; **LC** – Least Concern (Loots 2005)

C2: CITES Appendix 2 spp.

Other

Aloes

Aloes are protected throughout Namibia with 3 other aloe species not included in Table 6, but which potentially occur in the general area, and also viewed as important are *Aloe asperifolia*, *A. hereroensis* and *A. zebrina* (Rothmann 2004).

Commiphora

Many endemic *Commiphora* species are found throughout Namibia with Steyn (2003) indicating that *Commiphora crenato-serrata* (not included in the Table 6) potentially also occurring in the general area. *Commiphora* species have economic potential (i.e. resin properties used in the perfume industry – e.g. *C. wildii*) making them an important species (Nott and Curtis 2006).

Lithops

Lithops species – all protected (See Nature Conservation Ordinance No. 4 of 1975) – are also known to occur in the general area and often difficult to observe, especially during the dry season when their aboveground structures wither. The closest species are currently only known to occur west of Usakos and include *Lithops gracilidelineata* var. *gracilidelineata* and *L. wernerii* (Cole and Cole 2005, Earle and Round n.d.).

Ferns

At least 64 species of ferns, of which 13 species being endemic, occur throughout Namibia. Ferns in the general Karibib area include at least 15 indigenous species (*Actiniopteris radiata*, *Asplenium cordatum*, *Cheilanthes dinteri*, *C. eckloniana*, *C. marlothii*, *C. parviloba*, *Marselia aegyptiaca*, *M. ephippiocarpa*, *M. farinosa*, *M. macrocarpa*, *M. nubica*, *M. unicornis*, *M. vera*, *Ophioglossum polyphyllum* and *Pellaea calomelanos*) (Crouch *et al.* 2011). The general area is undercollected with more species probably occurring in the general area than presented above.

Lichens

The overall diversity of lichens is poorly known from Namibia, especially the coastal areas and statistics on endemism is even sparser (Craven 1998). More than 100 species are expected to occur in the Namib Desert with the majority being uniquely related to the coastal fog belt (Wirth 2010). Lichen diversity is related to air humidity and generally decreases inland from the Namibian coast (Schults and Rambold 2007). Off road driving is the biggest threat to these lichens which are often rare and unique to Namibia. To indicate how poorly known lichens are from Namibia, the recent publication by Schultz *et al.* (2009) indicating that 37 of the 39 lichen species collected during BIOTA surveys in the early/mid 2000's were new to science (i.e. new species), is a case in point. Lichens are known to occur in rocky terrain in the general area (Figure 25).



Figure 25. Unidentified lichen species observed in rocky area in the TSF3 area.

Other species with commercial potential that could occur in the general Karibib area include *Harpagophytum procumbens* (Devil's claw) – harvested for medicinal purposes and often over-exploited – and *Citrullus lanatus* (Tsamma melon) which potentially has a huge economic benefit (Mendelsohn *et al.* 2002).

3.9 Important Areas

The most important areas in the TSF3 area are:

1. Rocky areas/hills

Rocky areas generally have high biodiversity and consequently viewed as important habitat for all vertebrate fauna and flora in the general TSF3 area (Figures 26-27). Protected species associated with and confirmed from the hills in the TSF3 area include unique species such as *Commiphora glaucescens*, *Moringa ovalifolia* and *Sterculia africana*, etc. (See Table 6, Figures 14-16, 19, 22-23).

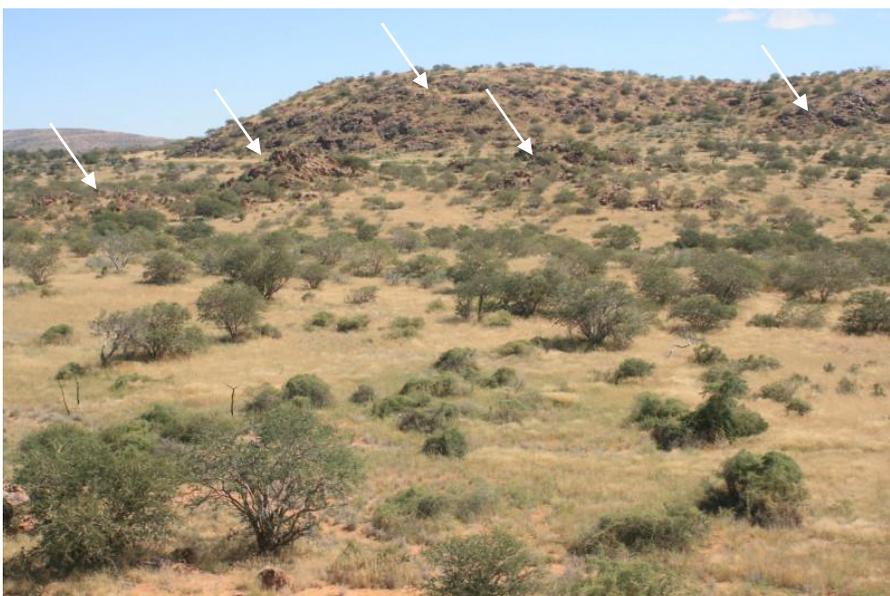


Figure 26. Rocky areas/hills have unique protected tree/shrub species and serve as habitat to a variety of unique vertebrate fauna (e.g. black mongoose, dassie rat, etc.) and flora species (See arrows).



