

**Cleanergy Green Hydrogen
Demonstration Plant (GHP) Walvis Bay,
Namibia: Environmental Impact
Assessment:**

Biodiversity Specialist Study

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[Updated 25/6/2025 for ECC]

Executive Summary

A comprehensive literature review was conducted on the vertebrate fauna (amphibians, avifauna, mammals and reptiles) and flora (larger trees/shrubs and grasses) known or expected to occur in the general Walvis Bay area (especially species associated with the gravel plains east of the dune belt) – i.e., species associated with the general GHDP area. This was followed by a rapid site visit to determine potentially affected habitats and conduct a flora survey in the proposed affected area. This was supplemented by work previously conducted by the author for various EIA's conducted throughout the general area including viewing Google Earth map images. An update including changes to the Farm 58 site layout was conducted during June 2025.

The central coastal region, and the Swakopmund/Walvis Bay area in particular, is regarded as “relatively low” in overall (all terrestrial species) diversity while the overall terrestrial endemism in the area on the other hand is moderate to high.

It is estimated that at least 54 reptile, 7 amphibian, 43 mammal, 185 bird species (breeding residents), 39 species of larger trees and shrubs and up to 48 grasses are known to or expected to occur in the general/immediate Walvis Bay area of which a high proportion are endemics (e.g., reptiles with 53.7%).

The GHDP area does not have any major unique habitats; is not in a pristine condition and is heavily impacted by various anthropomorphic activities. However, the gravel plains east of the mobile dune belt are classified as a ‘biodiversity yellow flag’ area due to:

- areas with high levels of endemism and diversity;
- conservation status of species;
- the extent to which habitats are threatened or vulnerable to disturbance; and
- habitats or migration routes which are critical for species’ survival.

The following findings are pertinent:

Construction Phase:

- Loss of vertebrate fauna habitat;
- Disrupt brown hyena movement patterns;
- Pipeline trench act as pitfall trap; and
- Loss of flora habitat.

Operational Phase:

- Aboveground pipeline a barrier to ungulates and ostrich;
- Aboveground transmission line result in avifauna mortalities; and
- Solar plant potentially disrupts avifauna.

There are no fatal flaws (impacts that cannot be mitigated that would imply that a portion of the project or the entire project is non-viable) regarding the GHDP. Furthermore, a net loss of biodiversity is not expected should recommendations and mitigations be followed, and there are no critical thresholds or limits that are expected to be reached as a result of the project and associated activities.

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Acronyms and Abbreviations

AC	Alternating Current
DC	Direct Current
EAP	Environmental Assessment Practitioner
ECC	Environmental Compliance Certificate
EIA	Environmental Impact Assessment
EMA	Environmental Management Act (Act No. 7 of 2007)
EMP	Environmental Management Programme
FCEV	Fuel Cell Electric Vehicles
GHDP	Green Hydrogen Demonstration Plant
kV	kilovolt
KVA	kilovolt-ampere
MEGC	Multiple Elements Gas Container
MW	Megawatt
O&L	Ohlthaver & List
PV	Photovoltaic
PEM	Polymer Electrolyte Membrane
ROC	Results Operation Centre
Spp.	Species
SRK	SRK Consulting (South Africa) (Pty) Ltd
t/a	Trading As
ToR	Terms of Reference
uPVC	Unplasticised Polyvinyl Chloride

Glossary

Baseline	Information gathered at the beginning of a study which describes the environment prior to development of a project and against which predicted changes (impacts) are measured.
Construction Phase	The stage of project development comprising site preparation as well as all construction activities associated with the development.
Cumulative Impacts	Direct and indirect impacts that act together with current or future potential impacts of other activities or proposed activities in the area/region that affect the same resources and/or receptors.
Environment	The external circumstances, conditions and objects that affect the existence of an individual, organism or group. These circumstances include biophysical, social, economic, historical and cultural aspects.
Environmental Compliance Certificate (ECC)	Permission granted by the competent authority for the applicant to undertake listed activities in terms of the Environmental Management Act (Act No. 7 of 2007) (EMA) and the associated Regulations (GN. R 28 of 2012).
Environmental Impact Assessment	A process of evaluating the environmental and socio-economic consequences of a proposed course of action or project.
Environmental Impact Assessment Report	The report produced to relay the information gathered and assessments undertaken during the Environmental Impact Assessment.
Environmental Management Programme	A description of the means (the environmental specification) to achieve environmental objectives and targets during all stages of a specific proposed activity.
Impact	A change to the existing environment, either adverse or beneficial, that is directly or indirectly due to the development of the project and its associated activities.
Mitigation measures	Design or management measures that are intended to minimise or enhance an impact, depending on the desired effect. These measures are ideally incorporated into a design at an early stage.
Operational Phase	The stage of the works following the Construction Phase, during which the development will function or be used as anticipated in the Environmental Authorisation.
Scoping	A procedure to consult with stakeholders to determine issues and concerns and for determining the extent of and approach to an Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP) (one of the phases in an EIA and EMP). This process results in the development of a scope of work for the EIA, EMP and specialist studies.
Specialist study	A study into a particular aspect of the environment, undertaken by an expert in that discipline.
Stakeholders	All parties affected by and/or able to influence a project, often those in a position of authority and/or representing others.

1 Introduction

1.1 Background

Cleanergy Solutions Namibia (Pty) Ltd (hereafter referred to as Cleanergy), a Joint Venture between CMB.TECH (<https://cmb.tech/>) and Ohlthaver & List (O&L) Group (<https://www.ol.na/>) is proposing to construct a 4-5-Megawatt (MW) Green Hydrogen Demonstration Plant (GHDP) in Walvis Bay, Namibia. The GHDP will be used to gain experience within Namibia and to train local employees with the conversion of renewable energy into green molecules like hydrogen and ammonia. This demonstration project will produce hydrogen for local heavy-duty equipment like trucks, locomotives, tugboat, port/mining equipment and gensets.

The proposed green hydrogen demonstration plant will be located on Farm 58, Walvis Bay in the new industrial zone near the Walvis Bay International Airport and Dune 7 (inland to the Dune), to the East of the new Walvis Bay-Swakopmund highway (D1984) (Figure 1-1). The total size of the plant will be approximately 24 ha.

Main components will include:

- 5 MW solar Photovoltaic (PV) (10 to 20 ha);
- 4 MW electrolyser;
- Compressors to densify the hydrogen gas for storage;
- Buffer tanks and storage tanks (300 bar/500 bar);
- Hydrogen fuelling station; and
- Information centre/building.

The project will also include the development of a site access road and a water connection from NamWater.

SRK Consulting (Pty) Ltd has been appointed by O&L Group as an Independent Environmental Assessment Practitioner (EAP), to compile an application for an Environmental Compliance Certificate (ECC) and to conduct an Environmental Impact Assessment (EIA) process together with the associated stakeholder engagement in terms of the Environmental Management Act (Act No. 7 of 2007) (EMA) and the associated Regulations (GN. R 28 of 2012) for the proposed GHDP. The stakeholder engagement process will be undertaken in terms of Regulation/Part 21 of EMA.

Development and operation of the proposed Cleanergy GHDP is subject to the application and granting of an ECC in terms of Regulation/Part 6 of the EMA by the Ministry of Environment, Forestry and Tourism (MEFT).

Peter Cunningham (t/a Environment & Wildlife Consulting, Namibia) was appointed to undertake a [Biodiversity – i.e., Vertebrate fauna & flora] specialist study of the project to inform the EIA process.

This report was updated during June 2025 including an altered Farm 58 site layout for Environmental Compliance Consultancy (ECC) who took over the project from SRK. Updates include the following:

- The construction of an ammonia plant (4 mtpd);
- 5 MW electrolyser (alkaline);
- Extension of the solar park from 5 MWp to 35 MWp (+ 30 MWp); and

- Battery extension from 5.9 MWh to 80 MWh (+ 63MWh) (Figure 1-2).

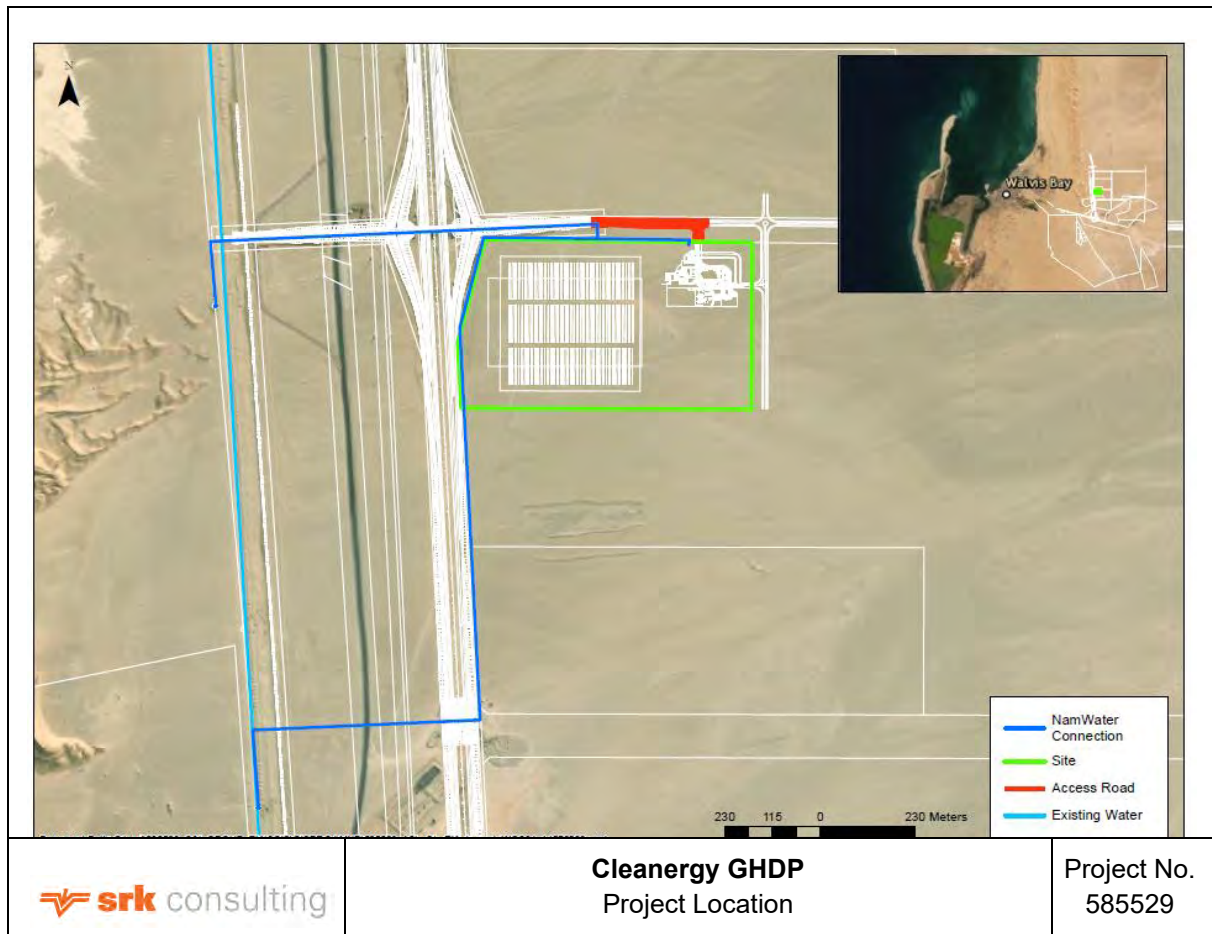


Figure 1-1: Location of the Cleanenergy GHDP within Walvis Bay, Namibia

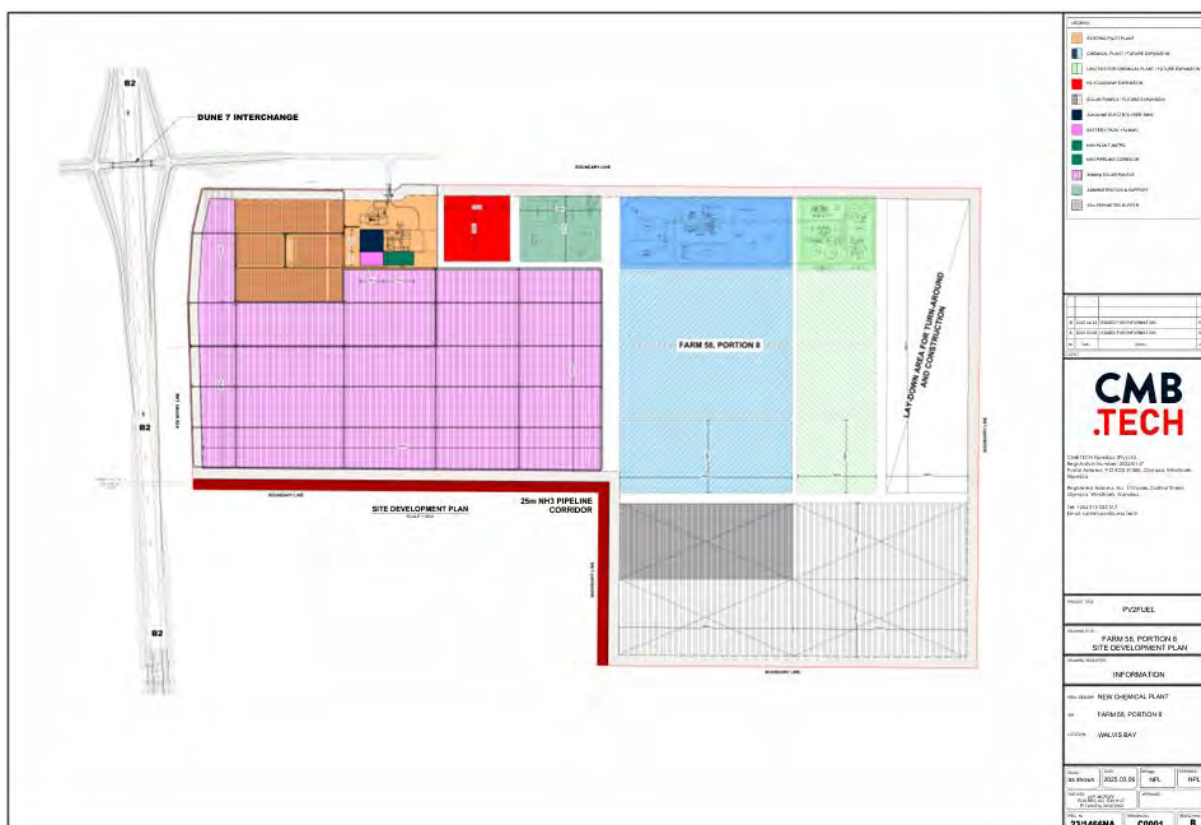


Figure 1-2: Updated site layout of the Cleanergy GHDP at Farm 58

1.2 Terms of Reference for Specialist Studies

According to the ToR the following is expected:

1. Assess the bio-physical (vertebrate fauna & flora) issues relevant to the above-mentioned area according to the available literature. Vertebrate fauna would include amphibians, reptiles, mammals (small & large) and birds (The avifauna section would also include power line sensitive birds). Flora would include grass, trees & shrubs.
2. Assess the significance of development and environmental impact that the proposed green hydrogen facility and associated infrastructure may have on the vertebrate fauna and flora at the proposed development sites including general comments.
3. Identify important species (vertebrate fauna & flora) of conservation value – i.e., endemic, rare, threatened and endangered species, etc.

1.3 Content of Report

The content of this specialist report and where the requirements are addressed, are summarised in Table 1-1.

Table 1-1: Content of specialist report as per EIA Regulations, 2014

Item	Report Section:
Details of the specialist who prepared the report;	1.1, App A
Expertise of that specialist to compile a specialist report including a curriculum vitae;	App A

Item	Report Section:
A declaration that the specialist is independent in a form as may be specified by the competent authority;	App B
An indication of the scope of, and the purpose for which, the report was prepared;	1.2
An indication of the quality and age of base data used for the specialist report;	2.2.2, 1.4
A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	5
The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	2.2.2
A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	2.2
Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	6
An identification of any areas to be avoided, including buffers;	6, 7
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	
A description of any assumptions made and any uncertainties or gaps in knowledge;	1.4
A description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	6
Any mitigation measures for inclusion in the EMPr;	6
Any conditions for inclusion in the environmental authorisation;	6
Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	6
A reasoned opinion whether the proposed activity, activities or portions thereof should be authorised;	7.2
A reasoned opinion regarding the acceptability of the proposed activity or activities;	7.2
If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	6
A description of any consultation process that was undertaken during the course of preparing the specialist report;	2.2.2
A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	See EIA Report
Any other information requested by the competent authority.	n/a
Where the government notice <i>gazetted</i> by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	2.1.3

1.4 Assumptions and Limitations

The study is based on a number of assumptions and is subject to certain limitations, which should be borne in mind when considering information presented in this report. The validity of the findings of the study is not expected to be affected by these assumptions and limitations:

It is assumed that:

- all the relevant documents/maps have been supplied;
- all the proposed development activities have been indicated;
- all the areas to be developed have been indicated; and
- no additional developments planned consequently to this study being undertaken.
- Vertebrate fauna studies were limited to a comprehensive literature study with no fieldwork – e.g., small mammal trapping, etc. – conducted to determine actual species composition present at each site. This could mean that species – especially rodents and bats – may be

present in the proposed development area that is not included in the literature review. However, this is unlikely with rather more species indicated as potentially occurring in the general area due to the greater extent of the literature study conducted; and

- Flora studies were limited to a rapid assessment of the flora potentially affected in the proposed development area. Flora is best assessed over a full season (often more than one season), especially in marginal areas with vegetation – especially annuals and other cryptic species – directly stimulated by localized rainfall. However, the rapid survey confirmed (although not limited to) annual and perennial species present.
- Lichen species were not identified to species level due to the complexities involved regarding identification and not within the scope of this project.
- A habitat survey focused on actual habitat(s) in the proposed development area.
- No quantification for vertebrate fauna and flora is available nor possible to determine within the scope of this project.

Other assumptions made in the report are explicitly stated in the relevant sections.

2 Approach

2.1 Guidelines

2.1.1 Literature review – vertebrate fauna

2.1.2 Rapid site assessment – flora and habitats

2.1.3 Protocols Applicable to the Study

This specialist report addresses the vertebrate fauna (amphibians, birds, mammals and reptiles) known and/or expected to occur in the general area Walvis Bay – inland – area (including the proposed GHDP development area) as conducted during an extensive literature review. This literature review includes numerous studies conducted by the author during various other EIA's in the general area.

The literature review was followed by a rapid site assessment to determine the flora and habitats on site potentially affected by the GHDP developments.

2.2 Methodology

This section provides an outline of the approach and methodology used in the study.

2.2.1 Literature Review

A comprehensive literature review on the existing as well as “recent” relevant publications pertinent to the topic was conducted between 1 and 5 August 2022 prior to the site visit. This review included vertebrate fauna (amphibians, avifauna, mammals and reptiles) and flora (larger trees/shrubs and grasses) known or expected to occur in the general Walvis Bay area (especially species associated with the gravel plains east of the dune belt) – i.e., species associated with the general GHDP area. The focus was on unique species – i.e., rare, threatened and endangered (R,T&E), protected and endemic species, etc. – as determined by the International and Namibian legal status for such species.

2.2.2 Fieldwork

A rapid site visit was conducted on 13-14 August 2022 to the proposed affected area – i.e., GHDP area, to familiarise myself with the local environment as well as conduct a rapid flora and habitat survey in the proposed affected area. This was supplemented by work previously conducted by the author for various EIA's conducted throughout the general area including viewing Google Earth map images.

Vertebrate fauna

The vertebrate fauna known and/or expected to occur along the above area GHDP area was limited to a literature study only.

Flora

A rapid vegetation and habitat survey was conducted at the proposed affected area – i.e., GHDP area. This was supplemented by work previously conducted by the author throughout the

general area. Furthermore, site assessments were supplemented by a literature study of species (e.g., larger trees/shrubs [>1m in height] and grasses) potentially occurring throughout the general area.

Trees, Shrubs & Grasses

Trees, shrubs and grasses were identified to species level and dominant species recorded with the focus on the protected species. Invasive alien species were also recorded when observed.

Other species

All other important species were identified whenever encountered (e.g., aloe, ferns, lichen, lithop, etc.).

Habitats

A general overview of important habitats (e.g., granite outcrops; salt pans; ephemeral drainage lines, etc. – with high and/or unique biodiversity) potentially affected was conducted at the GHDP area and adjacent areas.

2.3 Impact Assessment

Potential impacts of the proposed project were identified based on the baseline data, project description, review of other studies for similar projects and professional experience.

The significance of the impacts was assessed using the prescribed SRK impact rating methodology (see Section 6.1).

Practical mitigation and optimisation measures that can be implemented effectively to reduce or enhance the significance of impacts were identified. The impact significance was re-rated assuming the effective implementation of mitigation measures.

These impacts were updated with a change in the site layout at Farm 58 – See Figure 1-2.

3 Project Description

3.1 Solar Plant

The 5 MW Solar Plant will be situated on land (24 ha) on the Walvis Bay outskirts in the New Industrial Park. A 5 MW Photovoltaic solar power plant will be constructed and will produce clean electricity used to power the Hydrogen Production Demonstration Plant for 25 years.

Solar modules will be mounted on a single axis tracking system to allow the sun to be tracked in real time by adjusting the PV array positions automatically by using motors with General Positioning Algorithm.

High-level technical details available:

- Solar Plant output: 5 MW Alternating Current(AC);
- Land size: 24 hectares;
- Type of solar panels: Top Tier Manufacturer (Canadian Solar/Talesun/Jinko Solar);
- Type of inverters: Top Tier Manufacturer (SMA/Huawei/Schneider);
- Tracking system: Single axis – East to West tracking:
 - The voltage will be stepped up by a transformer from production range (400 V) to 11 kV or higher to transmit to the GHDP;
- Activities associated with the 5 MW solar PV power plant construction and operation includes:
 - The creating or upgrade of the access road to the construction area (New Industrial Park);
 - Construction site clearing and ground preparation;
 - Site fencing;
 - Mounting structures (tracking system) foundations and mounting of mechanical structures;
 - Installation of electrical subcomponents (inverters, transformers, motors, and control systems);
 - Direct Current (DC) wiring on the modules side, AC cabling and terminations;
 - Installation of overhead cables to the GHDP and feed-in points;
 - Testing and commissioning; and
 - Electricity generation and operation and maintenance of the solar equipment during its lifetime.

3.2 Hydrogen Production Demonstration Plant

Power from the 5 MW Solar Plant will be fed to a single or two electrolyzers to split water. Approximately 14 m³ of fresh water will be used daily to produce up to 600 kg of hydrogen daily. Water will either be supplied by NamWater (with drinking water quality) (preferred option) or will be trucked in.

Oxygen from the water will be emitted into the air. Compressors will condense the hydrogen for storage. The produced hydrogen will be used to first fill the Multiple Elements Gas Container (MEGC) trailers. A low-pressure hydrogen buffer at 30 bar will be fed (situated between the entrance of the compressor and electrolyser) to overcome start/stop sequence delays.

