Cleanergy Green Hydrogen Demonstration Plant Environmental Impact Assessment, Walvis Bay, Namibia

Environmental Impact Assessment Report

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Report Prepared for

Cleanergy Solutions Namibia (Pty) Ltd

Report Number 585529/Environmental Impact Assessment Report

Report Prepared by

srk consulting

February 2023

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SRK Project Number 585529/Environmental Impact Assessment Report

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Executive Summary

Introduction

In 2021, a joint venture was established between the Ohlthaver & List Group of Companies (Namibia's largest privately held group of companies) and CMB.TECH (a Belgian owned company working towards the development of large marine and industrial applications for hydrogen). The joint venture, Cleanergy Solutions Namibia (Pty) Ltd, aims to be the first company in Namibia to produce commercial grade hydrogen from water, utilising renewable energy sources.

Cleanergy Solutions Namibia (Pty) Ltd (henceforth referred to as either the proponent or Cleanergy) appointed SRK Consulting (South Africa) (Pty) Ltd (hereafter referred to as SRK) to facilitate the Environmental Impact Assessment (EIA) process for the proposed pilot site, also referred to as the Green Hydrogen Demonstration Plant (GHDP).

The proposed GHDP will be located outside Walvis Bay on Farm 58, near the Walvis Bay International Airport and Dune 7 (inland to the Dune), to the East of the new Walvis Bay-Swakopmund highway (D1984). The GHDP site falls within the heavy industrial zone which was previously declared by the Walvis Bay Municipality and registered as per the relevant processes under the Urban & Regional Planning Act, as well as the Local Authorities Act The property falls under the Walvis Bay Local Municipality and is situated within the Erongo Region. The total size of the area to be developed will be approximately 26 hectares (ha).

Main components of the GHDP will include:

- Five (5) Megawatts-peak (MW_p) solar Photovoltaic (PV) plant, with tracker configuration covering an area of 15 ha;
- Five (5) Megawatts (MW) battery energy storage system;
- Five (5) MW Polymer Electrolyte Membrane (PEM) electrolyser;
- One (1) hydrogen generation alkaline electrolyser system with a capacity of 100-300 Kilowatt (KW)/2-6 kg/h;
- Three (3) 45 kg/hr hydrogen compressors to densify the hydrogen gas for storage;
- Hydrogen buffer tanks and storage tanks (40 bar/300 bar/500 bar);
- Two (2) 350bar hydrogen dispensers for refuelling heavy-duty vehicles;
- Two (2) 500bar hydrogen tube trailer filling station;
- Two (2) air compressors and nitrogen generators installed in a 40 feet container;
- Water storage tanks with a total capacity of 400 cubic-meters; and
- Information centre/building, which will also be used for training and operations.

The following secondary infrastructure will also be required:

- Access road;
- Water connection (pipeline connecting to main NamWater supply); and
- Grid connection (Erongo RED).

It should be noted that the grid connection will also require an Environmental Clearance Certificate (ECC), but that the process will be managed outside the current application due to the fact that responsibility for complying with the requirements of the ECC will fall within the ambit of Erongo RED.

The demonstration project will be started at a 5 MW scale to:

- Evaluate the efficiency of current available technology within the Namibian context;
- Develop the required skills and competencies locally to operate and maintain the demonstration and possible commercial plant, as well as to share the necessary knowledge to allow for the conversion of existing equipment to allow for the utilisation of hydrogen as a fuel; and
- Develop an offtake for the green hydrogen locally (thus providing additional benefit to the country) to ensure multiple markets for the final product e.g., by converting heavy vehicles used in mining and within the port area to dual fuel vehicles.

One of the critical components of the demonstration plant will be the training centre, with course content being developed along with local vocational training and academic institutions, in order to ensure that the long-term staffing needs of the pilot and commercial facilities can be met. Cleanergy thus wants to commence with the construction of the training centre as soon as possible, in order to ensure that the necessary skills and competencies become available.

Motivation for the Proposed Project

Globally, green hydrogen is seen as imperative for the transition to cleaner economies and reducing reliance on fossil fuels, especially within the transport industry. Although the transition to green hydrogen production might initially be expensive, it is expected to decrease significantly as the economy of scale is grown along with the market. Additional derivatives from hydrogen production like ammonia, methanol, and e-kerosene, will further aid in the decarbonisation of the heavy transport sector. The final product can either be exported or utilised locally, though for the latter some investment will be required to develop a local market as well.

Namibia has been identified as one of the countries with the greatest potential for large scale, commercial production of green hydrogen. Though some of the technologies to be utilised are new, there is already a well-established solar plant design and construction industry within the country. Therefore, it is anticipated that existing skill sets will be further enhanced with the development of green hydrogen projects, and entirely new job markets will also open up within a country struggling with high unemployment rates and minimal economic diversification. The industry will also substantially contribute to the overall Gross Domestic Product (GDP) for the country.

The final Cleanergy product will be stored as compressed hydrogen compared to liquified hydrogen and liquid organic hydrogen carriers, which requires cryogenic temperatures because the boiling point of hydrogen at one atmosphere pressure is -252.8 °C. Some of the risks associated with green hydrogen production, are storage and transportation including that of fire and explosion hazards. Further, as hydrogen gas is colourless and odourless, leaks are hard to identify without dedicated leak detectors.

However, when one considers the potential risks associated with the project, against the benefits, there is an overall view that the development of green hydrogen projects within Namibia will be significantly beneficial, and that there is sufficient scope and skills to manage the risks locally.

Alternatives Considered

The project components for which alternatives were considered included:

- Site;
- Type of renewable energy to be utilised;
- Source of water used for hydrogen production; and
- Technology to be utilised for hydrogen production process.

Site alternatives that were considered included a site at Arandis and the proposed site near Walvis Bay. Both sites were suitably zoned for the proposed project. The site at Arandis has greater solar potential, but ultimately the decision was made to focus exclusively on securing the site in Walvis Bay, due in part to the following reasons:

- Shorter transport distances between the site and harbour (exports and local market opportunities);
- Greater potential for further expansion of production;
- Access to contractors with significant industrial expertise (maintenance and construction);
- Access to multiple distribution routes; and
- Access to large scale supply of water.

Due to the proximity of the preferred site to the airport, it was determined that only solar generation will be utilised at this stage. In order for hydrogen production to be considered “green”, it has to be generated from renewable energy sources, and therefore no other power sources could be considered.

In terms of water supply, the decision was made to utilise water supplied by the municipality with a direct connection to the main water pipelines. Depending on the season, it is anticipated that between 10 m^3/day and 14 m^3/day of potable water will be required for the overall operation of the proposed Cleanergy GHDP Project. This can comfortably be supplied from existing resources. Desalination is currently not a feasible option due to the distance the water will need to be transferred and the current volumes required.

For the electrolysis of water, the proton exchange membrane process was chosen over the alkaline electrolysis because of the availability of containerised solutions, quick response to fluctuations of renewable electricity, the lower importance of the pilot plant purpose, intrinsic hydrogen purity and elimination of a compression stage.

As the project focusses on local usage and long-distance shipment is not required, the decision was made to store the final product as compressed hydrogen compared to liquified hydrogen and liquid organic hydrogen carriers, which can be shipped over long distances.

The “no-go” option is the alternative of foregoing the implementation of the project entirely. If the project does not proceed, it will imply that no negative environmental impacts will materialise at the proposed footprint area – from this project (though other projects with higher potential impacts can be developed at a later stage by other proponents). However, the overall environmental benefit of using green hydrogen as an energy source globally will be lost, along with potential local socio-economic benefits. Therefore, the no-go option was not considered as a feasible alternative, since none of the impacts identified are currently considered as fatal flaws.

Environmental Impact Assessment Process

Who will Evaluate the Environmental Impact Assessment/Environmental Management Plan?

Before the proposed development can proceed, approval has to be obtained from the Ministry of Environment and Tourism (MEFT). The proposed project triggers listed activities of the Environmental Management Act, 2007 (Act No. 7 of 2007) (EMA) and will require an ECC from the Ministry.

The Scoping Report and Plan of Study (PoS) were submitted to the MEFT, who then advised the project team that the project should proceed to the Impact Assessment Phase (Acceptance Letter received 7 December 2022).

The impact assessment phase entails detailed specialist investigations, reporting, and further public participation. Only once a Final Environmental Impact Assessment Report (EIAR) and Environmental Plan

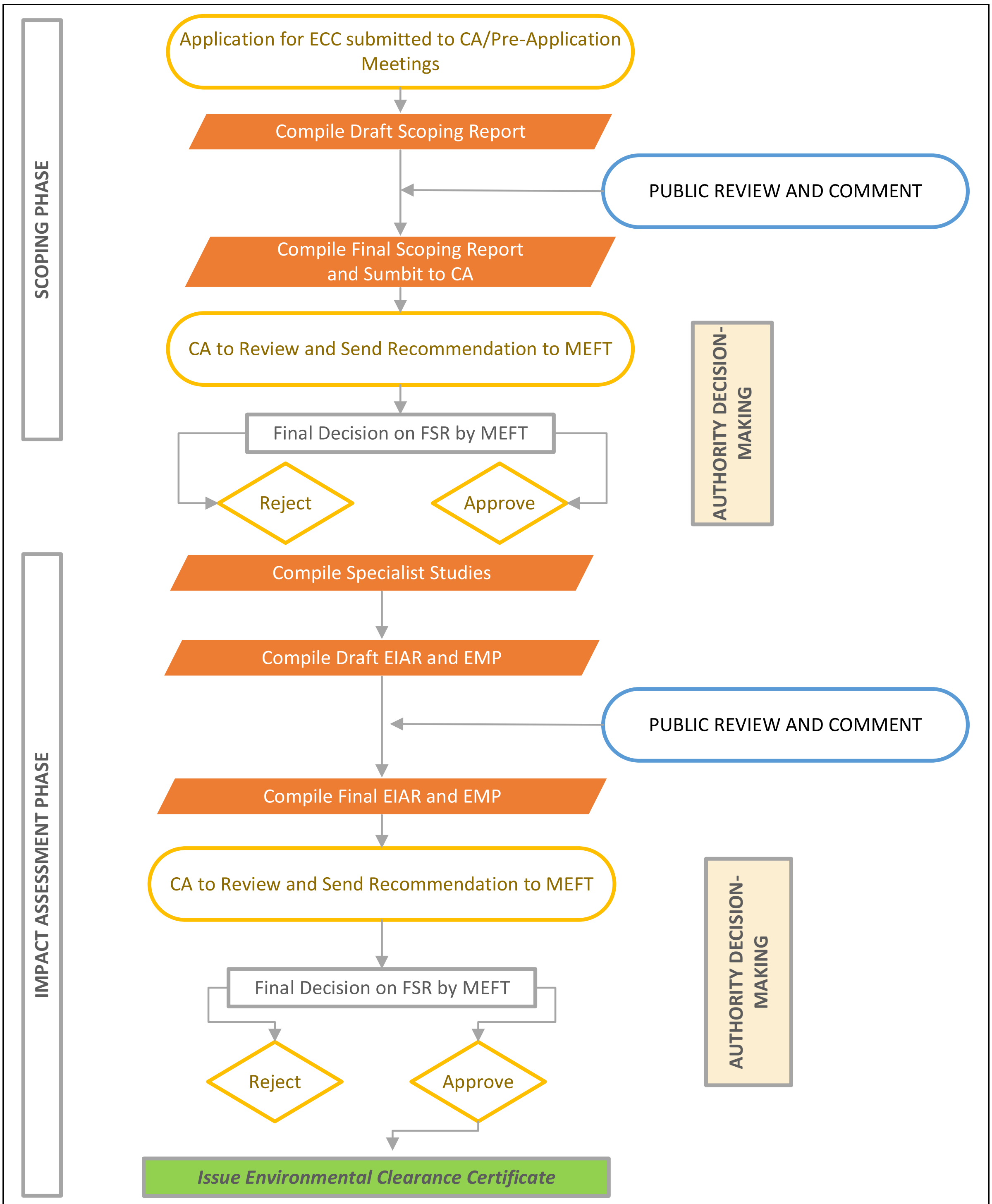
(EMP) have been submitted to the MEFT, can a decision be taken whether the project may proceed or not. If the project is approved, an ECC will be issued, and the proponent will be responsible for ensuring compliance to the EMP during construction and operation.

Approach to the Environmental Impact Assessment

The Namibian application and granting of an ECC process consists of primarily of two phases, the Scoping and Impact Assessment Phases. After submitting the application documents to the MEFT, a Draft Scoping Report was compiled and submitted for public review and comment. The Scoping Report was accepted on 7 December 2022 and the project team advised to commence with the EIA Phase of the project.

Specialist studies commenced, and the Draft EIAR and EMP were compiled. These draft documents were sent out for public review and comment (16 December 2022 – 13 January 2022), after which the Final EIAR and EMP are submitted to the MEFT for review and decision making. If the EIAR and EMP are accepted, an ECC will be issued.

Figure ES - 1 provides an illustration of the EIA process followed.



srk consulting	**CLEANERGY EIAR** Overview of the Namibian EIA Process	Project No. 585529

Figure ES - 1: Overview the Namibian Environmental Impact Assessment Process

Public Participation Process

Activities that have thus far been undertaken for the Public Participation Process (PPP) during the Scoping Phase and Impact Assessment Phase are:

- Development of a stakeholder database:
  - The stakeholder database comprises a variety of stakeholders identified from previous projects in the area, newly identified stakeholders and through the initial registering process as well as the Scoping and EIA Phases of the project;
  - The stakeholder database included institutions and organisations at all levels of government. The following list present some of the organisations but is not exhaustive:
    - MEFT;
    - Ministry of Defence and Military Veterans;
    - Ministry of Information and Communication Technology;
    - Ministry of Mines and Energy;
    - Ministry of Agriculture, Water and Land Reform;
    - Ministry of Labour, Industrial Relation and Employment Creation;
    - Ministry of Health and Social Services;
    - Ministry of Finance;
    - Ministry of Industrialisation and Trade;
    - Ministry of Works and Transport;
    - Ministry of Safety and Security;
    - Ministry of Fisheries and Marine Resources;
    - Ministry of International Relations and Cooperation;
    - Ministry of Land Reform;
    - Ministry of Urban and Rural Development;
    - Roads Authority;
    - Green Hydrogen Commissioner of Namibia;
    - National Heritage Council of Namibia;
    - Erongo Regional Council;
    - Arandis Town Council;
    - Namibia Chamber of Commerce and Industry;
    - Walvis Bay Municipality;
    - National Botanical Research Council;
    - NamWater;
    - NamPower;
    - NamPort;
    - National Planning Commission;

  - Namibia Civil Aviation Authority;
  - National Chamber of Environment;
  - Namibia Nature Foundation;
  - University of Namibia;
  - Namibia Airports Company;
  - Namibian Environment and Wildlife Society;
  - Chamber of Mines of Namibia;
  - National Petroleum Corporation of Namibia;
  - Namibia Investment Promotion and Development Board; and
  - Dorob National Park.
- The opportunity to participate in the ECC application process and to register as an Interested and Affected Party (I&AP) was announced in July – August 2022 through the following means:
  - Letter of invitations to register and Background Information Documents (BIDs);
  - Media advertisements were placed in The Namib Times (5 August 2022 and 12 August 2022) and The Namibian newspapers (8 August 2022 and 15 August 2022), respectively; and
  - Site notices were erected at several places in and around the proposed study area.
- A pre-application meeting was held with MEFT (17 August 2022), as well as focus group meetings with:
  - The Walvis Bay Municipality (18 August 2022);
  - Erongo RED (18 August 2022); and
  - The Walvis Bay Airport (19 August 2022).
- A public meeting was held in Walvis Bay on 18 August 2022;
- The Scoping Report was made available to the public for a 14-day commenting period (4 October 2022 to 17 October 2022);
- The EIAR and EMP was also made available to the public for a 14-day commenting period (16 December 2022 to 13 January 2023).[1]

All issues, comments and suggestions received from stakeholders were reviewed and collated into a Comments and Responses Register (CRR) (Appendix C_ 10). Where necessary, comments from stakeholders were incorporated into the Final EIAR that is submitted to the MEFT for decision-making.

The stakeholders will be notified of MEFT’s final decisions on the project once it has been communicated to the EAP and proponent (Cleanergy).

Summary of Issues Raised

Issues that have been raised to date by I&APs and other Stakeholders can be summarised as:

- Requests to be registered as I&AP;
- Source of funding for the project;

[1] It is noted that where stakeholders requested for an extension on the commenting period that this was granted till the 27th of January 2023.

- Potable water supply and the impact;
- Collaboration with other companies undertaking similar work in the area;
- Concerns relating to battery storage and connection to Erongo RED;
- Requirements to undertake a Social Impact Assessment;
- Negative Socio-Economic impacts associated with the proposed project;
- Upscaling of the GHDP;
- Cleaning associated with solar panels;
- Price competitiveness when compared to existing technologies;
- Number of people employed on-site;
- Involvement of Small, Medium and Micro Enterprises (SMMEs);
- Proximity of the GHDP to the Walvis Bay Airport and the associated impacts on the airport;
- Proximity of the GHDP to an artillery shooting range and a military base and the safety risks associated with green hydrogen storage;
- Potential impacts associated with increased traffic movement in the area;
- Potential impacts on biodiversity and the management thereof;
- Rehabilitation of the site;
- Climate change considerations;
- Occupational health and safety management considerations;
- Locality of Farm 58;
- Consultation with institutions and organisations at all levels of government; and
- Views of inhabitants within the vicinity of the development.

Profile of the Receiving Environment

Baseline information for this Impact Assessment Report was sourced through desktop analysis, information contained in studies undertaken by the various Namibian governmental departments, environmental non-governmental organisations and other Environmental Specialists as well as from Specialist Impact Assessments conducted as part of the Impact Assessment Phase.

A general description of the status quo of the receiving environment in the project area is provided below. It serves to set the scene and provide context to the area within which the EIA was conducted. This section also includes the main issues/impacts associated with each aspect and how the proposed project will affect the biophysical and social environment. A summary of the main baseline aspects is included in Table ES - 1, with more detail included in Section 6 of the report.

It is noted that the proposed Cleanergy GHDP Project area does not have any major unique habitats, is not in a pristine condition and is heavily impacted by various anthropomorphic activities.