Figure 27. Rocky areas/hills in the proposed TSF3 area are important habitats. The red dotted oblongs are viewed as more important (i.e. higher biodiversity) than the white dotted oblongs.

However, none of the important species are exclusively associated with these rocky areas located in the TSF3, and occur widespread throughout Namibia.

4 Alternative sites

No alternative sites were suggested.

The proposed TSF3 site has no unique habitats and/or species that are exclusively associated with this site and/or make this a no-go option.

5 Envisaged impacts

5.1 Introduction

All developments change or are destructive to the local fauna and flora to some or other degree. Assessing potential impacts is occasionally obvious, but more often difficult to predict accurately. Such predictions may change depending on the scope of the development – i.e. development, once initiated, may have a different effect on the fauna and flora as originally predicted. Thus continuing monitoring of such impacts during the development phase(s) is imperative.

5.2 Faunal disturbance

Faunal disturbance with the proposed TSF3 developments would be localised. The following table indicates the potential/envisaged impacts expected regarding faunal disturbance (which is obviously closely linked to habitat destruction):

Description	Faunal disturbance will vary depending on the scale/intensity of the development operation and associated and inevitable infrastructure.
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Extent	<p>1. Access route(s) - Localised disruption/destruction of the habitat and thus consequently fauna associated directly with the actual routes. This however, would be a relatively small area with localised implications.</p> <p>2. TSF3 - Localised disruption/destruction of the habitat and thus consequently vertebrate fauna associated directly with the actual site. This however, would be relatively small area – depending on scale/intensity of operations – with localised implications.</p>
Duration	<p>1. Access route(s) - The duration of the impact is expected to be permanent along the route(s). This however, would be a relatively small area(s) with localised implications.</p> <p>2. TSF3 - The duration of the impact is expected to be permanent at the site. This however, would be relatively small area with localised implications.</p>
Intensity	<p>1. Access route(s) - The actual sites where construction of the route(s) would be located would be permanently altered. This however, would be relatively small area(s) with localised implications.</p> <p>2. TSF3 - The actual TSF3 site would be permanently altered. This however, would be relatively small area with localised implications.</p> <p>The areas adjacent the TSF3 site and other associated infrastructure should not be significantly affected. This however, would depend on control over the contractors during the road building, construction phase(s), and groundwater leaching, but should be limited to localised implications.</p> <p>Areas not directly affected by the TSF3 site and associated infrastructure although within the immediate area would be affected minimally. This would include dust, noise, light and other associated disturbances in the area, but be limited to the TSF3 site and construction periods.</p>
Mitigation	<p>General</p> <p>1. Limit the development to actual TSF3 site only and avoid affecting adjacent areas, especially mountainous areas and ephemeral drainage lines, throughout the entire area.</p> <p>2. Avoid development and associated infrastructure in sensitive areas – e.g. rocky areas/hills in the immediate area (See 3.9). This would minimise the negative effect on the local environment especially unique features serving as habitat to various vertebrate fauna species.</p> <p>3. Remove (e.g. capture) unique fauna and sensitive fauna before commencing with the development activities and/or species serendipitously located during this period and relocate to a less sensitive/disturbed sites in the immediate area.</p> <p>4. Prevent and discourage the setting of snares (poaching), illegal collecting of veld foods (e.g. tortoises, etc.), indiscriminate killing of perceived dangerous species (e.g. snakes, etc.) and collecting of wood as this would diminish and negatively affect the local fauna – especially during the development phase(s).</p> <p>5. Attempt to avoid the removal of bigger trees during the development phase(s) – especially with the development of access routes – as these serve as habitat for a myriad of fauna.</p> <p>6. Prevent and discourage fires – especially during the development phase(s) – as this could easily cause runaway veld fires affecting the local fauna, but also causing problems (e.g. loss of grazing and domestic stock mortalities, etc.) for the neighbouring farmers.</p> <p>7. Rehabilitation of the disturbed areas – i.e. initial development access route “scars” and associated tracks. Preferably workers should be transported</p>