From the electrolyser and small buffer, the tube trailers/MEGC and hydrogen refuelling station for heavy duty mobility will be fed through high pressure buffers as cascading banks at 500 bar. Part of the hydrogen will additionally be used to fuel heavy duty mobility at 350 bars with a dual dispenser. A hydrogen filling station will be installed at the project site at 350 bars with a dual dispenser.

The produced hydrogen can be used to refill trucks on site or can be delivered to commercial partners in cylinders.

Main elements for the initial phase include:

- Sales:
 - Production capacity: 240-tonhydrogen/year based on average production; and
 - Customer categories: mobility and externals, 240 tons/year. Via MEGCs/tube trailers (500 bar) for several applications and by hydrogen refuelling station for heavy duty mobility.
- On site hydrogen generation Polymer Electrolyte Membrane (PEM) electrolyser system(s) (two electrolyser systems with combined capacity of 4-5 MW (70-90 kg/h) (based on a 5.5 MW solar park):
 - Two power containers, with transformer, rectifiers, harmonic filters etc.;
 - Two process containers with air compressor, water purification, cell stacks and gas treatment; and
 - Individual standalone control system with connection to an overall control system.
- On site hydrogen generation Alkaline (electrolyser system, 100-300 KW/2-6 kg/h):
 - Power and process container with:
 - Power: transformer, rectifier, and harmonic filter; and
 - Process equipment: air compressor, water purification, cell stacks, and gas treatment.
- Individual standalone control system with connection to an overall control system;
- Low pressure hydrogen buffer storage (30 bar) between electrolyser and compressors (located inside containers or within prefabricated noise hood) to overcome delays due to the start stop sequence of equipment
- Hydrogen compressors:
 - Three (3) times 50% Compressor for filling medium pressure buffer elements that feed 500 bar MEGC/trailers and HRS heavy duty mobility; and
 - Individual standalone control system with connection to an overall control system.
- Medium pressure hydrogen buffer storage (300 bar) with capacity of approximately 2 days of average production (Hydrogen buffer storage to overcome lack of production of electrolyser due to power shortage (caused by night-time or disadvantageous weather conditions));
- High pressure hydrogen buffer storage ≥ 550 design pressure for 350 bar fuelling and trailer filling (overflow) (Hydrogen buffer storage to optimize MEGC/trailer filling, HRS heavy duty fuelling and compressor control, 3 banks design for cascading);
- Filling of MEGCs and/or tube trailer:
 - Filling connection panel for each bay, two filling bays in total; and
 - One control panel and software for operator interface.
- Heavy Duty Mobility Refuelling
 - Dual Dispenser for refuelling heavy duty mobility vehicles at 350 bar.
- Seven hundred (700) bar Fuel Cell Electric Vehicles (FCEV) refuelling (Standalone compressor and single dispenser for refuelling FCEV vehicles at 700 bar)
- Infrastructure and interconnection piping and cabling:
 - Civil works (such as foundations) according to the system requirements;
 - Infrastructure works according to the site requirements, such as fencing, lighting, paving, buildings;
 - Interconnecting piping between major equipment;
 - Power distribution cabinet to distribute the main power supply to different major equipment;
 - Site power- and signal cables; and

- Additional site equipment to ensure safe operation according to the (local regulations), such as lightning protection and F&G detection.
- Supervisory control system:
 - Control system for supervisory controls various individual package control systems;
 - Load balancing function for electrolyzers and compressor(s);
 - Processing (non-package) field instruments for controls and visualization;
 - Trailer loading system (and analytics interface).
- Grid electricity will be used to support:
- The operation of the hydrogen compressors (2x ~110 kW);
- To maintain electrolyser on a stand-by mode (~250 kW); and
- Power supply for the facilities including site lighting (Power requirement is expected to be between 550 and 600 kVA at 11 kV).

Water that will be used for cooling is unavailable at the project location. Equipment will thus be installed with a closed loop cooling system suited for ambient conditions.

The site will be partly manned and unmanned. Operators and/or truck drivers will be able to connect and disconnect their own trailers safely. Surveillance and support will be provided via a Results Operation Centre (ROC).

Cleanergy will investigate the possibility of injecting excess electricity generated during daytime by the PV into the grid and trading it for electricity during night-time. Cleanergy will also explore the possibility of using off-peak grid power to produce hydrogen during the night (5 MW electrolysis along with power for the balance-of-plant).

Construction still required is an 11 kilovolt (kV) grid connection (500 kilovolt-ampere (kVA) and a road turnoff to access the site. The grid connection from Erongo Regional Electricity Company (Pty) Ltd does not form part of the current scope.

As mentioned previously, the project will also include the development of a site access road and a water connection from NamWater.

Illustrations of the site and project layout plans are provided in Figure 3-2 and Figure 3-2, respectively.

3.3 Services

A new access road will be developed from the D1984 road. The main portion of the access/service road will fall under the responsibility of the Walvis Bay Municipality, however, responsibility for the site access road will be that of Cleanergy (Figure 1-1).

A 1 km – 2 km water connection will be established from one of the Walvis Bay municipality water connection points indicated on Figure 1-1. An Unplasticised Polyvinyl Chloride (uPVC) pipeline of Class 9 will be installed between the proposed project site and one of the water connection points. The pipeline will be constructed in line with the municipality's specifications and then handed over when completed. A domestic water meter will be installed at the site access point. A 390 m³ water tank with booster pumps will be installed to cater for both domestic and fire water needs and supply the site via ring mains underground. Fire hydrants will be placed to cover the entire site with no point further than 90 m from the hydrants. A daily water demand of 14 m³ is anticipated for processing and domestic use.

A conventional gravity system will convey wastewater to a low point where it will be collected in conservancy tanks. A 30-person occupancy will be supported by 34 m³ tanks that will be emptied once a week by the local authority.

A standalone Environmental Authorisation process will be undertaken for the establishment of a 600 kVA electricity connection from Erongo Red to the project area.



Figure 3-1: Site Layout Plan

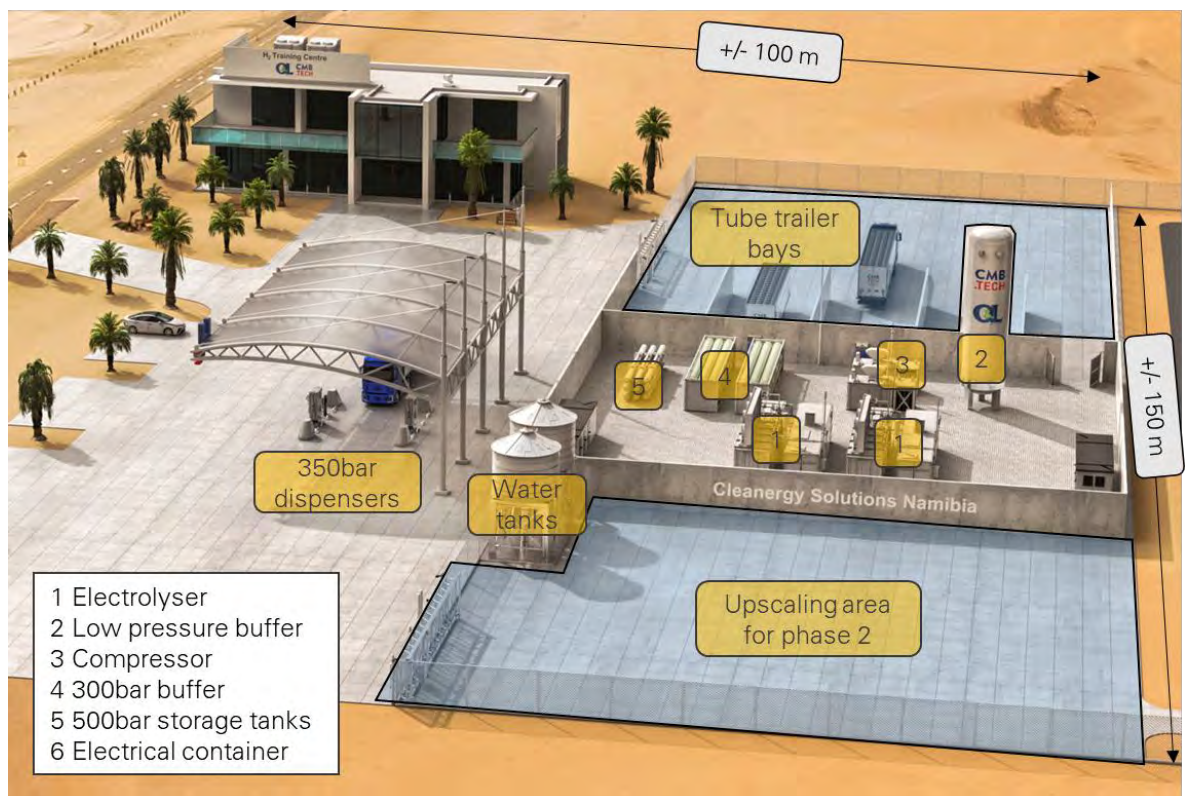


Figure 3-2: Project Layout Plan

This report was updated during June 2025 including an altered Farm 58 site layout. Updates include the following:

- The construction of an ammonia plant (4 mtpd);

- 5 MW electrolyser (alkaline);
- Extension of the solar park from 5 MWp to 35 MWp (+ 30 MWp); and
- Battery extension from 5.9 MWh to 80 MWh (+ 63MWh) (Figure 1-2).

4 Applicable Legislation and Policy

Various Namibian laws are applicable to the proposed green hydrogen project:

4.1 Soil Conservation Act 76 of 1969 (as amended in SA to March 1978)

The purpose of this Act is “to consolidate and amend the law relating to the combating and prevention of soil erosion, the conservation, improvement and manner of use of the soil and vegetation and the protection of the water sources in the Republic and the territory of South-West Africa; and to provide for matters incidental thereto.”

4.2 Environmental Assessment Policy for Sustainable Development and Environmental Conservation (1995)

The purpose of the Policy is seen as: informing decision makers and promoting accountability; ensuring that options and alternatives and environmental costs and benefits are considered; striving for a high degree of public participation and involvement of all sectors; incorporating internationally accepted norms and standards; taking into account secondary and cumulative environmental impacts; promoting the user pays principle; and promoting sustainable development. The Policy requires that all listed policies, programmes and projects, whether initiated by Government or the private sector, be subject to an Environmental Impact Assessment (EIA). Policies, programmes and projects requiring an Environmental Assessment (EA), amongst others, include: structure plans (e.g., land-use plans and policies); rezoning applications; establishment of settlements; power generation facilities with an output of 1 megawatt or more; electrical substations and transmission lines having equipment with an operating voltage in excess of 30 000 volts rms phase-to-phase; afforestation projects; major roads; major pipelines; major canals, aqueducts, river diversions and water transfers; permanent flood control schemes; small scale (formal) water supply schemes; deforestation projects; effluent plants; multinational projects; waste disposal sites; alternate energy programmes; and commercial tourism and recreation facilities (see Appendix B of the Policy).

4.3 Nature Conservation Ordinance (No. 4 of 1975) – Nature Conservation Amendment Act (5 of 1996)

The Nature Conservation Amendment Act 5 of 1996 amends the Nature Conservation Ordinance, 1975, “so as to provide for an economically based system of sustainable management and utilization of game in communal areas; to delete references to representative authorities; and to provide for matters incidental hereto.” Section 73. 1) provides: “No person other than the lawful holder of a permit granted by the local authority shall at any time pick (“pick”, as defined in Section 1 (xxxviii), includes to cut off, chop off, pick off, take, gather, uproot, damage or destroy) or transport any protected plant: Provided that – (a) the owner a nursery licensed under section 75 may without such permit pick and transport any protected plant cultivated on the premises of such nursery and cause such protected plant to be picked and transported; (b) the owner or lessee of land may on that land without such permit pick the flower of a protected plant for use as a decoration in his home; (c) the owner or lessee of land may without such permit pick a protected plant on that portion of such land – (i) which he needs for cultivated lands, the erection of a building, the construction of a road or airfield or any other development which necessitates the removal of vegetation; or (ii) on which such protected plant

has been specially cultivated" (Nature Conservation Ordinance 4 of 1975, Chapter VI INDIGENOUS PLANTS, Picking and transport of protected plants).

4.4 Forest Act (No. 12 of 2001)

The Act "provide for the establishment of a Forestry Council and the appointment of certain officials; to consolidate the laws relating to the management and use of forests and forest produce; to provide for the protection of the environment and the control and management of forest fires; to repeal the Preservation of Bees and Honey Proclamation, 1923 (Proclamation No.1 of 1923), Preservation of Trees and Forests Ordinance, 1952 (Ordinance No. 37 of 1952) and the Forest Act, 1968 (Act No. 72 of 1968); and to deal with incidental matters." Section 22. (1) provides: "Unless otherwise authorised by this Act, or by a licence issued under subsection (3), no person shall on any land which is not part of a surveyed erven of a local authority area as defined in section 1 of the Local Authorities Act, 1992 (Act No. 23 of 1992) cut, destroy or remove - (a) vegetation which is on a sand dune or drifting sand or on a gully unless the cutting, destruction or removal is done for the purpose of stabilising the sand or gully; or (b) any living tree, bush or shrub growing within 100 metres of a river, stream or watercourse."

4.5 Environmental Management Act (No. 7 of 2007)

The Environmental Management Act (EMA) gives legislative effect to the Environmental Assessment Policy. The purpose of EMA is to "promote the sustainable management of the environment and the use of natural resources by establishing principles for decision making on matters affecting the environment; to establish the Sustainable Development Advisory Council; to provide for the appointment of the Environmental Commissioner and environmental officers; to provide for a process of assessment and control of activities which may have significant effects on the environment; and to provide for incidental matters." Even though EMA has been promulgated, but not yet implemented, the twelve principles of environmental management (Part II, Section 3 of the Act) should be applied to all projects that may impact on the environment: i) use renewable resources on a sustainable basis for the benefit of present and future generations; ii) involve the community in natural resources management and promote and facilitate the sharing of benefits from the use of resources; iii) promote public participation in decisions affecting the environment and ensure that their interests, needs and values are taken into account; iv) promote equitable access to all environmental resources and consider the functional integrity of ecological systems so that the sustainability of systems is ensured and that harmful effects are prevented; v) undertake environmental assessments for all projects that may adversely impact on the environment, or the use of natural resources; vi) promote sustainable development in all aspects relating to the environment; vii) protect and respect Namibia's cultural and natural heritage, including its biological diversity, for the benefit of present and future generations; viii) reduce the generation of waste and polluting substances at source by adopting the option that provides the most benefit or causes the least environmental damage, at costs acceptable by society, in the short and long term; ix) promote the reduction, re-use and recycling of waste; x) adopt the "polluter pays principle"; xi) in cases where there is sufficient evidence to conclude that there are threats of serious or irreversible damage to the environment, the lack of full scientific certainty may not be used as an excuse for postponing cost-effective measures to prevent environmental degradation; and xii) prevent damage to the environment; if this is not possible, reduce, limit, or control activities that may cause damage (to the environment).

4.6 Namibia's Second National Biodiversity Strategy and Action Plan (2013-2022)

Namibia's NBSAP2 covers the period 2013-2022, and its vision is for "Namibia's biodiversity to be healthy and resilient to threats, and for the conservation and sustainable use of biodiversity to be key drivers of poverty alleviation and equitable economic growth, particularly in rural areas." The Strategic Goals and Targets of NBSAP2 are:

- i. Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society;
- ii. Reduce direct pressures on biodiversity and promote the sustainable use of biological resources;
- iii. Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity;
- iv. Enhance the benefits to all from biodiversity and ecosystem services; and
- v. Enhance implementation of NBSAP2 through participatory planning, knowledge management and capacity building.

Various international legally binding agreements are applicable to the proposed GHDP:

4.7 Convention on Biological Diversity

The Convention on Biological Diversity (CBD) was signed by 150 government leaders at the 1992 Rio Earth Summit and entered into force in December 1993. There are currently 188 Parties to the Agreement. The three objectives of the Convention are: the conservation of biodiversity, the sustainable use of biological resources and the fair and equitable sharing of benefits arising from the use of genetic resources. The principles of the CBD are broad in scope and unlike CITES, the CBD does not contain detailed provisions on implementation. Accordingly, implementation of the CBD depends on the incorporation of the Convention and associated policies and guidelines into the national legislation of Member States. The CBD was signed by Namibia on 12 June 1992 in Rio de Janeiro and ratified it on 18 March 1997. Accordingly Namibia is obliged to ensure that its domestic legislation conforms to the objectives and obligations of the CBD. Namibia gives effect to the CBD inter alia by implementing the National Biodiversity Strategy and Action Plan and has issued its sixth national report under the CBD for the period 2014-2018. Also of relevance is the Nagoya Protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their utilization to the convention on biological diversity which Namibia has acceded to.

4.8 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973)

The aim of CITES is to protect certain endangered species from over-exploitation by means of a system of import-export permits. The CITES Convention includes animals and plants whether dead or alive, and any recognizable parts or derivatives thereof. Appendix I to the Convention covers endangered species, trade in which is to be tightly controlled; Appendix II covers species that may become endangered unless trade is regulated; Appendix III covers species that any party wishes to regulate and requires international cooperation to control trade; and Appendix IV contains model permits. Permits are required for species listed in Appendices I and II stating that export / import will not be detrimental to the survival of the species. The CITES Secretariat is administered by UNEP and is located at Geneva, Switzerland. Namibia joined in 1990 through accession which came into force in 1991. MET is the agency responsible for the implementation of CITES.

4.9 The African Convention on the Conservation of Nature and Natural Resources (revised) 2003

Participating and signatory states undertake to adopt the measures necessary to ensure conservation, utilisation and development of soil, water, floral and faunal resources in accordance with scientific principles and with due regard to the best interests of the people (Article II); to take effective measures to conserve and improve the soil and to control erosion and land use (Article IV); and to establish policies to conserve, utilise and develop water resources, prevent pollution and control water use (Article V). Furthermore, the Convention imposes on states the obligation to protect flora and ensure its best utilisation, the management of forests and control of burning, land clearance and overgrazing (Article VI); and to conserve faunal resources and use them wisely, manage populations and habitats, control hunting, capture and fishing, and prohibit the use of poisons, explosives and automatic weapons in hunting (Article VII). States are required to tightly control traffic in trophies, to prevent trade in illegally killed and obtained trophies and to establish and maintain conservation areas (Article X). A list of protected species which enjoy full total protection, and a list of species, which may be taken only with authorisation is part of the Convention. Namibia signed the agreement in 2003.

4.10 SADC Protocol on Wildlife Conservation and Law Enforcement, 1999

This Protocol aims to establish within the framework of the respective national laws of each State Party, common approaches to the conservation and sustainable use of wildlife resources and to assist with the effective enforcement of laws governing those resources. Each State Party has to ensure the conservation and sustainable use of wildlife resources under its jurisdiction, and that activities within its jurisdiction or control do not cause damage to the wildlife resources of other states or in areas beyond the limits of national jurisdiction. In line with Article 4 of the Protocol, appropriate policy, administrative and legal measures have to be taken to ensure the conservation and sustainable use of wildlife and to enforce national legislation pertaining to wildlife effectively. Namibia signed the agreement in 1999.

4.11 United Nations Sustainable Development Goals (SDGs) 2015

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognise that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests. Of specific relevance to ecology is SDG 15: Life on Land which aims to “Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss”.

5 Baseline

5.1 Introduction

A desktop study (i.e., literature review) was conducted between 1 and 5 August 2022 on the vertebrate fauna (e.g., reptiles, amphibians, mammals, birds) and flora (trees and shrubs >1m in height and grass) expected to occur in the general Walvis Bay area in central western Namibia. The proposed development is located to the east of Walvis Bay behind the dune field in the general area known as Dune 7. This literature review was to determine the actual as well as potential vertebrate fauna and flora associated with the general area and was followed by a rapid site assessment conducted on 13-14 August 2022 to identify flora and habitats potentially affected by the proposed green hydrogen developments. The impact assessments were updated during June 2025 due to an altered Farm 58 site layout.

5.2 Natural Environment

5.2.1 Climate

Although temperatures vary throughout the year, the average annual temperature for the general area is 16-18°C with the average maximum and minimum temperatures varying between 22-24°C and 10-12°C, respectively. Frost is uncommon in this area. The relative humidity between the least and most humid months varies between 50-60% and >90%, respectively with the average annual rainfall being between <50mm. Variation in annual rainfall is however quite high with >100%. Groundwater is viewed as good with a productive porous aquifer along the Kuiseb River while the rest of the area has little or no groundwater (Mendelsohn *et al.* 2002).

5.2.2 Soils

The dominant soils are described as petric gypsisols – i.e., soils with a solid layer at a shallow depth that remains hard even when wet with an accumulation of calcium sulphate restricted to the very dry areas of the Namib. These soils are typically low in fertility with only the hardiest plants able to survive in them (Mendelsohn *et al.* 2002).

5.2.3 Geology

The dominant geology in the general area is associated with the Kalahari and Namib Sands (Kalahari Group) – i.e., relatively young at 0-70 million years. Mineral deposits in the area include uranium (Mendelsohn *et al.* 2002).

5.2.4 Habitat

The general area is commonly – albeit broadly – referred to as the Southern Namib (Giess 1971) or Southern Desert (Mendelsohn *et al.* 2002) and the vegetation structure is classified as grassland and dwarf shrubland (Mendelsohn *et al.* 2002) (Figure 5-1).

5.2.5 Vegetation

According to Maggs (1998) there are approximately 4,344 higher plant species with the most species being within the grasses (422), composites (Asteraceae) (385), legumes (Fabaceae) (377) and figies (Mesembryanthemaceae) (177), recorded from Namibia. Total species richness depends on further collecting and taxonomic revisions. High species richness is found in the Okavango, Otavi/Karsveld, Kaokoveld, southern Namib and Central Highland (Windhoek

Mountains) areas. Endemic species – approximately 687 species in total – are mainly associated with the Kaokoveld (northwestern) and the succulent Karoo (southwestern) Namibia. The major threats to the floral diversity in Namibia are:

- 1). Conversion of the land to agriculture (with associated problems); and
- 2). poorly considered development (Maggs 1998, Mendelsohn *et al.* 2002).

According to Giess (1971) the Southern Namib stretches from the Swakop River southwards until Lüderitz. *Stipagrostis sabulicola* (tough dune grass) occurs with *Trianthema hereroeensis* on the dunes while the inter-dune flats (streets) are covered with *Stipagrostis gonatostachys* after rains. The eastern inland sections – pro-Namib – are dominated by *Stipagrostis obtusa* and *S. ciliata* after rains while the plains closer towards the coast are dominated by *Mesembryanthemum cryptanthum* (Giess 1971).

An interesting feature of the coastal areas is the extensive formation of gypsum crusts in the soil as a result of sulphur releases during upwelling events in the ocean in the past. These substrates support the most diverse lichen fields in the world (Burke 2003). Namibia has some of the rarest and most interesting species of lichens in the world although many have still not been officially described (Craven and Marais 1986).

Burke (2003) estimates that over 400 species – 10% of the flora of Namibia – occur in the central Namib and although it has not been identified as a centre of endemism, it is dominated by endemics such as *Arthraerua leubnitziae*. The greatest variants affecting the diversity of plants are habitat and climate with the highest plant diversity generally associated with high rainfall areas.