Table ES - 1: Summary of the Profile of the Receiving Environment

Aspect	Description
Socio-Economy	As mentioned previously, the proposed GHDP will be located outside 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). The Narraville Community is the closest community to the proposed GHDP Project, with a line of site distance of almost 6 km. No unique habitats occur on site and the project area is heavily impacted by various anthropomorphic activities. Walvis Bay is in the Erongo Region of Namibia and is the largest town in the region, with a population of 62 000 in 2011 (NSA, 2014). The town is Namibia's main industrial harbour town with an efficient international port and is becoming a growing logistics hub for other Southern African Development Community (SADC) countries. It is also the base to a large fishing industry. The Erongo Region has a relatively young population, with a median age of 26 years, and over 68% of the urban population are people of working age (between 15 and 59 years) (NSA, 2014). The most common home languages spoken in the region are Oshiwambo, spoken by 38.8% of the population. Afrikaans is spoken as a home language by 20.4% of the population, Nama/Damara by 18.8%, English by 5.3% and German by 2.8% (NSA, 2014). One of the key concerns raised during the public participation and stakeholder engagement, was the possible impact of this project on the socio-economic environment. It was noted that past projects promised a lot but delivered little and care must therefore be taken to ensure that the project provides benefits to the community. In line with this a consultant was identified, to assist the proponent with ensuring that the impacts of, especially the construction phase, can be adequately managed. Due to the importance placed on this item by the proponent, it was decided to allow the consultant to define the baseline of the socio-economic component outside the formal EIA process and then to proactively work with the proponent and contractors to develop sensible mitigation controls prior to the start of construction. Therefore, the socio-economic study does not be part of the formal EIA process but was executed as part of the EMP in order to make it more proactive.
Biodiversity	According to Cunningham (2022), 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%) (Cunningham, 2022). 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 endemicity 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. Provision has been made for the practical impacts of the proposed Cleanergy GHDP Project on biodiversity to be assessed as part of the EIA Phase of the project.
Surface Water	The area is bordered by the Kuiseb 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 (Cunningham, 2022). These larger rivers, the Swakop and the Kuiseb, do not affect the local hydrology (Sarma, 2022). Two important coastal wetlands – i.e., Walvis Bay Wetlands and Sandwich Harbour – both Ramsar sites, occur in the area (Cunningham, 2022). 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 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 (Cunningham, 2022). 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

Aspect	Description
	oasis, riparian woodland, aquifer recharge, rich wildlife.) and Swakop River (Linear oasis, riparian woodland, aquifer recharge, rich wildlife, bird light paths) (Cunningham, 2022). 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 (Cunningham, 2022). A well vegetated hummock system is present 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 (Cunningham, 2022). Surface drainages are limited to seasonal streams that have catchments within the arid coastal areas (Sarma, 2022). Overall surface water and groundwater potential of the area is low and hypersaline underground brines with salinity exceeding that of seawater by more than five times is noted at shallow levels some 2 kilometres south of the site.
Geohydrology	A productive porous aquifer is located within close proximity of the project site. During a site visit undertaken to the Project Site on 17 August 2022, it was evident that construction activities in the area “exposes” groundwater where the top layer of the sand is removed. Water was found ponding on the surface in several of the areas in the surrounding areas. The study conducted by Namib Hydosearch (Sarma, 2022) also included information about the geohydrology surrounding the site. Data sources in this specialist study did not indicate any boreholes in the vicinity of the project area. The geology of the area consists of Damara Supergroup rocks that include the Nosib Group and the intrusive granites of a similar age, the Salem Granite. Mapped lithologies in the exposed hard rock outcrop in the vicinity of the site comprise of granite, quartzite, and marble. The land surface is covered by superficial deposits of sand and gravel, gypcrete, calcrete and alluvial deposits (sand and clay) along ephemeral rivers. Hardrock outcrops are few. Immediately west of the site towards Walvis Bay is a band of aeolian dune sand. Westward-flowing groundwater that originate in the inland hard rock areas discharge to the coastal sediments. The aquifers in the project site are generally of very low potential, and mostly saline to hyper-saline. This is a result of low groundwater flow rates and high residence time due to low hydraulic conductivity and gentle hydraulic gradient. Local groundwater recharge is also negligible under the hyper-arid conditions of the Namib Desert. Where the westward topographic gradient is steeper or impervious bedrock is present, springs emanate from the sediments. Cross-section A-B below frames the conceptual hydrogeological setting. The area is underlain by unconsolidated surficial sediments above Damara Supergroup meta-sedimentary rocks and granitic intrusive. No shallow groundwater is detected at the site. Springs discharging hypersaline groundwater are present approximately two kilometres south of the site. No groundwater of potable quality for use by humans or fauna is present in the area.
Visual	A Visual Impact Assessment study was conducted by InSite Landscape Architect (Bredell, 2022). Within the wider region and context of the receiving environment, the area has been modified due to numerous infrastructure-related and manmade interventions such as roads, bridges, etc. In stark contrast with this is the Natural uniqueness of the Dorob National Park and within that, Dune 7 desert landscape that dominates the skyline to the east of the study area. In terms of the natural uniqueness, “irreplaceability” of the site and within local, regional, and international context, the scenic, landmark and therefore tourism significance of Dune 7 is noted. Dune 7 is the highest dune in Namibia. The dune has been measured at over 383 meters and is named Dune 7 because it is the seventh dune one encounters after crossing the river Tsauchab. In the context of the surrounding region, at a local, regional, and national scale, the site has international relevance as a world-famous tourist attraction. Dune 7 is located within the Dorob National Park ("dry land") which is a protected area in the Erongo Region along the central Namibian coast, and stretches along the coastline for 1,600 km. The proposed development site is located (east) in a direct line approximately 500 m outside the conservation area. In terms of the general visual sensitivity of the affected environment, the site is vulnerable and exposed. The general sensitivity originates from the largely flat and very subtle undulating macro landscape to the east and south. To the east are open vistas in contrast to the “buffered” natural desert dunes to the west of the site. This expansive landscape is more sensitive to visual impacts due to the very low vegetation cover.

Aspect	Description
	Visual Sensitivity, in this instance, refers to the capacity of an environment to tolerate disturbance (taking the environment's natural capacity to recover from disturbance as well as existing cumulative impacts into account). The proposed development footprint itself is located on an already modified and disturbed landscape, thus resulting in a very little, or no permanent loss of vegetation cover or of a natural landscape. The affected environment could be categorised as having a low tolerance to disturbance and is mainly due to the macro landscape, context, and exposed short-, medium- and long-range views to the east. These sensitivities influence the sensitivity of the overall system, mainly due to the location of the existing aerodrome in relation to the proposed development site. The below baseline Visual Impact Assessment data collection was completed with thorough literature review as well as a site investigation and field survey conducted on 23 and 24 August 2022.
Climate	The Erongo Region, located in the western part of Namibia, falls within the west coast arid zone of southern Africa, and is characterised by low rainfall, extreme temperatures and unique climatic factors influencing the natural environment and biodiversity. Episodic dust storms, associated with easterly wind conditions, are common during austral autumn and winter months. During these events, dust is transported westwards over long distances across the Namibian continent towards the Atlantic Ocean (Liebenberg-Enslin et al., 2017). This descent of air leads to a drop in air pressure as a result of vertical air column expansion, and the development of warm berg-wind conditions as a result of adiabatic heating. Although strong, hot and often uncomfortable for people, easterly wind conditions are usually relatively short-lived (Liebenberg-Enslin et al., 2017). 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%. The relative humidity is high, ranging from a high of 81% in January and March to a low of 65% to 71% in May, June, July, and December. Rainfall is more-or-less evenly spread from July to December. The average amount of rainfall is slightly higher in January and from April to June and peaks in March at 4.4 mm.
Topography	The gradient of the Central Namib is gradual at 1% in elevation from the coast to the escarpment feet. There are no major landscape features aside from a few river valleys, inselbergs, and dunes influencing the climate between the escarpment and the ocean. This allows the steady development of gradients impacting temperature, humidity, fog, and wind patterns. The isohyets mostly run parallel to the coast; however, some gradients are in opposite directions, changing the climatic characteristics from the coast inland. The Central Namib was thus divided in several zones namely the Pro-Namib, eastern zone, middle zone, foggy interior zone, and cool foggy coastal zone which are analysed by vegetation, land use, and soil processes. The terrain is overall very flat aside from Dune 7 located on the proposed site's western side and some smaller sand dunes. The site is between 30 and 50 m above sea level.
Geography and 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 (Cunningham, 2022).
Soils, land use, and land capability	The dominant soils present at the Cleanergy GHDP Project area 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 (Cunningham, 2022). The proposed project area is located within an area zoned as Heavy Industrial Area. The proposed Cleanergy GHDP Project area does not have any major unique habitats, is not in a pristine condition and is heavily impacted by various anthropomorphic activities.
Heritage/Archaeology	Due to relative homogeneity of the site's topography and its geomorphology, no traces of significant archaeological and historical evidence relevant under the provisions of the National Heritage Act (Act No. 27 of 2004) were found (Nankela, 2022).
Air Quality	In general, the air quality in Walvis Bay is of good quality according to the Air Quality Index (AQI) and its main pollutant, $PM_{2.5}$ concentration meets the World Health Organisation (WHO) annual air quality guideline value of 2.1 µg/m^3. Surrounding areas in the proposed project area

Aspect	Description
	include roads and an airport which adds to the reduction of air quality, however, there are few other developments in the nearby area. The proposed Cleanergy GHDP Project may potentially result in nuisance dust during the construction phase of the project. The impacts of these emissions are expected to be low on the surrounding areas due to the status quo in the area. Provision has been made for the practical impacts of the proposed Cleanergy GHDP Project to be assessed during the EIA phase of the project but since the impact is expected to be limited, no specific air specialist study is envisaged.
Noise	Current sources of noise on the surrounding area include highways and the Walvis Bay International Airport. The construction and operation of the proposed Cleanergy GHDP is not expected to generate material noise nuisance. Provision is made for the practical impacts of the proposed project to be further considered during the impact assessment phase of the EIA, although, since the impact is expected to be limited, no specific noise specialist study is envisaged.
Areas of conservation concern	As mentioned previously, 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 (Cunningham, 2022). An eroded granite riverbank, which forms part 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 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. 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. An example of a dolerite ridge, further to the north of the GHDP area, is viewed as unique habitat to a variety of flora and vertebrate fauna. It is however noted that no areas of conservation concern are directly associated with the proposed Cleanergy GHDP Project footprint area.

Specialist Studies

The following site-specific specialist studies were undertaken during the impact assessment phase to address the impacts of significant relevance:

- Biodiversity Impact Assessment;
- Heritage and Archaeology Impact Assessment;
- Visual Impact Assessment;
- Surface Impact Assessment;
- Geohydrological Impact Assessment; and
- Socio-Economic Impact Assessment[2] which incorporates the views of inhabitants on the ground in close proximity to the development.

[2] Due to the importance placed on this item by the proponent, it was decided to allow the consultant to define the baseline of the socio-economic component outside the formal EIA process and then to proactively work with the proponent and contractors to developed sensible mitigation controls prior to the start of construction. Therefore, the socio-economic study will not be part of the formal EIA process but will be executed as part of the EMP in order to make it more proactive.

Certain impacts that are anticipated to be of limited or lower significance, either by virtue of the scale of the impacts, their short duration (e.g., Construction Phase only), disturbed nature of the receiving environment and/or distance to communities, were assessed by EAP Team and reported directly into the EIAR.

The full specialist studies are attached in Appendix D of this EIAR.

Quantification of Impacts

The anticipated impacts associated with the proposed project were assessed according to SRK's standardised impact assessment methodology which is presented in Section 7.1. This methodology has been utilised for the assessment of environmental impacts where the consequence (severity of impact, spatial scope of impact and duration of impact) and likelihood (frequency of activity and frequency of impact) have been considered in parallel to provide an impact rating and hence an interpretation in terms of the level of environmental management required for each impact.

The same methodology was used for the EAP's assessment of the anticipated impacts and are presented in Section 7.2. After mitigation, negative impacts during the construction phase of the project are mostly insignificant while negative impacts during the operational phase are mainly low to very low. Positive impacts during both construction and operational phases vary between medium to very high. Section 7.2. also presents possible mitigation measures that can be implemented to minimise the impacts.

Environmental Impact Assessment

A summary of the impact assessment results is presented in Table ES - 2 for the construction and operational phase.

Table ES - 2: Summary of the Findings of the Environmental Impact Assessment

Impact	Without Mitigation	With Mitigation
Construction Phase		
Socio-Economic		
Potential positive impact on livelihoods/increase in temporary employment opportunities.	Medium	Medium
Negative social impact as a result of an influx of job seekers and potential squatting leading to an increase in social pathologies and petty crimes.	Low	Very Low
Health and safety risk as a result of workers on site leading to the lighting of fires on site, littering, and lack of housekeeping.	Low	Very Low
Air Quality		
Potential deterioration of air quality due to the generation and dispersion of dust (Increase in ambient air concentrations).	Low	Very Low
Noise		
Potential increase in ambient noise levels (in the immediate vicinity of the project) as a result of vehicles and machines operating on site.	Very Low	Insignificant
Heritage and Archaeological Resources		
Potential destruction or loss of cultural artefacts and/or sites of archaeological importance as a result of vehicles and machines operating on site.	Very Low	Insignificant
Visual		
Landscape impact and the loss of vegetation cover as a result of the movement of vehicles and materials, to and from the site area.	Medium	Low
Potential deterioration of visual quality and sense of place as a result of construction activities and dust generation.	Medium	Low

Impact	Without Mitigation	With Mitigation
Biodiversity – Fauna and Flora		
Physical terrestrial habitat disturbance, alteration and loss of vertebrate fauna and flora habitat.	Medium	Low
Loss of fauna as a result of the movement of vehicles and machinery and materials to and from the site.	Medium	Low
Loss of flora as a result of the movement of vehicles and machinery and materials to and from the site.	Low	Low
Establishment and spread of alien invasive plants.	Medium	Low
Surface Water		
The physical disturbance and destruction of dry and ephemeral water courses and drainage lines.	Medium	Low
Deterioration of water bodies as a result of accidental spillages of hazardous substances from construction vehicles/machinery, as well as from hazardous materials storage areas.	Low	Insignificant
Increased surface runoff due to compacted land areas that decreases infiltration.	Medium	Low
Increased erosion, sedimentation, and deposition due to increased runoff caused by compact land that moves sand and soil with the runoff flow.	Low	Insignificant
Groundwater		
Possible deterioration of groundwater as a result of accidental spillages of hazardous substances from construction vehicles/machinery as well as from hazardous materials storage areas resulting in seeping into water bodies.	Medium	Low
Deterioration of reinforced concrete and metal structures due to the ingress of brine that causes weathering of infrastructure.	Medium	Low
Soils		
Physical damage and destruction of soil crusts and soil horizons as a result of the movement of vehicles and machinery and materials to and from the site.	Low	Insignificant
Possible deterioration of soils as a result of accidental spillages of hazardous substances from construction vehicles/machinery as well as from hazardous storage areas.	Low	Insignificant
Climate Change		
The movement of vehicles and earth moving machinery may result in the production of carbon dioxide (Green House Gas), which may have an impact on the climate in the area.	Medium	Low
Waste Storage, Handling and Disposal		
Inappropriate storage, handling and disposal of waste may lead to impacts on surface water, groundwater and soils.	Low	Very Low
Inappropriate storage, handling and disposal of waste may attract scavenging animals to the area which poses a safety risk to the Walvis Bay Airport.	High	Low
Operational Phase		
Socio-Economic		
Potential positive Socio-Economic impacts including: Skills development in the Green Energy Field; The hydrogen production experience gained within Namibia, the demonstration of the potential successful commercialisation of hydrogen within Namibia and the training of local employees with the conversion of renewable electricity energy into green molecules like hydrogen and the successful demonstration; The sale of hydrogen will contribute to the Namibian economy (albeit small as this is only a demonstration plant). Considerable economic investment will also be made during the design and construction phases of the project.	High	High

Impact	Without Mitigation	With Mitigation
Potential negative impact on Sense of Place due to the permanent alteration of the current landscape.	High	Medium
Loss of containment of hydrogen: At the electrolyser with the potential of explosion impacting of site workers/employees; and Stored on-site and at the hydrogen storage/refuelling facility with potential of explosion impacting on workers and general public.	Low	Very Low
Visual		
Light pollution	Medium	Very Low
Landscape impact due to a man-made structure that will be operated instead of the previous natural environment	Medium	Low
Potential deterioration of visual quality and sense of place as a result of operating the PV solar plant resulting in the glint and glare from the solar array.	High	Medium
Impact on aeronautical, particularly flights on approach and departure from the Walvis Bay Airport as a result of operating the PV solar plant resulting in the glint and glare from the solar array.	High	Medium
PV panels will likely impact both long- and short-range views of passers-by due to glint and glare.	High	Medium
The balance of the development footprint will also dominate the medium- and short-range views to and from the site due to the site containing a new development in a natural environment.	High	Medium
Impact on the regional landscape due to the GHDP being a new man-made development in the surrounding natural environment.	Very Low	Insignificant
Biodiversity – Fauna and Flora		
Restriction of animal movement and entrapment including: Disruption of brown hyena movement patterns; and Pipeline trench acts as pitfall trap; and Aboveground pipeline acting as a barrier to ungulates and ostrich.	High	Very Low
Establishment and spread of alien invasive plants.	Low	Very Low
Solar plant potentially disrupting avifauna i.e., bird collisions on infrastructure such as solar panel arrays and fencing.	Low	Low
Attraction of birds to novel habitats through the provision of artificial habitats and resources.	Medium	Low
Surface Water		
Increased surface runoff due to compacted land areas that decrease infiltration.	Medium	Very Low
Increased erosion, sedimentation, and deposition due to increased runoff caused by compact land that moves sand and soil with the runoff flow.	Low	Very Low
Groundwater		
Changes to geohydrological regime as a result of movement of vehicles and machinery and materials to and from the site resulting in the interaction of vehicles and machinery with the environment and hydrology lines.	Low	Very Low
Deterioration of reinforced concrete and metal structures due to the ingress of brine that causes weathering of infrastructure.	Medium	Low
Surface water, groundwater and soil deterioration as a result of inappropriate storage, handling and disposal of waste resulting in the seeping of waste.	Low	Very Low
Soils		
Possible deterioration of soils as a result of accidental spillages of hazardous substances from construction vehicles/machinery as well as from hazardous storage areas.	Low	Insignificant

Impact	Without Mitigation	With Mitigation
Climate Change		
Positive climate change adaption as a result of the development of green hydrogen projects.	High	High
Waste Storage, Handling and Disposal		
Inappropriate storage, handling and disposal of waste may lead to impacts on surface water, groundwater and soils.	Low	Very Low
Inappropriate storage, handling and disposal of waste may attract scavenging animals to the area which poses a safety risk to the Walvis Bay Airport.	High	Low

Mitigation and Monitoring

In terms of the Cleanergy GHDP Project, all negative environmental and social impacts identified will be managed and mitigated to acceptable levels whilst the positive impact will be enhanced to realise the potential positive impacts through the implementation of the commitments stipulated in the EMP. Cleanergy will be responsible for ensuring that all environmental and social obligations pertinent to the Cleanergy GHDP Project are met. The implementation of the EMP and meeting of the environmental objectives and targets are also the responsibility of Cleanergy.

An EMP specific to the Cleanergy GHDP Project has been prepared. The EMP contains specific management measures recommended by the specialists that should be implemented.

Way Forward

- The Final EIAR and CRR will be submitted to MEFT for a decision on the EIA Phase of the EIA process, including the EMP; and
- Following the approval of the EIAR, an ECC will be issued allowing the Cleanergy GHDP Project to proceed.

Conclusion

SRK Consulting has undertaken the ECC application process and subsequent reporting (Scoping as well as the EIAR/EMP) in terms of the proposed Cleanergy GHDP Project in accordance with the requirements of the EMA.

This has included a comprehensive public participation process which has sought to identify stakeholders, provide these parties with an adequate opportunity to participate in the project process and guide technical investigations that have taken place as part of the Impact Assessment Phase of this study. Extensive specialist input has been sought for all key environmental aspects.

To date, no serious flaws/aspects that could render this proposed project unfeasible and impractical, have been identified. Potential impacts require careful mitigation and monitoring measures.

Although some of the potential impacts identified during the Impact Assessment Phase were rated as a high significant rating, the overall significance of the activity's impact can be lowered through the implementation of the recommended mitigation measures, as detailed in the EMP.

It is anticipated that it will be possible to successfully mitigate all of the environmental impacts to acceptable levels and the implementation will be monitored and audited to determine the effectiveness of the measures implemented.

Therefore, from an EAP's perspective based on the current project description and the information obtained through existing and recent site-specific studies, there is no reason why the proposed development may not continue subject to the recommended mitigation measures being implemented. The proposed Cleanergy GHDP Project should be allowed to proceed, given the relatively small potential contribution of the project to cumulative impacts (given the implementation of the appropriate recommended environmental management measures) and also considering the positive social and economic benefits associated with the project.