	<p>in/out to the construction sites on a daily basis to avoid excess damage to the local environment (e.g. fires, wood collection, poaching, etc.). Such rehabilitation would not only confirm the company's environmental integrity, but also show true local commitment to the environment.</p> <p>8. Prevent domestic pets – e.g. cats and dogs – accompanying the workers during the construction phase as cats decimate the local fauna and interbreed and transmit diseases to the indigenous African wildcat found in the area. Dogs often cause problems when bonding on hunting expeditions thus negatively affecting the local fauna. The indiscriminate and wanton killing of the local fauna by such pets should be avoided at all costs.</p> <p>9. Initiate a suitable waste removal system (i.e. remove to Karibib and not store on site) as this often attracts wildlife – e.g. baboons and black-backed jackal, crows, etc. – which may result in human-wildlife conflict issues.</p> <p>10. Educate/inform contractors and staff on protected species (See Tables 1 to 5) to avoid and the consequences of illegal collection of such species.</p> <p>11. Investigate the idea of employing an Environmental Officer during the construction phase(s) to ensure compliance and minimise the overall impact on the fauna and the environment.</p> <p>Tracks</p> <p>12. Avoid placing access routes (roads and tracks) through sensitive areas – e.g. over hills and along drainage lines. This would minimise the effect on localised potentially sensitive habitats in the area.</p> <p>13. Avoid driving randomly through the area (i.e. “track discipline”), but rather stick to permanently placed roads/tracks – especially during the construction phase. This would minimise the effect on localised potentially sensitive habitats in the area.</p> <p>14. Stick to speed limits of maximum 30km/h as this would result in fewer faunal road mortalities. Speed humps could also be used to ensure the speed limit. Lower speeds would also minimise dust pollution.</p> <p>15. Implement erosion control. – i.e. avoid constructing tracks up steep gradients; incorporate erosion furrows (runoff sites) and humps along tracks to channel water off the tracks to minimise erosion problems; cross drainage lines at right angles, etc. The area(s) towards and adjacent the drainage line(s) are easily eroded and further development may exacerbate this problem. Avoid construction within 100m of the main drainage line(s) to minimise erosion problems as well as preserving the riparian associated flora and fauna.</p> <p>Access route</p> <p>16. Use existing access route(s) as far as possible.</p>
Frequency of occurrence	Expected to be a “once off” issue affecting the selected site. Future TSF's and associated access routes (should this become necessary/evident) throughout the area would however increase the frequency of occurrence.
Probability	<p>Definite (100%) negative impact on fauna is expected in the actual TSF3 site as well as along the access route(s). This however, would be much localised and cover only a small area(s) and should avoid sensitive areas.</p> <p>Highly Probable (75%) negative impact on fauna is expected in the general areas especially during the construction phase(s) as a result of noise, increased activities, groundwater leaching, etc.</p>

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	Probable (50%) negative impact on fauna is expected from the infrastructure (roads/tracks, etc.). Precautionary principle (e.g. avoid unique habitat features as well as adhering to the proposed mitigating measures would minimise this) would decrease the significance of these potential impacts.
Significance	Before mitigation: High After mitigation: Medium to Low
Status of the impact	Negative Localised unique habitats (e.g. rocky areas/hills) with associated fauna would bear the brunt of this proposed development, but be limited in extent and only permanent at the actual TSF3 site and access routes.
Legal requirements	Fauna related: Nature Conservation Ordinance No. 4 of 1975, CITES, IUCN and SARDB Habitat – Flora related: Forest Act No. 12 of 2001, Nature Conservation Ordinance No. 4 of 1975, CITES
Degree of confidence in predictions	As an ecologist I am sure of the above mentioned predictions made and would suggest that the mitigation measures be implemented to minimise potentially negative aspects regarding the local fauna in the area.

5.3 Floral disturbance

Floral disturbance with the TSF3 developments would be localised. The following table indicates the potential/envisaged impacts expected regarding floral disturbance (which is obviously closely linked to habitat destruction):

Description	Floral disturbance will vary depending on the scale/intensity of the development operation and associated and inevitable infrastructure.
Extent	1. Access route(s) - Localised disruption/destruction of the habitat and thus consequently flora associated directly with the actual routes. This however, would be a relatively small area with localised implications. 2. TSF3 - Localised disruption/destruction of the habitat and thus consequently flora associated directly with the actual site. This however, would be relatively small area – depending on scale/intensity of operations – with localised implications.
Duration	1. Access route(s) - The duration of the impact is expected to be permanent along the route(s). This however, would be a relatively small area(s) with localised implications. 2. TSF3 - The duration of the impact is expected to be permanent at the site. This however, would be relatively small area with localised implications.
Intensity	1. Access route(s) - The actual sites where construction of the route(s) would be located would be permanently altered. This however, would be relatively small area(s) with localised implications. 2. TSF3 - The actual TSF3 site would be permanently altered. This however, would be relatively small area with localised implications. The areas adjacent the TSF3 site and other associated infrastructure should not be significantly affected. This however, would depend on control over the contractors during the road building, construction phase(s), and groundwater leaching, but should be limited to localised implications. Areas not directly affected by the TSF3 site and associated infrastructure