The average plant production is extremely low (bare ground) with much variation (e.g., 0-5%) in green vegetation biomass (Mendelsohn *et al.* 2002). The overall plant diversity (all species - “higher” plants) in the general area is also low with <50 species (Mendelsohn *et al.* 2002). Plant endemism is viewed as low with 2-15 species expected from the general area (Mendelsohn *et al.* 2002). Simmons (1998b) puts the plant endemism at between 1 and 20 species depending on the locality.

Furthermore, Mendelsohn *et al.* (2002) views the grazing and browse as virtually nonexistent in the general area (although browse is good along the ephemeral Kuisieb River) with the risk of farming viewed as high and the tourism potential of this area viewed as average.

5.2.6 General

Climatically the coastal area is referred to as Cool Desert with a high occurrence of fog (van der Merwe 1983). The Namib Desert Biome makes up a large proportion (32%) of the land area of Namibia with parks in this biome making up 69% of the protected area network or 29.7% of the biome (Barnard 1998). This has increased since the establishment of the Dorob National Park. Four of 14 desert vegetation types are adequately protected with up to 94% representation in the protected area network in Namibia (Barnard 1998). The area is bordered by the Kuisieb River to the south (Walvis Bay area) and the Swakop River to the north (Swakopmund area) with catchment areas of 15,500 km² and 30,100 km², respectively with common riparian species including Ana tree, Tamarix, Camelthorn, Salvadora, Fig, Euclea, !Nara and Mesquite (Jacobson *et al.* 1995).

Two important coastal wetlands – i.e., Walvis Bay Wetlands and Sandwich Harbour – both Ramsar sites, occur in the area. According to Curtis and Barnard (1998) the entire coast and

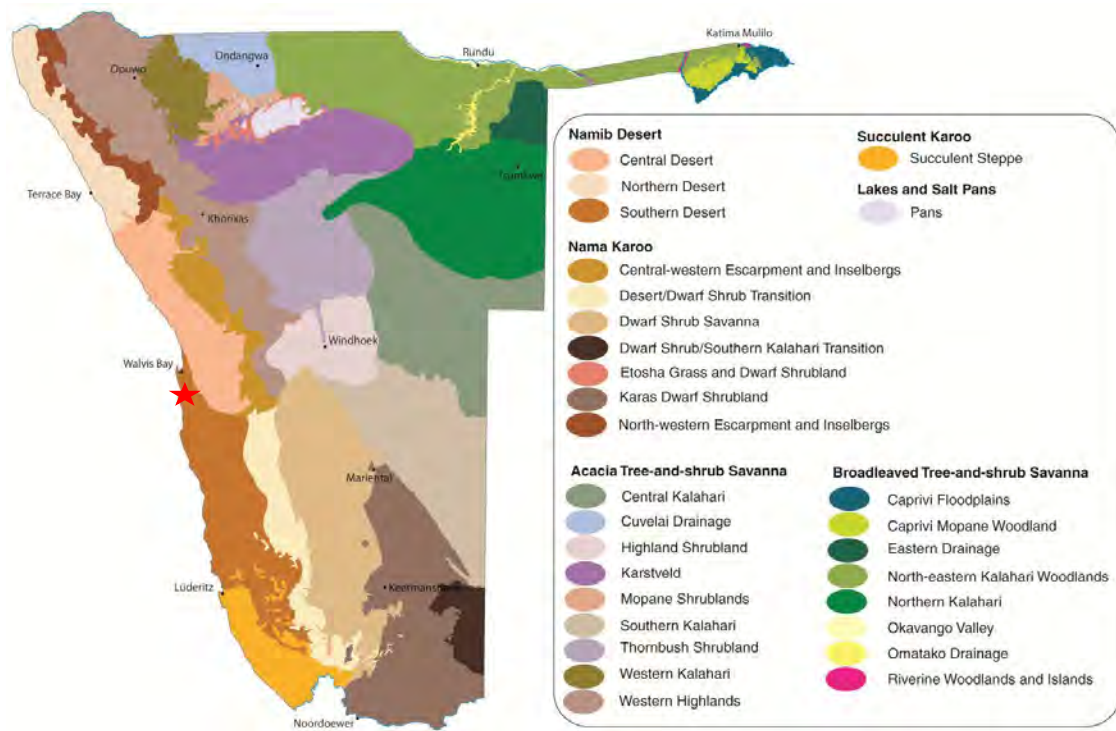
the Walvis Bay lagoon as a coastal wetland, are viewed as sites with special ecological importance in Namibia. The known distinctive values along the coastline are its biotic richness (arachnids, birds and lichens) with the Walvis Bay lagoon's importance being its biotic richness and migrant shorebirds as well as being the most important Ramsar site in Namibia. The Ramsar site covers 12,600 ha with regular counts of birds varying between 37,000 and well over 100,000 individuals, albeit mainly migratory species (Kolberg n.d.). The Walvis Bay wetland is considered the most important coastal wetland in southern Africa and one of the top 3 in Africa (Shaw *et al.* 2004). The Sandwich Harbour Ramsar site covers 16,500ha and falls within the Namib-Naukluft Park and enjoys full protection (Kolberg n.d.). This area is a centre of concentration of migratory shorebirds, waders and flamingos regularly supporting over 142,000 and 50,000 birds during summer and winter, respectively (Kolberg n.d.).

The gravel plains east of the dune belt are viewed as a biodiversity “Yellow Flag Area” due to lichens and biodiversity associated with the Tumas drainage area – i.e., Tumas ‘mouth’ (reedbed and ephemeral spring on eastern edge of dunes) – hummocks and ephemeral wetland (SAIEA 2010). Other important areas in the general vicinity include the biodiversity “Red Flag Areas” such as the coast immediately north of Walvis Bay (important bird area; high density of waders along beach and Damara tern breeding area); Kuiseb River (Linear oasis, riparian woodland, aquifer recharge, rich wildlife.) and Swakop River (Linear oasis, riparian woodland, aquifer recharge, rich wildlife, bird light paths) (SAIEA 2010).

The proposed development area falls adjacent the recently proclaimed Dorob National Park. No communal and freehold conservancies are located in the general area with the closest communal conservancy being the #Gaingu Conservancy in the Spitzkoppe area approximately 100 km to the northeast (Mendelsohn *et al.* 2002, MEFT/NACSO 2021).

The central coastal region, and the Swakopmund/Walvis Bay area in particular, is regarded as “relatively low” in overall (all terrestrial species) diversity while the overall terrestrial endemism in the area on the other hand is moderate to high (Mendelsohn *et al.* 2002).

It is estimated that at least 54 reptile, 7 amphibian, 43 mammal, 185 bird species (breeding residents), 39 species of larger trees and shrubs and up to 48 grasses are known to or expected to occur in the general/immediate Walvis Bay area of which a high proportion are endemics (e.g., reptiles with 53.7%).



Error! Reference source not found.: Biomes and vegetation types in Namibia with the Green Hydrogen Demonstration Plant (GHDP) area shown as red star (Source: Mendelsohn *et al.* 2002).

5.3 Description of Affected Environment

5.3.1 Vertebrate Fauna

5.3.1.1 Reptile Diversity

Reptile diversity known and/or expected to occur in the general project area (GHDP) – literature study only – is presented in Table 5-1.

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 area is estimated at between 41-50 species and 21-24 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.

At least 54 species of reptiles are expected to occur in the general area with 29 species being endemic – i.e., 53.7% endemic. Two species expected to occur in the area (*Stigmochelys pardalis* and *Varanus albigularis*) are classified as vulnerable and protected game although both, especially *S. pardalis*, probably only occasionally frequents the Kuiseb River area as a

vagrant and not expected to occur permanently in the area due to the overall arid conditions. *Pelomedusa subrufa* is only expected to occur in drainage lines in the area (e.g., Khan, Kuiseb, Swakop and Tumas Rivers and their tributaries) with suitable habitat – i.e., long-lasting water holes. *Lycophidion capense* and *Lycophidion namibianum* only marginally occur in the Namib-Naukluft Park (Griffin 1998a) and potentially could occur in the general area. Two important species not included in Table 5-1 due to both being sand/dune dwelling species, although potentially could occur in the area dependent on suitable habitat (both species do occur in the dune belt to the west of the GHDP, *pers. obs.*), are *Bitis peringueyi* (Péringuey's Adder) and *Pachydactylus rangei* (Web-footed gecko).

Afroedura africana africana is classified as insufficiently known and rare (Griffin 2003) and probably the reptile of most concern in the general area. Another important species from the general area is *Pedioplanis husabensis* which although secure (Griffin 2003) is associated with the Husab Mountains and surrounding area only (Cunningham *et al.* 2012). Nine species have an international conservation status (i.e., IUCN; SARDB and CITES) with *Varanus albigularis* the species of most concern and classified as vulnerable, peripheral and protected game under Namibian legislation and listed as safe to vulnerable by the SARDB (2004). Except for a few species all are classified as least concern although some reptiles have not yet been assessed for the IUCN Red List (IUCN 2025).

The 54 species expected to occur in the general area consist of at least 18 snakes (2 thread snakes, 1 quill snouted and 15 typical snakes) of which 8 species (44.4%) are endemic, 1 tortoises, 1 terrapin, 14 lizards of which 6 species classified as endemic (42.9% endemic), 1 plated lizards, 1 monitor, 1 agama, 1 chameleon and 15 geckos of which 13 species classified as endemic (i.e., 86.7% endemic).

Gecko's (15 species with 13 species being endemic) and snakes (18 species with 8 species being endemic) are the most important groups of reptiles expected from the general area followed by lizards (14 species with 6 species being endemic). Namibia with approximately 129 species of lizards (Lacertilia) has one of the continents richest lizard fauna (Griffin 1998a). Geckos expected and/or known to occur in the general area have the highest occurrence of endemics (86.7%) of all the reptiles in this area. Griffin (1998a) confirms the importance of the gecko fauna in Namibia.

The endemic *Afroedura africana africana* (African flat gecko) and *Pedioplanis husabensis* (Husab sand lizard) are viewed as the most important reptiles potentially occurring in the general area. *Pedioplanis husabensis* is very habitat specific and mainly occurs on "white/grey" geology in the Khan River area south of Arandis (Cunningham *et al.* 2012). *Leptotyphlops occidentalis* (western thread snake) and *Lycophidion namibianum* (Namibian wolf snake) are the snakes viewed as the most important in the area.

The most important species is the endemic *Pedioplanis husabensis* (Husab Sand Lizard) which is a restricted range species (100% of the taxon's range within Namibia) occurring in the general area of the confluence of the Swakop and Khan Rivers. It is furthermore viewed as "threatened" by the 'uranium rush' (SAIEA 2010) with its total known range currently estimated at <5,000km² (Wassenaar *et al.* 2010) which would put it in the "endangered" category according to the IUCN Red List Categories and Criteria (IUCN 2025). Cunningham *et al.* (2012) showed that *P. husabensis* is an extreme habitat specialist, selecting not only marble substrates, but specifically marble surrounded by other bare rock types. However, none of these habitats are known and/or expected in the proposed GHDP area.

Error! Reference source not found.: Reptile diversity known and/or expected to occur in the general GHDP project area – literature study.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
TURTLES AND TERRAPINS					
<i>Stigmochelys pardalis</i>	Leopard Tortoise	Vulnerable; Peripheral; Protected Game		LC	C2
<i>Pelomedusa galeata (subrufa)</i>	Marsh/Helmeted Terrapin	Secure		LC	C3
SNAKES					
Thread Snakes					
<i>Namibiana (Leptotyphlops) occidentalis</i>	Western Thread Snake	Endemic; Secure	P	LC	
<i>Namibiana (Leptotyphlops) labialis</i>	Damara Thread Snake	Endemic; Secure		LC	
Quill Snouted Snakes					
<i>Xenocalamus bicolor bicolor</i>	Bicoloured Quill-snouted Snake	Secure			
Typical Snakes					
<i>Boaedon (Lamprophis) fuliginosus</i>	Brown House Snake	Secure		LC	
<i>Lycophidion capense</i>	Cape Wolf Snake	Secure		LC	
<i>Lycophidion namibianum</i>	Namibian Wolf Snake	Endemic; Secure		LC	
<i>Pseudaspis cana</i>	Mole Snake	Secure		LC	

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
<i>Pythonodipsas carinata</i>	Western Keeled Snake	Endemic; Secure		LC	
<i>Dipsina multimaculata</i>	Dwarf Beaked Snake	Endemic; Secure		LC	
<i>Psammophis trigrammus</i>	Western Sand Snake	Endemic; Secure		LC	
<i>Psammophis notostictus</i>	Karoo Sand Snake	Secure		LC	
<i>Psammophis leightoni namibensis</i>	Namib Sand Snake	Secure		LC	
<i>Dasypeltis scabra</i>	Common/Rhombic Egg Eater	Secure		LC	
<i>Aspidelaps lubricus infuscatus</i>	Coral Snake	Secure		LC	
<i>Aspidelaps scutatus</i>	Shield-nose Snake	Endemic; Secure		LC	
<i>Naya nigricincta</i>	Black-necked Spitting Cobra	Endemic; Secure	R		
<i>Bitis arietans</i>	Puff Adder	Secure		LC	
<i>Bitis caudalis</i>	Horned Adder	Secure		LC	
LIZARDS					
Skinks					
<i>Typhlacontias brevipes</i>	FitzSimon's Burrowing Skink	Endemic; Secure		LC	
<i>Trachylepis acutilabris</i>	Wedge-snouted Skink	Secure		LC	
<i>Trachylepis occidentalis</i>	Western Three-striped Skink	Secure		LC	
<i>Trachylepis striata wahlbergi</i>	Striped Skink	Secure		LC	

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
<i>Trachylepis sulcata</i>	Western Rock Skink	Secure		LC	
<i>Trachylepis variegata variegata</i>	Variegated Skink	Secure		LC	
Old World Lizards					
<i>Heliobolus lugubris</i>	Bushveld Lizard	Secure		LC	
<i>Meroles anchietae</i>	Shovel-snouted Lizard	Secure		LC	
<i>Meroles reticulatus</i>	Reticulated Desert Lizard	Endemic; Secure		LC	
<i>Meroles suborbitalis</i>	Spotted Desert Lizard	Endemic; Secure		LC	
<i>Pedioplanis breviceps</i>	Short-headed Sand Lizard	Endemic; Secure		LC	
<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard	Secure		LC	
<i>Pedioplanis inornata</i>	Plain Sand Lizard	Endemic; Secure		LC	
<i>Pedioplanis husabensis</i>	Husab Sand Lizard	Endemic; Secure		LC	
Plated Lizards					
<i>Cordylus subtaeniatus</i>	Dwarf Plated Lizard	Endemic; Secure		LC	
Monitors					
<i>Varanus albigularis</i>	Rock or White-throated Monitor	Vulnerable; Peripheral; Protected Game	S to V	LC	C2
Agama					
<i>Agama planiceps</i>	Namibian Rock Agama	Endemic; Secure		LC	

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
Chameleons					
<i>Chamaeleo namaquensis</i>	Namaqua Chameleon	Secure		LC	C2
Geckos					
<i>Afroedura africana africana</i>	African Flat Gecko	Endemic; Insufficiently known; Rare?		LC	
<i>Chondrodactylus angulifer namibensis</i>	Giant Ground Gecko	Endemic; Secure		LC	
<i>Narudasia festiva</i>	Festive Gecko	Endemic; Secure		LC	
<i>Pachydactylus bicolor</i>	Velvety Thick-toed Gecko	Endemic; Secure		LC	
<i>Pachydactylus kochii</i>	Kock's Thick-toed Gecko	Endemic; Secure		LC	
<i>Pachydactylus turneri</i>	Turner's Thick-toed Gecko	Secure		LC	
<i>Pachydactylus punctatus</i>	Speckled Thick-toed Gecko	Secure		LC	
<i>Pachydactylus rugosus rugosus</i>	Rough Thick-toed Gecko	Endemic; Secure		LC	
<i>Pachydactylus weberi weneri</i>	Weber's Thick-toed Gecko	Endemic; Secure		LC	
<i>Ptenopus carpi</i>	Carp's Barking Gecko	Endemic; Secure		LC	
<i>Ptenopus garrulus maculatus</i>	Common Barking Gecko	Endemic; Secure		LC	
<i>Ptenopus kochi</i>	Koch's Barking Gecko	Endemic; Secure		LC	
<i>Phelsuma (Rhoptropus) afer</i>	Common Namib Day Gecko	Endemic; Secure			
<i>Phelsuma (Rhoptropus) boultoni</i>	Boulton's Namib Day Gecko	Endemic; Secure			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
<i>Phelsuma (Rhoptropus) bradfieldi</i>	Bradfield's Namib Day Gecko	Endemic; Secure			

Namibian conservation and legal status according to the Nature Conservation Ordinance No 4 of 1975 (Griffin 2003)

Endemic – includes Southern African Status (Branch 1998)

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

IUCN (2025): 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), Griffin (2003), Hebbard (n.d.), IUCN (2025), Marais (1992), SARDB (2004), Schleicher (2020), Tolley and Burger (2007)

Species such as *Chamaeleo namaquensis*, various *Phelsuma* (*Rhoptropus*) and *Meroles* spp. are probably the only ones inhabiting the proposed GHDP area.

As reptiles are generally understudied animals and occur at low densities in such marginal habitat, many more species are expected to occur in the general GHDP area than included in Table 5-1. However, no reptiles are exclusively associated with the GHDP area.

Other areas:

As reptiles are viewed as an important group in the desert areas of Namibia the following unpublished reports are included from the general area:

Other reptile related work in the general area includes Henschel *et al.* (2000) from Gobabeb, Griffin (2005) from Valencia, Cunningham (2006) from Trekkopje, Cunningham (2007) from Valencia, Cunningham (2010) from INCA and TRS, Cunningham (2011) from Khan River, Henschel *et al.* (2011) from Marenica, Cunningham (2013) from Ongolo and Tumas, Kavari (2007) from Rössing Uranium Mine, Cunningham (2019) from the Kuiseb River Delta area and Cunningham (2020) from Tumas area. Their findings are presented in the following tables:

According to Henschel *et al.* (2000) at least 20 species of lizards (12 geckos, 5 lizards and 3 skinks) have been recorded on the gravel plains at Gobabeb (Desert Research site approximately 70km southeast of the general GHDP area) (Table 5-2).

Table 5-2: Reptiles recorded on the gravel plains at Gobabeb.

Family and Scientific name	Common name
Gekkonidae	
<i>Chondrodactylus angulifer</i>	Giant Ground Gecko
<i>Pachydactylus kockii</i>	Koch's Thick-toed Gecko
<i>Pachydactylus turneri</i>	Turner's Thick-toed Gecko
<i>Pachydactylus scherzi</i>	Schertz's Thick-toed Gecko
<i>Pachydactylus rugosus</i>	Rough Thick-toed Gecko
<i>Pachydactylus rangei</i>	Palmato gecko
<i>Ptenopus carpi</i>	Banded Barking Gecko
<i>Ptenopus garrulus</i>	Common Barking Gecko
<i>Rhoptropus afer</i>	Common Namib Day Gecko
<i>Rhoptropus barnardi</i>	Lesser Namib Day Gecko
<i>Rhoptropus bradfieldi</i>	Bradfield's Namib Day Gecko
<i>Narudasia festiva</i>	Festive Gecko

Family and Scientific name	Common name
Lacertidae	
<i>Meroles suborbitalis</i>	Spotted Desert Lizard
<i>Pedioplanis breviceps</i>	Short-headed Sand Lizard
<i>Pedioplanis lineocellata</i>	Ocellated Sand Lizard
<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard
<i>Pedioplanis undata</i>	Western Sand Lizard
Scincidae	
<i>Trachylepis acutilabris</i>	Wedge-snouted Skink
<i>Trachylepis occidentalis</i>	Western Three-striped Skink
<i>Trachylepis spilogaster</i>	Namibian Tree Skink

Source: Henschel *et al.* (2000)

Table 5-3 indicates the reptile diversity known, reported and/or expected to occur (77 species) in the general Valencia Uranium area (approximately 50km northeast of the general GHDP area) as presented by Griffin (2005a).

Table 5-3: Reptiles reported and/or expected to occur in the general Valencia area.