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Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa) (Pty) Ltd (SRK) by the Cleanergy Solutions Namibia (Pty) Ltd (Cleanergy). The opinions in this Report are provided in response to a specific request from Cleanergy to do so. SRK has exercised all due care in reviewing the supplied information. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features, as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

List of Abbreviations

Abbreviation	Description
ATC	Air Traffic Control
AQI	Air Quality Index
BESS	Battery Energy Storage System
BID	Background Information Document
CITES	Convention on International Trade in Endangered Species
CRR	Comments and Response Register
DC	Direct Current
DEA	Department of Environmental Affairs
EAP	Environmental Assessment Practitioners
ECC	Environmental Clearance Certificate
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMA	Environmental Management Act
EMP	Environmental Management Plan
EDI	Electricity Distribution Industry
ERC	Erongo Regional Council
ESI	Electricity Supply Industry
GDP	Gross Domestic Product
GHDP	Green Hydrogen Demonstration Plant
GIS	Geographic Information System
Ha	Hectare
I&AP	Interested and Affected Parties
IWRM	Integrated Water Resource Management
IFC	International Finance Corporation
ILO	International Labour Organisation
IUSDF	Integrated Urban Spatial Development Framework
KDCA	Kuiseb Delta Conservation Areas
kV	Kilo Volt
kVA	kiloVolt-Ampere
kW	Kilo Watt

LOHC	Liquid Organic Hydrogen Carriers
MAWLR	Ministry of Agriculture, Water and Land Reform
MEFT	Ministry of Environment, Forestry and Tourism
MEGC	Multiple Elements Gas Container
MFMR	Ministry of Fisheries and Marine Resources
MHSS	Ministry of Health and Social Services
MLR	Ministry of Land Reform
MME	Ministry of Mines and Energy
MURD	Ministry of Urban and Rural Development
MVA	MegaVolt Ampere
MW	Mega Watt
MW_p	Megawatts-peak
NAC	Namibia Airports Company
NCAA	National Civil Aviation Authority
NHC	National Heritage Council
NIMT	Namibian Institute of Mining and Technology
NIPDB	Namibia Investment Promotion and Development Board
NUST	Namibia University of Science and Technology
PEM	Polymer Electrolyte Membrane
PoS	Plan of Study
PPP	Public Participation Process
PS	Performance Standard
PV	Photovoltaic
SADC	Southern African Development Community
SMME	Small, Medium and Micro Enterprises
SRK	SRK Consulting (South Africa) (Pty) Ltd
ToR	Terms of Reference
UN	United Nations
UNAM	University of Namibia
UNCBD	United Nations Convention on Biological Diversity
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
V	Volt
WBBR	Walvis Bay Biodiversity Report

WHO	World Health Organisation
WRMA	Water Resources Management Act

1 Introduction and Background to Proposed Project

In 2021, a joint venture was established between the Ohlthaver & List Group of Companies (Namibia's largest privately held group of companies) and CMB.TECH (a Belgian owned company working towards the development of large marine and industrial applications for hydrogen). The joint venture, Cleanergy Solutions Namibia (Pty) Ltd, aims to be the first company in Namibia to produce commercial grade hydrogen from water, utilising renewable energy sources.

Cleanergy Solutions Namibia (Pty) Ltd (henceforth referred to as either the proponent or Cleanergy) appointed SRK Consulting (South Africa) (Pty) Ltd (hereafter referred to as SRK) to facilitate the Environmental Impact Assessment (EIA) process for the proposed pilot site, also referred to as the Green Hydrogen Demonstration Plant (GHDP).

The proposed GHDP will be located outside Walvis Bay on Farm 58, near the Walvis Bay International Airport and Dune 7 (inland to the Dune), to the East of the new Walvis Bay-Swakopmund highway (D1984). The GHDP site falls within the heavy industrial zone which was previously declared by the Walvis Bay Municipality and registered as per the relevant processes under the Urban & Regional Planning Act, as well as the Local Authorities Act The property falls under the Walvis Bay Local Municipality and is situated within the Erongo Region. The total size of the area to be developed will be approximately 26 hectares (ha).

Main components of the GHDP will include:

- Five (5) Megawatts-peak (MWp) solar Photovoltaic (PV) plant, with tracker configuration covering an area of 15 ha;
- Five (5) Megawatts (MW) battery energy storage system;
- Five (5) MW Polymer Electrolyte Membrane (PEM) electrolyser;
- One (1) hydrogen generation alkaline electrolyser system with a capacity of 100-300 Kilowatt (KW)/2-6 kg/h;
- Three (3) 45 kg/hr hydrogen compressors to densify the hydrogen gas for storage;
- Hydrogen buffer tanks and storage tanks (40 bar/300 bar/500 bar);
- Two (2) 350bar hydrogen dispensers for refuelling heavy-duty vehicles;
- Two (2) 500bar hydrogen tube trailer filling stations;
- Two (2) air compressors and nitrogen generators installed in a 40 feet container;
- Water storage tanks with a total capacity of 400 cubic-meters; and
- Information centre/building, which will also be used for training and operations.

The following secondary infrastructure will also be required:

- Access road;
- Water connection (pipeline connecting to main NamWater supply); and
- Grid connection (Erongo RED).

It should be noted that the grid connection will also require an Environmental Clearance Certificate (ECC), but that the process will be managed outside the current application due to the fact that responsibility for complying with the requirements of the ECC will fall within the ambit of Erongo RED.

The demonstration project will be started at a 5 MW scale to:

- Evaluate the efficiency of current available technology within the Namibian context;
- Develop the required skills and competencies locally to operate and maintain the demonstration and possible commercial plant, as well as to share the necessary knowledge to allow for the conversion of existing equipment to allow for the utilisation of hydrogen as a fuel; and
- Develop an offtake for the green hydrogen locally (thus providing additional benefit to the country) to ensure multiple markets for the final product e.g., by converting heavy vehicles used in mining and within the port area to dual fuel vehicles.

One of the critical components of the demonstration plant will be the training centre, with course content being developed along with local vocational training and academic institutions, in order to ensure that the long-term staffing needs of the pilot and commercial facilities can be met. Cleanergy thus wants to commence with the construction of the training centre as soon as possible, in order to ensure that the necessary skills and competencies become available.

SRK, as the appointed Independent Environmental Assessment Practitioner (EAP), compiled an application for an ECC and conducted an EIA process together with the associated Public Participation Process (PPP) in terms of the Environmental Management Act (Act No. 7 of 2007) (EMA) and the associated Regulations 30 of 2012 (Figure 3-1) for the proposed GHDP. The PPP was undertaken in terms of Regulation/Part 21 of EMA.

Development and operation of the proposed 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), the competent authority.

An application was therefore submitted to the MEFT in terms of EMA and its associated EIA Regulations. Commenting authorities reviewed the application for the ECC and relevant reports, and submitted comments to the MEFT for their final review and decision.

This Environmental Impact Assessment Report (EIAR) has been compiled and was distributed for review and comment as part of the EIA process undertaken for the proposed Cleanergy GHDP Project. This EIAR sets out the approach to the EIA process, provides a description of the proposed project, policy and legal framework, the proposed project activities and the characteristics of the baseline environment. It further summarises the findings of the specialist studies, the assessment of potential impacts associated with the Cleanergy GHDP project as well as the mitigation and management measures necessary to mitigate potentially significant impacts.

PPP is a key element of the environmental decision-making process, and PPP forms an integral part of the Scoping Phase as well as the Impact Assessment Phase.

All the comments received were captured and addressed where feasible in the Final Environmental Impact Assessment Report (EIAR), which is submitted to the MEFT for their decision.

Figure 3-1 provides an illustration of the proposed EIA process that was followed.

1.1 Purpose of the Report and Opportunity to comment

This EIAR documents the methodology followed and findings of the Impact Assessment Phase. An EIA is defined as the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made. The aim of the EIA is to prevent substantial damage to the environment. The objectives of this study are:

- To comply with the requirements of EMA and associated Regulations;

- Provide sufficient information on the relevant baseline environmental conditions at the project site;
- Motivate the need for and the overall benefits of the Cleanergy GHDP Project;
- Provide sufficient information on the assessment of the significant impacts that the project may have on the environment;
- Identify and assess the environmental (biophysical, socio-economic, and cultural) impacts of the construction and operation of the proposed project. The cumulative impacts of the proposed development will also be identified and evaluated;
- Identify and evaluate potential management and mitigation measures that will reduce the possible negative impacts of the proposed development and enhance the positive impacts;
- Compile monitoring, management, mitigation and training needs in the EMP;
- Identify ways to enhance positive impacts; and
- Provide the decision-making authorities with sufficient and accurate information in order to make a sound decision on the proposed development and set conditions that must be adhered to.

Comments received through the PPP undertaken (Please refer to Section 3.9) have been collated into a Comments and Responses Register (CRR) (Appendix C_ 10).

The EIAR and EMP were made available to the public for comment from **16 December 2022** to **13 January 2023**[3], to provide Interested and Affected Parties (I&APs) the opportunity to comment on the environmental and social aspects associated with the proposed GHDP.

I&APs were requested to provide comments and information on the following aspects of the proposed project:

- Information on how I&APs consider that the proposed activities will impact on them or their socio-economic conditions;
- Written responses stating their suggestions to mitigate the anticipated impacts of each activity;
- Information on current land uses and their location within the area under consideration;
- Information on the location of environmental features on site to make proposals as to how and to what standard the impacts on site can be remedied; and
- How to mitigate the potential impacts on their socio-economic conditions and to make proposals as to how the potential impacts on their infrastructure can be managed, avoided or remedied.

The availability of the EIAR and EMP were announced by means of letters and emails sent to registered I&APs.

In addition to emailing an Executive Summary of the EIAR to Registered I&APs, the Report was also available to the public via the SRK's website at www.srk.com by clicking on the following link Draft Environmental Impact Assessment (EIA) Report for the Proposed Green Hydrogen Demonstration Plant in Walvis Bay, Namibia (srk.com).

Copies of the EIAR and EMP were made available at the following public places for review:

[3] It is noted that where stakeholders requested for an extension on the commenting period that this was granted till the 27th of January 2023.

- Narraville Library; and
- Walvis Bay Library.

The EIAR and EMP were also made available to commenting authorities during the PPP.

Comments on the EIAR and EMP were submitted to SRK. These comments were used to update the Final EIAR and EMP for submission to MEFT for review and acceptance.

1.2 Project Motivation (Need and Desirability)

Motivation for support of the proposed GHDP is strategic both in the sense of strategy and economy. The project is envisaged to transfer specialist knowledge to the local skillset and set Namibia at the forefront for the supply of green hydrogen as a source of fuel.

Globally, green hydrogen is seen as imperative for the transition to cleaner economies and reducing reliance on fossil fuels, especially within the transport industry. Although the transition to green hydrogen production might initially be expensive, it is expected to decrease significantly as the economy of scale is grown along with the market. Additional derivatives from hydrogen production like ammonia, methanol, and e-kerosene, will further aid in the decarbonisation of the heavy transport sector. The final product can either be exported or utilised locally, though for the latter some investment will be required to develop a local market as well.

Namibia has been identified as one of the countries with the greatest potential for large scale, commercial production of green hydrogen. Though some of the technologies to be utilised are new, there is already a well-established solar plant design and construction industry within the country. Therefore, it is anticipated that existing skill sets will be further enhanced with the development of green hydrogen projects, and entirely new job markets will also open up within a country struggling with high unemployment rates and minimal economic diversification. The industry will also substantially contribute to the overall Gross Domestic Product (GDP) for the country.

One of the main components of the GHDP is also the training centre which will be developed alongside local vocational training and academic institutions. The training centre will serve to ensure long-term staffing needs can be met and that necessary skills and competencies become available.

The final Cleanergy product will be stored as compressed hydrogen compared to liquified hydrogen and liquid organic hydrogen carriers, which require cryogenic temperatures because the boiling point of hydrogen at one atmosphere pressure is -252.8 °C. Some of the risks associated with green hydrogen production, are storage and transportation including that of fire and explosion hazards. Further, as hydrogen gas is colourless and odourless, leaks are hard to identify without dedicated leak detectors.

However, when one considers the potential risks associated with the project, against the benefits, there is an overall view that the development of green hydrogen projects within Namibia will be significantly beneficial, and that there is sufficient scope and skills to manage the risks locally.

The Namibian Constitution, the Supreme Law of Namibia, includes provisions on the protection of the environment and promotes the preservation of biological diversity and ecosystems. It states that natural resources should be used sustainably to make sure that they are available for future generations. Additionally, it guards against the dumping of toxic waste. The State may thus not infringe on the protection and preservation of natural resources and biodiversity and should protect it against any harmful conduct.

It is expected that the proposed project will have some negative environmental impacts as set out in this report. The impacts were investigated in detail during the Impact Assessment Phase of the project. Measures to mitigate the impacts of the project were identified and investigated. The mitigation measures include designs and management practices that will be embarked on, to prevent and/or minimise the identified impacts on the social, cultural, and environmental aspects. These mitigation measures are described in more detail in the EMP that Cleanergy will be required to comply with throughout the life of the project.

The EMP will also include environmental monitoring programme that will allow Cleanergy to keep track of the impacts of the project on the environment and where required, to take remedial action.

When evaluating project specific applications, the strategic context of such applications and the broader societal needs and the public interest are considered. The contents of relevant plans, frameworks, and strategies are taken into account. Whether the proposed activity will be in line with or deviate from the plan, framework, or strategy per se is not the issue, but rather the ecological, social, and economic impacts that will result because of the alignment or deviation. Where an application deviates from a plan, framework, or strategy the EIA shows why the deviation might be justifiable.

Considering the merits of a specific application in terms of the need and desirability consideration, it must be decided which alternative represents the most practicable environmental option which is the option that provides the most benefit and causes the least damage to the environment as a whole, at a cost acceptable to society, in the long-term as well as the short-term. This is the ultimate goal of the EIA process.

1.3 Environmental Impact Assessment Project Team

SRK Consulting has been appointed by Cleanergy as the independent EAP, to conduct an EIA process together with the associated PPP for the proposed GHDP.

SRK was established in 1974 and has since undertaken a large variety of environmental studies. SRK is a South African founded international organisation of professionals providing a comprehensive range of consulting services to natural resource industries and organisations. South African offices are staffed with over 400 professional consultants in nine offices, operating in a range of disciplines, mainly related to the environment, water, social, and mining sectors. Back-up and peripheral expertise are available within these offices for all environmental projects.

The details of the team, including the EAPs and specialists undertaking the EIA process are provided in Table 1-1.

Table 1-1: EAP Contact Details

Environmental Assessment Practitioner		
EAP Name	**Contact Number**	**Email Address**
Dr Laetitia Coetser Project Partner and EAP	+27 (0) 12 361 1908	lcoetser@srk.co.za
Ndomupei Masawi Project Manager and EAP	+27 (0) 12 361 1908	nmasawi@srk.co.za
Marissa Swart Project Consultant	+27 (0) 12 361 1908	mswart@srk.co.za
Fredrika Shagama Project Consultant	+26 (0) 81 407 5536	fredrika@serjaconsultants.com
Environmental and Social Specialists		
Environmental Aspect	**Name**	**Consultant**
Heritage and Archaeology Impact Assessment	Dr Alma Nankela (Research Culture Heritage Services CC: Archaeosciences & Consultants)	ahamulo@gmail.com / rcheritageservices@gmail.com
Biodiversity Impact Assessment	Peter L Cunningham (Environment & Wildlife Consulting, Namibia)	pckkwrc@yahoo.co.uk
Visual Impact Assessment	Theo Bredell (In Site Landscape Architects)	theo@insitegroup.co.za
Surface and Geohydrological Impact Assessment	Diganta Sarma (Namib Hydrosearch)	diganta@namibhydro.com
Socio-Economic Impact Assessment	Randolph Mouton (Sustainable Development Africa cc)	randolphmouton@susdaf.com

Dr Laetitia Coetser is a Partner within SRK and has been involved in the field of water and environmental management for more than 23 years. She holds a PhD. in Water Resource Management at the University of Pretoria and is a registered Professional Natural Scientist (SACNASP) (Pr. Sci. Nat 400312/06). She has an in-depth understanding and application of Integrated Environmental Management. She provides specialist advise to EIAs and EMPs as well as to Water Use Authorisations/Permitting. Laetitia has a range of specialisations including water resource management, surface water management, stakeholder engagement, data management and interpretation, environmental compliance auditing and due diligences. She has solid knowledge and understanding of the environmental legislation and subsequent regulations. Laetitia has further been involved with acid mine treatment and diffuse pollution and has compiled numerous articles and presentations on these matters. She is therefore well placed to be the Team Leader on this project.

Ndomupei Masawi is a registered Professional Natural Scientist (SACNASP Reg Number 400045/14) with an MSc Degree in Geo-Information for Environmental Management and an MSc Degree in Integrated Water Resource Management. Ndomupei has more than 15 years of Integrated Environmental Management and project management experience. Her experience includes compiling Environmental Management Plans, undertaking Public Participation Processes, providing Geographic Information System (GIS) Services and undertaking the processes and assessments to support applications for Environmental Authorisations, Water Use Authorisation/Permitting, Waste Management Licences and Air Emission Licences, for steel galvanising, roads, railway lines, power stations, airports, dams, housing developments, schools in South Africa, Tanzania, Botswana, Lesotho, Zimbabwe, and Uganda.

Fredrika Shagama is a Geological Engineer (Hydrogeologist) with 7 years of experience in Groundwater and Environmental Consulting, with experience both in Namibia (mainly), South Africa and the Czech Republic. Her core skills are in Hydrogeology (Groundwater exploration, Supply, Drilling supervision, Impact Assessment and monitoring), Geotechnical investigation phase 1. Although Fredrika is a geological engineer (Hydrogeologist) by qualification and experience, she has also gained valuable experience in conducting EIAs and compilation of EMPs, facilitating EIA Consultation meetings and Stakeholders' Engagement. The specific groundwater and EIA project responsibilities range from proposal writing, technical report compilation, public meeting facilitation, site visits & assessments (fieldwork) to environmental compliance monitoring / auditing on sites.

Marissa Swart holds an Honours degree in Geography and Environmental Science and is busy completing her master's degree in Environmental Management. Ms Swart is a newly appointed Junior Environmental Scientist at SRK and is eager to gain experience in the Environmental Management field.

The Curriculum Vitae and declaration of interest of the EAP team and the background on experience gained by SRK in the field of Environmental Impact Assessments are provided in Appendix A.

1.4 Structure of this Report

The outline and brief description of each section in this report is provided in Table 1-2.

Table 1-2: Structure and Content of the EIAR

Section	Contents
Executive Summary	The Executive Summary provides an overview of issues addressed in the report and results from the impact assessment.
Section 1	This section introduces the project, motivates for the project and a detailed overview of the EIA team.
Section 2	This section provides both national legal frameworks that needs to be adhered to as well as any international obligations that Namibia has.
Section 3	This section provides the process that was followed both during the Scoping Phase and Impact Assessment phase of the report.
Section 4	This section provides a detailed overview and description of the project, site layout, and technologies that will be used.
Section 5	This section describes the alternatives that were considered when designing the project.
Section 6	This section describes various sections of the environment to be able to accurately assess impacts that the proposed project might have on the environment.
Section 7	This section lists and describes environmental, social and cultural impacts that are anticipated during the construction and operational phases of the project.
Section 8	This section describes the impact assessment methodology that was used, provides the risk assessment results, possible mitigation measures for the impacts, and methods to monitor mitigation of the impacts.
Section 9	This section describes assumptions and limitations to the proposed project and impact assessment thereof from the EAP as well as from the different specialists.
Section 10	This section serves as an undertaking of oath by the EAP.
Section 11	This section provides a conclusion to the report, any recommendations as well as an environmental impact statement from the EAP.
Section 12	This section provides the full references to the in-text citations used in this report.

2 Environmental Policy and Legal Framework

The EIA Regulations (2012) requires that all legislation and guidelines considered in the EIA process be documented. This Section provides an overview of the relevant Namibian legislation and policies considered and also provides an overview of the Namibian administrative framework and international treaties, industry standards and guidelines applicable to the Cleanergy GHDP Project.

2.1 Namibian Institutional and Administrative Structure

The Namibian Constitution makes provision for the creation and enforcement of applicable legislation. Five tiers of law exist and include:

- The Constitution;
- Statutory law;
- Common law;
- Customary law; and
- International law.

Numerous laws intended to protect the natural environment and to manage potential environmental impacts have been passed following the Independence of Namibia in 1990. Table 2-1 provides a summary of the applicable legislation, policies and guidelines identified as relevant to the proposed Cleanergy GHDP Project.