	<p>although within the immediate area would be affected minimally. This would include dust and other associated disturbances in the area, but limited to the TSF3 site and construction periods.</p>
<p>Mitigation</p>	<p>General</p> <ol style="list-style-type: none"> 1. Limit the development to actual TSF3 site only and avoid affecting adjacent areas, especially mountainous areas and ephemeral drainage lines, throughout the entire area. 2. Avoid development and associated infrastructure in sensitive areas – e.g. rocky areas/hills in the immediate area (See 3.9). This would minimise the negative effect on the local environment especially unique features serving as habitat to various flora species. 3. Remove unique and sensitive flora (e.g. <i>Moringa ovalifolia</i> – See 3.9) before commencing with the development activities and relocate to a less sensitive/disturbed sites in the immediate area. 4. Prevent and discourage the collecting of firewood as dead wood has an important ecological role – especially during the development phase(s). Such collecting of firewood, especially for economic reasons, often leads to abuses – e.g. chopping down of live and/or protected tree species such as <i>Acacia erioloba</i>, etc. which are good quality wood. 5. Attempt to avoid the removal of bigger trees during the development phase(s) – especially with the development of access routes – as these serve as habitat for a myriad of fauna. Avoid the destruction of larger trees associated with the ephemeral drainage lines. 6. Prevent and discourage fires – especially during the development phase(s) – as this could easily cause runaway veld fires causing problems (e.g. loss of grazing and domestic stock mortalities, etc.) for the neighbouring farmers. 7. Rehabilitation of the disturbed areas – i.e. initial development access route “scars” and associated tracks. Preferably workers should be transported in/out to the construction sites on a daily basis to avoid excess damage to the local environment (e.g. fires, wood collection, poaching, etc.). Such rehabilitation would not only confirm the company’s environmental integrity, but also show true local commitment to the environment. 8. Prevent the planting of potentially invasive alien plant species (e.g. <i>Tecoma stans</i>, <i>Pennisetum setaceum</i>, etc.) for ornamental purposes as part of the landscaping – e.g. TSF site, etc. Alien species often “escape” and become invasive causing further ecological damage as is evident from previous human habitation in the area (i.e. invasive aliens on site include <i>Nicotiana glauca</i> – See Section 3.7; Figure 24). 9. Eradicate – destroy – all invasive alien plants encountered on site – e.g. <i>Nicotiana glauca</i> – See Section 3.7; Figures 24). This would ensure that the spread is limited and show environmental commitment. 10. Incorporate indigenous vegetation – especially the protected species e.g. <i>Moringa ovalifolia</i> – into the overall landscaping. Indigenous species require less water and overall maintenance. 11. Educate/inform contractors and staff on protected species (See Table 6 and Section 3.8) to avoid and the consequences of illegal collection of such species.

	<p>12. Investigate the idea of employing an Environmental Officer during the construction phase(s) to ensure compliance and minimise the overall impact on the flora and the environment.</p> <p>Tracks</p> <p>13. Avoid placing access routes (roads and tracks) through sensitive areas – e.g. rocky areas/hills. This would minimise the effect on localised potentially sensitive flora and habitats in the area.</p> <p>14. Avoid driving randomly through the area (i.e. “track discipline”), but rather stick to permanently placed roads/tracks – especially during the construction phase. This would minimise the effect on localised potentially sensitive flora and habitats in the area.</p> <p>15. Stick to speed limits of maximum 30km/h as this would result in less dust pollution. Speed humps could also be used to ensure the speed limit</p> <p>16. Implement erosion control. – i.e. avoid constructing tracks up steep gradients; incorporate erosion furrows (runoff sites) and humps along tracks to channel water off the tracks to minimise erosion problems; cross drainage lines at right angles, etc. The area(s) towards and adjacent the drainage line(s) are easily eroded and further development may exacerbate this problem. Avoid construction within 100m of the main drainage line(s) to minimise erosion problems as well as preserving the riparian associated flora and fauna.</p> <p>Access route</p> <p>17. Use existing access route(s) as far as possible.</p> <p>TSF</p> <p>18. Cover bund wall with soil to facilitate plant regrowth rather than leaving as exposed rock wall (See Figure 28).</p>
Frequency of occurrence	Expected to be a “once off” issue affecting the selected site. Future TSF’s and associated access routes (should this become necessary/evident) throughout the area would however increase the frequency of occurrence.
Probability	<p>Definite (100%) negative impact on flora is expected in the actual TSF3 site as well as along the access route(s). This however, would be much localised and cover only a small area(s) and should avoid sensitive areas.</p> <p>Highly Probable (75%) negative impact on flora is expected in the general areas especially during the construction phase(s) as a result of dust, increased activities, groundwater leaching, etc.</p> <p>Probable (50%) negative impact on flora is expected from the infrastructure (roads/tracks, etc.). Precautionary principle (e.g. avoid unique habitat features as well as adhering to the proposed mitigating measures would minimise this) would decrease the significance of these potential impacts.</p>
Significance	<p>Before mitigation: High</p> <p>After mitigation: Medium to Low</p>
Status of the impact	<p>Negative</p> <p>Localised unique habitats (e.g. rocky areas/hills) with associated flora would bear the brunt of this proposed development, but be limited in extent and only permanent at the actual TSF3 site and access routes.</p>