Species: Scientific name	Common name
Turtles and Tortoises and Terrapins	
<i>Geochelone pardalis</i>	Leopard tortoise
<i>Pelomedusa subrufa</i>	Marsh/Helmeted Terrapin
Snakes	
Worm Snakes	
<i>Leptotyphlops occidentalis</i>	Western Thread/Worm Snake
<i>Leptotyphlops labialis</i>	Damara Thread/Worm Snake
<i>Leptotyphlops scutifrons</i>	Peter's Thread/Worm Snake
Blind Snakes	
<i>Rhinotyphlops lalandei</i>	Delalande's Blind Snake
<i>Rhinotyphlops schinzi</i>	Beaked Blind Snake
Boas and Pythons	
<i>Python anchietae</i>	Namibian Dwarf Python

Species: Scientific name	Common name
Typical Snakes	
<i>Lamprophis fuliginosus</i>	Brown House Snake
<i>Pseudaspis cana</i>	Mole Snake
<i>Psammophylax rhombeatus</i>	Spotted Skaapsteker
<i>Dipsina multimaculata</i>	Dwarf Beaked Snake
<i>Psammophis trigrammus</i>	Western Sand Snake
<i>Psammophis notostictus</i>	Karoo Sand Snake
<i>Psammophis leightoni namibensis</i>	Namib Sand Snake
<i>Psammophis subtaeniatus</i>	Western Striped-bellied Sand Snake
<i>Psammophis leopardinus</i>	Leopard Whip Snake
<i>Dasypeltis scabra</i>	Common/Rhombic Egg Eater
<i>Philothamnus semivariatus</i>	Spotted Bush Snake
<i>Telescopus beetzii</i>	Namaqua Tiger Snake
<i>Telescopus semiannulatus</i>	Southern Tiger Snake
<i>Telescopus sp. nov.</i>	Damara Tiger Snake
<i>Pythonodipsas carinata</i>	Western keeled Snake
<i>Prosymna frontalis</i>	Shouthwestern Shovel-snout
<i>Aspidelaps lubricus infuscatus</i>	Coral Snake
<i>Aspidelaps scutatus scutatus</i>	Shield-nose Snake
<i>Naja anchietae</i>	Angolan Cobra
<i>Naja nigricollis nigricincta</i>	Black-necked Spitting Cobra
<i>Naja woodi</i>	Black Spitting Cobra
<i>Naja nivea</i>	Cape Cobra
<i>Dendroaspis polylepis</i>	Black Mamba
<i>Bitis arietans</i>	Puff Adder
<i>Bitis caudalis</i>	Horned Adder
Lizards	
Worm Lizards	
<i>Zygaspis quadrifrons</i>	Kalahari Round-headed Worm Lizard

Species: Scientific name	Common name
Skinks	
<i>Trachylepis acutilabris</i>	Wedge-snouted Skink
<i>Trachylepis occidentalis</i>	Western Three-striped Skink
<i>Trachylepis hoeschi</i>	Western Rock Skink
<i>Trachylepis spilogaster</i>	Namibian Tree Skink
<i>Trachylepis sulcata</i>	Western Rock Skink
<i>Trachylepis variegata variegata</i>	Variegated Skink
<i>Trachylepis wahlbergii</i>	Wahlberg's Striped Skink
Old World Lizards	
<i>Nucras intertexta</i>	Spotted Sandveld Lizard
<i>Heliobolus lugubris</i>	Bushveld Lizard
<i>Meroles knoxii</i>	Round-snouted Sand Lizard
<i>Meroles cuneirostris</i>	Wedge-snouted Desert Lizard
<i>Meroles suborbitalis</i>	Spotted Desert Lizard
<i>Pedioplanis breviceps</i>	Short-headed Sand Lizard
<i>Pedioplanis lineoocellata</i>	Ocellated Sand Lizard
<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard
<i>Pedioplanis gaerdesi</i>	Damara Sand Lizard
<i>Pedioplanis undata</i>	Western Sand Lizard
<i>Pedioplanis inornata</i>	Plain Sand Lizard
<i>Pedioplanis hasabensis</i>	Husab Sand Lizard
Plated Lizards	
<i>Cordylosaurus subtessellatus</i>	Dwarf Plated Lizard
<i>Gerrhosaurus nigrolineatus</i>	Black-lined Plated Lizard
<i>Gerrhosaurus validus</i>	Giant Plated Lizard
Monitors	
<i>Varanus albigularis</i>	Rock Monitor
Agamas	
<i>Agama anchietae</i>	Western Rock Agama

Species: Scientific name	Common name
<i>Agama planiceps</i>	Namibian Rock Agama
Chameleons	
<i>Chamaeleo namaquensis</i>	Namaqua Chameleon
Geckos	
<i>Afroedura africana africana</i>	African Flat Gecko
<i>Chondrodactylus angulifer namibensis</i>	Giant Ground Gecko
<i>Narudasia festiva</i>	Festive Gecko
<i>Pachydactylus bicolour</i>	Velvety Thick-toed Gecko
<i>Pachydactylus capensis</i>	Cape Thick-toed Gecko
<i>Pachydactylus fasciatus</i>	Damaraland Banded Thick-toed Gecko
<i>Pachydactylus kockii</i>	Koch's Thick-toed Gecko
<i>Pachydactylus punctatus</i>	Speckled Thick-toed Gecko
<i>Pachydactylus turneri</i>	Turner's Thick-toed Gecko
<i>Pachydactylus scherzi</i>	Schertz's Thick-toed Gecko
<i>Pachydactylus rugosus rugosus</i>	Rough Thick-toed Gecko
<i>Pachydactylus weberi</i>	Weber's Thick-toed Gecko
<i>Lygodactylus bradfieldi</i>	Namibian Dwarf Gecko
<i>Ptenopus garrulus maculatus</i>	Common Barking Gecko
<i>Rhoptropus afer</i>	Common Namib Day Gecko
<i>Rhoptropus barnardi</i>	Lesser Namib Day Gecko
<i>Rhoptropus bradfieldi</i>	Bradfield's Namib Day Gecko

Source: Griffin (2005)

A survey of the reptiles associated with the Trekkopje Uranium Mining area (approximately 110km northeast of the general GHDP area) conducted by Cunningham (2006b) indicated the presence of 22 reptiles species (8 snakes, 1 skink, 2 lizards, 2 agamas, 1 chameleon and 8 geckos) (Table 5-4).

Table 5-4: Reptiles recorded in the general Trekkopje Uranium Mining area.

Species: Scientific name	Species: Common name
Typical Snakes	
<i>Lamprophis fuliginosus</i>	Brown House Snake
<i>Lycophidion namibianum</i>	Namibian Wolf Snake
<i>Dipsina multimaculata</i>	Dwarf Beaked Snake
<i>Psammodromus leightoni namibensis</i>	Namib Sand Snake
<i>Dasypeltis scabra</i>	Common Egg Eater
<i>Aspidelaps lubricus infuscatus</i>	Coral Snake
<i>Naja nigricincta</i>	Black-necked Spitting Cobra
<i>Bitis caudalis</i>	Horned Adder
Lizards	
Skinks	
<i>Trachylepis acutilabris</i>	Wedge-snouted Skink
Old World Lizards	
<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard
<i>Pedioplanis husabensis</i>	Husab Sand Lizard
Agamas	
<i>Agama aculeata</i>	Ground Agama
<i>Agama anchietae</i>	Anchieta's Agama
Chameleons	
<i>Chamaeleo namaquensis</i>	Namaqua Chameleon
Geckos	
<i>Chondrodactylus angulifer namibensis</i>	Giant Ground Gecko
<i>Lygodactylus bradfieldi</i>	Bradfield's Dwarf Gecko
<i>Pachydactylus bicolor</i>	Velvety Thick-toed Gecko
<i>Pachydactylus serval serval</i>	Western Spotted Thick-toed Gecko
<i>Ptenopus carpi</i>	Carp's Barking Gecko
<i>Rhoptropus afer</i>	Common Namib Day Gecko
<i>Rhoptropus boultoni</i>	Boulton's Namib Day Gecko
<i>Rhoptropus bradfieldi</i>	Bradfield's Namib Day Gecko

Source: Cunningham (2006b)

A survey of the reptiles associated with the Valencia Mine (approximately 50km northeast of the general GHDP area) conducted by Cunningham (2007) indicated the presence of 14 reptile species (5 snakes, 2 skinks, 1 lizards, 1 agama, 1 chameleon and 4 geckos) (Table 5-5).

Table 5-5: Reptiles recorded in the general Valencia area.

Species: Scientific name	Species: Common name
Typical Snakes	
<i>Lamprophis fuliginosus</i>	Brown House Snake
<i>Psammophis trigrammus</i>	Western Sand Snake
<i>Psammophis leightoni namibensis</i>	Namib Sand Snake
<i>Aspidelaps lubricus infuscatus</i>	Coral Snake
<i>Bitis caudalis</i>	Horned Adder
Lizards	
Skinks	
<i>Trachylepis hoeschi</i>	Western Rock Skink
<i>Trachylepis sulcata</i>	Western Rock Skink
Old World Lizards	
<i>Pedioplanis husabensis</i>	Husab Sand Lizard
Agamas	
<i>Agama anchietae</i>	Anchieta's Agama
Chameleons	
<i>Chamaeleo namaquensis</i>	Namaqua Chameleon
Geckos	
<i>Chondrodactylus angulifer namibensis</i>	Giant Ground Gecko
<i>Pachydactylus turneri</i>	Turner's Thick-toed Gecko
<i>Ptenopus garrulus maculatus</i>	Common Barking Gecko
<i>Rhoptropus bradfieldi</i>	Bradfield's Namib Day Gecko

Source: Cunningham (2007)

A survey of the reptiles associated with the INCA and TRS sites (approximately 40km northeast of the general GHDP area) conducted by Cunningham (2010) indicated the presence of 14 reptiles species (3 snakes, 1 skink, 2 lizards, 1 chameleon and 7 geckos) (Table 5-6).

Table 5-6: Reptiles recorded in the general INCA and TRS areas.

Family and Scientific name	Common name
Typical Snakes	
<i>Psammophis leightoni namibensis</i>	Namib Sand Snake
<i>Naja nigricincta</i>	Black-necked Spitting Cobra
<i>Bitis caudalis</i>	Horned Adder
Lizards	
Skinks	
<i>Trachylepis acutilabris</i>	Wedge-snouted Skink
Old World Lizards	
<i>Meroles suborbitalis</i>	Spotted Desert Lizard
<i>Pedioplanis inornata</i>	Plain Sand Lizard
Chameleons	
<i>Chamaeleo namaquensis</i>	Namaqua Chameleon
Geckos	
<i>Chondrodactylus angulifer namibensis</i>	Giant Ground Gecko
<i>Pachydactylus bicolor</i>	Velvety Thick-toed Gecko
<i>Pachydactylus kochii</i>	Kock's Thick-toed Gecko
<i>Pachydactylus punctatus</i>	Speckled Thick-toed Gecko
<i>Ptenopus carpi</i>	Carp's Barking Gecko
<i>Ptenopus garrulus maculatus</i>	Common Barking Gecko
<i>Rhoptropus afer</i>	Common Namib Day Gecko

Source: Cunningham (2010)

A survey of the reptiles associated with the Khan River area (approximately 40km northeast of the general GHDP area) conducted by Cunningham (2011) indicated the presence of 6 reptile species (2 skinks, 1 lizard, 1 agama and 2 geckos) (Table 5-7).

Table 5-7: Reptiles recorded in the general Khan River area.

Species: Scientific name	Species: Common name
LIZARDS	
Skinks	
<i>Trachylepis variegata variegata</i>	Variegated Skink
<i>Trachylepis hoeschi</i>	Hoesch' Skink
Old World Lizards	
<i>Meroles suborbitalis</i>	Spotted Desert Lizard
Agama	
<i>Agama planiceps</i>	Namibian Rock Agama
Geckos	
<i>Rhoptropus afer</i>	Common Namib Day Gecko
<i>Rhoptropus boultoni</i>	Boulton's Namib Day Gecko

Source: Cunningham (2011)

A survey of the reptiles associated with the Marenica Mining site in the Spitzkoppe area (approximately 170km northeast of the general GHDP area) conducted by Henschel *et al.* (2011) indicated the presence of 19 reptiles species (1 snake, 5 skinks, 6 lizards, 2 agamas, 1 chameleon and 4 geckos) (Table 5-8).

Table 5-8: Reptiles recorded in the general Marenica (Spitzkoppe) area.

Family and Scientific name	Common name
Typical Snakes	
<i>Psammophis leightoni namibensis</i>	Namib Sand Snake
Lizards	
Skinks	
<i>Trachylepis acutilabris</i>	Wedge-snouted Skink
<i>Trachylepis occidentalis</i>	Western Three-striped Skink
<i>Trachylepis hoeschi</i>	Western Rock Skink

Family and Scientific name	Common name
<i>Trachylepis spilogaster</i>	Namibian Tree Skink
<i>Trachylepis variegata variegata</i>	Variegated Skink
Old World Lizards	
<i>Pedioplanis breviceps</i>	Short-headed Sand Lizard
<i>Pedioplanis inornata</i>	Plain Sand Lizard
<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard
Agamas	
<i>Agama anchietae</i>	Anchieta's Agama
<i>Agama planiceps</i>	Namibian Rock Agama
Chameleons	
<i>Chamaeleo namaquensis</i>	Namaqua Chameleon
Geckos	
<i>Chondrodactylus angulifer namibensis</i>	Giant Ground Gecko
<i>Pachydactylus bicolor</i>	Velvety Thick-toed Gecko
<i>Pachydactylus turneri</i>	Turner's Thick-toed Gecko
<i>Pachydactylus scherzi</i>	Schertz's Thick-toed Gecko
<i>Ptenopus garrulus maculatus</i>	Common Barking Gecko
<i>Rhoptropus boultoni</i>	Boulton's Namib Day Gecko
<i>Rhoptropus bradfieldi</i>	Bradfield's Namib Day Gecko

Source: Henschel *et al.* (2011)

A survey of the reptiles associated with the Ongolo and Tumas sites (approximately 60km northeast of the general GHDP area) conducted by Cunningham (2013) indicated the presence of 26 reptiles species (6 snakes, 3 skinks, 6 lizards, 1 monitor, 1 chameleon and 9 geckos) (Table 5-9).

Table 5-9: Reptiles recorded in the general Ongolo and Tumas areas.

Family and Scientific name	Common name
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Typical Snakes

<i>Dipsina multimaculata</i>	Dwarf Beaked Snake
<i>Psammophis leightoni namibensis</i>	Namib Sand Snake
<i>Aspidelaps lubricus infuscatus</i>	Coral Snake
<i>Naya nigricincta</i>	Black-necked Spitting Cobra
<i>Bitis arietans</i>	Puff Adder
<i>Bitis caudalis</i>	Horned Adder

LIZARDS

Skinks

<i>Trachylepis acutilabris</i>	Wedge-snouted Skink
<i>Trachylepis sulcata</i>	Western Rock Skink
<i>Trachylepis variegata variegata</i>	Variegated Skink

Old World Lizards

<i>Meroles reticulatus</i>	Reticulated Desert Lizard
<i>Meroles suborbitalis</i>	Spotted Desert Lizard
<i>Pedioplanis breviceps</i>	Short-headed Sand Lizard
<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard
<i>Pedioplanis inornata</i>	Plain Sand Lizard
<i>Pedioplanis husabensis</i>	Husab Sand Lizard

Monitors

<i>Varanus albigularis</i>	Rock or White-throated Monitor
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Chameleons

<i>Chamaeleo namaquensis</i>	Namaqua Chameleon
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Geckos

<i>Chondrodactylus angulifer namibensis</i>	Giant Ground Gecko
<i>Pachydactylus bicolor</i>	Velvety Thick-toed Gecko
<i>Pachydactylus kochii</i>	Kock's Thick-toed Gecko
<i>Pachydactylus turneri</i>	Turner's Thick-toed Gecko
<i>Pachydactylus punctatus</i>	Speckled Thick-toed Gecko

<i>Ptenopus carpi</i>	Carp's Barking Gecko
<i>Ptenopus garrulus maculatus</i>	Common Barking Gecko
<i>Rhoptropus afer</i>	Common Namib Day Gecko
<i>Rhoptropus boultoni</i>	Boulton's Namib Day Gecko

Source: Cunningham (2013)

A pilot study conducted by Kavari (2007) on the reptile diversity associated with the future expansion of the Rössing Uranium Mine (approximately 50km northeast of the general GHDP area) indicated the presence of 6 reptile species (3 geckos, 1 lizard, 1 chameleon and 1 snake) (Table 5-10).

Table 5-10: Reptiles recorded in the general Rössing Uranium Mine area.

Family and Scientific name	Common name
Typical snakes	
<i>Psammophis notostictus</i>	Karoo Sand Snake
Geckkonidae	
<i>Trachylepis variegata variegata</i>	Variegated Skink
<i>Trachylepis hoeschi</i>	Western Rock Skink
<i>Ptenopus garrulus</i>	Common Barking Gecko
Lacertidae	
<i>Pedioplanis hasabensis</i>	Husab Sand Lizard
Chameleons	
<i>Chamaeleo namaquensis</i>	Namaqua Chameleon

Source: Kavari (2007)

A survey of the reptiles associated with the Kuseb River Delta area (approximately 25km southwest of the general GHDP area) conducted by Cunningham (2019) indicated the presence of 5 reptiles species (2 snakes, 1 burrowing skink, 1 typical skink and 1 lizard) (Table 5-11).

Table 5-11: Reptiles recorded in the general Kuseb River Delta area.

Family and Scientific name	Common name
Typical snakes	

Family and Scientific name	Common name
<i>Bitis arietans</i>	Puff Adder
<i>Bitis caudalis</i>	Horned Adder
Skinks	
<i>Typhlacontias brevipes</i>	FitzSimmons' Burrowing Skink
<i>Trachylepis variegata variegata</i>	Variegated Skink
Lacertidae	
<i>Meroles reticulatus</i>	Reticulated Desert Lizard

Source: Cunningham (2019)

A survey of the reptiles associated with the Tumas area (approximately 50km east/northeast of the general GHDP area) conducted by Cunningham (2020) indicated the presence of 6 reptile species (1 snake, 2 skinks, 1 lizard and 2 geckos) (Table 5-12).

Table 5-12: Reptiles recorded in the general Tumas area.

Family and Scientific name	Common name
Typical snakes	
<i>Psammophis leightoni namibensis</i>	Namib Sand Snake
Skinks	
<i>Typhlacontias brevipes</i>	FitzSimmons' Burrowing Skink
<i>Trachylepis sulcata</i>	Western Rock Skink
Old World Lizards	
<i>Meroles reticulatus</i>	Reticulated Desert Lizard
Geckos	
<i>Phelsuma (Rhoptropus) afer</i>	Common Namib Day Gecko
<i>Phelsuma (Rhoptropus) bradfieldi</i>	Bradfield's Namib Day Gecko

Source: Cunningham (2020)

Access route – Impact

The impact during construction, are expected to be detrimental to reptiles associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of access route is not expected to be detrimental to reptiles – i.e., would not impede their movement, etc.

Solar PV plant – Impact

The impact during construction, are expected to be detrimental to reptiles associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of aboveground PV plant infrastructure is not expected to be detrimental to reptiles – i.e., would not impede their movement, etc.

Pipeline impact

The impact of heavy machinery during excavation of a trench to bury the proposed water pipeline is expected to be detrimental to reptiles associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

However, an open trench could act as a giant pitfall trap and should not be left open overnight and/or have regular exists along its route, especially at the two ends of the trench.

The impact of above/below ground pipeline infrastructure is not expected to be detrimental to reptiles – i.e., would not impede their movement, etc.

Transmission line – Impact

The impact of heavy machinery during construction, and especially the excavation of holes to plant pylons for a transmission line (if applicable) are expected to be detrimental to reptiles associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

However, open holes could act as pitfall traps and should not be left open overnight and/or covered.

The impact of aboveground transmission line infrastructure is not expected to be detrimental to reptiles – i.e., would not impede their movement, etc.

Farm 58 infrastructures – Impact

The impact during construction, are expected to be detrimental to reptiles associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of various infrastructures is not expected to be detrimental to reptiles – i.e., would not impede their movement, etc.

5.3.1.2 Amphibian Diversity

Amphibian diversity known and/or expected to occur in the general GHDP area (literature study only), is presented in Table 5-13.

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. Desert areas and saline soils/pans are marginal habitat for amphibians (Cunningham and Jankowitz 2010).

According to Mendelsohn *et al.* (2002), the overall frog diversity in the general area is estimated at between 1-3 species. Griffin (1998b) puts the species richness in the general area at 2 species.

At least 5 species of amphibians can occur in suitable habitat in the general area (Du Preez and Carruthers 2009). The area is under represented, with 2 toads and 1 species each for rubber, sand and platanna known and/or expected to occur in the area (i.e., potentially could be found in the area). Of these, 2 species are endemic (*Poyntonophrynus hoeschi* and *Phrynomantis annectens*) (Griffin 1998b) – i.e., high level (40%) of amphibians of conservation value from the general area. The IUCN (2025) classifies all the species as least concern.

The most important species are the 2 endemics although they are widespread throughout Namibia and not specifically associated with the GHDP area. Overall suitable habitat for amphibians in the general area is viewed as the ephemeral Khan, Kuiseb, Swakop and Tumas Rivers and their tributaries. Temporary pools after localised rainfall events could potentially serve as habitat for amphibians throughout the area while leakages from the various NamWater pipelines could also serve as a habitat, albeit artificial. None of the unique/important amphibian species are exclusively associated with the proposed GHDP area.

Error! Reference source not found.3: Amphibian diversity known and/or expected to occur in the general GHDP project area – literature study.

Species: Scientific name	Species: Common name	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	Endemic	LC
Rubber Frog			
<i>Phrynomantis annectens</i>	Marbled Rubber Frog	Endemic	LC
Sand Frogs			
<i>Tomopterna tandyi</i>	Tandy's Sand Frog		LC
Platannas			
<i>Xenopus laevis</i>	Common Platanna		LC

Endemic – Griffin (1998b)

IUCN (2025): LC – Least Concern

Source for literature review: Carruthers (2001), Channing (2001), Channing and Griffin (1993), Du Preez and Carruthers (2009), Griffin (1998b), IUCN (2025), Passmore and Carruthers (1995)

The area is extremely marginal with very little rainfall generally occurring in the area (<50mm annual average) and being highly variable (>100% coefficient of variation) and sporadic of nature (Mendelsohn *et al.* 2002). Very little surface water collects in the Tumas River and its tributaries with few other natural sources (e.g., temporary pools in granite hollows, etc.) available in this ravel plain dominated habitat. Furthermore, no amphibians were observed by Cunningham (2010, 2013, 2019, 2020) at adjacent sites nor in the Marenica area (Spitzkoppe area) (Henschel *et al.* 2011), either.

However, the general area undoubtedly has suitable, albeit temporary of nature, amphibian habitat during the rainy season (or where rainfall does occur) when pools could collect in the Tumas River and its tributaries and more especially in rocky hollows. The amphibians expected to occur in the general area are however not exclusively associated with the GHDP area with the 2 endemics that could potentially occur in the area occurring widespread throughout Namibia and not specifically associated with the proposed development sites.

Access route – Impact

The impact during construction, are expected to be detrimental to amphibians associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of access route is not expected to be detrimental to amphibians – i.e., would not impede their movement, etc.

Solar PV plant – Impact

The impact during construction, are expected to be detrimental to amphibians associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of aboveground PV plant infrastructure is not expected to be detrimental to amphibians – i.e., would not impede their movement, etc.

Pipeline impact

The impact of above/below ground pipeline infrastructure is not expected to be detrimental to amphibians – i.e., would not affect their habitat or impede their movement, etc.

Transmission line – Impact

The impact of aboveground transmission line infrastructure is not expected to be detrimental to amphibians – i.e., would not affect their habitat or impede their movement, etc.

Farm 58 infrastructures – Impact

The impact during construction, are expected to be detrimental to amphibians associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of various infrastructures is not expected to be detrimental to amphibians – i.e., would not impede their movement, etc.

5.3.1.3 Mammal Diversity

Mammal diversity known and/or expected to occur in the GHDP area (literature study only), is presented in Table 5-14.

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 low to average respectively in the central western central part of Namibia (Mendelsohn *et al.* 2002). The overall diversity (1-2 species) and abundance of large herbivorous mammals is low in the general area with oryx and springbok having the highest density 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 brown hyena having the highest density of the larger species (Mendelsohn *et al.* 2002). The overall mammal diversity in the general area is estimated at between 16-30 species with 3-4 species being endemic to the area (Mendelsohn *et al.* 2002). Griffin (1998c) puts the species richness distribution of endemics also between 3-4 species in the general area while the Namib-Naukluft Park has an estimated 80 species in total and the Skeleton Coast National Park has at least 87 species of mammals.

At least 49 species of mammals are known and/or expected to occur in the general area of which 8 species (16.3%) are classified as endemic. The Namibian legislation classifies 5 species as vulnerable, 1 species as rare, 2 species as insufficiently known, 1 species as specially protected game, 5 species as protected game, 4 species as huntable game, 3 species as problem animals, 1 species as invasive alien, 1 species as a migrant and 1 species is not listed. At least 28.6% (14 species) of the mammalian fauna that occur or are expected to occur in general area are represented by rodents of which 3 species (21.4%) are endemic. This is followed by bats with 13 species (26.5%) of which 1 species is listed as endemic and rare (7.7%) and carnivores with 11 species (22.5%) of which 1 species (9.1%) is endemic and 5 species listed as vulnerable (45.5%).

The IUCN (2025) classifies 3 species as vulnerable (*Acinonyx jubatus*, *Panthera pardus*, *Equus zebra hartmannae*) and 2 species as near threatened (*Eidolon helvum*, *Parahyaena (Hyaena) brunnea*) and the rest as least concern and/or have not yet been assessed for the Red List while 1 species is classified as endangered, 2 species as vulnerable and 7 species as near threatened and by the SARDB (2004) and 6 species as either CITES Appendix 1 (2 species) and 2 (4 species) species. 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 (Picker and Griffiths 2011). Although the brown and house rats are expected to occur in Walvis Bay and Swakopmund, they are commensally with humans and could occur in the general area although they probably do not occur in the open gravel plain areas.