2.1.1 Ministry of Environment, Forestry and Tourism

MEFT develops, administers, and enforces environmental legislation and policy in Namibia. The mission of MEFT is to promote biodiversity conservation in the Namibian environment through the sustainable utilization of natural resources and tourism development for the maximum social and economic benefit of its citizens.

The MEFT's Department of Environmental Affairs (DEA) gives effect to Article 95L of the Constitution by promoting environmental sustainability and is responsible for, inter alia, the administration of the EIA processes undertaken in terms of EMA and the EIA Regulations (2012). The Environmental Commissioner serves as head of the DEA.

The DEA will be responsible for the issuing of a decision on the ECC application in the form of an ECC, based on recommendations from other Commenting Authorities.

2.1.2 Ministry of Mines and Energy (MME)

The MME comprises of six directorates of which one is the Directorate of Energy. The Directorate of Energy consists of 2 divisions, namely the Electricity Division and the Renewable Energy Division.

The Directorate of Energy enforces compliance of legal requirements of energy legislation (Electricity Act, Act No. 4 of 2007).

In March 2017, a directive was issued from MEFT which requires that applications for ECC for projects relating to power generation be submitted to MME as the Competent Authority.

It is noted that the purpose of the Cleanergy GHDP Project is not that of power generation but rather that of alternative energy supply in the form of green hydrogen for the use in local heavy-duty equipment like trucks, locomotives, tugboats, port/mining equipment and gensets.

2.1.3 Ministry of Agriculture, Water and Land Reform (MAWLR)

The MAWLR has as its mission the realization of the potential of the Agricultural, Water and Forestry sectors towards the promotion of an efficient and sustainable socio-economic development for a prosperous Namibia. The MAWLR is mandated to promote, develop, manage and utilize Agricultural and Water resources.

It is noted that as potable water will be sourced from municipality with a direct connection to the main water pipelines, the Cleanergy GHDP Project will not require the installation of a desalination plant.

2.1.4 Ministry of Fisheries and Marine Resources (MFMR)

The Ministry of Fisheries and Marine Resources (MFMR) is responsible for the management and development of fisheries and aquaculture in Namibia. The Ministry is comprised of four directorates; two of which include the Directorate of Resource Management and Directorate of Operations and Surveillance.

The Directorate of Resource Management is responsible for scientific research and providing advice on the state of commercially important marine fish stocks and recommending catch quotas. It is also responsible for managing and regulating species fish size limits, dates of closed fishing seasons, declaring areas closed to fishing and determining fishing gear use.

The Directorate of Operations and Surveillance is responsible for monitoring, controlling and surveillance of fishing-related activities both at sea and onshore.

It is noted that the proposed Cleanergy GHDP Project will have no impact on marine ecology and the fishing industry due to its proximity to the sea and the fact that no desalination plant will be required.

2.1.5 Namibia Power Corporation and Regional Electricity Distributors

Erongo RED was formed by merging the service of electricity distribution from the various municipalities and town councils in the Erongo region namely: the Municipality of Walvis Bay, Swakopmund, Henties Bay and Omaruru; the Town Council of Karibib, Usakos and Arandis; Erongo Regional Council (ERC); and NamPower. All these individual institutions are shareholders of Erongo RED. The initiative to create REDs was part of the Electricity Supply Industry (ESI) and Electricity Distribution Industry (EDI) restructuring Policy to distribute and supply electricity through economies of scale, the pooling together of human and operational capital resources to ultimately stabilize electricity prices and ensure reasonable, affordable and cost-effective tariffs to electricity consumers.

The company purchases electricity from NamPower for both urban and rural customers. The electricity is then transmitted and distributed to the various customer segments ranging from residential, business and industrial. Erongo RED uses about 21% of the total electricity requirement of Namibia. The electricity industry in Namibia is regulated by the Electricity Control Board of Namibia, thus Erongo RED operates under set regulations.

A 5 MegaVolt Ampere (MVA) connection from the Erongo RED electricity distribution grid will be required. It should be noted that the grid connection will also require an ECC, but that the process will be managed outside the current application due to some minor technical components which still need to be finalised and the fact that responsibility for complying with the requirements of the ECC will fall within the ambit of Erongo RED.

2.1.6 Namibian Water Corporation

The Namibia Water Corporation (NamWater) is another key stakeholder in the project and the EIA process. NamWater supplies water in bulk to industries, government institutions, municipalities, local authorities, commercial entities, such as mines, and to the Directorate of Water Supply and Sanitation in the MAWLR. The Directorate in turn supplies water to rural communities.

NamWater is a commercialized water entity, wholly owned by the Government of the Republic of Namibia, NamWater's mandate is to provide quality water and related services to the satisfaction of all stakeholders, taking cognizance of the environment, scarcity of and dependency of all on water. The Board of Directors ensures that NamWater utilizes the scarce water resources in the best interests of Namibia and the Namibian People.

The water which will be used in the process, is potable water supplied directly to site from municipality with a direct connection to the main water pipelines. Depending on the season, it is anticipated that between 10 m^3 and 14 m^3/day of potable water will be required for the overall operation of the Proposed Cleanergy GHDP Project.

2.2 Namibian Legislation

Table 2-1 provides a summary of the applicable legislation, policies and guidelines identified as relevant to the proposed project. In addition, a description of how the proposed activity complies with and responds to the legislation and policy context, is provided. This list is not exhaustive but rather represents an indication of the most applicable pieces of environmental legislation relevant to the project.

Table 2-1 Policy and Legislative Context of Proposed Project

Legislation	Description and Relevance	Responsible Authority
Namibian Constitution First Amendment Act (Act No. 34 of 1998)	Article 95 (l) of the Constitution of the Republic of Namibia states that *"the State shall actively promote and maintain the welfare of the people by adopting, inter alia, policies aimed at … maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of natural resources on a sustainable basis for the benefit of all Namibians both present and future; in particular the Government shall provide measures against the dumping or recycling of foreign nuclear and toxic waste on Namibian Territory*." Article 100 states "*that the land, water and natural resources below and above the surface of the land … shall belong to the State if they are not otherwise lawfully owned*." Article 101 of the Namibian Constitution further states that the principles embodied within the constitution "*shall not of and by themselves be legally enforceable by any court but shall nevertheless guide the Government in making and applying laws. … The courts are entitled to have regard to the said principles in interpreting any laws based on them*." *Ecological sustainability informed and guided this ECC Application process and the proposed Cleanergy GHDP Project.* The constitutional recognition of environmental concerns triggered widespread legislative reform relating to the management of natural resources in Namibia. The country's environmental protection effort is currently comprised of the EMA and its Regulations (2012).	Not Applicable
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 EIA. Policies, programmes and projects requiring an Environmental Assessment, 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). The EIA Policy of 1995 therefore promotes accountability and informed decision making through the requirement of EIAs for listed programmes and projects. As mentioned above, the EIA policy is currently enforced through the EMA and its Regulations (2012). *The Environmental Assessment Policy for Sustainable Development and Environmental Conservation is applicable to the proposed Cleanergy GHDP Project as listed activities in terms of the EIA Regulations, GNR 30 of 2012 published in terms of the EMA Section 56 are triggered. Please refer to Section Table 2-2 for EMA Listed Activities.*	MEFT
Environmental Management Act (Act No. 7 of 2007)	The EMA promotes the sustainable management of the environment and the use of natural resources. It establishes principles for decision making on environmental related matters, establishes the Sustainable Development Advisory Council, provides to the appointment of an Environmental Commissioner along with environmental Officers, provides for	MEFT

Legislation	Description and Relevance	Responsible Authority
	the control and assessment of activities that might have a significant impact on the environment, and provides for incidental matters. *The EIA Regulations, GNR 30 of 2012 published in terms of the EMA Section 56 regulates this proposed project and will be used to conduct a Scoping and Environmental Impact Assessment to obtain an ECC before commencing with the project. Please refer to Section 2.2.1 for EMA Listed Activities.*	
Water Act (Act No. 54 of 1956) Water Resources Management Act (Act No. 11 of 2013)	The Water Resources Management Act (WRMA) (Act No. 11 of 2013) provides a framework for the management, protection, development, use, and conservation of water resources, for the regulation and monitoring of water services, and incidental matters. Currently the Water Act (Act No. 54 of 1956) is still applicable law. WRMA will become applicable law once the Government publishes a Government Notice in the Government Gazette, confirming the commencement of the new Act. A person may only abstract and use water from a water resource, which exceeds the threshold authorised in terms of a law relating to water resources above a certain threshold, if the person holds a licence issued by the Minister that authorises the abstraction and use of water from that water resource. *As potable water will be used for the Cleanergy GHDP Project, no abstraction from a water resource will take place. There will also not be any discharge of water back to the environment. Therefore, no licence to abstract or use water resources will be required for the Cleanergy GHDP Project.* Part 13 of the WRMA deals with Water Pollution Control and the opening section stipulates that "*a person may not by any act or omission cause a water resource to be polluted, either directly or indirectly, unless authorised to do so by or under this Act or any other law, and in accordance with that authorisation*." *The protection of ground and surface water resources should be a priority for the proposed Cleanergy GHDP Project. Possible deterioration of surface and groundwater as a result of accidental spillages concrete during construction, accidental spillages of hazardous substances from construction vehicles and machinery, as well as from hazardous materials storage areas are the main threats to water resources associated with the proposed project.*	Ministry of Agriculture, Water, and Rural Development
Namibia Water Corporation Act (Act No. 12 of 1997)	The Namibian Water Corporation Act (Act No. 12 of 1997) aims to establish the Namibia Water Corporation Limited; to regulate its powers, duties, and functions; to provide for a more efficient use and control of water resources; and to provide for incidental matters. *The protection of ground and surface water resources should be a priority for the proposed Cleanergy GHDP Project. Possible deterioration of surface and groundwater as a result of accidental spillages concrete during construction, accidental spillages of hazardous substances from construction vehicles and machinery, as well as from hazardous materials storage areas are the main threats to water resources associated with the proposed project.*	Ministry of Agriculture, Water, and Rural Development
Nature Conservation Ordinance (No. 4 of 1975) – Nature Conservation Amendment Act (Act No. 5 of 1996)	The Nature Conservation Amendment Act No. 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)*	MEFT

Legislation	Description and Relevance	Responsible Authority
	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). *The Proposed Cleanergy GHDP Project 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" i.e., habitats or migration routes which are critical for species' survival. This Act and Ordinance will be applicable to the proposed project as a large area of land will be impacted on by the development and needs to be cleared for the development which may include the need to remove protected and endangered species as well as invasive species. In accordance with this, a biodiversity impact assessment was conducted as part of the specialist studies.*	
Forest Act (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*." *The Proposed Cleanergy GHDP Project 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" i.e., habitats or migration routes which are critical for species' survival. This Act and Ordinance will be applicable to the proposed project as a large area of land will be impacted on by the development and needs to be cleared for the development which may include the need to remove protected and endangered species as well as invasive species. In accordance with this, a biodiversity impact assessment was conducted as part of the specialist studies.*	MEFT
Civil Aviation Act (Act No. 6 of 2016)	The Civil Aviation Act, Act No 6 of 2016 was brought into force on 1 November 2016 and was published in GG 6047. This act consolidates laws relating to civil aviation and related offences, provides powers and functions of the Minister, establishes the Namibia Civil Aviation Authority (NCAA) including its powers and functions, establishes the Air Navigation Services, provides for a civil aviation regulatory and control framework for the safety and security of civil aviation to ensure the implementation of international agreements, establishes the Directorate of Aircraft Accident and Incident Investigations with its powers and functions, establishes the Namibia Register of Aircraft and the Civil Aviation Registry, repeals civil aviation and offence laws, and provides for incidental matters. The Namibian Civil Aviation Regulations was published in terms of the Civil Aviation Act in 2001 (GG 2467). These regulations were amended twice in 2006, once in 2017, twice in 2018, once in 2019, and twice in 2020. *This Act with its regulations may be applicable to the project as solar panels will be installed and the project area is located in close proximity to the Walvis Bay International Airport. A visual impact assessment will be undertaken as part of the EIA to assess the potential impacts associated with the PV plant location in relation to the Walvis Bay Airport. Light reflection*	Ministry of Works and Transport (MWT)

Legislation	Description and Relevance	Responsible Authority
	from the solar array may further impact on aeronautical users, particularly flights on approach and departure from the Walvis Bay Airport. In accordance with this, a visual impact assessment was conducted as part of the specialist studies.	
National Heritage Act (Act No. 27 of 2004)	This Act provides for, inter alia, the protection and conservation of places and objects of heritage significance. A National Heritage Council (NHC) has been established to identify, conserve, manage, and protect places and objects of heritage significance. Permits are required for the removal, damage, alteration or excavation of heritage sites or remains. Any person who discovers an archaeological site should notify the NHC. These aspects could be relevant during the construction activities of the proposed project and will require to be assessed. *Potential deterioration of cultural artefacts within the proposed footprint of the project area. Construction activities may overturn currently unidentified historical artefacts. A heritage and archaeological impact assessment will be conducted as part of the EIA Phase of the project. Any heritage resources (e.g., human remains, artefacts etc.) discovered during the Construction Phase of the project will require a permit from the NHC for relocation. In accordance with this, a heritage impact assessment was conducted as part of the specialist studies.*	MEFT
Burial Place Ordinance 27 of 1966	Burial Place ordinance 27 of 1966 prohibits the desecration or disturbance of graves and regulates how bodies may be unearthed or dug up. *A heritage and archaeological impact assessment was conducted as part of the EIA Phase of the project. Any heritage resources (e.g., human remains, artefacts etc.) discovered during the Construction Phase of the project will require a permit from the NHC for relocation.*	MEFT
National Monuments Act (Act No. 28 of 1969)	This Act establishes a National Monuments Council and provides for the preservation of certain property as National Monuments and the maintenance of certain burial grounds. *No property of National importance is located within the project footprint area.*	MEFT
Soil Conservation Act (Act No. 76 of 1969)	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*." *Cognizance is to be taken in identifying potential impacts on soil, vegetation, water supply sources and resources by following the hierarchy of environmental impact mitigation i.e., avoid, then minimise, then restore impacted areas and finally offset any impacts that remain.*	Ministry of Agriculture, Water, and Rural Development
Hazardous Substances Ordinance 14 of 1974	The Hazardous Substances Ordinance 14 of 1974 provide for the control of toxic substances which may result in injury, ill health or death of human beings. *Storage and handling of various hazardous chemicals. Hydrogen will be produced which is a combustible fuel. Facilities for the storage and handling of dangerous goods including the storage of hydrogen.*	Ministry of Health and Social Services (MHSS)
Atmospheric Pollution Prevention Ordinance 11 of 1976	The Atmospheric Pollution Prevention Ordinance, 11 of 1976 (GG 3555) came into force on 18 August 1976. This Ordinance provides for the prevention of the pollution of the atmosphere and for related incidental matters. *Potential deterioration of air quality due to the generation and dispersion of dust caused by construction activities.*	MHSS

Legislation	Description and Relevance	Responsible Authority
Labour Act (Act No. 11 of 2007)	The Labour Act, Act No 11 of 2007 (GG 3971) was enforced on 1 March 2009 and was amended by Act No 2 in 2012 (GG 4925). This Act consolidates and amends the labour law, establishes a comprehensive labour law, entrenches fundamental labour rights and protections, regulates basic employment terms and conditions, ensures the safety, health, and welfare of employees, protects employees from unfair labour practices, regulates trade union and employer organisation registrations, regulates collective labour relations, provides for systematic prevention and resolution of labour disputes, establishes the Labour Advisory Council, the Labour Court, the Wages Commission and the labour inspectorate, provides for the appointment of the Labour Commissioner and Deputy Labour Commissioner, and provides for incidental matters. This Act can also be linked to other related Acts such as the Social Security Act (Act No. 34 of 1994), the Employees Compensation Act (Act No. 5 of 1995), and the Affirmative Action (Employment) Act (Act No. 29 of 1998). *Cleanergy should ensure that all contractors involved during the Construction, Operation and Maintenance Phases of the Cleanergy GHDP Project comply with the provisions of these legal instruments.*	Ministry of Labour, Industrial Relations and Employment Creation
Public and Environmental Health Act (Act No. 1 of 2015)	The Public and Environmental Health Act, Act No 1 of 2015 was published in GG 5740 and brought into force on 17 September 2020. This Act provides a framework for a structured uniform public and environmental health system in Namibia. It also provides for incidental matters. The Public Health Covid-19 General Regulations, GNR 91 of 2021 (GG 7522) was published in terms of the Public and Environmental Health Act and was repealed numerous times in 2021 and 2022. *Cleanergy should ensure that all contractors involved during the Construction, Operation and Maintenance Phases of the Cleanergy GHDP Project comply with the provisions of these legal instruments.*	MHSS
Regulations relating to the health and safety of employees at work (GN 156 of 1997)	These Regulations establish health and safety regulations for the workplace. *Cleanergy should ensure that all contractors involved during the Construction, Operation and Maintenance Phases of the Cleanergy GHDP Project comply with the provisions of these legal instruments.*	MHSS
Urban and Regional Planning Act (Act No. 5 of 2018)	The Urban and Regional Planning Act, Act No 5 of 2018 (GG 6631) came into force on 3 September 2020 and aims to consolidate laws relating to urban and regional planning, provide the legal framework for spatial planning, provide principles and standards of spatial planning, establish the regional and urban planning board, decentralise matters relating to spatial planning, prepare, approve, and review the national spatial development framework, regional structure plans, and urban structure plans, prepares, approves, reviews, and amendments zoning schemes, establish townships, alter boundaries of approved townships, disestablishment of approved townships, change names of approved townships, subdivide and consolidate land, alter, suspend, and delete conditions relating to land, and provide for incidental matters. Regulations relating to Urban and Regional Planning (GG 223) of 2020 (GG 7327) were published in terms of the Urban and Regional Planning Act Section 131. *Area zoned as Heavy Industrial Area.*	Ministry of Urban-Rural Development

Legislation	Description and Relevance	Responsible Authority
Roads Ordinance 17 of 1972	The Roads Ordinance, 17 of 1972 (OG 3268) was brought into force on 1 January 1973 and was amended in 1973 (twice), 1974, 1975, 1979, 1980, 1984, 1986, and 1993. This Ordinance consolidates and amends laws relating to roads and incidental matters: • Reserve boundaries (S3.1); • Control of traffic on urban trunk and main roads (S27.1); • Rails, tracks, bridges, wires, cables, subways or culverts across or under proclaimed roads (S36.1); • Infringements and obstructions on and interference with proclaimed roads. (S37.1); and • Distance from proclaimed roads at which fences are erected (S38). *The limitations applicable to the Roads ordinance on proclaimed roads should inform the proposed layout and zonings where applicable.*	MWT
Walvis Bay Town Planning Scheme	This statutory document provides land use regulations and development. *Land uses and developments associated with the proposed Cleanergy GHDP Project, should be in accordance with the Town Planning Scheme.*	Walvis Bay Municipality
Integrated Urban Spatial Development Framework (IUSDF) of Walvis Bay	Provides future land use planning within the Walvis Bay district. *The IUSDF was utilized to see if the proposed activity is in accordance with the future planning of Walvis Bay.*	Walvis Bay Municipality
Walvis Bay Climate Strategic Action Plan	Provides action plans on how Town Planning can help mitigate Climate Change. To promote two-storey developments, reduce urban sprawl and land competition. Encourage EIA studies with regards to rezoning. *Area zoned as Heavy Industrial Area.*	Walvis Bay Municipality
Walvis Bay Biodiversity Report of 2008 (WBBR, 2008)	Provides a comprehensive summary and map of sensitive Biodiversity Areas and Zoning in the Walvis Bay district. *To ensure that the proposed activity is not located close to any Biodiversity Area or Zoning.*	Walvis Bay Municipality
Sustainable Urban Energy Planning: A handbook for cities and towns in developing countries (SUEP, 2004)	Provides a comprehensive list and case studies to implement energy saving measures. *Implementing energy-efficiency and carbon mitigation measures. Conserve natural resources with city planning.*	Walvis Bay Municipality

2.2.1 EMA Listed Activities and Description

Table 2-2 provides a summary of the proposed listed activities triggered in terms of the EIA Regulations.