Legal requirements	Habitat – Flora related: Forest Act No. 12 of 2001, Nature Conservation Ordinance No. 4 of 1975, CITES
Degree of confidence in predictions	As an ecologist I am sure of the above mentioned predictions made and would suggest that the mitigation measures be implemented to minimise potentially negative aspects regarding the local flora in the area.



Figure 27. The TSF3 rock bunding walls should be covered with soil to facilitate vegetation regrowth and not left as bare bedrock. Note the limited, albeit natural, grass establishment in areas where some soil had accumulated over time.

5.4 Impacts – Methods

The construction and operation of the proposed new TSF3 would result in various impacts on the vertebrate fauna and flora and can be placed into three categories:

Direct Impacts: These are directly as a result of the construction of the proposed development – i.e. TSF3 project – and include general habitat destruction and the destruction of species of conservation concern.

Indirect Impacts: These are not directly associated with the proposed development, but potentially affect species of conservation concern recorded within the general area and include impacts as a result of changes in the hydrology, etc. and affect species rather on a population level.

Cumulative Impacts: These are impacts that the proposed development will have from a broad area perspective by considering land-use and transformation of natural habitat in areas surrounding the site (i.e. considering past, present and anticipated changes to biodiversity).

Mitigation measures are not always straightforward and/or easy to implement, but should be based on the following steps as mitigation hierarchy:

Step 1: Avoid/prevent loss to biodiversity and ecosystem services: The project location, layout and phasing should avoid negative impacts on biodiversity. Areas of high biodiversity should be identified prior to development activities to avoid negative impacts;

Step 2: Minimise impacts on biodiversity and ecosystem services: The project location, layout, and phasing should minimise the negative impacts on biodiversity;

Step 3: Rehabilitation – concurrently, progressively and on cessation of the activity: Rehabilitation should attempt to return the affected area(s) to pre-development natural state; and

Step 4: Offset significant residual negative impacts on biodiversity or ecosystem services: This refers to the compensation for the remaining and unavoidable negative impacts on biodiversity.

Assessment Criteria

The environmental impacts are assessed with and without mitigation measures and the results are presented in impact tables summarising the assessment. Mitigation and management actions are recommended in an attempt to enhance positive impacts and minimising negative impacts.

The following risk assessment was used to determine the significance of impacts.

Significance = (Magnitude + Duration + Scale) x Probability

The maximum potential value for significance of an impact is 100 points. Environmental impacts are rated as high, medium or low significance on the following basis:

High environmental significance = 60-100 points

Medium environmental significance = 30-59 points

Low environmental significance = 0-29 points

Magnitude (M)

[Description & Numerical value]

Very high = 10

High = 8

Moderate = 6

Low = 4

Minor = 2

Duration (D)

[Description & Numerical value]

Permanent = 5

Long-term (ceases at end of operation) = 4

Medium-term = 3

Short-term = 2

Immediate = 1

Scale (S)

[Description & Numerical value]

International = 5

National = 4

Regional = 3

Local = 2

Site = 1

None = 0

Probability (P)**[Description & Numerical value]**

Definite (or unknown) = 5

High = 4

Medium = 3

Low = 2

Improbable = 1

None = 0

The following criteria against which these activities are assessed are presented below.

Nature of the Impact

This is an appraisal of the type of effect the project would have on the environment. This description includes what would be affected and how and whether the impact is expected to be positive or negative.

Scale of the Impact

A description of whether the impact will be local, limited to the study area and its immediate surroundings, regional, national or international scale.