The most important species from the general area are the Namibian wing-gland bat (*Cistugo seabrae*) listed as endemic and rare; Littledale’s whistling rat (*Protomys littledalei namibensis*) – of which the subspecies “*namibensis*” is known to occur in the ephemeral river courses in the “Swakopmund area” Griffin (2003) – listed as endemic; brown hyena (*Parahyaena brunnea*) and leopard (*Parthera pardus*) listed as near threatened and vulnerable (population trends decreasing), respectively by the IUCN (2025). However, leopard is only expected to occasionally pass through the area as the general gravel plain area is not viewed as favoured habitat. Hartmann’s mountain zebra are known to occur further inland (westwards – i.e., Tumas and Langer Heinrich areas, etc.) and do not frequent the barren gravel plains close to the coast.

Habitat alteration and overutilization are the two primary processes threatening most mammals (Griffin 1998c) with species probably underrepresented in the above-mentioned table for the general area being the bats and rodents, as these groups have not been well documented from the arid central western part of Namibia.

However, none of the mammal species known and/or expected to occur in the general area are exclusively associated with the GHDP area.

Table 5-14: Mammal diversity expected to occur in the general GHDP area – literature study.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
Elephant Shrews					
<i>Macroscelides (proboscideus) flavicaudatus</i>	Round-eared Elephant-shrew	Endemic; Secure		LC	
Aardvark					
<i>Orycteropus afer</i>	Aardvark	Secure; Protected Game		LC	
Bats					
<i>Eidolon helvum</i>	African Straw-coloured Fruit Bat	Secure; Migrant		NT	
<i>Rhinolophus darlingi</i>	Darling's Horseshoe Bat	Secure; Peripheral	NT	LC	
<i>Rhinolophus fumigatus</i>	Rüppell's Horseshoe Bat	Secure	NT	LC	
<i>Taphozous mauritanus</i>	Mauritian Tomb Bat	Secure		LC	
<i>Nycteris thebaica</i>	Egyptian Slit-faced Bat	Secure		LC	
<i>Sauromys petrophilus</i>	Robert's Flat-headed Bat	Secure		LC	
<i>Tadarida aegyptiaca</i>	Egyptian Free-tailed Bat	Secure		LC	
<i>Miniopterus natalensis</i>	*Natal Long-fingered Bat	Secure	NT	LC	
<i>Cistugo seabrae</i>	*Namibian Wing-gland Bat	Endemic; Rare	V	LC	

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
<i>Eptesicus hottentotus</i>	Long-tailed Serotine Bat	Secure		LC	
<i>Mimetillus thomasi</i>	Thomas's Flat-headed Bat	Not listed			
<i>Neoromicia zuluensis</i>	Zulu Serotine Bat	Secure		LC	
<i>Pipistrellus rueppellii</i>	Rüppell's Pipistelle Bat	Insufficiently known; Peripheral		LC	
Hares and Rabbits					
<i>Lepus capensis</i>	Cape Hare	Secure		LC	
Porcupine					
<i>Hystrix africaustralis</i>	Porcupine	Secure		LC	
Rats and Mice					
<i>Petromys typicus</i>	Dassie Rat	Endemic; Secure	NT		
<i>Pedetes capensis</i>	Springhare	Secure		LC	
<i>Rhabdomys pumilio</i>	Four-striped Grass Mouse	Secure		LC	
<i>Mastomys coucha</i>	Southern Multimammate Mouse	Secure		LC	
<i>Aethomys chrysophilus</i>	Red Veld Rat	Secure		LC	
<i>Aethomys namaquensis</i>	Namaqua Rock Mouse	Secure		LC	
<i>Protomys littledalei namibensis</i>	Littledale's Whistling Rat	Endemic	NT		
<i>Desmodillus auricularis</i>	Cape Short-tailed Gerbil	Secure		LC	

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
<i>Gerbillurus paeba</i>	Hairy-footed Gerbil	Secure		LC	
<i>Gerbillurus setzeri</i>	Setzer's Hairy-footed Gerbil	Endemic		LC	
<i>Petromyscus collinus</i>	Pygmy Rock Mouse	Endemic; Secure		LC	
<i>Mus musculus</i>	House Mouse	Invasive alien		LC	
Primates					
<i>Papio ursinus</i>	Chacma Baboon	Secure; Problem animal		LC	C2
Carnivores					
<i>Parahyaena (Hyaena) brunnea</i>	Brown Hyena	Insufficiently known; (Vulnerable?); Peripheral	NT	NT	
<i>Crocuta crocuta</i>	Spotted Hyena	Secure?; Peripheral	NT	LC	
<i>Felis silvestris</i>	African Wild Cat	Vulnerable		LC	C2
<i>Suricata suricatta marjoriae</i>	Suricate	Endemic; Secure		LC	
<i>Otocyon megalotis</i>	Bat-eared Fox	Vulnerable(?); Peripheral; Protected Game		LC	
<i>Vulpes chama</i>	Cape Fox	Vulnerable?		LC	
<i>Canis mesomelas</i>	Black-backed Jackal	Secure; Problem animal		LC	
<i>Ictonyx striatus</i>	Striped Polecat	Secure		LC	
<i>Mellivora capensis</i>	Ratel	Secure; Protected Game		LC	
<i>Acinonyx jubatus</i>	Cheetah	Vulnerable; Protected Game	V	V	C1

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
<i>Caracal caracal</i>	Caracal	Secure; Problem animal		LC	C2
<i>Panthera pardus</i>	Leopard	Secure(?); Peripheral; Protected Game		V	C1
Pigs					
<i>Phacochoerus africanus</i>	Warthog	Secure; Huntable game		LC	
Zebra					
<i>Equus zebra hartmannae</i>	Hartmann's Mountain Zebra	Endemic; Secure; Specially Protected Game	E	V	C2
Antelopes					
<i>Oryx gazella</i>	Gemsbok	Secure; Huntable game		LC	
<i>Tragelaphus strepsiceros</i>	Kudu	Secure; Huntable game		LC	
<i>Sylvicapra grimmia</i>	Common Duiker	Secure		LC	
<i>Antidorcas marsupialis</i>	Springbok	Secure; Huntable game		LC	
<i>Raphicerus campestris</i>	Steenbok	Secure; Protected Game		LC	

SARDB (2004): NT – Near Threatened, V – Vulnerable

IUCN (2025): V – Vulnerable, NT – Near Threatened, All the other species are listed as LC – Least Concern or not yet been assessed for the Red List.

CITES: CITES Appendix 1 or 2 species

* - Monandjem *et al.* (2010): NT – Near Threatened

Source for literature review: De Graaff (1981), Estes (1995), Frost (2014), Griffin and Coetzee (2005), IUCN (2025), Joubert and Mostert (1975), Monandjem *et al.* (2010), Picker and Griffiths (2011), Skinner and Smithers (1990), Skinner and Chimimba (2005), Stander and Hannsen (2003) and Taylor (2000)

Access route – Impact

The impact during construction, are expected to be detrimental to mammals associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of access route is not expected to be detrimental to mammals – i.e., would not impede their movement, etc.

Solar PV plant – Impact

The impact during the construction, are expected to be detrimental to mammals associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of aboveground PV plant infrastructure is not expected to be detrimental to mammals – i.e., would not impede their movement, etc.

Pipeline impact

The impact of heavy machinery during excavation of a trench to bury the proposed water pipeline is expected to be detrimental to mammals associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

However, an open trench could act as a giant pitfall trap and should not be left open overnight and/or have regular exists along its route, especially at the two ends of the trench.

Height

A detailed study on the effects of an aboveground pipeline infrastructure on vertebrate fauna was conducted by Cunningham et al. (2015) on a 40km section from the Swakopmund Base Station to the Langer Heinrich Mine junction. Heights, crossing points and species affected were assessed. It was determined that most springbok crossed the pipeline with heights between 40-70cm (91.1%) with the greatest number crossing at 50-60cm (44%) while gemsbok crossed with difficulty (e.g., individuals only) at 60cm. This indicates that a pipeline height of >70cm is an effective barrier to most springbok and >60cm for gemsbok while anything >80cm is a total barrier (e.g., only 0.4% of springbok crossings were above 80cm) (Cunningham et al. 2015). Although springbok have been observed crossing cattle fences of 1.5m when pressed, often with fatalities, most avoid this height (Pers. obs.). Mountain zebra are expected to be similarly negatively affected while kudu, a typical jumping species, is not affected (however both species not expected to occur in the DHDP area).

The effect of aboveground pipeline infrastructure >80cm is expected to be detrimental to most ungulates – i.e., would impede their movement, etc. As the existing aboveground pipeline(s) already act as a barrier to most ungulates (Cunningham et al. 2015) the cumulative impact of another aboveground pipeline, running adjacent these pipelines, is not expected to increase the barrier effect.

Crossing Points

Ungulate activity is associated with the availability of vegetation, especially along ephemeral drainage lines. Most pipeline crossing attempts were made in the vicinity of vegetated drainage lines (Cunningham et al. 2015).

Raised – earth covered – crossing points, 30m in width were not used by ungulates while buried sections did not impede movements at all (Cunningham et al. 2015).

Pipeline infrastructure >80cm in height would be viewed as an effective barrier to most ungulates while belowground crossing points would be best situated at drainage lines.

To prevent the pipeline serving as a barrier to ungulates, it would be recommended to bury the pipeline along the entire route from the T/Off section to the GHDP area. Where it follows the existing pipeline infrastructure between Swakopmund and Walvis Bay it should mimic the current crossing points and leave enough space between the pipelines for maintenance purposes.

Transmission line – Impact

The impact of heavy machinery during construction, and especially the excavation of holes to plant pylons for a transmission line (if applicable) are expected to be detrimental to mammals associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

However, open holes could act as pitfall traps and should not be left open overnight and/or covered.

The impact of aboveground transmission line infrastructure is not expected to be detrimental to mammals – i.e., would not impede their movement, etc. However, some mammals – e.g., small-spotted genet, mongoose – are attracted to the substations and on-pole-mounted switching gear probably for foraging and heat and may cause problems at these structures. This could be mitigated by electrostatic animal and/or squirrel guards on the bushings (Van Rooyen 2003). Other mammals that could be affected by the electrical infrastructure are baboons which often get electrocuted by various types of infrastructure and giraffe. Pole mounted transformers and bushings can be insulated and/or substations could be equipped with electric fencing to prevent baboons entering such areas while giraffe require a minimum clearance of 5820mm for 22kV transmission lines (Van Rooyen 2003). However, baboon and giraffe are not known to occur in the general area.

Farm 58 infrastructures – Impact

The impact during construction, are expected to be detrimental to mammals associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of various infrastructures is not expected to be detrimental to mammals – i.e., would not impede their movement, etc.

5.3.1.4 Bird Diversity

Bird diversity known and/or expected to occur in the general GHDP area (literature study only), is presented in Table 5-15. This table excludes coastal marine birds although some may occasionally occur in the area (e.g., gulls and terns), migratory birds (e.g., Petrel, Albatross, Skua, 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.

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 is viewed as “average” in the general area with 141-170 species estimated and 1-3 species being endemic (Mendelsohn *et al.* 2000). Simmons (1998a) suggests 4-6 endemic species and a low to average ranking for southern African endemics and high ranking for southern African red data birds expected from the general area. The Bannerman Water Supply Pipeline Project area does not fall within an Important Birding Area (IBA). Important Birding Areas, which are in the general vicinity, include Walvis Bay (global IBA status), Sandwich Harbour (global IBA status), 30 km beach (national IBA status) and the Mile 4 Saltworks (global IBA status) (Simmons 1998a) all approximately 20-50km towards the southwest and/or northwest along the coast.

At least 130 species of terrestrial [“breeding residents”] birds occur and/or could occur in the general area at any time (Hockey *et al.* 2006, Maclean 1985, Tarboton 2001). All the migrant and aquatic species have been excluded here. Seven of the 14 Namibian endemics are expected to occur in the general area (50% of all Namibian endemic species or 5.4% of all the species expected to occur in the area). However, Simmons *et al.* (2015) indicates that Rüppell’s parrot is viewed as near endemic. Furthermore, Simmons *et al.* (2015) list 7 species as endangered (Ludwig’s bustard, white-backed vulture, black harrier, martial eagle, tawny eagle, booted eagle, black stork), 2 species as vulnerable (Lappet-faced vulture, secretarybird) and 5 species as near threatened (Rüppell’s parrot, Cape eagle owl, kori bustard, Verreaux’s eagle and peregrine falcon). Other important species known to occur in the general area but not included in Table 5-15 are maccoa duck (NT) and great white pelican (V). Both these species are however aquatic species and not expected to occur in the GHDP area, but probably only pass over on their way to the coast.

Forty-three species have a southern African conservation rating with 9 species classified as endemic (20.1% of southern African endemics or 7% of all the birds expected) and 34 species classified as near endemic (79.1% of southern African endemics or 26.2% of all the birds expected) (Hockey *et al.* 2006). The IUCN (2025) lists 1 species as critically endangered (white-backed vulture), 5 species as endangered (Ludwig’s bustard, lappet-faced vulture, martial eagle, black harrier, secretarybird), 1 species as vulnerable (tawny eagle,) and 2 species as near threatened (kori bustard, red-necked falcon) (All other species are listed as Least Concern and/or not yet been assessed by the Red List).

Table 5-15. Avian diversity expected to occur in the general GHDP area – literature study.

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
<i>Struthio camelus</i>	Common Ostrich			
<i>Pternistis adspersus</i>	Red-billed Spurfowl		N-end	
<i>Numida meleagris</i>	Helmeted Guineafowl			
<i>Dendropicos namaquus</i>	Bearded Woodpecker			
<i>Tockus monteiri</i>	Monteiro's Hornbill	End		
<i>Tockus damarensis</i>	Damara Hornbill	End	N-end	
<i>Tockus leucomelas</i>	Southern yellow-billed Hornbill		N-end	
<i>Tockus nasutus</i>	African Grey Hornbill			
<i>Upupa africana</i>	African Hoopoe			
<i>Phoeniculus purpureus</i>	Green Wood-Hoopoe			
<i>Rhinopomastus cyanomelas</i>	Common Scimitarbill			
<i>Colius colius</i>	White-backed Mousebird		End	
<i>Urocolius indicus</i>	Red-faced Mousebird			
<i>Poicephalus rueppellii</i>	Rüppell's Parrot	End; NT	N-end	

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
<i>Agapornis roseicollis</i>	Rosy-faced Lovebird	End	N-end	
<i>Cypsiurus parvus</i>	African Palm Swift			
<i>Tachymarpis melba</i>	Alpine Swift			
<i>Apus bradfieldi</i>	Bradfield's Swift		N-end	
<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>Ptilopsis granti</i>	Southern White-faced Scops Owl			
<i>Bubo capensis</i>	Cape Eagle-Owl	NT		
<i>Bubo africanus</i>	Spotted Eagle Owl			
<i>Bubo lacteus</i>	Verreaux's Eagle-Owl			
<i>Glaucidium perlatum</i>	Pearl-spotted Owlet			
<i>Asio capensis</i>	Marsh Owl			
<i>Columba livia</i>	Rock Dove			
<i>Columba guinea</i>	Speckled Pigeon			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
<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	N-end	E
<i>Ardeotis kori</i>	Kori Bustard	NT		NT
<i>Eupodotis rueppellii</i>	Rüppell's Korhaan	End	N-end	
<i>Pterocles namaqua</i>	Namaqua Sandgrouse		N-end	
<i>Pterocles bicinctus</i>	Double-banded Sandgrouse		N-end	
<i>Vanellus armatus</i>	Blacksmith Lapwing			
<i>Rhinoptilus africanus</i>	Double-banded Courser			
<i>Elanus caeruleus</i>	Black-shouldered Kite			
<i>Torgos tracheliotos</i>	Lappet-faced Vulture	V		E
<i>Gyps africanus</i>	White-backed Vulture	E		CE
<i>Circaetus pectoralis</i>	Black-chested Snake-Eagle			
<i>Melierax canorus</i>	Southern Pale Chanting Goshawk		N-end	
<i>Melierax gabar</i>	Gabar Goshawk			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
<i>Accipiter badius</i>	Shikra			
<i>Circus maurus</i>	Black Harrier	E	End	E
<i>Buteo augur</i>	Augur Buzzard			
<i>Aquila verreauxii</i>	Verreaux's Eagle	NT		
<i>Polemaetus bellicosus</i>	Martial Eagle	E		E
<i>Aquila rapax</i>	Tawny Eagle	E		V
<i>Aquila pennatus</i>	Booted Eagle	E		
<i>Sagittarius serpentarius</i>	Secretarybird	V		E
<i>Falco rupicolus</i>	Rock Kestrel			
<i>Falco rupicoloides</i>	Greater Kestrel			
<i>Falco chicquera</i>	Red-necked Falcon			NT
<i>Falco biarmicus</i>	Lanner Falcon			
<i>Falco peregrinus</i>	Peregrine Falcon	NT		
<i>Ciconia nigra</i>	Black Stork	E		
<i>Egretta garzetta</i>	Little Egret			
<i>Ardea cinerea</i>	Grey Heron			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
<i>Ardea melanocephala</i>	Black-headed Heron			
<i>Bubulcus ibis</i>	Cattle Egret			
<i>Scopus umbretta</i>	Hamerkop			
<i>Dicrurus adsimilis</i>	Fork-tailed Drongo			
<i>Nilaus afer</i>	Brubru			
<i>Tchagra australis</i>	Brown-crowned Tchagra			
<i>Telophorus zeylonus</i>	Bokmakierie		N-end	
<i>Batis pririt</i>	Pririt Batis		N-end	
<i>Corvus capensis</i>	Cape Crow			
<i>Corvus albus</i>	Pied Crow			
<i>Lanius collaris</i>	Common Fiscal			
<i>Parus cinerascens</i>	Ashy Tit		End	
<i>Riparia paludicola</i>	Brown-throated Martin			
<i>Hirundu albigularis</i>	White-throated Swallow			
<i>Hirundo dimidiata</i>	Pearl-breasted Swallow			
<i>Hirundo fuligula</i>	Rock Martin			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
<i>Pycnonotus nigricans</i>	African Red-eyed Bulbul		N-end	
<i>Sylvietta rufescens</i>	Long-billed Crombec			
<i>Eremomela icteropygialis</i>	Yellow-bellied Eremomela			
<i>Eremomela gregalis</i>	Karoo Eremommela		End	
<i>Parisoma layardi</i>	Layard's Tit-Babbler		End	
<i>Parisoma subcaeruleum</i>	Chestnut-vented Tit-Babbler		N-end	
<i>Zosterops pallidus</i>	Orange River White-eye		End	
<i>Cisticola subruficapilla</i>	Grey-backed Cisticola		N-end	
<i>Cisticola juncidis</i>	Zitting Cisticola			
<i>Cisticola jaridulus</i>	Desert Cisticola			
<i>Prinia flavicans</i>	Black-chested Prinia			
<i>Mirafrja sabota</i>	Sabota Lark			
<i>Ammomanopsis grayi</i>	Gray's Lark	End		
<i>Certhilauda subcoronata</i>	Karoo Long-billed Lark		End	
<i>Eremopterix verticalis</i>	Grey-backed Sparrowlark		N-end	
<i>Calandrella cinerea</i>	Red-capped Lark			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
<i>Alauda starki</i>	Stark's Lark		N-end	
<i>Bradornis infuscatus</i>	Chat Flycatcher		N-end	
<i>Melaenornis mariquensis</i>	Marico Flycatcher		N-end	
<i>Muscicapa striata</i>	Spotted Flycatcher			
<i>Cercotrichas paena</i>	Kalahari Scrub-Robin			
<i>Namibornis herero</i>	Herero Chat	End	N-end	
<i>Oenanthe monticola</i>	Mountain Wheatear		N-end	
<i>Oenanthe pileata</i>	Capped Wheatear			
<i>Cercomela schlegelii</i>	Karoo Chat		N-end	
<i>Cercomela tracter</i>	Tracter Chat		N-end	
<i>Cercomela familiaris</i>	Familiar Chat			
<i>Myrmecocichla formicivora</i>	Ant-eating Chat		End	
<i>Onychognathus nabouroup</i>	Pale-winged Starling		N-end	
<i>Lamprotornis nitens</i>	Cape Glossy Starling			
<i>Creatophora cinerea</i>	Wattled Starling			
<i>Chalcomitra senegalensis</i>	Scarlet-chested Sunbird			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
<i>Nectarinia fusca</i>	Dusky Sunbird		N-end	
<i>Sporopipes squamifrons</i>	Scaly-feathered Finch		N-end	
<i>Plocepasser mahali</i>	White-browed Sparrow-Weaver			
<i>Philetairus socius</i>	Sociable Weaver		End	
<i>Ploceus velatus</i>	Southern Masked-Weaver			
<i>Quelea quelea</i>	Red-billed Quelea			
<i>Amadina erythrocephala</i>	Red-headed Finch		N-end	
<i>Estrilda erythronotos</i>	Black-faced Waxbill			
<i>Estrilda astrild</i>	Common Waxbill			
<i>Passer domesticus</i>	House Sparrow			
<i>Passer motitensis</i>	Great Sparrow		N-end	
<i>Passer melanurus</i>	Cape Sparrow		N-end	
<i>Passer griseus</i>	Southern Grey-headed Sparrow			
<i>Motacilla capensis</i>	Cape Wagtail			
<i>Crithagra atrogularis</i>	Black-throated Canary			
<i>Serinus flaviventris</i>	Yellow Canary		N-end	

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
<i>Serinus albogularis</i>	White-throated Canary		N-end	
<i>Emberiza impetuari</i>	Lark-like Bunting		N-end	
<i>Emberiza tahapisi</i>	Cinnamon-breasted Bunting			
<i>Emberiza capensis</i>	Cape Bunting		N-end	

Simmons *et al.* (2015): End – Endemic, E – Endangered, V – Vulnerable, NT – Near Threatened

Hockey *et al.* (2006): End – Endemic, N-End – Near Endemic

IUCN (2025): CE – Critically Endangered, E – Endangered, V – Vulnerable, NT – Near Threatened, All the other species are listed as LC – Least Concern or not yet been assessed for the Red List.

Source for literature review: Brown *et al.* (1998), Hockey *et al.* (2006), IUCN (2025), Komen (n.d.), Little and Crowe (2011), Maclean (1985) Peacock (2015), Simmons *et al.* (2015), Tarboton (2001)

The most important birds known/expected to occur in the general area are all the endemics (See Table 5-15), especially Ruppel's korhaan, Gray's lark and Herero chat. Gray's lark is one of the species with the most restricted range in Namibia (Simmons 1998a). Other important species are the birds listed as endangered (Ludwig's bustard, white-backed vulture, black harrier, martial eagle, tawny eagle, booted eagle, black stork), vulnerable (Lappet-faced vulture, secretarybird) and near threatened (Rüppell's parrot, Cape eagle owl, kori bustard, Verreaux's eagle and peregrine falcon) by Simmons *et al.* (2015) and the species classified as critically endangered (white-backed vulture), endangered (Ludwig's bustard, lappet-faced vulture, black harrier), vulnerable (martial eagle, tawny eagle, secretary bird) and near threatened (kori bustard, red-necked falcon) by the IUCN (2025).