Table 2-2: Detailed Description of the Proposed Listed Activities

Proposed Listed Activities	Description and Relevance
Energy generation, transmission, and storage	
1. The construction of facilities for – (a) the generation of electricity.	Construction and operation of a 5 MW_p demonstration solar PV power plant, including a battery storage facility, powering a 5 MW electrolyser allowing for the production of green hydrogen.
Waste management, treatment, handling, and disposal activities	
2.1. The construction of facilities for waste sites, treatment of waste and disposal of waste.	The construction of a wastewater collection system comprising of a conventional gravity system and conservancy tanks.
Hazardous substance treatment, handling, and storage	
9.1. The manufacturing, storage, handling, or processing of a hazardous substance defined in the Hazardous Substances Ordinance, 1974.	Storage and handling of various hazardous chemicals. Hydrogen will be produced which is a combustible fuel.
9.4. The storage and handling of a dangerous goods, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 cubic meters at any one location.	Facilities for the storage and handling of dangerous goods including the storage of hydrogen.
9.5. Construction of filling stations or any other facility for the underground or aboveground.	Construction and operation of a hydrogen filling station.
Infrastructure	
10.1. The construction of – (a) oil, water, gas, and petrochemical and other bulk supply pipelines. (b) public roads.	The project will require the construction of: • Access road(s) to site; and • Water supply pipeline from closest NamWater connection point.

2.2.2 Other Key Relevant Namibian Policies

Policies provide the framework to applicable legislation and are used to provide support to legal interpretation or guidance regarding the implementation of governmental objectives. Relevant policies not mentioned before applicable to the proposed Cleanergy GHDP Project include, but is not limited to:

- Environment:
  - 2nd National Biodiversity Strategy and Action Plan NBSAP2 (2013-2022);
  - Policy for Prospecting and Mining in Protected Areas (2018);
  - Access and Benefit Sharing Act (2017);
  - Environmental Assessment Policy (1995);
  - Land Use Planning towards Sustainable Development Policy (1994);
  - Draft Pollution Control and Waste Management Bill (1999); and
  - Nature Conservation Ordinance 4 of 1975.

- Water:
  - Water Resources Management Act (2004 and revised 2013);
  - Namibia's integrated Water Resources Management (IWRM) plan (2010);
  - Water and Sanitation Policy (2008);
  - Namibia's Draft Wetland Policy (2004); and
  - National Water Policy White Paper (2000).
- Planning:
  - National Development Plan 5 and Vision 2030;
  - Fifth National Development Plan (2017);
  - National Integrated Resource Plan (2016);
  - Harambee Prosperity Plan (2016);
  - Vision 2030 (2004);
  - Regional Poverty Reduction Action Programme (2003); and
  - Regional Planning and Development Policy (1997).
- Forestry, Parks and Wildlife:
  - National Policy on Human Wildlife Conflict Management (2011);
  - Forestry Development Policy (1998);
  - Amendment to the 1975 Nature Conservation Ordinance (1996);
  - Wildlife management, Utilization and Tourism in Communal Areas Policy (1995);
  - Promotion of Community Based Tourism Policy (1995);
  - Policy for the Conservation of Biotic Diversity and Habitat Protection (1994); and
  - National Forest Policy (1992).
- Land:
  - National Agricultural Policy (2015);
  - Land Degradation Neutrality Report (2015);
  - National Industrial Policy (2012);
  - Communal Land Reform Act (2002);
  - National Land Tenure Policy (2005);
  - Land Tax and Communal land Reform Act (2002);
  - National Resettlement Policy (2001);
  - National Land Policy (1998);
  - National Land Policy, the National Resettlement Policy, The Agricultural (Commercial) Land Reform Act (1995); and
  - Commercial Land Reform Act (1995).
- Energy:

  - National Energy Policy (2017); and
  - White Paper Policy on Energy (1998).
- Disaster risk management:
  - The Windhoek Declaration for Enhancing Resilience to Drought in Africa (2016); and
  - National Policy for Disaster Risk Management (2009).
- Climate change:
  - Intended Nationally Determined Contributions of The Republic of Namibia to the United Nations Framework Convention on Climate Change (2015);
  - National Climate Change Strategy and Action Plan (2013); and
  - National Policy on Climate Change for Namibia (2011).
- Tourism:
  - National Tourism Growth and promotion Strategy (MET, 2016);
  - National Policy on Tourism for Namibia (2008);
  - National Policy on Tourism for Namibia (2008);
  - Community Based Tourism Policy (1995); and
  - The Tourism White Paper (1994).
- Local Authorities:
  - Public and Environmental Health Act (Act No.1 of 2015); and
  - Local Authority Act (Act No. 23 of 1992)

2.3 Overview of Relevant International Standards

2.3.1 International Conventions

Relevant international conventions and protocols to which Namibia is a signatory include:

- The Kyoto Protocol on United Nations (UN) climate change (ratified in 2020);
- Basel Convention on the control of trans boundary movements of hazardous wastes and their disposal (1992);
- Ramsar (wetlands) Convention (ratified in 2001);
- Convention for the Safeguarding of the Intangible Cultural Heritage Paris, 17 October 2003 (Ratification in Nigeria 2005);
- Convention of International Trade in Endangered Species of 1973;
- Convention of Biological Diversity, 1992;
- The Convention on International Trade in Endangered Species (CITES) of 1973;
- Convention Concerning the Protection of the World Cultural and Natural Heritage. Paris, 16 November 1972 (Ratification in Nigeria 1974);
- United Nations Convention to Combat Desertification (ratified in 1997);
- National Rangeland Management Policy and Strategy of 2012;

- National Biodiversity Strategy and Action Plan 1 and 2 (Draft);
- Vienna Convention for the protection of the ozone layer (1985);
- Montreal Protocol on Substances that Deplete the Ozone Layer (1987) (Ratification in Nigeria 1988);
- United Nations Convention on Biological Diversity (UNCBD);
- Equator Principles;
- United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) 2007; and
- The International Labour Organisation (ILO) Eight Fundamental Conventions, consisting of the following:
  - Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87);
  - Right to Organise and Collective Bargaining Convention, 1949 (No. 98);
  - Forced Labour Convention, 1930 (No. 29), and its 2014 protocol;
  - Abolition of Forced Labour Convention, 1957 (No. 105);
  - Minimum Age Convention, 1973 (No. 138);
  - Worst Forms of Child Labour Convention, 1999 (No. 182);
  - Equal Remuneration Convention, 1951 (No. 100); and
  - Discrimination (Employment and Occupation) Convention, 1958 (No. 111).

Many of these are incorporated into the various World Bank Operational Procedures and the International Finance Corporation (IFC) Performance Standards (PS). So, by conforming to these two sets of standards, the EIA complies with the requirements of the relevant international protocols and conventions.

2.3.2 The Equator Principles

Institutions adopt the Equator Principles as a risk management framework to determine, assess and manage potential environmental and social impacts. These principles aid due diligence and making decisions. This is done in compliance with the International Finance Corporation (IFC) Performances Standards and the Health and Safety Guidelines provided by the World Bank Group.

The Equator Principles consist of 10 principles that support the EIA process and risk management. Table 2-3 provides the 10 principles that needs to be consider in this EIA.

Table 2-3: Equator Principles

No.	Principle	Description
1	Review and Categorisation	This Principle reviews the project activities in terms of risk on the environment and society to be able to categorise the project either as a Category A (significant risk), Category B (potential limited adverse risk), or Category C (minimal or no adverse risk).
2	Environmental and Social Assessment	This principle requires the client to conduct appropriate assessments to determine the environmental and socio-economic impact that the project might have. These assessments should also consider Climate Change risk assessment
3	Applicable Environmental and Social Standards	Assessments done should address compliance with the relevant country's laws, regulations and permits including due diligence. Projects located in non-designated countries should comply with applicable IFC Performance Standards and the World Bank Group Environmental, Health and Safety (EHS) Guidelines, while projects in

No.	Principle	Description
		designated countries should comply with the host country laws, regulations and permits.
4	Environmental and Social Management System and Equator Principles Action Plan	For projects that fall within Category A or Category B should also develop and maintain and Environmental and Social Management System. This should also include an Environmental and Social Management Plan that can be incorporated.
5	Stakeholder Engagement	Ongoing stakeholder engagement is a requirement for a Category A and Category B projects. This should take into account risks and impact, the development, language preferences, advantages and disadvantages, etc. In addition, appropriate assessment documentation should be readily available to affected communities and other stakeholders. Indigenous knowledge is imperative to each project.
6	Grievance Mechanism	A grievance mechanism should be in place with the goal to resolve concerns promptly, using consultation, but should not impede access to judicial or administrative remedies.
7	Independent Review	The review and assessments should be conducted by an independent environmental and social consultant and should ensure due diligence
8	Covenants	If the client does not comply with the social and environmental covenants, remedial actions can be worked on for the project to comply. If this fails remedies can be implemented on the client's behalf.
9	Independent Monitoring and Reporting	Monitoring and reporting should also be done by an independent environmental and social consultant, or the client could retain qualified and experienced external experts.
10	Reporting and Transparency	The Social and Environmental Impact Assessment should be available and accessible online, summarising human rights, climate change risks, and impacts. The client should publicly report on Greenhouse gas emissions once a year during operation. Finally, the client is encouraged to share the non-sensitive project-specific biodiversity commercially to global data repositories.

2.3.3 International Finance Corporation Performance Standards

The IFC PSs on Environmental and Social Sustainability, which were published in January 2012, are recognised as being the most comprehensive standards available to international finance institutions working within the private sector. The principles provide a framework for an accepted international approach to the management of social and environmental issues. Table 2-4 summarises the eight (8) different IFC PSs and applicability that will apply to the EIA.

PS1 thus establishes the importance of (i) integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client's management of environmental and social performance throughout the life of the project. IFC PSs 2 through 8 present requirements to avoid, reduce, mitigate, or compensate for impacts on people and the environment, and to improve conditions where appropriate. Where social or environmental impacts are anticipated, the client is required to manage them through its Environmental Management System consistent with PS1.

Along with these the IFC also has Environmental Health and Safety Guidelines that needs to be considered. Guidelines applicable to this specific project are the General EHS Guidelines of 2007 that contains the performance levels and measures that are considered as achievable.

Table 2-4: Summary of International Finance Corporation Performance Standards and how they will be addressed

IFC PS	Objectives	How this EIA addresses it
Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts	PS 1 underscores the importance of managing environmental and social performance throughout the life of a project. PS 1 requires the client to conduct a process of environmental and social assessment and to establish and maintain an Environmental and Social Management System (ESMS), appropriate to the nature and scale of the project and commensurate with the level of its environmental and social risks and impacts. PS1 aims to: • Identify and evaluate environmental and social risks and impacts of the project[4] ; • Adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimise, and, where residual impacts remain, compensate/offset for risks and impacts to workers, affected communities, and the environment; • Promote improved environmental and social performance of clients through the effective use of management systems; • Ensure that grievances from affected communities and external communications from other stakeholders are responded to and managed appropriately; • Promote and provide means for adequate engagement with affected communities throughout the project cycle on issues that could potentially affect them; and • Ensure that relevant environmental and social information is disclosed and disseminated.	In order to comply with the IFC requirements of PS 1 for the effective management of grievances and PPP for the proposed project, a number of site-specific management plans including but not limited to, PPP, grievance redress mechanism, traffic management were incorporated in the EIA. Where sufficient detail for a site-specific management plan is not available, a framework will be included, to provide a basis for the development of a site-specific management plan (e.g., waste, water).
Performance Standard 2: Labour and Working Conditions	PS 2 recognises that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. PS2 aims to: • Promote fair treatment, non-discrimination and equal opportunity of workers; • Establish, maintain and improve the worker-management relationship; • Promote compliance with national employment and labour laws;	The need to protect the rights of workers involved in the GHDP Project is triggered by PS2. The EIA addresses the impacts related to the employment of locals and identifies mitigation measures that will be implemented by Cleanergy to safeguard the rights of its workers and ensure safe and healthy working conditions.

[4] This includes cumulative impacts. The IFC's Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets, published in 2013 provides guidance.

IFC PS	Objectives	How this EIA addresses it
	• Protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties and workers in the client's supply chain; and • Promote safe and healthy working conditions and the health of workers; and avoid the use of forced labour.	
Performance Standard 3: Resource Efficiency and Pollution Prevention	PS 3 recognises that increased economic activity and urbanisation often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. Thus, PS3 aims to: • Avoid or minimise pollution from project activities; • Promote more sustainable use of resources (including energy and water); and • Reduce project-related Greenhouse Gas (GHG) emissions.	The EIA includes an assessment of the risk of pollution and includes mitigation measures that will be aimed at the minimisation of pollution. The requirements of PS3 on pollution management are addressed in the air quality monitoring plan and waste and water quality management frameworks. Complying with the mitigation measures in the Environmental and Social Management and Monitoring Plan and relevant management plans will ensure that negative environmental impact is avoided and/or reduced and the positive impacts are enhanced.
Performance Standard 4: Community Health, Safety, and Security	PS 4 recognises that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. PS4 aims to: • Anticipate and avoid adverse impacts on the health and safety of affected communities during the project life from both routine and non-routine circumstances; and • Ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimises risks to the affected communities.	The EIA includes an assessment of the potential health and safety impacts that may occur due to the Cleanergy GHDP Project. The EMP include health and safety training for contractors and workers. A safety risk assessment is undertaken as part of the EMP conditions to make recommendations to minimise safety risks from the new hydrogen storage facilities to surrounding communities. Noise, air quality, traffic, and water studies, as well as the social impact assessment, took community health and safety into account in the assessment of impacts.
Performance Standard 5: Land Acquisition and Involuntary Resettlement	PS 5 recognises that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. PS5 thus aims to: • Avoid, and when avoidance is not possible, minimise displacement by exploring alternative project designs; • Avoid forced eviction; • Anticipate and avoid, or where avoidance is not possible, minimise adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation and the informed participation of those affected; and • Improve, or restore, the livelihoods and standards of living of displaced persons.	The EIA includes a socio-economic impact assessment as part of the EMP actions, where the impacts (negative and positive) of the proposed project on the communities around the project will need to be assessed. No resettlement activities will be required for the proposed Cleanergy GHDP Project.

IFC PS	Objectives	How this EIA addresses it
Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	PS 6 recognises that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. PS6 aims to: • Protect and conserve biodiversity; • Maintain the benefits from ecosystem services; and • Promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.	The EIA includes a biodiversity assessment undertaken by a specialist, which provides a description of the biodiversity in the affected area. The assessment identifies any biodiversity of importance such as Red List listed species requiring special protection. The assessment includes the identification of the project's potential impacts on biodiversity and an assessment of the significance of the identified impacts. Mitigation measures were identified and included in the Biodiversity Management Plan that is included in the project's EMP.
Performance Standard 7: Indigenous Peoples	PS 7 recognises that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalised and vulnerable segments of the population. PS7 thus aims to: • Ensure that the development process fosters full respect for human rights, dignity, aspirations, culture and natural resource-based livelihoods of Indigenous Peoples; • Anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimise and/or compensate for such impacts; • Promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner; • Establish and maintain an ongoing relationship based on informed consultation and participation with the Indigenous Peoples affected by a project throughout the project's life cycle; • Ensure the Free, Prior and Informed Consent of the affected communities of Indigenous Peoples when the circumstances described in this Performance Standard are present; and • Respect and preserve the culture, knowledge, and practices of Indigenous Peoples.	No recognized Indigenous Peoples are impacted in this project, hence PS7 is not triggered.
Performance Standard 8: Cultural Heritage	PS 8 recognises the importance of cultural heritage for current and future generations. As such, PS8 aims to: • Protect cultural heritage from the adverse impacts of project activities and support its preservation; and • Promote the equitable sharing of benefits from the use of cultural heritage.	The EIA included a specialist Cultural and Heritage Impact Assessment which entailed the identification of existing cultural and heritage resources that may be affected by the proposed project. Mitigation measures aimed at minimising the significance of potential impacts on cultural and heritage resources were included in the EMP.

3 Environmental Impact Assessment Approach and Methodology

The Namibian application and granting of an ECC process consists primarily of two phases, the Scoping and Impact Assessment Phases. After submitting the application documents to the MEFT, a Draft Scoping Report were compiled and submitted for public review and comment. The Final Scoping Report was submitted to MEFT and accepted on 7 December 2022 advising the project team to commence with the EIA Phase of the project.

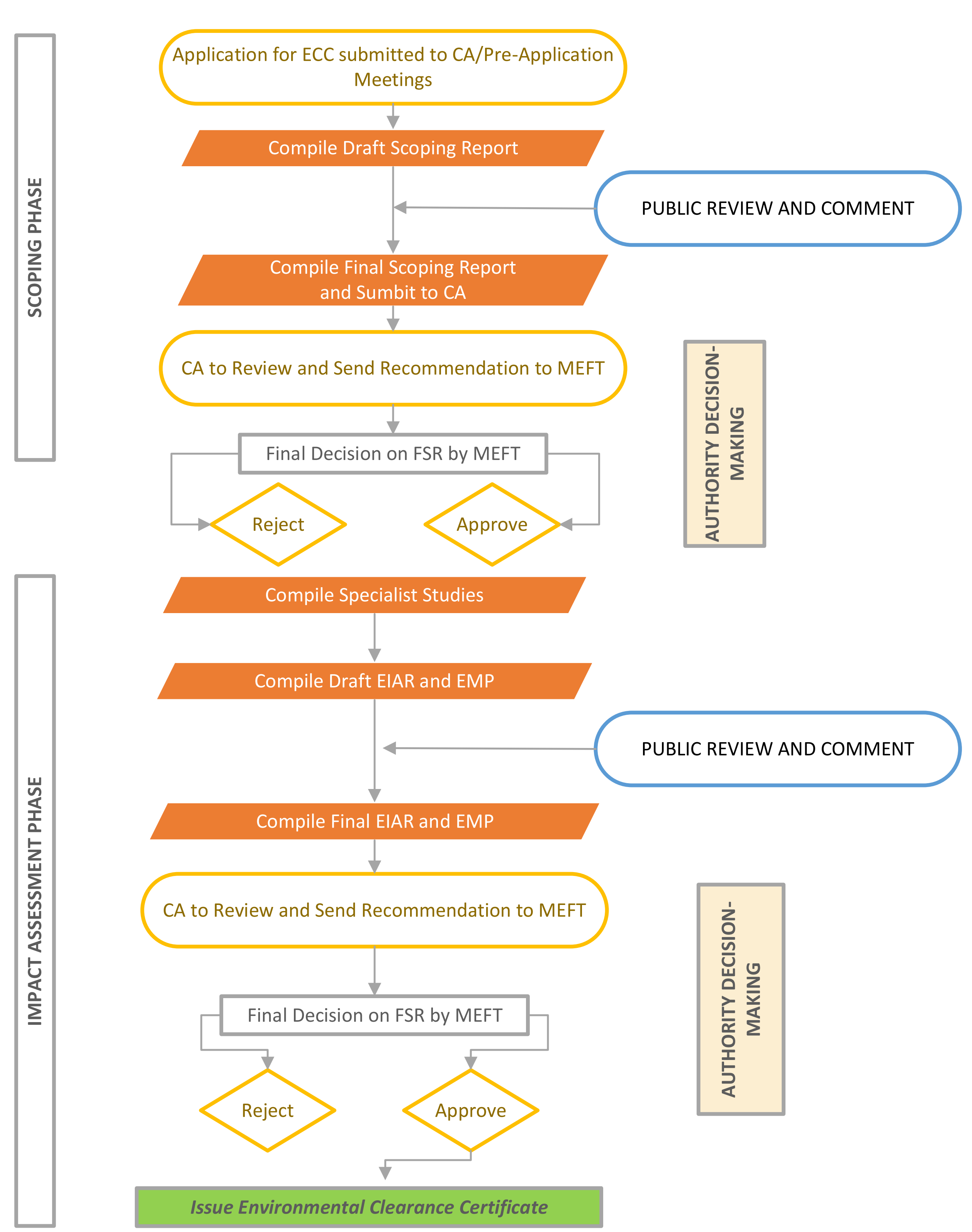
Specialist studies then commenced, and the Draft EIAR and EMP were compiled. These draft documents were also sent out for public review and comment, after which the Final EIAR and EMP are submitted to the MEFT for review and decision making. If the EIA and EMP are accepted, an ECC will be issued.