Duration of the Impact

This provides an indication of whether the lifespan of the impact would be immediate, short term (0-5 years), medium term (6-15 years), long term (cesses at end of operational phase) or permanent.

Probability of Occurrence

This describes the probability of the impact actually occurring. This is rated as none, improbable (low likelihood), low, medium, high and definite.

Significance

This describes the degree of significance for the predicted impact based on the available information and level of knowledge and expertise – i.e. High, Medium and Low.

5.5 Assessment: Construction, Operational and Decommissioning Phases

The proposed new TSF3 project at the Navachab Gold Mine would include the construction of the following:

- Access route; and
- TSF.

The impacts that the construction and operation of the proposed new TSF3 project may have on the vertebrate fauna and flora recorded throughout the general area were based on a comprehensive literature review and rapid field assessment.

Possible impacts and their sources that this development is likely to have on the biodiversity and ecology (vertebrate fauna and flora) are provided for the construction phase (Table 10), operational phase (Table 11) and decommissioning phase (Table 12).

Table 10. Impacts expected to occur during the Construction Phase.

Impact - Description	Impact - Source	Affected Area
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Destruction of vertebrate fauna, especially protected spp.	Access route & TSF development	Project area
Destruction of vegetation, especially protected tree/shrub spp.	Access route & TSF development	Project area
Destruction of sensitive habitats	Access route & TSF development	Project area
Soil erosion issues	Mechanised clearing activities	Project area
Introduction & spread of invasive alien plant spp.	Habitat change	Project area

Table 11. Impacts expected to occur during the Operational Phase.

Impact - Description	Impact - Source	Affected Area
Destruction of vertebrate fauna, especially protected spp.	Vehicle movement	Project area
Soil erosion issues	Vehicle movement & groundwater leaching	Project area
Introduction & spread of invasive alien plant spp.	Vehicle movement & groundwater leaching	Project area

Table 12. Impacts expected to occur during the Decommissioning Phase.

Impact - Description	Impact - Source	Affected Area
Destruction of vertebrate fauna, especially protected spp.	Vehicle movement	Project area
Soil erosion issues	Vehicle movement & groundwater leaching	Project area

Introduction & spread of
invasive alien plant spp.Vehicle movement &
groundwater leaching

Project area

5.6 Impacts: Construction, Operational and Decommissioning Phases

The following impact tables describe the impacts that are expected to occur during the Construction, Operational and Decommissioning Phases:

CONSTRUCTION PHASE:

1. Destruction of vertebrate fauna, especially protected species

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without Mitigations	Site (1)	Permanent (5)	Very high (10)	Definate (5)	High (80)	Definate
With Mitigations	Site (1)	Long term (4)	Moderate (6)	High (4)	Medium (44)	High

Description of Impact: The establishment of the TSF3 would result in site specific protected species, being eradicated and/or dispersed (See Tables 1-5). Vertebrate fauna (e.g. especially sedentary, slow moving and ground nesting species; various cavity dwellers such as bats, gallago, hornbills, parrots, various reptiles, etc.; various avifauna using vegetation in affected area for perching/roosting/breeding, etc.) associated with the area, especially the old/large tree specimens, would be killed and/or displaced.

Mitigation Measures:

- Remove important slow moving species such as tortoise, chameleon, etc. prior to construction activities as well as when serendipitously encountered;
- Minimise activity in rocky areas/hills;
- Incorporate hills as part of the TSF3 bund walls;
- Maintain and enforce track discipline;
- Avoid all areas not directly targeted for the TSF3 development; and
- Use existing access route(s).

2. Destruction of vegetation, especially protected tree/shrub species

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without Mitigations	Site (1)	Permanent (5)	Very high (10)	Definate (5)	High (80)	Definate
With Mitigations	Site (1)	Long term (4)	Moderate (6)	High (4)	Medium (44)	High

Description of Impact: The establishment of the TSF3 would result in site specific protected species, being eradicated (See Table 6). Vertebrate fauna (e.g. cavity dwellers such as bats, gallago, hornbills, parrots, various reptiles, etc. including various raptors e.g. eagles, vultures using such trees as perching/roosting/breeding) associated with these trees, especially the old/large specimens, would be killed and/or displaced.

Mitigation Measures:

- Remove unique species which are easy to transplant and relocate such as *Moringa ovalifolia* prior to construction activities;
- Minimise activity in rocky areas/hills;
- Incorporate hills as part of the TSF3 bund walls;
- Cover rock bund walls with soil to facilitate vegetation regrowth (grasses will establish naturally);
- Re-seed bund walls with seeds from sacrificed protected tree species – i.e. collect seeds from *Acacia erioloba*, *Moringa ovalifolia*, *Sterculia africana*, etc. and re-seed after covered with soil;
- Maintain and enforce track discipline;

- Avoid all areas not directly targeted for the TSF3 development; and
- Use existing access route(s).