According to Cunningham (2010, 2013, 2019, 2020) between 8 (2010), 13 (2020), 17 (2013) and 18 (2019) species of birds were observed and/or confirmed (e.g., evidence thereof found) from the neighbouring INCA/TRS, Tumas, Ongolo and Kuiseb Delta areas. Furthermore, only 12 bird species were observed at Marenica (Spitzkoppe area) by Henschel *et al.* (2011).

However, the most important bird known to occur (and breed) along the coast is the Damara tern (*Sternula balaenarum*) classified as near endemic and near threatened under Namibian legislation (Simmons *et al.* 2015) and least concern (population trend decreasing with 2,200-5,700 mature individuals due to increased recreation and construction pressure on breeding grounds) by the IUCN (2025). With 98% of the Damara tern breeding population being in Namibia (Braby 2010a, Braby 2010b; Braby 2011; Crawford and Simmons 1997); very low inter-colony dispersal rates with only 70 known colonies (Braby 2011); the importance of the general area cannot be stressed enough. Furthermore, the Caution Reef breeding colony (~13 to 120 nests since 1994) closer to Swakopmund is viewed as the third largest known breeding colony (Braby 2011). Disturbance and urbanisation, especially off-road vehicles, impact on breeding success and consequently pose the biggest threat to Damara terns along the Namibian coast (Braby *et al.* 2001, Braby 2011, Braby and Braby 2002). Although Damara tern potentially could breed on the sandy gravel gypsum plains in the general GHDP area, this has not yet been recorded and neither are these areas the quiet undisturbed habitat the birds prefer.

However, none of the bird species known and/or expected from the general area are exclusively associated with the GHDP area.

Access route – Impact

The impact during construction, are expected to be detrimental to avifauna associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of access route is not expected to be detrimental to avifauna – i.e., would not impede their movement, etc.

Solar PV plant – Impact

The impact during construction, are expected to be detrimental to birds, especially ground nesting species associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of aboveground PV plant infrastructure is not expected to be detrimental to birds – i.e., would not impede their movement, etc. Other problems such as “reflective surfaces” and “mirror collisions”, etc. are not applicable – i.e., does not pose the same avifaunal impact as CSP

(Concentrated Solar Power) (Jenkins et al. 2017, Smit n.d.). However, the collision mortality impacts of birds with PV panels may be underestimated (Jenkins et al. 2017) and ongoing long-term monitoring is viewed as imperative to determine local bird mortalities.

Transmission line – Impact

The impact of heavy machinery during the construction, and especially the excavation of holes to plant pylons for the proposed transmission line (if applicable) are expected to be detrimental to birds, especially ground nesting species associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

However, open holes could act as pitfall traps for some species (e.g., ostrich – should these occur) and should not be left open overnight and/or covered.

None of the unique/important species are exclusively associated with the proposed development area although the effect of aboveground transmission line infrastructure is expected to be detrimental to certain birds – e.g., “pylon sensitive species”. Existing transmission line infrastructures include 66kV, 132kV and 220kV overhead lines in the area.

Birds expected to be negatively affected (i.e., collision and/or electrocution) by transmission lines include:

- Birds flying at pylon height – e.g., bustards, swifts, sandgrouse, ravens, raptors and aquatic and marine species.
- Birds with nocturnal transients – e.g., Palaearctic migrants and wetland birds (i.e., coastal area).
- Birds following certain geological and/or landscape features (e.g., rivers; mountain ranges, etc.) whilst foraging and/or migrating – e.g., aquatic/marine species and raptors.
- Birds attracted to the area during rainfall events – e.g., bustards – and temporary water sources in ephemeral rivers/drainage lines – e.g., aquatic/marine species.

Pylon sensitive species

Pylon sensitive bird species (“Pylon sensitive species” is a term used by Scott and Scott n.d. and includes bird species potentially affected by pylons and transmission lines) known/expected to occur in the general area include:

- Black harrier;
- Black stork;
- Booted eagle;
- Caspian tern;
- Chestnut-banded plover;
- Great crested grebe;
- Great white pelican;
- Greater flamingo;
- Kori bustard;
- Lappet-faced vulture;
- Lesser flamingo;
- Ludwig’s bustard;
- Maccoa duck;
- Martial eagle;
- Peregrine falcon;
- Tawny eagle;
- Verreaux’s eagle; and
- White-backed vulture.

Other potential transmission line issues related to birds would be species that typically nest on such structures.

Nest induced faulting caused by birds (See Scott and Scott n.d.) includes:

- *Cape crow;*
- *Pied crow;*
- *Heron – large;*
- *Eagles – large; and*
- *Vultures.*

Factors influencing collision risk

The following factors influence the collision risk for birds (See: Van Rooyen 2003):

- *Voltage levels – i.e., there is correlation between the physical size of a bird and the risk of collision;*
- *Body size and flight behaviour – i.e., birds with a heavy body size and small wing surface are more prone to collisions;*
- *Flight height and habitat use – i.e., birds that fly short distances at low altitude where there is an increased frequency of overhead structures have increased levels of collision with these structures;*
- *Age (i.e., young birds are more prone to collisions);*
- *Resident versus migratory birds (i.e., birds that move into unfamiliar terrain have increased risk of collisions);*
- *Weather (i.e., inclement weather increases collisions);*
- *Time of day (i.e., nocturnal movement increases collisions);*
- *Land use (i.e., cultivated areas attract birds with increased risk of collisions); and*
- *Topography (i.e., birds following mountains/rivers/shorelines, which act as corridors, have increased risk of collisions with structures placed in these areas).*

As many of the “pylon sensitive” bird species occur in the general area (e.g., white-backed vultures [critically endangered, IUCN 2025] are known to breed in the area, etc.), it is recommended that BFD’s (Bird Flight Diverters – e.g., coils, flappers, etc.) are installed along all new overhead transmission lines in the vicinity of the GHDP area to increase visibility and minimise/prevent bird mortalities.

Although very little is known regarding the actual flight paths used by the birds frequenting the general area, Figures 5-2 and 5-3 indicate potential flight paths and documented bird mortalities caused by power lines in Namibia.



Figure 5-2: Expected bird flight paths along the coast (yellow dashed arrows); saltworks and sewerage ponds and other inland ponds (black dashed arrows); Tumas River (orange dashed arrows) and rocky outcrops (white dashed arrows). The approximate location of the GHDP area is indicated by the green rectangle.

pipeline(s) already act as a barrier to ostrich (Cunningham et al. 2015) the cumulative impact of another aboveground pipeline, running adjacent these pipelines, is not expected to increase the barrier effect.

Crossing Points

Ostrich activity is correlated to the availability of vegetation, especially vegetated drainage lines in the Namib.

Raised – earth covered – crossing points, 30m in width were not used by ostrich while buried sections did not impede movements at all (Cunningham et al. 2015).

The effect of aboveground pipeline infrastructure is expected to be detrimental to ostrich – i.e., would impede their movement, etc.

To prevent the pipeline serving as a barrier to ostrich, it would be recommended to bury the pipeline along the entire route from the T/Off section to the GHDP area. Where it follows the existing pipeline infrastructure between Swakopmund and Walvis Bay it should mimic the current crossing points and leave enough space between the pipelines for maintenance purposes.

Farm 58 infrastructures – Impact

The impact during construction, are expected to be detrimental to birds associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of various infrastructures is not expected to be detrimental to birds – i.e., would not impede their movement, etc.

5.3.1.5 Tree and Shrub Diversity

It is estimated that at least 20-39 species of larger trees and shrubs (>1m in height) Burke 2003 [24 spp.], Coats Palgrave 1983 [20 spp.], Craven and Marais (1986) [23 spp.], Curtis and Mannheimer 2005 [39 spp.], Mannheimer and Curtis 2009 [26 spp.], Mannheimer and Curtis 2018 [14 spp.], Van Wyk and Van Wyk 1997 [20 spp.]) occur in the general GHDP area. A total of 39 species is expected from the general area according to the above-mentioned authors (See Table 5-16).

A total of 39 larger trees and shrubs are known and/or expected to occur in the general area (See Table 5-16 – various authors). According to Curtis and Mannheimer (2005), Mannheimer and Curtis (2009) and Mannheimer and Curtis (2018) between 14 and 39 species of larger trees and shrubs are known and/or expected to occur in the general area although not only specifically with the GHDP area, but rather associated with various habitats, mainly Kuiseb, Swakop and Tumas Rivers and rocky areas further inland.

Of the 39 species of trees and shrubs expected to occur in the area, 4 species are classified as endemic (10.3%), 1 species as near endemic (2.6%), 10 species are protected under the Forest Act No. 12 of 2001 (25.6%), 3 species are protected under the Nature Conservation Ordinance No. 4 of 1975 (7.7%) while 2 species are listed as CITES Appendix 2 (5.1%) species. *Arthroa leubnitziae* is endemic to the fog zone in the central Namib region (Burke 2003). The IUCN (2025) classifies *Gossypium anomalum* as near threatened while all the other species are classified as least concern or have not yet been assessed by the IUCN Red List.

The most important species expected to occur in the general area are *Acanthosicyos horridus* (protected F; near endemic) which could be considered one of Namibia's most characteristic plants (Seely 2010) and remains an important commodity to the local Topnaar people (Burke 2003); *Capparis hereroensis* (endemic) and *Welwitschia mirabilis* (protected F & NC; C2). However, *A. horridus* and *C. hereroensis* are mainly associated with sandy areas (e.g., dune belt and Kuiseb River) and not the gravel plains in the proposed GHDP area while *W. mirabilis* is found further inland. Furthermore, none of the important larger tree and shrub species is exclusively associated with the GHDP area.

Table 5-16 indicates the tree and shrub diversity known and/or expected to occur in the general area and are derived from Mannheimer and Curtis (2018). Species are known from the quarter-degree square distribution principle used and don't necessarily occur throughout the entire area. Trees and larger shrubs likely to occur in the general area indicated by Burke (2003) (trees, shrubs and stem succulents) and Craven and Marais (1986), are also included. Species confirmed during the fieldwork are also included. Some species indicated to possibly occur in the area according to Coats Palgrave (1983) and Van Wyk and Van Wyk (1997) is excluded here.

Table 5-16. Tree and shrub diversity expected (literature study) and confirmed (✓ - fieldwork) in the proposed GHDP area.

Species: Scientific name	Species confirmed: Gravel plain area	Expected: Mannheimer and Curtis (2018)	Expected: Burke (2003)	Expected: Craven and Marais (1986)	Namibian conservation and legal status
<i>Acacia erioloba</i>		✓	✓	✓	Protected (F)
<i>Acacia reficiens</i>				✓	
<i>Acanthosicyos horridus</i>		✓	✓	✓	Protected (F); N-end
<i>Adenolobus garipensis</i>			✓		
<i>Adenolobus pechuelii</i>		✓	✓	✓	
<i>Aloe asperifolia</i>				✓	NC
<i>Aptosimum spinescens</i>			✓		
<i>Arthraerua leubnitziae</i>	✓		✓	✓	End
<i>Asclepias buchenaviana</i>				✓	
<i>Barleria lancifolia</i>			✓		
<i>Boscia foetida</i>			✓		
<i>Calicorema capitata</i>			✓		
<i>Capparis hereroensis</i>		✓			End
<i>Commiphora glaucescens</i>			✓		

<i>Commiphora saxicola</i>		√	√	End; Protected (F)
<i>Cyphostemma currorii</i>		√		Protected (F)
<i>Dyerophytum africanum</i>		√		
<i>Euclea pseudebenus</i>		√	√	Protected (F)
<i>Euphorbia virosa</i>		√		C2
<i>Faidherbia albida</i>	√		√	Protected (F)
<i>Gossypium anomalum</i>	√			
<i>Hoodia currorii</i>		√	√	NC
<i>Ipomoea adenioides</i>			√	
<i>Lycium cinereum</i>	√		√	
<i>Lycium hirsutum</i>	√			
<i>Lycium tetrandrum</i>	√			
<i>Maerua schinzii</i>		√		Protected (F)
<i>Monechma cleomoides</i>		√		
<i>Moringa ovalifolia</i>		√		Protected (F)
<i>Parkinsonia africana</i>			√	
<i>Pechuel-Loeschea leubnitziae</i>	√		√	
<i>Petalidium setosum</i>		√	√	
<i>Salsola</i> spp.	√Δ	√	√	√
<i>Salvadora persica</i>		√	√	√
<i>Sarcocaulon marlothii</i>				√
<i>Tamarix usneoides</i>		√	√	√
<i>Tetragonia reduplicata</i>				√
<i>Welwitschia mirabilis</i>		√	√	Protected (F); NC; C2
<i>Zygophyllum stapffii</i>	√	√	√	End

End; N-end = Endemic and Near-endemic (Craven 1999, Mannheimer and Curtis 2018)

Protected (F) = Forest Act No. 12 of 2001

NC = Nature Conservation Ordinance No. 4 of 1975

C2 = CITES Appendix 2 species

Δ = Dominant species

Loots (2005) lists at least 4 species of conservation concern – i.e., Red Data species – from the general Swakopmund/Walvis Bay (inland) area of which 3 species are endemic, 1 species viewed as near threatened (*Adenia pechuelii*), 3 species protected by the Nature Conservation Ordinance No. 4 of 1975, 1 species listed by CITES as Appendix 2 species and 3 species viewed as least concern (Table 5-17).

Table 5-17. Important species – i.e., Red Data spp. – known to occur in the general Swakopmund/Walvis Bay (inland) area according to Loots (2005).

Species: Scientific name	Conservation status
<i>Adenia pechuelii</i>	End, NT
<i>Aloe namibensis</i>	End, NC, C2, LC
<i>Lithops gracilidelineata</i> subsp. <i>gracilidelineata</i>	NC, LC
<i>Lithops ruschiorum</i>	End, NC, LC

End = Endemic (Loots 2005)

NT = Near Threatened; LC – Least Concern (Loots 2005)

NC = Nature Conservation Ordinance No. 4 of 1975

C2 = CITES Appendix 2 species

During the rapid site assessment only 3 species of larger trees/shrubs were observed in the GHDP area with *Salsola nollothensis* (saltbush) being the most numerous, especially along one of the southernmost (and least significant) channels of the ephemeral Tumas River drainage lines (Figure 5-4). The two endemic species (*Arthraerua leubnitziae* [pencil bush], *Zygophyllum stapffii* [dollar bush]) occurred at low densities interspersed with *S. nollothensis* shrubs throughout the area and more numerous the further one moves eastwards (i.e., inland), especially along the above-mentioned ephemeral drainage line and inland granite ridges (Figures 5-5 and 5-6).



Figure 5-4: *Salsola nollothensis* (saltbush) shrubs are the most numerous plants in the GHDP area.



Figure 5-5: The endemic *Arthroa leubnitziae* (pencil bush) occurs in the GHDP area although at low densities.



Figure 5-6: The endemic *Zygophyllum stapffii* (dollar bush) occurs in the GHDP albeit as individual plants only.

All three species occur widespread along the central Namibian coastal area and are not exclusively associated with the GHDP area. The GHDP area is sparsely vegetated with individual *A. leubnitziae* and *S. nollothensis* shrubs scattered throughout the otherwise sandy gravel gypsum plain area. Hummock forming is often associated with these species which result in unique habitat to a variety of vertebrate fauna, increasing their value from an ecological point. The initial stages of such hummocks can be viewed further eastwards along the ephemeral drainage line (Figure 5-7).



Figure 5-7: *Salsola nollothensis* (saltbush) hummocks forming along the ephemeral drainage line.

Access route – Impact

The impact during construction, are not expected to be detrimental to larger trees/shrubs associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

Solar PV plant – Impact

The impact during the construction, are not expected to be detrimental to larger trees/shrubs associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of aboveground PV plant infrastructure is not expected to be detrimental to larger trees/shrubs.

Transmission line – Impact

The impact of aboveground transmission line infrastructure is not expected to be detrimental to larger trees/shrubs associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

Pipeline route – Impact

The impact during construction, are not expected to be detrimental to larger trees/shrubs associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of above- and belowground pipeline infrastructure is not expected to be detrimental to larger trees/shrubs.

Farm 58 infrastructures – Impact

The impact during construction, are expected to be detrimental to larger trees/shrubs associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of various infrastructures is not expected to be detrimental to larger trees/shrubs – i.e., would not impede their movement, etc.

5.3.1.6 Grass Diversity

It is estimated that up to 48 grasses – 6 to 37 species – (Burke 2003 [6 spp.], Curtis and Marais 1986 [5 spp.], Müller 2007 [21 spp.], Müller 1984 [24 spp.], Van Oudshoorn 1999 [37 spp.]) occur in the general GHDP area.

Southern Namib

Desert grasses are dominated by the genus *Stipagrostis* (Lovegrove 1999). *Stipagrostis sabulicola* (tough dune grass) occurs on the dunes while the inter-dune flats (streets) are covered with *Stipagrostis gonatostachys* after rains. The eastern inland sections – pro-Namib – are dominated by

Stipagrostis obtusa and *S. ciliata* after rains (Giess 1971, Lovegrove 1999). Possibly the most common and well adapted grass in the Walvis Bay area is the hardy salt loving *Odyssea paucinervis* (Müller 1984, Van Oudtshoorn 1999).

Table 5-18 indicates the grasses known and/or expected to occur in the general area and are derived from ¹Müller (1984), ²Van Oudtshoorn (1999), ³Burke (2003), ⁴Curtis and Marais (1986) and ⁵Müller (2007).

Table 5-18. Grass diversity expected (literature study) and confirmed (✓ - fieldwork) to occur in the general GHDP area.

Species: Scientific name	Species confirmed: Gravel plain area	Namibian conservation and legal status	Ecological Status	Grazing Value
^{2,5} <i>Antheophora pubescens</i>			Decreaser	High
² <i>Aristida adscensionis</i>			Increaser 2	Low
² <i>Aristida congesta</i>			Increaser 2	Low
^{2,5} <i>Bachiarua deflexa</i>			Increaser 2	Average
^{2,3} <i>Cenchrus ciliaris</i>			Decreaser	High
^{1,2,3} <i>Centropodia glauca</i>			Decreaser	High
^{1,2} <i>Chloris virgata</i>			Increaser 2	Average
^{2,4} <i>Cladoraphis spinosa</i>			Increaser 1	Average
^{1,2,5} <i>Cynodon dactylon</i>			Increaser 2	High
^{1,2} <i>Dactyloctenium aegyptium</i>			Increaser 2	Average
^{1,2} <i>Enneapogon cenchroides</i>			Increaser 2	Low
^{1,2,3} <i>Enneapogon desvauxii</i>			Intermediate	Average
^{1,2} <i>Enneapogon scaber</i>			?	Low
² <i>Enneapogon scoparius</i>			Increaser 2	Low
^{1,5} <i>Entoplocamia aristulata</i>			Intermediate	Low
^{1,5} <i>Eragrostis annulata</i>			Increaser 2	Low
² <i>Eragrostis cilianensis</i>			Increaser 2	Low
^{1,2,5} <i>Eragrostis echinochloidea</i>			Increaser 2	Average
² <i>Eragrostis lehmanniana</i>			Increaser 2	Average
^{2,3,5} <i>Eragrostis nindensis</i>			Increaser 2	Average

¹ <i>Eragrostis omaheensis</i>	End	?	Low
^{1,5} <i>Eragrostis porosa</i>		Intermediate	Low
² <i>Eragrostis rotifer</i>		Intermediate	Low
^{2,5} <i>Eragrostis superba</i>		Increaser 2	Average
^{2,5} <i>Fingerhuthia africana</i>		Decreaser	Average
² <i>Melinis repens</i>		Increaser 2	Low
^{1,4,5} <i>Odyssea paucinervis</i>		?	Low
^{2,5} <i>Panicum repens</i>		Decreaser	High
^{2,4} <i>Phragmites australis</i>		Decreaser	Low
^{1,5} <i>Pogonarthria fleckii</i>		Increaser 2	Low
² <i>Polypogon monspeliensis</i>		?	Average
² <i>Schmidtia kalahariensis</i>		Increaser 2	Low
^{1,2} <i>Schmidtia pappophoroides</i>		Decreaser	High
¹ <i>Setaria appendiculata</i>		Decreaser	High
² <i>Setaria megaphylla</i>		Decreaser	High
^{1,2} <i>Setaria verticillata</i>		Increaser 2	Average
⁴ <i>Sporobolus consimilis</i>		?	Low
² <i>Sporobolus festivus</i>		Increaser 2	Low
⁴ <i>Sporobolus nebulosus</i>		Increaser 2	Low
^{1,2,3,5} <i>Stipagrostis ciliata</i>		Decreaser	High
^{1,2,5} <i>Stipagrostis hirtigluma</i>		Increaser 2	Low
^{1,5} <i>Stipagrostis hochstetteriana</i>		Decreaser	Average
^{1,2,5} <i>Stipagrostis namaquensis</i>		?	Average
³ <i>Stipagrostis sabulicola</i>	End*	?	?
^{1,2,5} <i>Stipagrostis obtusa</i>		Decreaser	High
^{1,2,5} <i>Stipagrostis uniplumis</i>		Increaser 2	Average
^{1,2,5} <i>Tricholaena monachne</i>		Increaser 2	Average
^{2,5} <i>Tragus berteronianus</i>		Increaser 2	Low

End = Endemic (Müller 1984, 2007; *Burke 2003)

? = Undetermined in literature

▲ = Dominant species

Between 21 and 24 species of grass potentially could occur in the general area (Müller 1984, Müller 2007). According to Müller (1984) the endemic grass *Eragrostis omahekensis* potentially occurs in the general area although the updated Müller (2007) excludes this species suggesting that it probably does not occur in the area. Burke (2003) describes *Stipagrostis sabulicola* as a “true Namib endemic” which only occurs in the dune fields of the Namib Desert. The annual *Stipagrostis hermannii* occurs on the gravel and sandy/gravel plains, while *S. sabulicola* is common on hummocks along in the Kuiseb River Delta area as well as some parts of the dune belt area. Patches of *Phragmites australis* also occurs in the area but usually associated with surface water – e.g., leakages along the various pipelines and closer to the coastal areas (including the Walvis Bay sewerage works) (Cunningham 2020).

Grasses are not well represented throughout the dune belt and gravel plain areas although *Stipagrostis sabulicola* and *Cladoraphis spinosa* form dense stands in some parts of the Kuiseb River Delta area (Cunningham 2020). According to Burke (2003) the endemic *Stipagrostis sabulicola* is strictly confined to mobile dunes and as it is often the only perennial species present, it provides habitat for a variety of species, especially insects. The preferred habitat of *Cladoraphis spinosa* is dunes and riverbeds in the Namib (Burke 2003).

The most important species expected to occur in the area are *Eragrostis omahekensis* and *Stipagrostis sabulicola*. However, none of the important grass species is exclusively associated with the GHDP area.

During the fieldwork, no grasses were observed from the GHDP area (Figure 5-8).