In order to ensure compliance with the objectives of EMA and the EIA Regulations, the EIA process seeks to identify the environmental consequences of a proposed project from the beginning, and helps to ensure that the project, over its life cycle, will be environmentally acceptable, and integrated into the surrounding environment in a sustainable way. It further seeks to provide the decision-making authorities with sufficient and accurate information in order to make a sound decision on the proposed development and set conditions that must be adhered to.

The EIA process for the proposed GHDP Project was undertaken in two phases:

- Scoping Phase; and
- Impact Assessment Phase.

Figure 3-1 provides an illustration of the EIA process that will be followed. Sections 3.1 - 3.9 provide a summary of the approach taken as well as the key steps and corresponding activities.



srk consulting	**CLEANERGY EIAR** Overview of the Namibian EIA Process	Project No. 585529

Figure 3-1: Overview the Namibian Environmental Impact Assessment Process

3.1 Project Initiation Phase

The GHDP Project Initiation Phase has been completed and included the following tasks:

- Project inception and initiation meetings between Cleanergy and the SRK Consulting;
- Desktop review of the available information to become familiar with the project, the geographical area, other projects in the area and any other information that may assist in the execution of the project;
- Undertaking of a site visit to conduct a preliminary assessment of the baseline conditions at the project site and area of impact;
- Scoping of key environmental risks/potential impacts, and confirming the need for the identified detailed studies;
- Identification of key stakeholders that need to be involved in the project and compilation of a Stakeholder Database;
    - The stakeholder database included institutions and organisations at all levels of government. The following list present some of the organisations but is not exhaustive:
        - MEFT;
        - Ministry of Defence and Military Veterans;
        - Ministry of Information and Communication Technology;
        - MME;
        - MAWLR;
        - Ministry of Labour, Industrial Relation and Employment Creation;
        - MHSS;
        - Ministry of Finance;
        - Ministry of Industrialisation and Trade;
        - Ministry of Works and Transport;
        - Ministry of Safety and Security;
        - MFMR;
        - Ministry of International Relations and Cooperation;
        - Ministry of Land Reform (MLR);
        - Ministry of Urban and Rural Development (MURD);
        - Roads Authority;
        - Green Hydrogen Commissioner of Namibia;
        - NHC of Namibia;
        - ERC;
        - Arandis Town Council;
        - Namibia Chamber of Commerce and Industry;
        - Walvis Bay Municipality;
        - National Botanical Research Council;

  - NamWater;
  - NamPower;
  - NamPort;
  - National Planning Commission;
  - NCAA;
  - National Chamber of Environment;
  - Namibia Nature Foundation;
  - University of Namibia (UNAM);
  - Namibia Airports Company (NAC);
  - Namibian Environment and Wildlife Society;
  - Chamber of Mines of Namibia;
  - National Petroleum Corporation of Namibia;
  - Namibia Investment Promotion and Development Board (NIPDB); and
  - Dorob National Park.
- Confirmation of the list of activities, according to the EMA, that are associated with the project, and which may not commence without an ECC;
- Confirmation of the Stakeholder Engagement approach; and
- Establishing Scoping Phase Requirements.

3.2 Scoping Phase

The GHDP Scoping Phase has been completed and included:

- Registration of the project and EIA process with the relevant Competent Authority, MEFT. This was done through the submission of a hard copy of the application to MEFT's offices on 16 August 2022 (Appendix B);
- Providing opportunity to identified stakeholders and registered I&APs to be involved in the process through an interactive PPP;
- Providing an overview of the legal requirements with regards to the proposed project;
- Providing baseline environmental and social information of the project area;
- Identification of gaps in relevant environmental and social legislation;
- Identification of anticipated key environmental and social issues and impacts that will be further investigated in the EIA;
- To assess the receiving environment in terms of current state and determine potential positive or negative impacts which may result due to the proposed development;
- To consider alternatives for achieving the project's objectives;
- To identify significant issues to be investigated further during the execution of the EIA phase; and

- Setting out the scope of the EIA process (Plan of Study (PoS)) and the ToR for specialist studies and outlining the approach and methodologies to be used in the EIA process, e.g., the proposed impact rating methodology.

The Scoping Report was be made available for a 14-day commenting period as detailed in Section 3.9.

Where necessary, comments and concerns received from I&AP's, including commenting authorities, on the Draft Scoping Report were incorporated and addressed in the Final Scoping Report.

The Final Scoping Report and Plan of Study (PoS) were submitted to the MEFT, who then advised the project team that the project should proceed to the Impact Assessment Phase (Acceptance Letter received 7 December 2022).

3.3 Environmental Impact Assessment Phase

The GHDP EIA Phase has also been completed and included:

- An overview of the legal requirements with regards to the proposed project;
- Baseline environmental and social information of the project area;
- Assessment of the receiving environment in terms of current state and determine potential positive or negative impacts which may result due to the proposed development and conducting specialist studies;
- Consideration of alternatives for achieving the project's objectives; and
- Compilation of an EMP and monitoring programme to manage the GHDP development.

The EIAR was be made available for a 14-day commenting period from **16 December 2022** to **13 January 2023**[5]. All comments received on the Draft EIAR were addressed and taken into consideration prior to submission of the Final EIAR to the MEFT.

3.4 Environmental Management Plan

An EMP was compiled with the aim of providing effective management and mitigation measures pertaining to the proposed development relating to the identified environmental impacts. These management and mitigation measures strive to minimise the negative impacts of the proposed development and enhance the positive impacts.

Comments received during the PPP (Section 3.9) undertaken to date have been incorporated into this report.

Table 3-1 provides an EIA Report Index in relation to the EIA Regulations that have been addressed and the section of the EIA Report where these requirements can be found.

Table 3-1: Requirements of Regulation 15 of GNR 30

Section of the EIA Regulations, 2012	Description of EIA Regulations Requirements for Assessment Reports	Completed	Section
Regulation 15	An assessment must contain all information that is necessary for the Environmental Commissioner to consider and to make a decision on the application, and must include –		
Regulation 15 (a)	The curriculum vitae of the EAP who compiled the report.	Yes	Section 1.3 Appendix A

[5] It is noted that where stakeholders requested for an extension on the commenting period that this was granted till the 27th of January 2023.

Section of the EIA Regulations, 2012	Description of EIA Regulations Requirements for Assessment Reports	Completed	Section
Regulation 15 (b)	A detailed description of the proposed listed activity.	Yes	Section 41.2
Regulation 15 (c)	A description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity.	Yes	Section 6
Regulation 15 (d)	A description of the need and desirability of the proposed listed activity and identified potential alternatives to the proposed listed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity.	Yes	Section 1.2
Regulation 15 (e)	An indication of the methodology used in determining the significance of potential effects.	Yes	Section 7.1
Regulation 15 (f)	A description and comparative assessment of all alternatives identified during the assessment process;	Yes	Section 7
Regulation 15 (g)	A description of all environmental issues that were identified during the assessment process, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures.	Yes	Section 7
Regulation 15 (h)	An assessment of each identified potentially significant effect, including –		
Regulation 15 (h) (aa)	Cumulative effects.	Yes	Section 7.2
Regulation 15 (h) (bb)	The nature of the effects.	Yes	
Regulation 15 (h) (cc)	The extent and duration of the effects.	Yes	
Regulation 15 (h) (dd)	The probability of the effects occurring.	Yes	
Regulation 15 (h) (ee)	The degree to which the effects can be reversed.	Yes	
Regulation 15 (h) (ff)	The degree to which the effects may cause irreplaceable loss of resources.	Yes	
Regulation 15 (h) (gg)	The degree to which the effects can be mitigated.	Yes	
Regulation 15 (i)	A description of any assumptions, uncertainties, and gaps in knowledge.	Yes	Section 8
Regulation 15 (j)	An opinion as to whether the proposed listed activity must or may not be authorised, and if the opinion is that it must be authorised, any conditions that must be made in respect of that authorisation.	Yes	Section 10
Regulation 15 (k)	A non-technical summary of the information.	Yes	Executive Summary

3.5 Submission of Environmental Impact Assessment Report and Environmental Management Plan for Review

The EIAR and EMP were made available to the public for comment from **16 December 2022** to **13 January 2023**[6], to provide I&APs the opportunity to comment on the environmental and social aspects associated with the proposed GHDP. Registered I&APs were notified of the availability of the Draft EIAR.

Where necessary, comments and issues raised by I&AP's during the commenting period were consolidated into the Final EIAR and EMP with the relevant response issued by the EAP. The Final

[6] It is noted that where stakeholders requested for an extension on the commenting period that this was granted till the 27th of January 2023.

EIAR and EMP will be submitted to the MEFT for decision making. The comments were also collated into the CRR that forms an Appendix to the Final EIAR.

3.6 Authority Consultation

Ongoing consultation with the different authorities was conducted during the EIA process. Further consultations with the competent authorities will be conducted should they become necessary. Authority consultation is considered an on-going process until a decision is made on the environmental application.

3.7 Alternatives

In accordance with Section 8(g) of the EIA Regulations, feasible alternatives need to be considered and assessed during the Scoping Phase of the project. During the Scoping Phase, based on professional judgement of the EAP, the engineering design consultants and I&AP comments, alternatives have been considered for the proposed GHDP. In addition to these alternatives, the “no–go” alternative was also assessed.

3.8 Specialist Studies

Based on the outcome of the Scoping Phase, various specialist studies have been identified to provide information and expert opinion necessary to address key issues requiring further investigation and detailed assessment (Section 7).

The following site-specific specialist studies were conducted during the impact assessment phase:

- Biodiversity Impact Assessment;
- Heritage and Archaeology Impact Assessment;
- Visual Impact Assessment;
- Surface and Geohydrological Impact Assessment; and
- Socio-Economic Impact Assessment[7] which incorporates the views of inhabitants on the ground in close proximity to the development.

Specific ToRs were given for each of the specialist studies. The generic ToR for each specialist study was to:

- Describe the existing baseline characteristics of the study area and place this in a regional context;
- Identify and assess potential impacts resulting from the project (including impacts associated with the construction and operation of the project), using SRK’s prescribed impact rating methodology;
- Identify and describe potential cumulative impacts resulting from the proposed development in relation to proposed and existing developments in the surrounding area;
- Recommend mitigation measures to avoid or minimise impacts and/or optimise benefits associated with the proposed project; and

[7] Due to the importance placed on this item by the proponent, it was decided to allow the consultant to define the baseline of the socio-economic component outside the formal EIA process and then to proactively work with the proponent and contractors to developed sensible mitigation controls prior to the start of construction. Therefore, the socio-economic study will not be part of the formal EIA process but will be executed as part of the EMP in order to make it more proactive.

- Recommend and draft a monitoring plan, if applicable.

Certain impacts that are anticipated to be of limited or lower significance, either by virtue of the scale of the impacts, their short duration (e.g., construction phase only), disturbed nature of the receiving environment and/or distance to communities, were assessed by EAP Team and reported directly into the EIAR.

3.9 Public Participation Process

The PPP is prepared in response to the requirements of Regulation/Part 21 of the EMA. Regulation 21 requires that a person (proponent, specialist, EAP or other professional) who undertakes public participation as part of an environmental impact assessment process to obtain an ECC, must do the public participation process in compliance with the following:

"*(2) The person conducting a public consultation process must give notice to all potential I&APs of the application which is subjected to public consultation by –*

(a) fixing a notice board at a place conspicuous to the public at the boundary or on the fence of the site where the activity to which the application relates is or is to be undertaken;

(b) giving written notice to -

(i) the owners and occupiers of land adjacent to the site where the activity is or is to be undertaken or to any alternative site;

(ii) the local authority council, regional council and traditional authority, as the case may be, in which the site or alternative site is situated;

(iii) any other organ of state having jurisdiction in respect of any aspect of the activity; and

(c) advertising the application once a week for two consecutive weeks in at least two newspapers circulated widely in Namibia.

(3) A notice, notice board or advertisement referred to in sub-regulation (2) must -

(a) give details of the application which is subjected to public consultation; and

(b) state -

(i) that the application is to be submitted to the Environmental Commissioner in terms of these regulations;

(ii) the nature and location of the activity to which the application relates;

(iii) where further information on the application or activity can he obtained: and

(c) the manner in which and the person to whom representations in respect of the application may be made.

(4) A notice board referred to in sub-regulation (2) must be of a size at least 60cm by 42cm.

(5) If a deviation from sub-regulation (2) is appropriate the person conducting the public participation process may deviate from the requirements of that sub-regulation to the extent and in the manner agreed by the Environmental Commissioner after consultation with the competent authority.

(6) When complying with this regulation, the person conducting the public consultation process must ensure that -

(a) information containing all relevant facts in respect of the application is made available to potential I&APs; and

> *(b) consultation by potential I&APs is facilitated in such a manner that all potential I&APs are provided with a reasonable opportunity to comment on the application.*

(7) The public consultation process -

> *(a) in respect of an application for an environmental clearance certificate in terms of regulation 6(1); and*
>
> *(b) the notification of an application and an assessment report in terms of regulation 16(1)(h),*

must be completed within 21 days."

3.9.1 Approach to Public Participation

The PPP forms an important part of the ECC application process. The PPP is aligned with Regulation 21 of EMA. The following tasks have been undertaken in line with the stated regulations:

- Role players, including potential and registered I&APs, state departments, organs of state, and the Competent Authority (MEFT) will be provided with an opportunity to obtain clear, accurate and understandable information about the environmental impacts of the proposed activity and the implications associated with proceeding with the proposed project. SRK compiled a list of all role players (please refer to Appendix C_ 1) focussing on landowners/land occupiers of the affected properties and of the properties immediately adjacent to the affected properties, this list will be updated continuously throughout the process until the authorisation is obtained;
- Providing the role-players for which contact information is available, and other registered and potential I&APs an opportunity to voice their concerns and questions regarding the proposed project, during the project announcement phase and the impact assessment phase of the project;
- Registered I&APs will be notified of the outcome of the application process, once the ECC is received/denied from the Competent Authority (MEFT);
- Incorporating the needs, preferences and values of role-plays and I&APs voiced, into the proposed project's environmental authorisation process;
- Provide opportunities to clear up misunderstandings about technical issues, resolving disputes and reconciling conflicting interests associated with the proposed project; and
- Encouraging transparency and accountability in decision-making during the PPP.

The primary aim is to afford I&APs the opportunity to understand the project, prioritises the participation of parties who potentially have an interest in the proposed project, or may be directly or indirectly affected by the proposed development. The process sought to lead to a joint effort by stakeholders, technical specialists, the authorities, and the proponent/developer through working together to produce better decisions than if they had acted independently.

The PPP was conducted in two phases:

- Phase 1 – Scoping Phase; and
- Phase 2 – Impact Assessment Phase.

Both the Scoping and EIA Phases of the EIA process was completed and the EIAR and EMP was submitted to the MEFT decision making. Table 3-2 summarises the PPP followed thus far.

Table 3-2: Public Participation Plan for the Proposed Cleanergy GHDP

Task	Activities	Date
Notification of Project to Regulatory Authorities and Registered Interested and Affected Parties		
Stakeholder Identification and Database Development	I&APs were identified and contact details obtained where possible using databases from other EIAs conducted in the area, engagements with key stakeholders, telephone calls and meetings. A stakeholder database was developed and maintained throughout the process (Please refer to Appendix C_ 1 for a copy of the Stakeholder Database).	July – September 2022
Project Announcement Letters	Project Announcement letters (Appendix C_ 2) and Background Information Documents (BIDs) (Appendix C_ 3) were distributed to all I&APs on the Stakeholder Database. Please refer to C for an example of the notifications sent via e-mail.	August – September 2022
Background Information Document (BID)	Background Information Documents (BIDs) describing the project and the legal requisites associated with the Authorisation process were compiled. The BID included a Reply Form (Appendix C_ 3), which granted the public opportunity to register as an I&AP, and to raise queries or concerns regarding the project. BIDs were distributed electronically (where possible) to all I&APs on the Stakeholder Database (Please refer to Appendix C_ 2 for copies of the Project Announcement Letters). Copies of the BIDs were also made available on request to SRK. A copy of the BID was also made available on the SRK website. Appendix C_ 3 for a copy of the BID.	July – September 2022
Newspaper Advertisements	Newspaper advertisements providing information on the proposed project, the availability of the BID and time and venue of planned public meeting were placed in two newspapers (circulated widely in Namibia) for two consecutive weeks, in English: – The Namib Times (5 August 2022 and 12 August 2022); and – The Namibian Newspapers (8 August 2022 and 15 August 2022). Please refer to Appendix C_ 4 for copies of the advertisements placed.	August 2022
Site Notices	English site notices (Sized 60 cm x 42 cm) were placed at the following locations on 17 August 2022 (Please refer to Appendix C_ 5 for photos of the site notices as well as a layout illustrating their positions): – On-site, next to D1984 road (x2); – Dune 7 Adventures; – Wormann Brock Narraville Supermarket; – Checkers, Dunes Mall; and – Walvis Bay Library.	July – September 2022
Other	English advertisement was placed on the Walvis Bay Municipality Facebook Page on 11 August 2022 (Please refer to Appendix C_ 6 for a copy of the post as placed); and Telephonic Consultation with key stakeholders.	August - September 2022
Meeting with Competent Authorities	A meeting was held with the Competent Authority (MEFT) to confirm approach and listed activities prior to commencement of the application process (Appendix C_ 7 for Minutes of the Meeting).	17 August 2022

Task	Activities	Date
Scoping Phase Meetings and Submission of Comments		
Focus Group Meetings	Focus group meetings were held with: – Walvis Bay Municipality officials on 18 August 2022 (Please refer to Appendix C_ 8 for Minutes of the Meeting); – Walvis Bay International Airport officials on 19 August 2022 (Please refer to Appendix C_ 8 for Minutes of the Meeting); and – Erongo RED on 18 August 2022 (Please refer to Appendix C_ 8 for Minutes of the Meeting).	18 – 19 August 2022
Public Meeting	A public meeting was held in Walvis Bay at Amjicaja Guesthouse (No 8 Temple Crescent, Meersig) on Thursday 18 August 2022 at 18h00. The presentation that was made at the meeting and the Minutes of the Meeting are attached in Appendix C_ 9.	18 August 2022
Comments and Responses	The CRR can be found in Appendix C_ 10 detailing all comments and responses received thus far. Comments received are attached in Appendix C_ 11. The registration and initial commenting period ended 2 September 2022. Comments received from Commenting Authorities are attached in Appendix C_ 12.	August – September 2022
Review of Scoping Report		
Scoping Report for public and Authorities Comment	The availability of the Scoping Report was announced by means of letters and emails sent to registered I&APs. An Executive Summary of the Scoping Report was also distributed to all Stakeholders and I&APs via emails that are registered on the Stakeholder Database (Appendix C_ 1). In addition to emailing an Executive Summary of the Scoping Report to Registered I&APs, the Report was also made available to the public via the website at www.srk.com by clicking on the following link Draft Scoping Report for the Proposed Green Hydrogen Demonstration Plant in Walvis Bay, Namibia (srk.com). Proof of distribution of the scoping report is attached in Appendix C_ 13 and Appendix C_ 14. Hard copies of the Scoping Report were made available at the following public places: – Narraville Library; and – Walvis Bay Library. The availability of the Scoping Report was announced by means of letters and emails sent to registered I&APs. As per request made by MEFT during the meeting held 17 August 2022, hard copies (as well as electronic copies), of the Scoping Report were distributed to the following commenting authorities: – The Green Hydrogen Commissioner; – The MME; – Ministry of Agriculture, Water and Land Reform (MAWLR); and – Ministry of Defence. Hard copies (as well as electronic copies) of the Scoping Report were further distributed to the following commenting authorities: – Ministry of Industrialisation, Trade and Small and Medium Enterprises (SMEs) Development;	4 October 2022 – 17 October 2022

Task	Activities	Date
	– Governor of Erongo Region; – NIPDB; – Walvis Bay Municipality; – Erongo RED; – MURD; – NHC of Namibia; – National Botanical Research Institute; and – MLR. – Electronic copies of the Scoping Report were also made available to the following bodies: – Walvis Bay Airport; – Roads Authority; – NamPower; and – NamWater. Electronic copies of the Scoping Report were also made available to the following bodies: – Walvis Bay Municipality; – Erongo RED; – Walvis Bay Airport; – Roads Authority; – NamPower; and – NamWater. Authorities and IAPs were provided with 14 days to review the Scoping Report and submit comments in writing to SRK Consulting. The commenting period ended on the 17 October 2022.	
Review of EIAR/EMP		
EIAR/EMP for public and Authorities Comment	The availability of the EIAR/EMP was announced by means of letters and emails sent to registered I&APs. An Executive Summary of the EIAR was also distributed to all Stakeholders and I&APs via emails that are registered on the Stakeholder Database (Appendix C_ 1). In addition to emailing an Executive Summary of the EIAR/EMP to Registered I&APs, the Report was also made available to the public via the website at www.srk.com by clicking on the following link Draft Environmental Impact Assessment (EIA) Report for the Proposed Green Hydrogen Demonstration Plant in Walvis Bay, Namibia (srk.com). Proof of distribution of the EIAR and EMP is attached in Appendix C_ 15 and Appendix C_ 16.	16 December 2022 – 13 January 2023[9]

[9] It is noted that where stakeholders requested for an extension on the commenting period that this was granted till the 27th of January 2023.