3. Destruction of sensitive habitats

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without Mitigations	Site (1)	Permanent (5)	Very high (10)	Definite (5)	High (80)	Definite
With Mitigations	Site (1)	Long term (4)	Moderate (6)	High (4)	Medium (44)	High

Description of Impact: The establishment of the TSF3 would result in site specific sensitive habitats being destroyed and/or detrimentally affected (See Section 3.9). Vertebrate fauna and flora associated with these sensitive habitats would be killed and/or displaced.

Mitigation Measures:

- Limit the development to actual TSF3 site and avoid affecting adjacent areas, especially mountainous areas and ephemeral drainage lines, throughout the entire area;
- Minimise activity in rocky areas/hills;
- Incorporate hills as part of the TSF3 bund walls;
- Maintain and enforce track discipline; and
- Use existing access route(s).

4. Soil erosion issues

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without Mitigations	Site (1)	Long term (4)	High (8)	High (4)	Medium (52)	High
With Mitigations	Site (1)	Short term (2)	Low (4)	Low (2)	Low (14)	High

Description of Impact: The establishment of the TSF3 would result in site specific erosion issues.

Mitigation Measures:

- Avoid clear felling of vegetation in areas viewed as erosion prone – i.e. steep slopes (rocky/hill areas);
- Reroute or limit the size of or avoid access route(s) in areas viewed as erosion prone – i.e. steep slopes (rocky/hill areas);
- Where new tracks have to be made off the main routes, the routes should be selected causing minimal damage to the environment – e.g. use the same tracks; cross drainage lines at right angles; avoid placing tracks within drainage lines; avoid collateral damage (i.e. select routes that do not require the unnecessary removal of trees/shrubs, especially protected species);
- Cover rock bund walls with soil to facilitate vegetation regrowth (grasses will establish naturally) – minimise runoff;
- Rehabilitate all new tracks created; and
- Implement erosion control measures where applicable – e.g. cross drains on slopes, etc.

5. Invasion and spread of invasive alien plant species

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without Mitigations	Site (1)	Long term (4)	Moderate (6)	High (4)	Medium (44)	High
With Mitigations	No (0)	Immediate (1)	Minor (2)	Low (2)	Low (6)	High

Description of Impact: Soil disturbances by mechanical methods, would favour invasive alien plant species becoming established. Invasive alien plant species, already present in the area (See Section 3.7), would flourish in the disturbed areas and could also inadvertently

be transported into the area as seed on the various vehicles accessing the TSF3 site and access route.

Mitigation Measures:

- Limit land clearing activities to the actual TSF3 site so as to prevent random soil disturbances favouring invasive alien plant species;
- Remove and destroy all invasive alien plants encountered in the project area (e.g. *Nicotiana glauca*); and
- Ensure that vehicles accessing the route are free of vegetation, especially if contractors are used which also use their vehicles in urban areas.

OPERATIONAL PHASE:

6. Destruction of vertebrate fauna, especially protected spp.

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without Mitigations	Site (1)	Long term (4)	High (8)	High (4)	Medium (52)	High
With Mitigations	Site (1)	Short term (2)	Minor (2)	High (4)	Low (20)	High

Description of Impact: Vehicle movement along the various access routes would result in the continued destruction of vertebrate fauna (i.e. especially slow moving species).

Mitigation Measures:

- Capture, remove and relocate all vertebrate fauna that may enter the TSF3 site and remove to similar habitat in the general area;
- Maintain and enforce track discipline;
- Place speed humps along access routes to minimise wildlife mortalities.

7. Soil erosion issues

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without Mitigations	Site (1)	Long term (4)	Moderate (6)	High (4)	Medium (44)	High
With Mitigations	Site (1)	Short term (2)	Minor (2)	Low (2)	Low (10)	High

Description of Impact: Vehicle movement along the various access routes would result in continued erosion issues if not continuously maintained. Bund wall leakages could result in erosion issues.

Mitigation Measures:

- Implement and maintain erosion control measures where applicable along the access route – i.e. use the same tracks; cross drainage lines at right angles;
- Rehabilitate eroded areas annually – i.e. after the rainy season (during winter months);
- Maintain track discipline – i.e. no offroad driving; speed control; use the same track, etc.; and
- Monitor bund wall for any leakages and rehabilitate immediately.