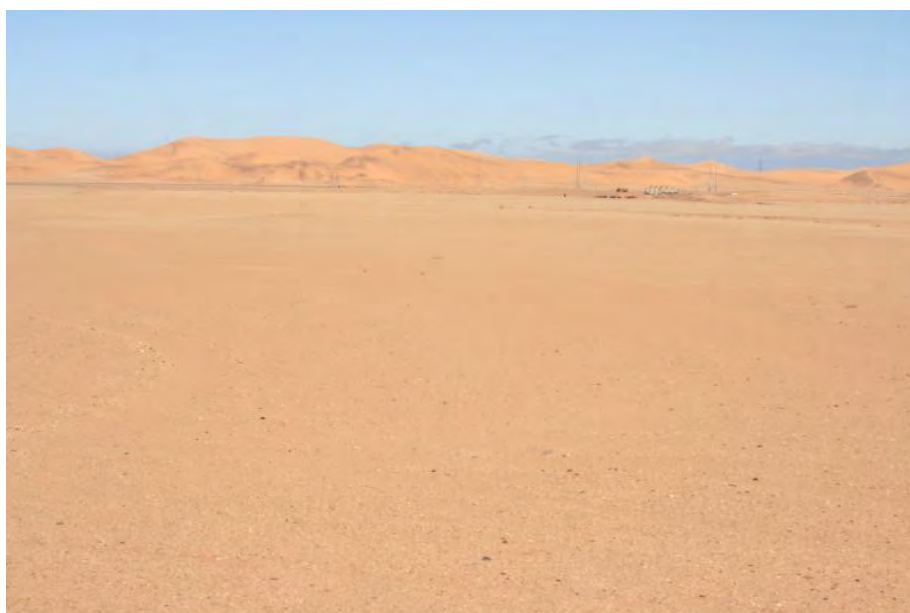


Figure 5-8: The barren sandy gravel gypsum plain area is devoid of vegetation including grasses.

Access route – Impact

The impact during construction, are not expected to be detrimental to grasses associated with the affected area/habitat.

Solar PV plant – Impact

The impact during the construction, are not expected to be detrimental to grasses associated with the affected area/habitat.

The impact of aboveground PV plant infrastructure is not expected to be detrimental to grasses.

Transmission line – Impact

The impact of aboveground transmission line infrastructure is not expected to be detrimental to grasses associated with the affected area/habitat.

Pipeline route – Impact

The impact during construction, are not expected to be detrimental to grasses associated with the affected area/habitat.

The impact of above- and/or belowground pipeline infrastructure is not expected to be detrimental to grasses.

Farm 58 infrastructures – Impact

The impact during construction, are expected to be detrimental to grasses associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of various infrastructures is not expected to be detrimental to grasses – i.e., would not impede their movement, etc.

5.3.1.7 Other Species Diversity

Aloe spp.

All the aloes are protected in Namibia (See Nature Conservation Ordinance No. 4 of 1975). Other than *Aloe asperifolia* listed in Table 5-16, *Aloe namibensis* and *A. hereroensis* probably also occur in the general area (Rothmann 2004). *Aloe namibensis* are known to occur in the general area (Pers. obs.).

Commiphora spp.

Many endemic *Commiphora* species are found throughout Namibia (Steyn 2003) with other *Commiphora* species known/expected to occur in the general area include *Commiphora glandulosa*, *C. namaensis* and *C. wildii*. Furthermore, some species are also known to have an economic potential – i.e., resin properties of *C. wildii* used in the perfume industry (Nott and Curtis 2006) – which makes them an important group of plants.

Euphorbia spp.

At least 47 *Euphorbia* spp. occur throughout Namibia of which 4 species are listed as rare, 1 endangered, 1 vulnerable and 1 near threatened (Möller and Becker 2019). *Euphorbia* species known/expected to occur in the general area include at least 8 species (*Euphorbia avasmontana*, *E. gariepina*, *E. giessii*, *E. guerichiana*, *E. lignosa*, *E. mauritanica*, *E. monteiroi*, *E. virosa*).

Ferns

At least 64 species of ferns, of which 13 species being endemic, occur throughout Namibia. Ferns in the general area include at least 2 endemic species (*Cheilanthes nielsii*, *Isoetes giessii*,) and 9 indigenous species (*Actiniopteris radiata*, *Asplenium cordatum*, *Cheilanthes dinteri*, *C. inaequalis*, *C. marlothii*, *C. parviloba*, *Isoetes aequinoctialis*, *Ophioglossum polyphyllum*, *Pellaea calomelanos*) (Crouch *et al.* 2011). Although the area is marginal habitat for ferns the general area is undercollected with more species probably occurring than presented above.

Lichen spp.

The overall diversity of lichens is poorly known from Namibia, especially the coastal areas and statistics on endemism is even sparser (Craven 1998). 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 BIOTO surveys in the early/mid 2000's was new to science (i.e., new species), is a case in point. More than 120 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 (Schulze and Rambold 2007). Many lichens look similar are highly variable in appearance and notoriously difficult to identify unless with the use of a microscope (e.g., crustose lichens) or certain chemical tests. Off road driving is the biggest threat to these lichens which are often rare and unique to Namibia. Lichens are important as the endemic Damara tern often uses these fields as a breeding ground (Craven and Marais 1986) and may even reveal life-saving antibiotics in future (Seely 2010).

Lichen diversity and abundance decreases from the sandy/gravel plains just south of the Swakop River to the sandy/gypsum plains north of the Kuiseb River east of the dune belt. The closest lichen hotspots include a Crustose lichen zone east of the dune belt area, just south of the Swakop River, while extensive patches of fruticose and foliose lichens occur in the Mile 8 and Wlotzkasbaken areas between Swakopmund and Henties Bay – i.e., far to the north of the proposed GHDP area.

During the fieldwork, only one species of lichen was observed from the GHDP area (Figure 5-9).



Figure 5-9: An unidentified lichen species (probably *Caloplaca* spp.) observed in the GHDP area.

Lithop spp.

Lithop species – all protected – are also known to occur in the general area and often difficult to observed, especially during the dry season when their aboveground structures wither. *Lithops ruschiorum* var. *ruschiorum* is known to occur in the general area (Cole and Cole 2005, Earle and Round n.d.)

Other

Other species with commercial potential that could occur in the general area include *Citrullus lanatus* (Tsamma melon) which potentially has a huge economic benefit (Mendelsohn *et al.* 2002).

Often deserts and plants associated with this marginal area look “dead” although are not, and thus not viewed as important. All desert vegetation serves as a source of habitat and/or food for desert dwelling fauna – e.g., arthropods and reptiles. Although the focus during this literature survey was on the more visible trees, shrubs, grasses and more important other species potentially occurring in the general GHDP area, many more species (e.g., herbs) occur throughout the area and are viewed as important.

5.3.2 Important species

Reptiles

The endemic *Pedioplanis husabensis* (Husab Sand Lizard), which is a restricted range species (100% of the taxon’s range within Namibia) potentially, occurs in suitable habitat – e.g., “light coloured” geology (marble/granite ridges) – throughout the general area although probably not in the GHDP area. Other reptile species of concern and expected to occur in the general area are the endemic *Afroedura africana africana* (African flat gecko), *Leptotyphlops occidentalis* (western thread snake) and *Lycophidion namibianum* (Namibian wolf snake).

Sedentary species – e.g., most species including all geckos – will be adversely affected by the proposed GHDP developments, however none of the reptiles expected to occur in the general area are exclusively associated with the proposed GHDP area.

Amphibians

Amphibians are not viewed as important throughout the GHDP area although the ephemeral Tumas River may occasionally serve as temporary habitat. The endemic *Poyntonophrynus hoeschi* and *Phrynomantis annectens* are viewed as the most important although they are not exclusively associated with the proposed GHDP area.

Mammals

The most important species from the general area are the Namibian wing-gland bat (*Cistugo seabrai*) listed as endemic and rare; Littledale's whistling rat (*Protomys littledalei namibensis*) – of which the subspecies “*namibensis*” is known to occur in the ephemeral river courses in the “Swakopmund area” Griffin (2003) – listed as endemic; brown hyena (*Parahyaena brunnea*) and leopard (*Parthera pardus*) listed as near threatened and vulnerable (population trends decreasing), respectively by the IUCN (2025). However, leopard is only expected to occasionally pass through the area as the general area is not viewed as favoured habitat.

Other important species expected to occur in the general area include the African wild cat (*Felis sylvestris*), suffering genetic pollution with domestic cats throughout its range and the endemic Hartmann's mountain zebra (*Equus zebra hartmannae*), classified as “Vulnerable” by the IUCN (2025). However, the Hartmann's mountain zebra favour the better vegetated inland areas and may only pass-through during foraging and do not necessarily occur in the area permanently.

Sedentary species – e.g., rodents – will be adversely affected by the proposed GHDP developments and species not being able to negotiate above ground pipeline infrastructures (e.g., oryx, Hartmann's mountain zebra); however, none are exclusively associated with the proposed development area.

Birds

The most important birds known/expected to occur in the general area are all the endemics especially Rüppell's korhaan, Gray's lark and Herero chat. Gray's lark is one of the species with the most restricted range in Namibia (Simmons 1998a). Other important species are the birds listed as endangered (Ludwig's bustard, white-backed vulture, black harrier, martial eagle, tawny eagle, booted eagle, black stork), vulnerable (Lappet-faced vulture, secretarybird) and near threatened (Rüppell's parrot, Cape eagle owl, kori bustard, Verreaux's eagle and peregrine falcon) by Simmons *et al.* (2015) and the species classified as critically endangered (white-backed vulture), endangered (Ludwig's bustard, lappet-faced vulture, martial eagle, black harrier, secretarybird), vulnerable (tawny eagle) and near threatened (kori bustard) by the IUCN (2025).

Bird species most likely to be adversely affected by the proposed GHDP developments are the ground nesting species associated with gravel plains such as the endemic Gray's lark and Rüppell's korhaan as well as larger raptors, especially the disturbance at breeding sites (i.e., lappet-faced vulture nesting sites mainly isolated with bigger *Acacia erioloba* trees) and species not being able to negotiate above ground pipeline infrastructures (e.g., ostrich); however none are exclusively associated with the proposed development area.

Trees/Shrubs

Acanthosicyos horridus (Inara) can be considered one of the most characteristic plants in the Namib Desert (Seely 2010). It is viewed as the most important plant species in the Kuiseb River Delta area, not only because of its social and financial value to the Topnaar community, but as it is viewed as a keystone species in the area – i.e., plays a unique and crucial role in the way the ecosystem functions. The plant is eaten by ostrich (and donkeys) and the fruit by various small rodents (gerbils), black backed jackal, oryx, black rhino and various invertebrates (Burke 2003, Mannheimer and Curtis 2018, Seely 2010). It is also viewed as of “vital existence for several desert animals” (Mannheimer *et al.* 2008). Detritus (dead organic matter) associated with this plant also attracts a variety of insects (Burke 2003) while various reptiles are also associated with this plant for shelter and invertebrates attracted to it – e.g., the mainly herbivorous *Angolosaurus skoogi* (desert plated lizard) in the northern Namib (Seely 2010). Other important species include *Capparis hereroensis* and *Welwitschia mirabilis* although *A. horridus* and *C. hereroensis* are mainly associated with sandy areas (e.g., dune belt and Kuiseb River) and not the gravel plains in the proposed GHDP area while *W. mirabilis* is found further inland. *Gossypium anomalum* classified as near threatened by the IUCN (2025) is also viewed as a potentially important species although usually found further inland.

Species listed by Loots (2005) as of conservation concern – i.e., Red Data species – from the general Swakopmund/Walvis Bay (inland) area, are also viewed as important.

Furthermore, Southern Africa is an important centre of diversity for the melon family (*Cucurbitaceae*) and they have an excellent potential for development to supplement or replace cereal production in arid regions (Kolberg 1998).

Grasses

The most important species expected to occur in the area are *Eragrostis omahekensis* and *Stipagrostis sabulicola*.

Other species

Various *Aloe*, *Euphorbia*, fern, lichens, *Lithop* species associated with the gravel plain habitat are viewed as important, especially the large lichen diversity known from certain ‘lichen field’ sites.

5.3.3 Important areas

The GHDP area does not have any major unique habitats; is not in a pristine condition and is heavily impacted by various anthropomorphic activities. However, the following areas are viewed as the most unique (sensitive) throughout the general area although only the Inland Gravel Plains are directly relevant to the proposed GHDP area:

Inland Gravel Plains [*biodiversity yellow flag area*]

The gravel plains east of the mobile dune belt are classified as a ‘biodiversity yellow flag’ area (SAIEA 2010). The ‘red’ and ‘yellow’ flag areas have been proposed on the basis of the following guiding principles:

- areas with high levels of endemism and diversity;
- conservation status of species;
- the extent to which habitats are threatened or vulnerable to disturbance; and
- habitats or migration routes which are critical for species’ survival (SAIEA 2010).

According to SAIEA (2010) the lichens, invertebrates and biodiversity associated with the Tumas River drainage area and Tumas River 'mouth' (reedbed and ephemeral spring on eastern edge of dunes) – hummocks and ephemeral wetland are viewed as important. Curtis and Barnard (1998) list the Namib gravel plains (coastal fog belt) as a site of special ecological importance with its known distinctive values including its biotic richness and endemism (e.g., lichens, arachnids and insects) and habitat threatened by off-road driving. Dolerite ridges are also viewed as important habitat, rich in lichens and other plant diversity – e.g., *Aloe namibensis*, *Euphorbia lignosa*, etc. (SAIEA 2010), albeit not as numerous and/or well vegetated south of the Swakop River as in the general Wlotskasbaken area (Figures 5-15 to 5-16).

However, this area is not pristine anymore and heavily impacted by various anthropomorphic activities (past and present) which include road construction activities, existing pipeline and transmission line infrastructures; litter dumping; various tracks; off road driving; etc. (Figures 5-10 to 5-12).



Figure 5-10: Off road driving and old tracks remain visible for years in the sandy gravel gypsum plain areas.



Figure 5-11: Various past and present construction activities have degraded the general area.



Figure 5-12: Litter is scattered throughout the area.

An eroded granite riverbank, which forms part of the of the ephemeral Tumas River drainage lines, on the eastern side of the GHDP area is viewed as the most important habitat in the general GHDP area. It serves as habitat to a variety of vertebrate fauna – e.g., near threatened brown hyena (*Parahyaena (Hyaena) brunnea*) resting site (Figure 5-13) and the diurnal and endemic Namib day gecko (*Phelsuma [Rhoptropus] afer*). Although this habitat is not exclusively associated with the GHDP area, nor particularly unique, it nevertheless is viewed as the most important habitat in the general proposed GHDP area (Figure 5-14).



Figure 5-13: A well frequented brown hyena (*Parahyaena (Hyaena) brunnea*) resting site (See arrow) beneath the granite riverbank.



Figure 5-14: The eroded granite riverbank system viewed as the most important habitat in the general GHDP area.



Figure 5-15: A well vegetated hummock system in one of the ephemeral Tumas River drainage lines further to the north of the GHDP area. Such a well-developed hummock system is viewed as unique and can be compared to the sparsely vegetated drainage line in the GHDP area.



Figure 5-16: An example of a dolerite ridge, further to the north of the GHDP area, viewed as unique habitat to a variety of flora and vertebrate fauna.

Other important non-marine areas in the immediate vicinity:

Coast immediately north of Walvis Bay [biodiversity red flag area]

This coastal area is 90km² in size and viewed as an Important Bird Area (IBA) with a high density of waders along the beach including a known Damara tern breeding area (SAIEA 2010). Furthermore, the entire coastline is viewed as a site of special ecological importance in Namibia with distinctive values such as its biotic richness especially for arachnids, birds and lichens (Curtis and Barnard 1998).

Swakop River [biodiversity red flag area]

The Swakop River is an important habitat due to the linear oasis, riparian woodland, aquifer recharge, rich wildlife and bird flypaths associated with this ephemeral drainage line (SAIEA 2010).

Kuiseb River Delta [biodiversity red flag area]

The Kuiseb River has a catchment area of 15,500km² and a total length of 420km with the common riparian vegetation including species such as *Acacia erioloba*, *Acanthosicyos horridus*, *Euclea pseudebenus*, *Faidherbia albida*, *Ficus* spp., *Salvadora persica* and *Tamarix usneoides* (Jacobsen *et al.* 1995). Ephemeral rivers are viewed as sites of special ecological importance mainly for its biotic richness; large desert-dwelling mammals; high value for human subsistence and tourism (Curtis and Barnard 1998) while the lower catchment of the Kuiseb River passes through a unique arid environment divided by this linear oasis and has great conservation and tourism significance to Namibia (Jacobsen *et al.* 1995). Such vegetated rivers in an otherwise extreme arid environment are unique habitat and a virtual lifeline to many desert dwelling fauna. The Kuiseb River Delta is viewed as an area with high biodiversity value (i.e., very high density of !nara plants and important for Topnaar livelihoods) and listed as a 'biodiversity red flag' area (SAIEA 2010).

!Nara Fields [biodiversity red flag area]

The *Acanthosicyos horridus* (!nara) fields in the Kuseb River Delta area fall within the 'biodiversity red flag' area (and the *raison d'être* for the listing) (SAIEA 2010). The endemic and protected *Acanthosicyos horridus* (!nara) is important as a commodity for the Topnaars living along the Kuseb River. Furthermore, it serves as refuge and a source of food for various desert dwelling fauna. According to Jacobsen *et al.* (1995) the over extraction of groundwater from alluvial aquifers has lowered the water table and caused the death of natural vegetation such as *Faidherbia albida* (anna tree) and the loss of production of *Acanthosicyos horridus* (!nara) in the lower Kuseb River. Although the roots are 30-40m long to access water deep underground (Mannheimer *et al.* 2008) – i.e., roots are always in contact with water (Seely 2010) – the lowering of the water table may have disastrous effects on this species and all those species reliant on it for their survival (including the Topnaar community).

6 Impact Assessment

6.1 Impact Assessment Methodology

Impacts are rated according to SRK's prescribed impact assessment methodology presented below.

The **significance** of an impact is defined as a combination of the **consequence** of the impact occurring, including possible irreversibility of impacts and/or loss of irreplaceable resources, and the **probability** that the impact will occur.

The criteria used to determine impact consequence are presented in the table below.

Table 6-1: Criteria used to determine the consequence of the impact

Rating	Definition of Rating	Score
A. Extent – the area (distance) over which the impact will be experienced		
Local	Confined to project or study area or part thereof (e.g., the development site and immediate surrounds)	1
Regional	The region (e.g., Municipality or Quaternary catchment)	2
(Inter) national	Nationally or beyond	3
B. Intensity – the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered and/or irreplaceable resources ¹ are lost	3
C. Duration – the timeframe over which the impact will be experienced and its reversibility		
Short-term	Up to 2 years (i.e., reversible impact)	1
Medium-term	2 to 15 years (i.e., reversible impact)	2
Long-term	More than 15 years (state whether impact is irreversible)	3

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

Table 6-2: Method used to determine the consequence score

Combined Score (A+B+C)	3 – 4	5	6	7	8 – 9
Consequence Rating	Very low	Low	Medium	High	Very high

Once the consequence was derived, the probability of the impact occurring was considered, using the probability classifications presented in the table below.

Table 6-3: Probability classification

Probability – the likelihood of the impact occurring	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

¹Defined as important cultural or biological resource which occur nowhere else, and for which there are no substitutes.

The overall **significance** of impacts was determined by considering consequence and probability using the rating system prescribed in the table below.

Table 6-4: Impact significance ratings

		Probability			
		Improbable	Possible	Probable	Definite
Consequence	Very Low	INSIGNIFICANT	INSIGNIFICANT	VERY LOW	VERY LOW
	Low	VERY LOW	VERY LOW	LOW	LOW
	Medium	LOW	LOW	MEDIUM	MEDIUM
	High	MEDIUM	MEDIUM	HIGH	HIGH
	Very High	HIGH	HIGH	VERY HIGH	VERY HIGH

Finally the impacts were also considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The prescribed system for considering impacts status and confidence (in assessment) is laid out in the table below.

Table 6-5: Impact status and confidence classification

<i>Status of impact</i>	
Indication whether the impact is adverse (negative) or beneficial (positive).	+ ve (positive – a 'benefit')
	– ve (negative – a 'cost')
<i>Confidence of assessment</i>	
The degree of confidence in predictions based on available information, SRK's judgment and/or specialist knowledge.	Low
	Medium
	High

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **INSIGNIFICANT:** the potential impact is negligible and **will not** have an influence on the decision regarding the proposed activity/development.
- **VERY LOW:** the potential impact is very small and **should not** have any meaningful influence on the decision regarding the proposed activity/development.
- **LOW:** the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.
- **MEDIUM:** the potential impact **should** influence the decision regarding the proposed activity/development.
- **HIGH:** the potential impact **will** affect the decision regarding the proposed activity/development.
- **VERY HIGH:** The proposed activity should only be approved under special circumstances.

Practicable mitigation and optimisation measures are recommended and impacts are rated in the prescribed way both without and with the assumed effective implementation of mitigation and optimisation measures. Mitigation and optimisation measures are either:

- **Essential:** measures that must be implemented and are non-negotiable; and
- **Best Practice:** recommended to comply with best practice, with adoption dependent on the proponent's risk profile and commitment to adhere to best practice, and which must be shown to have been considered and sound reasons provided by the applicant if not implemented.

6.2 Potential Impacts: Construction Phase

The following potential construction phase impacts were identified and assessed:

- Loss of vertebrate fauna habitat;
- Disrupt brown hyena movement patterns;
- Pipeline trench act as pitfall trap; and
- Loss of flora habitat.

6.2.1 Potential Impact: Loss of vertebrate fauna habitat

As part of the implementation of the new GHDP infrastructure, all vegetation within its footprint will be cleared and ecology altered from natural to artificial. The impact is therefore irreversible. Although the area is not particularly unique (i.e., low diversity) it is habitat to various vertebrate fauna species (mainly reptiles).

This transformation corresponds to a direct loss of local habitat for all vertebrate fauna species directly associated with the proposed GHDP area. This inland gravel plain habitat (including dolerite ridges) is viewed as a 'biodiversity yellow flag' area due to the lichens, invertebrates and biodiversity associated with the Tumas River drainage area (SAIEA 2010) while the Namib gravel plains (coastal fog belt) as a site of special ecological importance with its known distinctive values including its biotic richness and endemism (e.g., lichens, arachnids and insects) and habitat threatened by off-road driving (Curtis and Barnard 1998).

However, this area is not pristine anymore and heavily impacted by various anthropomorphic activities (past and present) which include road construction activities, existing pipeline and transmission line infrastructures; litter dumping; various tracks; off road driving; etc. (Figures 5-9 to 5-11).

Although the long-term loss of this section of inland gravel plain habitat corresponds to a significant change in natural processes, the proposed development area has a small footprint; occurs in barren sandy gravel gypsum plain with no unique vertebrate fauna expected to be exclusively associated with the development area.

The impact is assessed to be of **medium** significance and with the implementation of mitigation is reduced to **low** (Table 6-6).