Task	Activities	Date
	As per request made by MEFT during the meeting held 17 August 2022, hard copies (as well as electronic copies), of the EIAR/EMP were also distributed to the following commenting authorities: – The Green Hydrogen Commissioner; – The MME; – Ministry of Agriculture, Water and Land Reform (MAWLR); and – Ministry of Defence. Hard copies (as well as electronic copies) of the EIAR/EMP were further distributed to the following commenting authorities: – Ministry of Industrialisation, Trade and Small and Medium Enterprises (SMEs) Development; – Governor of Erongo; – NIPDB; – MURD; – NHC of Namibia; – National Botanical Research Institute; and – MLR. Electronic copies of the EIAR were also made available to the following bodies: – Walvis Bay Municipality; – Erongo RED; – Walvis Bay Airport; – Roads Authority; – NamPower; and – NamWater. The EIAR and EMP were made available to the public for comment from **16 December 2022 to 13 January 2022**[8].	
Comments and Responses	The CRR can be found in Appendix C_ 10 detailing all comments and responses received thus far. Comments received are attached in Appendix C_ 11. Comments received from Commenting Authorities are attached in Appendix C_ 12.	August 2022 – January 2023

[8] It is noted that where stakeholders requested for an extension on the commenting period that this was granted till the 27th of January 2023.

Summary of Issues Raised

Issues that have been raised to date by I&APs and other Stakeholders can be summarised as:

- Requests to be registered as I&AP;
- Source of funding for the project;
- Potable water supply and the impact;
- Collaboration with other companies undertaking similar work in the area;
- Concerns relating to battery storage and connection to Erongo RED;
- Requirements to undertake a Social Impact Assessment;
- Negative Socio-Economic impacts associated with the proposed project;
- Upscaling of the GHDP;
- Cleaning associated with solar panels;
- Price competitiveness when compared to existing technologies;
- Number of people employed on-site;
- Involvement of Small, Medium and Micro Enterprises (SMMEs);
- Proximity of the GHDP to the Walvis Bay Airport and the associated impacts on the airport;
- Proximity of the GHDP to an artillery shooting range and a military base and the associated safety risks associated with green hydrogen storage;
- Potential impacts associated with increased traffic movement in the area;
- Potential impacts on biodiversity and the management thereof;
- Rehabilitation of the site;
- Climate change considerations;
- Occupational health and safety management considerations;
- Locality of Farm 58;
- Consultation with institutions and organisations at all levels of government; and
- Views of inhabitants within the vicinity of the development.

4 Description of Proposed Project

4.1 Proponent

As mentioned previously, in 2021, a joint venture was established between the Ohlthaver & List Group of Companies (Namibia's largest privately held group of companies) and CMB.TECH (a Belgian owned company working towards the development of large marine and industrial applications for hydrogen). The joint venture, Cleanergy Solutions Namibia (Pty) Ltd, aims to be the first company in Namibia to produce commercial grade hydrogen from water, utilising renewable energy sources.

Table 4-1 provides the details of the Proponent and facility owner's representative.

Table 4-1: Proponent Contact Details

Contact details of the Proponent:
Company: Cleanergy Solutions Namibia (Pty) Ltd **Physical Address**: 23-33 Fidel Castro Street, Windhoek, Namibia **Contact Person**: Eike Krafft **Tel**: +264 61 207 5224 / +264 81 143 6373 **E mail**: eike.krafft@ol.na

4.2 Project Overview

Cleanergy is proposing to construct a 5 MW GHDP in Walvis Bay, Namibia. The total size of the plant will be approximately 26 ha and the extent of the different project components are as follows:

- Solar PV plant with an output of 5 MW_p, with tracker configuration covering an area of 15 ha;
- Five (5) MW battery energy storage system;
- A 5 MW PEM electrolyser (electrolyser systems with a capacity of producing 90 kg of hydrogen per hour. This system will be installed in two 40-feet (12.192 m long x 2.438 m wide x 2.591 m high) containers;
- One hydrogen generation Alkaline electrolyser system with a capacity of 100-300 KW/2-6 kg/h. This system will be installed in a 20-feet container (5.898 m long x 2.352 m wide x 2.393 m high);
- Compressor(s) with a combined capacity of 135 kg/h (1500 Nm^3/h) at 40 bar inlet pressure to densify the hydrogen gas for storage. The compressors will be installed in three (3) 10-feet containers;
- Hydrogen buffer and storage tanks:
  - Low pressure hydrogen buffer tank at 40 bar with a volume of 40 m^3;
  - Medium pressure hydrogen storage tank at 300 bar; and
  - High pressure hydrogen buffer storage tank at 500 bar for distributing hydrogen for refuelling heavy-duty vehicles and filling MEGC trailers;
- Hydrogen fuelling station covering an area of approximately 335 m^2; and
- Information centre/building covering an area of approximately 2 605 m^2.

The following secondary infrastructure will also be required:

- Access road of approximately 280 meters covering an area of approximately 4 364 m^2;

- Water connection (pipeline connecting to main NamWater supply), with a length of approximately 3 392 m; and
- Grid connection (Erongo RED).

It should be noted that the grid connection will also require an ECC, but the process will be managed outside the scope of this process.

The demonstration project will be started at a 5 MW scale to:

- Evaluate the efficiency of current available technology within the Namibian context;
- Develop the required skills and competencies locally to operate and maintain the demonstration and possible commercial plant, as well as to share the necessary knowledge to allow for the conversion of existing equipment to allow for the utilisation of hydrogen as a fuel; and
- Develop an offtake for the green hydrogen locally (thus providing additional benefit to the country) to ensure multiple markets for the final product e.g., by converting heavy vehicles used in mining and within the port area to dual fuel vehicles.

One of the critical components of the demonstration plant will be the training centre, with course content being developed along with local vocational training and academic institutions, in order to ensure that the long-term staffing needs of the pilot and commercial facilities can be met. Cleanergy thus wants to commence with the construction of the training centre as soon as possible, in order to ensure that the necessary skills and competencies become available.

Please refer to Figure 4-1 for an illustration of the Cleanergy GHDP Project.

srk consulting	**CLEANERGY EIAR** Project Illustration	Project No. 585529

Figure 4-1: Project Illustration

4.3 Project Location

The proposed GHDP will be located outside Walvis Bay on Farm 58, near the Walvis Bay International Airport and Dune 7 (inland to the Dune), to the East of the new Walvis Bay-Swakopmund highway

(D1984). The GHDP site falls within the heavy industrial zone which was previously declared by the Walvis Bay Municipality and registered as per the relevant processes under the Urban & Regional Planning Act, as well as the Local Authorities Act The property falls under the Walvis Bay Local Municipality and is situated within the Erongo Region. The total size of the plant will be approximately 26 ha (Figure 4-2) covering approximately 12% of Portion 8 of farm 58.

The proposed project is located on the erf numbers as illustrated in Table 4-2 and Figure 4-3 provides a description of the affected properties.

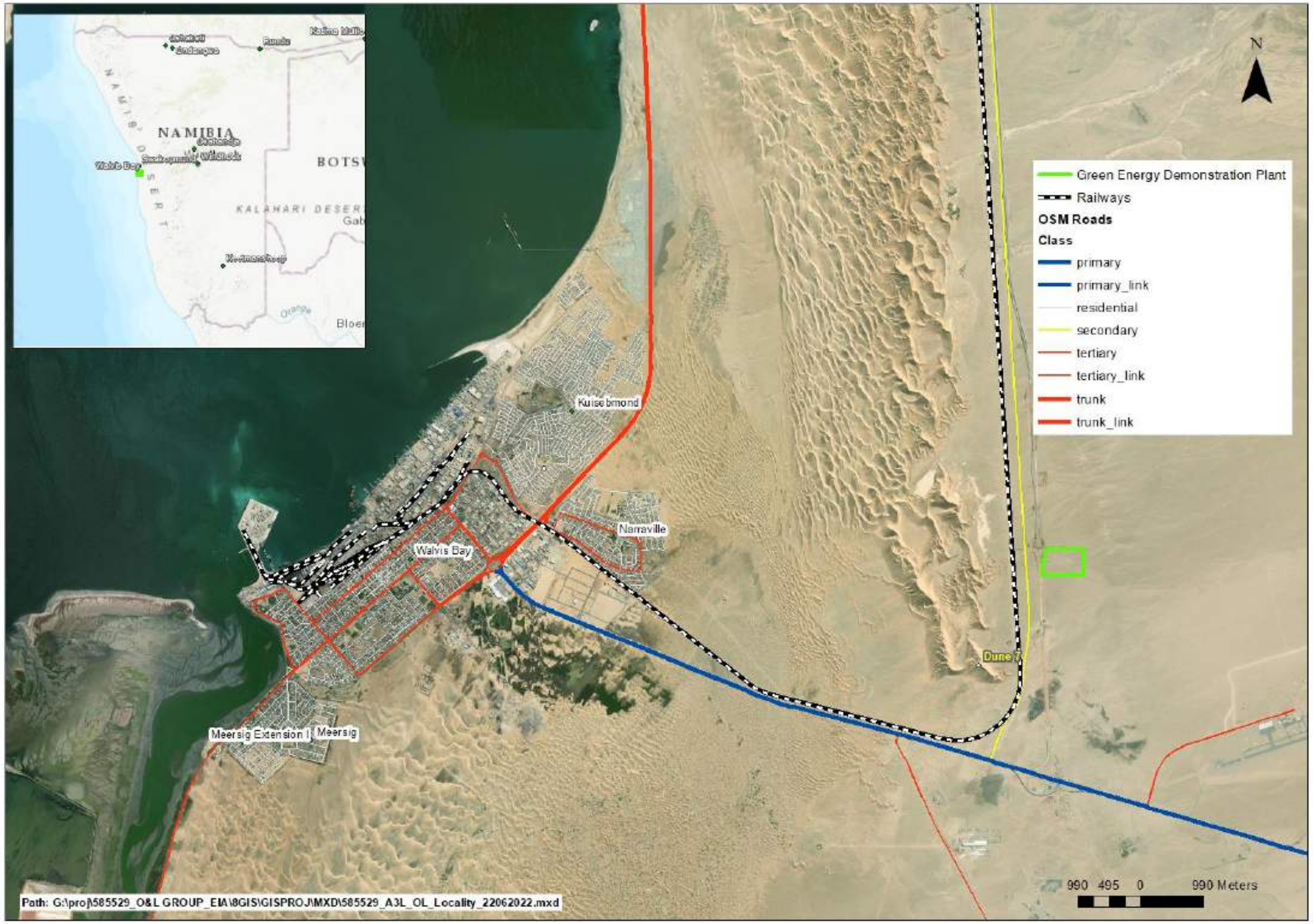
Table 4-2: List of Affected Properties and Property Portions

Physical Address	Owner	Portion
Farm No. 58, Walvis Bay, Namibia	Walvis Bay Municipality	Portion 8

Coordinates of the different components to the project, namely the solar photovoltaic plant, green hydrogen demonstration plant, training centre, access road, potable water pipeline connection, and electrical transmission line as well as the site boundary are provided in Table 4-3.

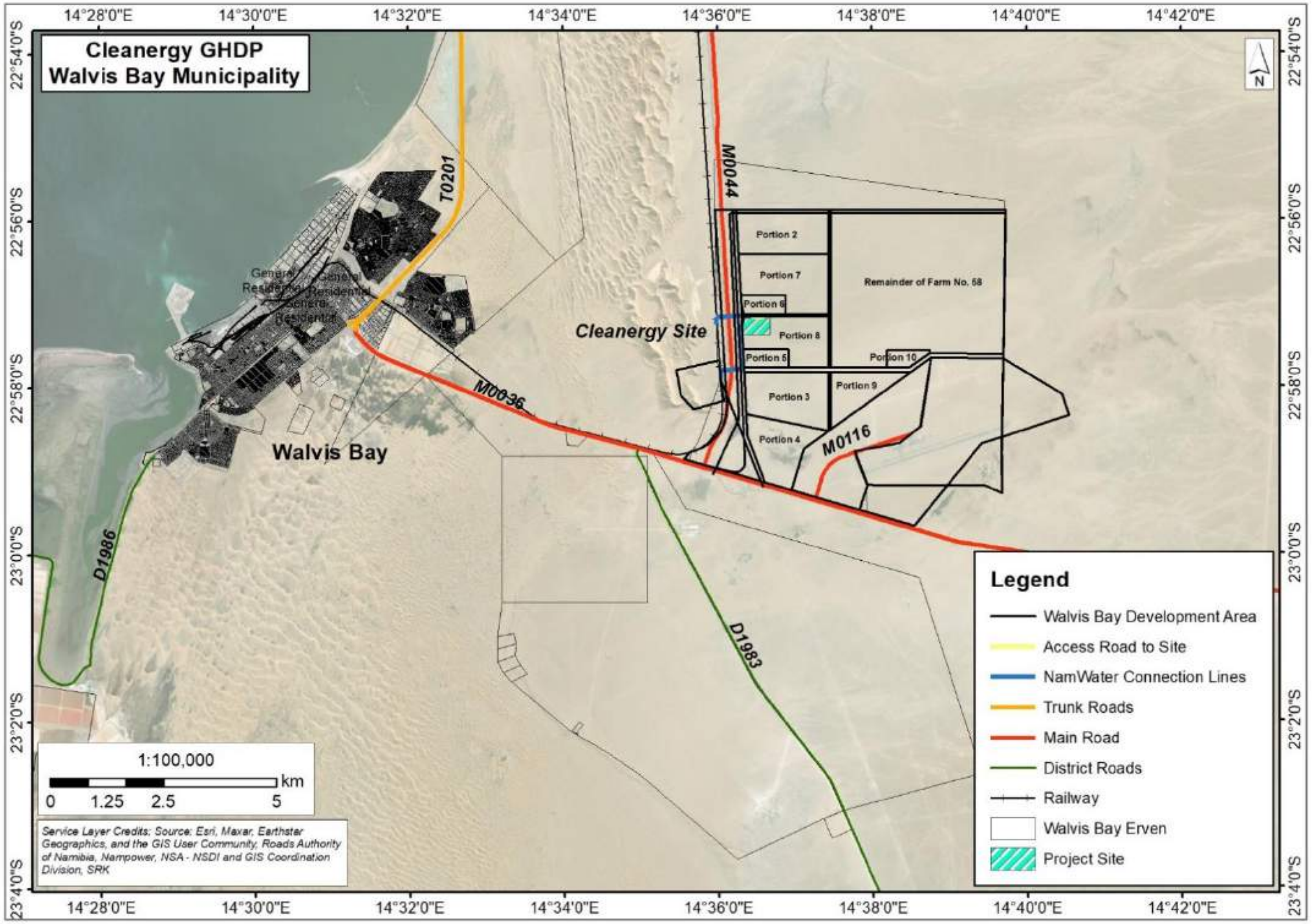
Table 4-3: Coordinates of the Different Project Components

Project Component	Latitude	Longitude
Site Boundary		
1	22°57'11.43"S	14°36'18.05"E
2	22°57'11.67"S	14°36'38.89"E
3	22°57'24.68"S	14°36'38.85"E
4	22°57'24.62"S	14°36'16.17"E
5	22°57'19.45"S	14°36'15.90"E
Solar Photovoltaic Plant		
Central coordinates		
Green Hydrogen Demonstration Plant		
Central coordinates		
Training Centre		
Central coordinates		
Access Road		
Start point		
Mid-point		
End point		
Potable Water Pipeline Connection		
Start point		
Mid-point		
End point		
Electrical Transmission		
Not applicable as application will be addressed in a separate EIA process		



srk consulting	**CLEANERGY EIAR** Project Location	Project No. 585529

Figure 4-2: Project Location



srk consulting	**CLEANERGY EIAR** Relevant Properties	Project No. 585529

Figure 4-3: Relevant Properties

4.4 Schedule and Life of Project

Whilst the solar PV plant itself will have an anticipated life cycle of 25 years, the GHDP will only be in operation for as long as it is feasible.

4.5 Project Components

4.5.1 Solar Photovoltaic Plant

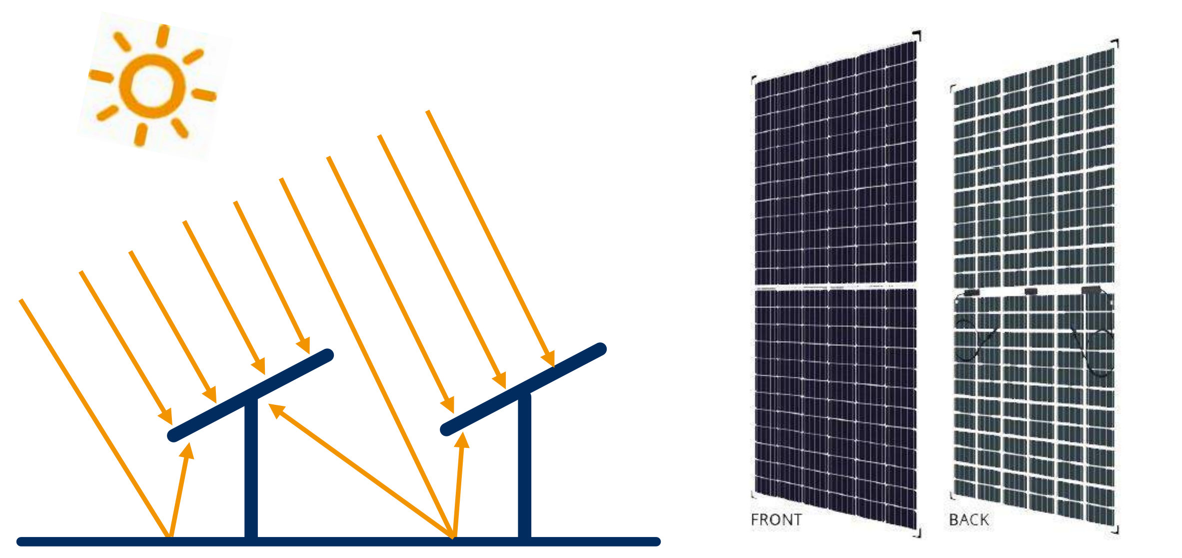
The solar PV plant technology as considered by Cleanergy is a high-quality, single axis, horizontal tracking, bifacial photovoltaic power plant. The power plant will be fully designed according to local and international standards. This includes Tier 1 bifacial PV modules, inverters as well as a high-quality tracking system specifically selected to withstand the local environment conditions close to the coast. Furthermore, a fully integrated monitoring system as well as a weather station will be installed for optimal plant performance and monitoring, forecasting and downtime control.