8. Introduction & spread of invasive alien plant spp.

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without Mitigations	Site (1)	Long term (4)	Moderate (6)	High (4)	Medium (44)	High
With Mitigations	Site (1)	Short term (2)	Minor (2)	Low (2)	Low (10)	High

Description of Impact: Invasive alien plant species would become established on disturbed areas and could also inadvertently continuously be transported into the area as seed on the

various vehicles accessing the mining site. Seepages through the bund wall would further encourage invasive alien plant establishment and growth.

Mitigation Measures:

- Remove and destroy all invasive alien plants encountered throughout the TSF3 area; and
- Ensure that vehicles accessing the project area are free of vegetation, especially if contractors are used which also use their vehicles in urban areas.

DECOMMISSIONING PHASE:

9. Destruction of vertebrate fauna, especially protected spp.

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without Mitigations	Site (1)	Medium term (3)	Low (4)	High (4)	Medium (32)	High
With Mitigations	None (0)	Short term (2)	Minor (2)	High (4)	Low (16)	High

Description of Impact: Typical mine closure operations, including some vehicle movement along the various access routes, would result in some destruction of vertebrate fauna (i.e. especially slow moving species).

Mitigation Measures:

- Avoid nocturnal vehicle movement; and
- Maintain and enforce track discipline.

10. Soil erosion issues

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without Mitigations	Site (1)	Short term (2)	Low (4)	High (4)	Low (28)	High
With Mitigations	None (0)	Immediate (1)	Minor (2)	Low (2)	Low (6)	High

Description of Impact: Typical mine closure operations, including some vehicle movement along the various access routes, would result in some erosion issues if not continuously maintained. Bund wall leakages could result in erosion issues.

Mitigation Measures:

- Rehabilitate eroded areas annually – i.e. after the rainy season (during winter months);
- Maintain track discipline – i.e. no offroad driving; speed control; use the same track, etc.; and
- Monitor bund wall for any leakages and rehabilitate immediately.

11. Introduction & spread of invasive alien plant spp.

	Scale	Duration	Magnitude	Probability of occurrence	Significance	Confidence
Without Mitigations	Site (1)	Short term (2)	Low (4)	High (4)	Low (28)	High
With Mitigations	None (0)	Immediate (1)	Minor (2)	Low (2)	Low (6)	High

Description of Impact: Invasive alien plant species would become established on disturbed areas and could also inadvertently continuously be transported into the area as seed on the various vehicles accessing the site.

Mitigation Measures:

- Remove and destroy all invasive alien plants encountered throughout the mine project area; and

- Ensure that vehicles accessing the project area are free of vegetation, especially if contractors are used which also use their vehicles in urban areas.

6 Conclusion

As all development have potential negative environmental consequences, identifying the most important faunal species including high risk habitats beforehand, coupled with environmentally acceptable mitigating factors, lessens the overall impact of such development.

Vertebrate fauna species most likely to be adversely affected by the proposed TSF3 development would be site specific sedentary species (i.e. species with limited mobility) such as unique reptiles (i.e. tortoises *Stigmochelys pardalis* and *Psammobates oculiferus*; pythons – *P. anchietae* and *P. natalensis*; Namibian wolf snake (*Lycophidion namibianum*) – *Varanus albigularis*; some of the endemic and little known gecko species – e.g. *Pachydactylus* species and species viewed as “rare” – i.e. *Rhinotyphlops lalandei*, *Mehelya vernayi* and *Afroedura africana* – although very little is known about these species). Amphibians are not viewed as important in the area and mammals are more mobile and although important species are known to occur and/or pass through the area (see elsewhere in this report) none are expected to be specifically associated and/or expected to be negatively affected by the developments. Although general disturbances could affect bird species of concern – i.e. species classified as endangered (violet wood-hoopoe, Ludwig’s bustard, white-backed vulture, black harrier, tawny eagle, booted eagle, martial eagle, black stork), vulnerable (lappet-faced vulture, secretarybird) and near threatened (Rüppel’s parrot, kori bustard, Verreaux’s eagle, peregrine falcon, marabou stork) – birds are also mobile and not limited to the area.

Flora species most likely to be adversely affected by the TSF3 development would be the various site specific protected species – See Tables 6 and 9; Section 3.9 – although these species are not exclusively associated with the development site.

Important areas in the general vicinity are viewed as rocky areas/hills – See Section 3.9 and Figure 26.

As the proposed TSF3 site is small and does not have any unique habitats and/or associated vertebrate fauna and flora, it is not expected that the proposed TSF3 developments will adversely affect any unique vertebrate fauna and flora in the Navachab Gold Mine area, especially if the proposed recommendations (mitigation measures) are incorporated – See Sections 3.8, 3.9, 4 and 5.

7 References

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