Table 6-6: Significance of loss of vertebrate fauna habitat

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Medium 2	Long-term 3	Medium 6	Definite	MEDIUM	– ve	High
Essential mitigation measures: • Limit vegetation clearance and the footprint of construction activities to what is absolutely essential. • Designate the eroded granite ephemeral river bank to the east of the GHDP area as a No Go area. • Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase.								
With mitigation	Local 1	Low 1	Long-term 3	Low 5	Definite	LOW	– ve	High

6.2.2 Potential Impact: Disrupt brown hyena movement patterns

As part of the implementation of the new GHDP infrastructure, all vegetation within its footprint will be cleared and ecology altered from natural to artificial. The impact is therefore irreversible. Although the area is not particularly unique (i.e., low diversity) it currently forms part of a brown hyena (*Parahyaena brunnea*) home range (at least one individual) from the numerous tracks and well frequented resting site encountered (See Figure 5-12).

This transformation corresponds to a direct loss of local habitat for brown hyena directly associated with the proposed GHDP area. Brown hyena is classified as near threatened by the IUCN (2025) and insufficiently known; vulnerable (?) and peripheral under Namibian legislation (See Table 5-14). Although the general Swakopmund/Walvis Bay area is not pristine and/or favoured habitat for brown hyena, they nevertheless frequent the area scavenging for food. Den sites would be more important although resting and foraging sites within their home range are also important for social and to source food. However, brown hyenas are very adaptable and known to be commensal with humans, even entering towns to scavenge for food (e.g., Lüderitz, Oranjemund, Swakopmund, etc.) and are expected to adapt to the local changes in habitat, etc.

The impact is assessed to be of **medium** significance and with the implementation of mitigation is reduced to **very low** (Table 6-).

Table 6-7: Significance of disrupting brown hyena movement patterns

	<i>Extent</i>	<i>Intensity</i>	<i>Duration</i>	<i>Consequence</i>	<i>Probability</i>	<i>Significance</i>	<i>Status</i>	<i>Confidence</i>
Without mitigation	Local 1	Medium 2	Long-term 3	Medium 6	Probable	MEDIUM	– ve	High
Essential mitigation measures: - Limit vegetation clearance and the footprint of construction activities to what is absolutely essential. - Designate the eroded granite ephemeral river bank with brown hyena resting site to the east of the GHDP area as a No Go area. - Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase.								
With mitigation	Local 1	Low 1	Short-term 1	Very Low 3	Probable	VERY LOW	– ve	High

6.2.3 Potential Impact: Pipeline trench act as pitfall trap

The impact of heavy machinery during excavation of a trench to bury the proposed water pipeline is expected to be detrimental to mammals associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

However, an open trench could act as a giant pitfall trap and should not be left open overnight and/or have regular exists along its route, especially at the two ends of the trench.

The impact is assessed to be of **very low** significance and with the implementation of mitigation is reduced to **very low** (Table 6-).

Table 6-8: Significance of pipeline acting as pitfall trap

	<i>Extent</i>	<i>Intensity</i>	<i>Duration</i>	<i>Consequence</i>	<i>Probability</i>	<i>Significance</i>	<i>Status</i>	<i>Confidence</i>
Without mitigation	Local 1	Medium 2	Short-term 1	Very low 4	Definite	VERY LOW	– ve	High
Essential mitigation measures: - Limit pipeline trench activities to what is absolutely essential. - Do not leave an open trench overnight. - Have regular exists along the trench route, especially at the two ends of the trench. - Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase.								
With mitigation	Local 1	Low 1	Short-term 1	Very Low 3	Definite	VERY LOW	– ve	High

6.2.4 Potential Impact: Loss of flora habitat

As part of the implementation of the new GHDP infrastructure, all vegetation within its footprint will be cleared and ecology altered from natural to artificial. The impact is therefore irreversible. Although the area is not particularly unique (i.e., low diversity) it is habitat to endemic flora (e.g., *Arthraerua leubnitziae*, *Zygophyllum stapfii*) and lichen species.

This transformation corresponds to a direct loss of local habitat for all flora species directly associated with the proposed GHDP area. This inland gravel plain habitat (including dolerite ridges) is viewed as a 'biodiversity yellow flag' area due to the lichens, invertebrates and biodiversity associated with the Tumas River drainage area (SAIEA 2010) while the Namib gravel plains (coastal fog belt) as a site of special ecological importance with its known distinctive values including its biotic richness and endemism (e.g., lichens, arachnids and insects) and habitat threatened by off-road driving (Curtis and Barnard 1998).

However, this area is not pristine anymore and heavily impacted by various anthropomorphic activities (past and present) which include road construction activities, existing pipeline and transmission line infrastructures; litter dumping; various tracks; off road driving; etc. (Figures 5-9 to 5-11).

Although the long-term loss of this section of inland gravel plain habitat corresponds to a significant change in natural processes, the proposed development area has a small footprint; occurs in barren sandy gravel gypsum plain with no unique flora expected to be exclusively associated with the development area.

The impact is assessed to be of **low** significance and with the implementation of mitigation is reduced to **low** (Table 6-6).

Table 6-9: Significance of loss of flora habitat

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Long-term 3	Low 5	Definite	LOW	– ve	High
Essential mitigation measures: - Limit vegetation clearance and the footprint of construction activities to what is absolutely essential. - Designate the better vegetated ephemeral drainage line (i.e., with low <i>Sa/sola</i> hummock) to the east of the GHDP area as a No Go area. - Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase.								
With mitigation	Local 1	Low 1	Long-term 3	Low 5	Definite	LOW	– ve	High

6.3 Potential Impacts: Operation Phase

The following potential operation phase impacts were identified and assessed:

- Aboveground pipeline a barrier to ungulates and ostrich;
- Aboveground transmission line result in avifauna mortalities; and
- Solar plant potentially disrupts avifauna.

6.3.1 Potential Impact: Aboveground pipeline a barrier to ungulates and ostrich

Height: A detailed study on the effects of an aboveground pipeline infrastructure on vertebrate fauna was conducted by Cunningham et al. (2015) on a 40km section from the Swakopmund Base Station to the Langer Heinrich Mine junction. Heights, crossing points and species affected were assessed. It was determined that most springbok crossed the pipeline with heights between 40-70cm (91.1%)

with the greatest number crossing at 50-60cm (44%) while gemsbok crossed with difficulty (e.g., individuals only) at 60cm. This indicates that a pipeline height of >70cm is an effective barrier to most springbok and >60cm for gemsbok while anything >80cm is a total barrier (e.g., only 0.4% of springbok crossings were above 80cm) (Cunningham et al. 2015). Although springbok have been observed crossing cattle fences of 1.5m when pressed, often with fatalities, most avoid this height (Pers. obs.). Mountain zebra are expected to be similarly negatively affected while kudu, a typical jumping species, is not affected (however both species not expected to occur in the GHDP area).

The effect of aboveground pipeline infrastructure >80cm is expected to be detrimental to most ungulates – i.e., would impede their movement, etc. As the existing aboveground pipeline(s) already act as a barrier to most ungulates (Cunningham et al. 2015) the cumulative impact of another aboveground pipeline, running adjacent these pipelines, is not expected to increase the barrier effect.

Crossing Points: Ungulate activity is associated with the availability of vegetation, especially along ephemeral drainage lines. Most pipeline crossing attempts were made in the vicinity of vegetated drainage lines (Cunningham et al. 2015).

Raised – earth covered – crossing points, 30m in width were not used by ungulates while buried sections did not impede movements at all (Cunningham et al. 2015).

Pipeline infrastructure >80cm in height would be viewed as an effective barrier to most ungulates while belowground crossing points would be best situated at drainage lines.

To prevent the pipeline serving as a barrier to ungulates, it would be recommended to bury the pipeline along the entire route from the T/Off section to the GHDP area. Where it follows the existing pipeline infrastructure between Swakopmund and Walvis Bay it should mimic the current crossing points and leave enough space between the pipelines for maintenance purposes.

The impact is assessed to be of **high** significance and with the implementation of mitigation is reduced to **very low** (Table 6-10).

Table 6-10: Significance of aboveground pipeline as barrier to ungulates and ostrich

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	High 3	Long-term 3	High 7	Definite	HIGH	– ve	High
Essential mitigation measures: • Bury pipeline along the entire route. • Bury pipeline at well vegetated drainage lines. • Aboveground sections should be <80cm in height so as not to act as a barrier to ungulates & ostrich. • Aboveground sections should mimic existing pipeline crossing points. • Aboveground crossing points should be longer than 30m in length for ungulates and ostrich to use it.								
With mitigation	Local 1	Low 1	Short-term 1	Very Low 3	Definite	VERY LOW	– ve	High

6.3.2 Potential Impact: Aboveground transmission line result in avifauna mortalities

None of the unique/important species are exclusively associated with the proposed development area although the effect of aboveground transmission line infrastructure is expected to be detrimental to certain birds – e.g., “pylon sensitive species”. Existing transmission line infrastructures include 66kV, 132kV and 220kV overhead lines in the area.

Birds expected to be negatively affected (i.e., collision and/or electrocution) by transmission lines include:

- Birds flying at pylon height – e.g., bustards, swifts, sandgrouse, ravens, raptors and aquatic and marine species.
- Birds with nocturnal transients – e.g., Palaearctic migrants and wetland birds (i.e., coastal area).
- Birds following certain geological and/or landscape features (e.g., rivers; mountain ranges, etc.) whilst foraging and/or migrating – e.g., aquatic/marine species and raptors.
- Birds attracted to the area during rainfall events – e.g., bustards – and temporary water sources in ephemeral rivers/drainage lines – e.g., aquatic/marine species.

Pylon sensitive species: Pylon sensitive bird species (“Pylon sensitive species” is a term used by Scott and Scott (n.d.) and includes bird species potentially affected by pylons and transmission lines) known/expected to occur in the general area include:

- Black harrier;
- Black stork;
- Booted eagle;
- Caspian tern;
- Chestnut-banded plover;
- Great crested grebe;
- Great white pelican;
- Greater flamingo;
- Kori bustard;
- Lappet-faced vulture;
- Lesser flamingo;
- Ludwig’s bustard;
- Maccoa duck;
- Martial eagle;
- Peregrine falcon;
- Tawny eagle;
- Verreaux’s eagle; and
- White-backed vulture.

As many of the “pylon sensitive” bird species occur in the general area (e.g., white-backed vultures [critically endangered, IUCN 2025] are known to breed in the area, etc.), it is recommended that BFD’s (Bird Flight Diverters – e.g., coils, flappers, etc.) are installed along all new overhead transmission lines in the vicinity of the GHDP area to increase visibility and minimise/prevent bird mortalities.

The impact is assessed to be of **very high** significance and with the implementation of mitigation is reduced to **very low** (Table 6-10).

Table 6-11: Significance of aboveground transmission line result in avifauna mortalities

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	(Inter)-national 3	Medium 2	Long-term 3	Very high 8	Definite	VERY HIGH	– ve	High
Essential mitigation measures: • Ensure that BFD's (Bird Flight Diverters) are attached to the new transmission line along the entire route. • Monitor bird mortalities monthly along the entire line to determine impact.								
With mitigation	Local 1	Low 1	Long-term 3	Low 5	Definite	LOW	– ve	High

6.3.3 Potential Impact: Solar plant disrupting avifauna

The impact of aboveground PV plant infrastructure is not expected to be detrimental to birds – i.e., would not impede their movement, etc. Other problems such as “reflective surfaces” and “mirror collisions”, etc. are not applicable – i.e., does not pose the same avifaunal impact as CSP (Concentrated Solar Power) (Jenkins et al. 2017, Smit n.d.). The increase in size from 5MWp to 30MWp would increase the “reflective surfaces” area although this increase in surface area is not expected to pose a threat to avifauna.

However, the collision mortality impacts of birds with PV panels may be underestimated (Jenkins et al. 2017) and ongoing long-term monitoring is viewed as imperative to determine local bird mortalities.

The impact is assessed to be of **low** significance and with the implementation of mitigation is reduced to **low** (Table 6-10).

Table 6-12: Significance of solar plant disrupting avifauna

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Long-term 3	Low 5	Probable	LOW	– ve	High
Essential mitigation measures: • Monitor bird mortalities monthly to determine impact.								
With mitigation	Local 1	Low 1	Long-term 3	Low 5	Probable	LOW	– ve	High

6.4 Cumulative Impacts

6.4.1 Introduction

For the purposes of this report, cumulative impacts are defined as ‘direct and indirect impacts that act together with existing or future potential impacts of other activities or proposed activities in the area / region that affect the same resources and / or receptors’.

For the most part, cumulative effects or aspects thereof are too uncertain to be quantifiable, due mainly to a lack of data availability and accuracy. This is particularly true of cumulative effects arising from potential or future projects, the design or details of which may not be finalised or available and the direct and indirect impacts of which have not yet been assessed.

For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognised as important on the basis of scientific concerns and/or concerns of affected communities.

6.4.2 Activities Considered

Activities that potentially have cumulative impacts with the proposed Cleanergy GHDP project site and which are considered in the cumulative impact assessment are listed in Table 6-7 and shown, where possible, in **Error! Reference source not found.. Note that past and present projects, activities and stressors should have been largely considered in the baseline and thus the impact assessment in Sections 6.2 and 6.3.**

Table 6-7: Projects, activities and/or stressors with potential cumulative impacts

Project, activity and/or natural stressor	Potentially cumulatively impacted environmental resource										
	Soil / Land	Air quality	Noise	Groundwater	Freshwater	Marine/Coast	Flora / Fauna	Socio-econ	Heritage	Visual	Traffic
Possible present natural stressors											
Past and present projects and activities											
Past activities: Various transmission lines; water pipelines & road upgrade.											
Current activities:											
Possible future natural stressors											
Variations in rainfall and temperature due to climate change											
Potential future projects											
Approved future projects:											
Possible future projects: Exploration & mining activities.											
Approved renewable energy facilities											

6.4.3 Cumulative Impact Analysis

Expected cumulative impacts associated with the proposed GHDP are:

1. An increase in transmission line developments potentially exacerbating the current negative impact of these structures on 'pylon sensitive bird' species;
2. An increase in aboveground pipeline developments potentially exacerbating the current negative impact of these structures on ungulate and ostrich movement and foraging patterns;

3. An increase in all general urban development's potentially exacerbating the foraging patterns and inter- and intra- social behaviour of unique species such as brown hyena;
4. An increase in available food generally associated with humans could result in an increase in 'problem animal' numbers (e.g., black-backed jackal; crows, etc.) potentially affecting unique ground nesting birds (e.g., Damara tern, Rüppel's korhaan) and reptiles (e.g., *Chamaeleo namaquensis*, various *Phelsuma* (*Rhoptropus*) and *Meroles* spp.); and
5. An increase in all general urban development's potentially exacerbating the overall impact on the Tumas River drainage line 'delta area' and associated *Salsolea* hummock habitats.

7 Findings and Conclusions

7.1 Findings

The following findings are pertinent:

Construction Phase:

- Loss of vertebrate fauna habitat

Although the area is not particularly unique (i.e., low diversity) it is habitat to various vertebrate fauna species (mainly reptiles). This inland gravel plain habitat (including dolerite ridges) is viewed as a 'biodiversity yellow flag' area due to the lichens, invertebrates and biodiversity associated with the Tumas River drainage area (SAIEA 2010) while the Namib gravel plains (coastal fog belt) as a site of special ecological importance with its known distinctive values including its biotic richness and endemism (e.g., lichens, arachnids and insects) and habitat threatened by off-road driving (Curtis and Barnard 1998). However, this area is not pristine anymore and heavily impacted by various anthropomorphic activities (past and present) which include road construction activities, existing pipeline and transmission line infrastructures; litter dumping; various tracks; off road driving; etc. (Figures 5-9 to 5-11).

- Disrupt brown hyena movement patterns

Although the area is not particularly unique (i.e., low diversity) it currently forms part of a brown hyena (*Parahyaena brunnea*) home range (at least one individual) from the numerous tracks and well frequented resting site encountered (See Figure 5-12). Brown hyena is classified as near threatened by the IUCN (2025) and insufficiently known; vulnerable (?) and peripheral under Namibian legislation (See Table 5-14). Although the general Swakopmund/Walvis Bay area is not pristine and/or favoured habitat for brown hyena, they nevertheless frequent the area scavenging for food. Den sites would be more important although resting and foraging sites within their home range are also important for social and to source food. However, brown hyenas are very adaptable and known to be commensal with humans, even entering towns to scavenge for food (e.g., Lüderitz, Oranjemund, Swakopmund, etc.) and are expected to adapt to the local changes in habitat, etc.

- Pipeline trench act as pitfall trap

An open trench could act as a giant pitfall trap and should not be left open overnight and/or have regular exists along its route, especially at the two ends of the trench.

- Loss of flora habitat

Although the area is not particularly unique (i.e., low diversity) it is habitat to endemic flora (e.g., *Arthraerua leubnitziae*, *Zygophyllum stapffii*) and lichen species. This inland gravel plain habitat (including dolerite ridges) is viewed as a 'biodiversity yellow flag' area due to the lichens, invertebrates and biodiversity associated with the Tumas River drainage area (SAIEA 2010) while the Namib gravel plains (coastal fog belt) as a site of special ecological importance with its known distinctive values including its biotic richness and endemism (e.g., lichens, arachnids and insects) and habitat threatened by off-road driving (Curtis and Barnard 1998). However, this area is not pristine anymore and heavily impacted by various anthropomorphic activities (past and present) which include road construction activities, existing pipeline and transmission line infrastructures; litter dumping; various tracks; off road driving; etc. (Figures 5-9 to 5-11). Although the long-term loss of this section of inland gravel plain habitat corresponds to a significant change in natural processes, the proposed development area has a small footprint; occurs in barren sandy gravel gypsum plain with no unique flora expected to be exclusively associated with the development area.

Operational Phase:

- Aboveground pipeline a barrier to ungulates and ostrich

The effect of aboveground pipeline infrastructure >80cm is expected to be detrimental to most ungulates – i.e., would impede their movement, etc. – while belowground crossing points would be best situated at drainage lines. To prevent the pipeline serving as a barrier to ungulates, it would be recommended to bury the pipeline along the entire route from the T/Off section to the GHDP area.

Where it follows the existing pipeline infrastructure between Swakopmund and Walvis Bay it should mimic the current crossing points and leave enough space between the pipelines for maintenance purposes.

- Aboveground transmission line result in avifauna mortalities

As many of the “pylon sensitive” bird species occur in the general area (e.g., white-backed vultures [critically endangered, IUCN 2025] are known to breed in the area, etc.), it is recommended that BFD’s (Bird Flight Diverters – e.g., coils, flappers, etc.) are installed along all new overhead transmission lines in the vicinity of the GHDP area to increase visibility and minimise/prevent bird mortalities.

- Solar plant potentially disrupts avifauna

The impact of aboveground PV plant infrastructure, including the increase from 5MWp to 30MWp, is not expected to be detrimental to birds – i.e., would not impede their movement, etc. Other problems such as “reflective surfaces” and “mirror collisions”, etc. are not applicable – i.e., does not pose the same avifaunal impact as CSP (Concentrated Solar Power). However, the collision mortality impacts of birds with PV panels may be underestimated and ongoing long-term monitoring is viewed as imperative to determine local bird mortalities.

A summary of impacts and mitigation / optimisation measures is provided in Table 7-1.

Table 7-1: Summary of impacts and mitigation / optimisation measures

Impact	Significance rating		Key mitigation/optimisation measures
	Before mitigation/optimisation	After mitigation/optimisation	
CONSTRUCTION PHASE IMPACTS			
Loss of vertebrate fauna	Medium	Low (-ve)	- Limit vegetation clearance and the footprint of construction activities to what is absolutely essential. - Designate the eroded granite ephemeral river bank to the east of the GHDP area as a No Go area. - Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase.
Disrupt brown hyena movement	Medium (-ve)	Very low (-ve)	- Limit vegetation clearance and the footprint of construction activities to what is absolutely essential. - Designate the eroded granite ephemeral river bank with brown hyena resting site to the east of the GHDP area as a No Go area. - Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase.
Pipeline act as a pitfall trap	Very low (-ve)	Very low (-ve)	- Limit pipeline trench activities to what is absolutely essential. - Do not leave an open trench overnight. - Have regular exists along the trench route, especially at the two ends of the trench. - Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase.
OPERATION PHASE IMPACTS			
Aboveground pipeline a barrier to ungulates and ostrich	High (-ve)	Very Low (-ve)	- Burry pipeline along the entire route. - Burry pipeline at well vegetated drainage lines. - Aboveground sections should be <80cm in height so as not to act as a barrier to ungulates & ostrich. - Aboveground sections should mimic existing pipeline crossing points. - Aboveground crossing points should be longer than 30m in length for ungulates and ostrich to use it.
Aboveground transmission line result in avifauna mortalities	Very high (-ve)	Low (-ve)	- Ensure that BFD's (Bird Flight Diverters) are attached to the new transmission line along the entire route. - Monitor bird mortalities monthly alone the entire line to determine impact.
Solar plat disrupting avifauna	Low (-ve)	Low (-ve)	Monitor bird mortalities monthly to determine impact.

7.2 Conclusion and Authorisation Opinion

There are no fatal flaws (impacts that cannot be mitigated that would imply that a portion of the project or the entire project is non-viable) regarding the GHDP. This includes the updated Farm 58 site layout with the following additions: The construction of an ammonia plant (4 mtpd); 5 MW electrolyser (alkaline); extension of the solar park from 5 MWp to 35 MWp (+ 30 MWp); and battery extension from 5.9 MWh to 80 MWh (+ 63MWh) (See Figure 1-2).

Furthermore, a net loss of biodiversity is not expected should recommendations and mitigations be followed, and there are no critical thresholds or limits that are expected to be reached as a result of the project and associated activities.

The 'No Go' option – i.e., without project – could be viewed as the alternative.

The No-Go alternative anticipates changes to the biophysical environment (vertebrate fauna and flora) that would occur in the absence of the proposed GHDP project developments. The environment is not static with the main drivers of change expected to be envisaged urban developments, abstraction of groundwater and climate change.

However, the biggest driver of change would probably be human influences altering the habitat to suit their needs – e.g., development and mining activities, etc. In this scenario vertebrate fauna and flora and sensitive habitats would be affected by changes in land use, etc. Therefore, the anticipated impact of the 'No-Go' scenario on the biophysical environment (vertebrate fauna and flora) is expected to be minor-negative over time.

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Appendices

Appendix A: Specialist CV

Appendix B: Declaration of Independence

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

Application for authorization in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Biodiversity Impact Assessment for the Proposed Cleanergy Green Hydrogen Demonstration Plant in Walvis Bay, Namibia: Environmental Impact Assessment
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SPECIALIST INFORMATION

Specialist Name:	Company	Environment & Wildlife Consulting, Namibia	
Specialist Name:	Peter Cunningham		
Specialist Qualifications:	BSc, BSc Hons, MSc Conservation Ecology		
Professional Affiliation/Registration:	N/A		
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DECLARATION BY THE SPECIALIST

I, Peter Cunningham, declare that –

- I act as the independent specialist in this application.
- I will perform the work relating to the application objectively, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, Regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken concerning the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- All the particulars furnished by me in this form are true and correct.
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

EWC Namibia

Name of Company

21/08/2022

Date