Key equipment technologies associated with the solar PV plant are described below.

Bifacial PV Modules

Cleanergy is proposing to utilize crystalline module technology due to its bankability and reliability. Compared to thin film technology, crystalline modules build up the major share (close to 90%) of all 177 GW installed PV capacity worldwide. Monocrystalline technology has a proven operational track record over the last four decades and power degradation values are well known. Therefore, the long-term performance bares significantly less risk than with the much younger thin film technology.

Based on the strong increase of bifacial installation in the last couple of years, we consider the advantages of bifacial monocrystalline modules for the respective PV Plants. Bifacial modules are further developed crystalline silicon modules, which are active on the front and the rear side. Due to ground reflection of radiation, they additionally use the light on the back side. The higher the albedo, the more irradiance reaches the rear surface of the module and the more the yield increases. CRONIMET is working with Tier 1 supplier companies for highest reliability and guarantees. The PV modules standard is a 10-year limited product warranty and a 30-year peak power warranty. Figure 4-4 indicates a typical module from Canadian Solar.



srk consulting	**CLEANERGY EIAR** Scheme of functionality of bifacial PV modules and example for monocrystalline PV modules of Canadian Solar	Project No. 585529

Figure 4-4: Scheme of functionality of bifacial PV modules and example for monocrystalline PV modules of Canadian Solar

Inverters

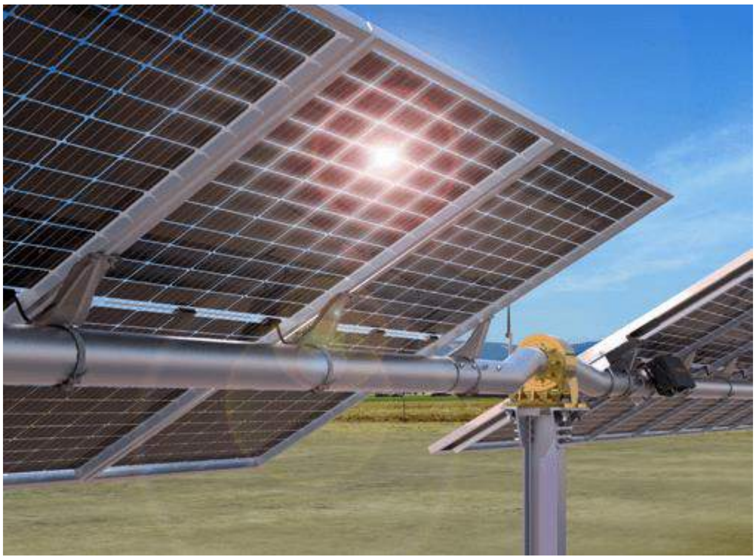
For the inverters, Cleanergy is proposing decentralized Tier 1 inverters for the power plant. The following figure shows decentralized inverter solutions from the top tier suppliers such as Huawei to guarantee highest performance and energy output combined with its high reliability which ensures minimum downtime and low O&M costs. The inverters come with a standard 5-year factory warranty. Our proposed inverter is the Huawei SUN2000 215kTL as illustrated in Figure 4-5 which has been in operation in some of the extreme conditions at our plants in Namibia.

srk consulting	**CLEANERGY EIAR** Decentralised 215 kW Inverter from Huawei	Project No. 585529

Figure 4-5: Decentralised 215 kW Inverter from Huawei

Photovoltaic Tracking System

As there are no constrains in available area and shape, Cleanergy proposes a single axis PV tracking solution (Figure 4-6). The PV Power Plant’s electrical output increases as the system upgrades from the fixed tilt to single tracking system and with only marginal one-time capex and yearly operating and maintenance cost increases. Depending on the site and precise characteristics of the solar irradiation, bi-facial trackers may increase the annual energy yield by up to 20% for single-axis tracker as it can be seen in the table below. Cleanergy proposes to utilize the Schletter Single Axis Tracking system designed specifically for this Class 4 environmental corrosion conditions. Cleanergy have also procured and installed trackers from major suppliers like Exosun and Lumax. Beforementioned suppliers offer very durable solutions, and long warranty periods.



srk consulting	**CLEANERGY EIAR** Example for Bifacial Horizontal Tracking System	Project No. 585529

Figure 4-6: Example for Bifacial Horizontal Tracking System

Summary of Components Data

Table 4-4 summarises the offered Power Plant information data and its equipment data and ratings.

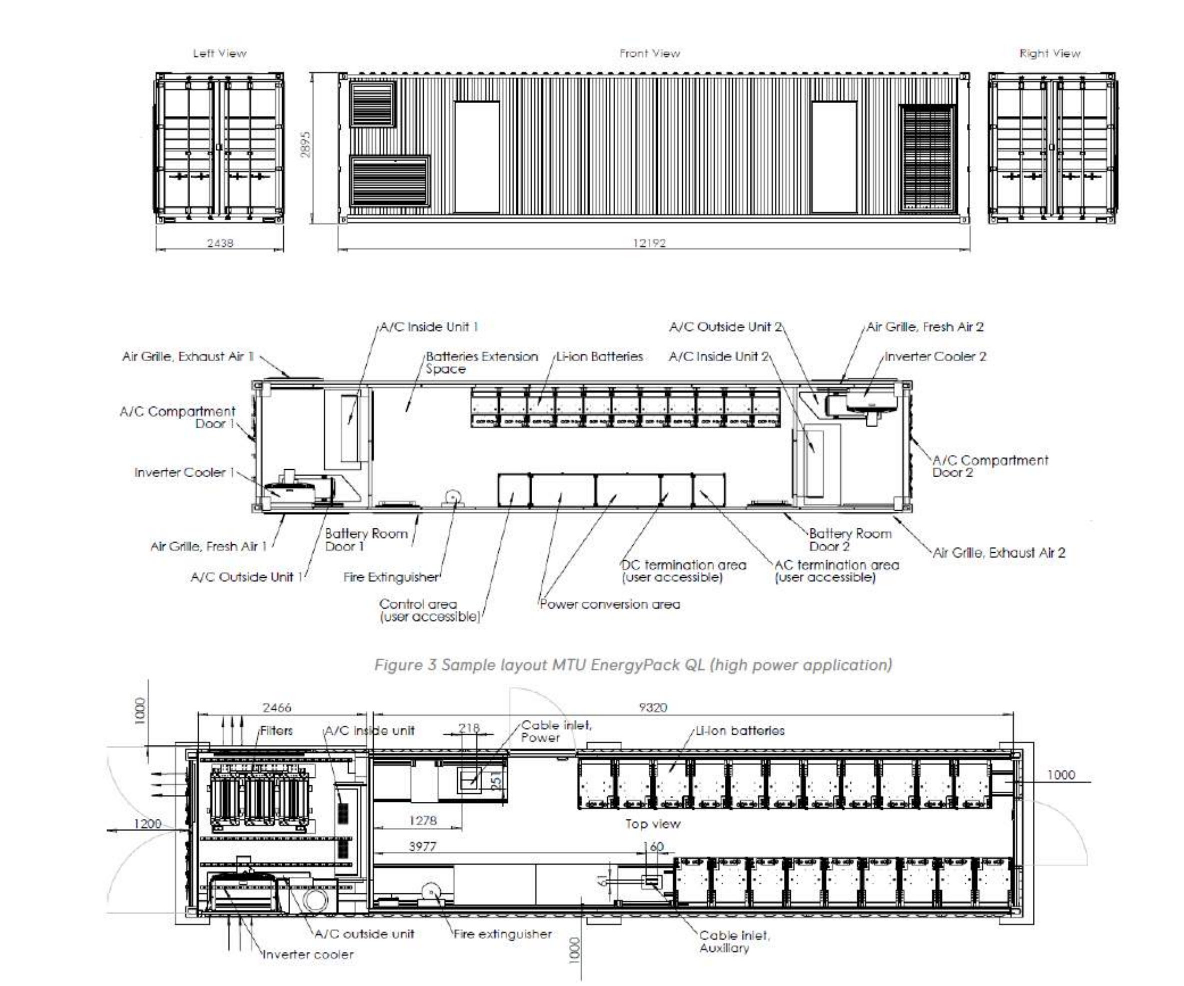
Table 4-4: GHDP PV Plant Technical Specifications

Technical Specifications of the PV Plant	
Plant Data	
Module Technology	Bifacial polycrystalline
Inverter Topology	Decentralized
Racking System	Horizontal Bifacial Single Axis, East-West Tracking
PV Module Data	
Supplier	Canadian Solar or Similar (Tier One)
Type	CS3U-370MB
Nominal Power	520 Wp
Efficiency	20.2 %
Warranty	10 years product warranty 30 years peak power warranty

Technical Specifications of the PV Plant	
Inverter Data	
Supplier	Huawei or Similar (Tier One)
Type	SUN2000 110kTL
Nominal Power	215 kW
Euro Efficiency	98.6 %
Output	400V 3 Phase
Warranty	5 years factory warranty
Racking System	
Supplier	Schletter or Similar (Tier One)
Type	Single Axis Tracker
Table Inclination (Both sides)	60°
Slope Gradient	10°
Wind Speed	Maximum operating wind speed of 60km/h; up to 290km/h in the security(stow) position.
Material	H4 Material Specification in order to withstand class 4 corrosion conditions.

Battery Energy Storage System (BESS)

The leading technology for stationary large-scale energy storage application are containerized Li-Ion Storage Systems (Figure 4-7). This solution is offered by several manufacturers such as Huawei, ABB, mtu or Tesla. The representative system comprises Li-Ion battery racks, each containing typically 480 MCN cells, combined in Battery Modules and controlled by a Battery Management System, including switchgear. The batteries' cells are usually supplied by leading manufacturers like SAMSUNG, LG Chem or Panasonic and will perform at 80% of initial capacity after 4000 cycles with an assumed D.O.D (Depth of discharge) of 80%. The main advantage of Li-Ion storage compared to other technologies is its high roundtrip efficiency of around 88%, consequently PV loss due to battery charging is kept to a minimum. Operation and maintenance costs do not occur for this type of battery; however, lifetime is limited to the above discussed 4000 cycles which corresponds to about ten to fifteen years of operation.



srk consulting	**CLEANERGY EIAR** Sample Layout MTU EnergyPack QL	Project No. 585529

Figure 4-7: Sample Layout MTU EnergyPack QL

O&L Nexentury has successfully built large-scale Li-Ion battery systems in previous projects. Depending on further specifications, O&L Nexentury proposes a fixed ground-mounted bifacial layout with a state-of-the-art Li-Ion BESS.

4.5.2 Green Hydrogen Demonstration Plant

Figure 4-8 illustrates the key components of the 5 MW GHDP.

srk consulting	**CLEANERGY EIAR** Key Componentry of the 5 MW GHDP	Project No. 585529

Figure 4-8: Key Componentry of the 5 MW GHDP

Hydrogen System

For the demonstration project, Cleanergy Solutions Namibia will be using the state-of-the-art electrolyser for the production of green hydrogen using solar panels as energy source. To deliver hydrogen to end-customers, hydrogen molecules need to be produced, then purified, compressed, and stored at the right pressure. All the equipment will be fully containerised to safely produce purified hydrogen from on-site water and power utility inputs.

Electrolyser

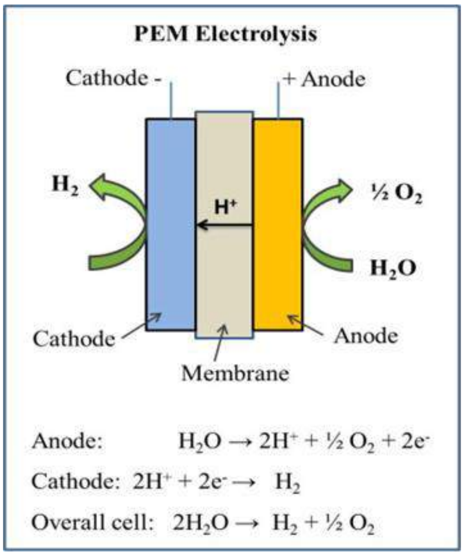
The site will be equipped with a 5 MW PEM electrolyser. The electrolyser is the key component for producing green hydrogen. It uses electricity to break water molecules into hydrogen and oxygen in a process called electrolysis (Figure 4-9).

This hydrogen production equipment called a PEM electrolyser, consists of two electrodes, an anode and a cathode, and a semi-permeable membrane. Water molecules enter at the anode side and are split, when an electrical current is applied on the cell stack, into oxygen (O_2), hydrogen ion (H+) (proton) and two electrons. The protons flow through the membrane and form hydrogen at the cathode side through the combination of two protons and two electrons (Figure 4-9).

The produced oxygen gas is released to the atmosphere or can be captured and processed for industrial processes or even medical gases in some cases.

The hydrogen gas is then purified to meet the required quality standards.

The electricity will be provided by the solar park which is located next to the hydrogen production site. As the electrolyser requires Direct Current (DC) power, a power container will be installed next to the electrolyser. This power container is equipped with transformers and rectifiers to deliver the desired voltage to the electrolyser cell stack.



srk consulting	**CLEANERGY EIAR** Electrochemical Reaction of Water Electrolysis	Project No. 585529

Figure 4-9: Electrochemical Reaction of Water Electrolysis (Kumar & Himabindu, 2019)

The electrolyser system is divided into 2 parts:

- Power container: The 40 feet container is equipped with transformers and rectifiers; and
- Process and utility containers: Two (2) 40 feet containers consist of one 5x 1 MW PEM electrolyser cell stack, water and hydrogen purification system, cooling system, instrumentation, and control system.

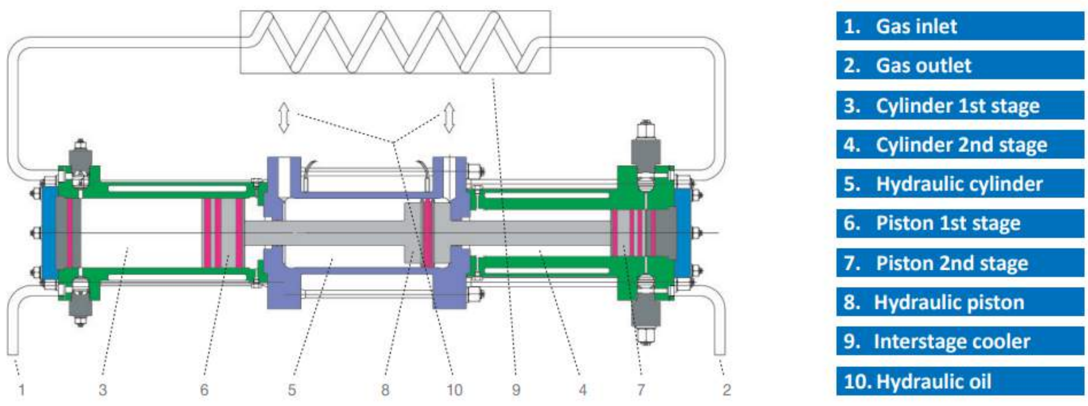
Table 4-5: PEM Electrolyser Specifications

Capacity	5 MW
H_2 production at max. power	90 kg/h
Outlet pressure	40 bar
Total anticipated water consumption	1.2 m3/h
Footprint	Global footprint of 200 m2 divided into: One (1) 40 feet container: power container Two (2) 40 feet containers stacked on each other for the hydrogen production

Compressor

Once the hydrogen molecules are produced and purified, these are compressed to increase their energy density in order to facilitate the storage thereof. The site will be equipped with three compressors to increase the pressure of the hydrogen gas up to 500 bar.

The Piston technology is chosen for the project, a piston compressor is mainly composed of one hydraulic cylinder and two gas cylinders (Figure 4-10). A steel rod connects the oil piston with two gas pistons. The pressure of the oil on the oil piston moves the connecting rod and gas is compressed in the gas cylinders by the gas pistons. The only moving part is the connecting rod. With this simple construction all forces are applied towards the same direction and are balanced by the hydraulic oil. Two sets of seals (one on the gas and one on the oil side) ensure that the hydrogen molecules are not contaminated by other fluids.



srk consulting	**CLEANERGY EIAR** Piston Compressor	Project No. 585529

Figure 4-10: Piston Compressor (Hofer, n.d.)

To ensure redundancy, three compressors will be installed. Each compressor has the capacity of 50% of the total required capacity, thus three times 50%. During normal operations, two systems will be in use whilst one system serves as a spare. Each compressor will have a maximal hydrogen flow of 45 kg/h.

Storage

A 40-bar buffer is placed between the electrolyser and the compressors to overcome the time to start the electrolyser and the possibility to run the compressor in partial mode. This buffer consists of one big, Type I, steel cylinder placed vertically. The capacity of the 40-bar buffer is 40 cubic-meters.

Hydrogen will be stored at 300 bar and 500 bar. To ensure safe and continuous delivery of hydrogen, the site will have a capacity of about two days of production distributed between 300 bar and 500 bar. The total capacity of the 300-bar buffer is 60 cubic-meters installed in two standard 40-feet MEGC containers composed of horizontally aligned Type IV cylinders. Type IV cylinders are made of a polymer liner wrapped in carbon fibres or glass fibres. This technology ensures a low weight and high storage pressure.

The total capacity of the 500-bar storage is 12.6 cubic meters, composed of vertically aligned Type IV cylinders installed in stillages.

Hydrogen Refuelling Station

One dual dispenser (1x TK16 & 1x TK16 HF) for heavy-duty vehicles will be installed. The discharge pressure for fuelling equals 350 bar. This dual dispenser is designed according to the safety and operation protocols specified in SAE hydrogen refuelling standards. Features as described in the Dutch PSG35 code.

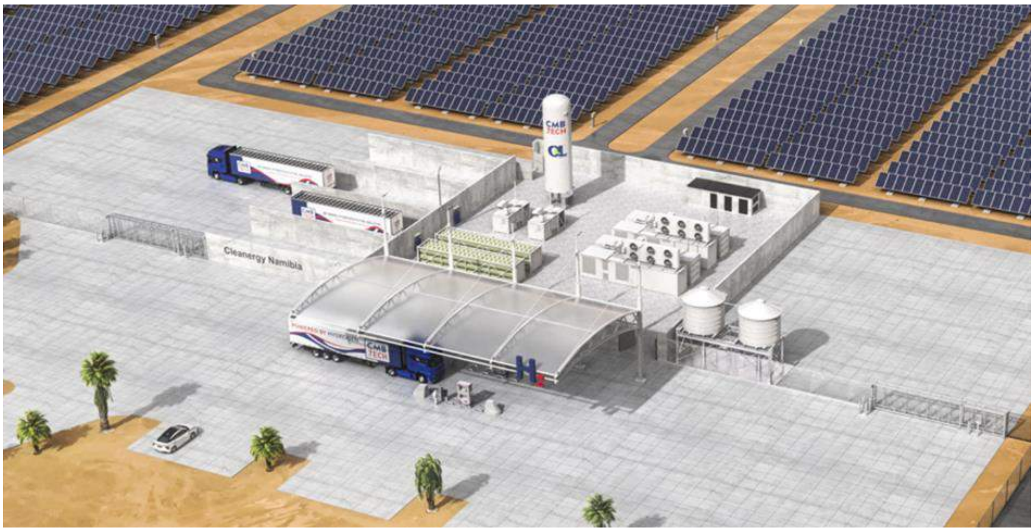
The demonstration plant will also have a 500-bar mobile refueller for transporting hydrogen from the production site to locations where it will be needed for refuelling heavy-duty applications. Following are the potential CMB.TECH projects in Namibia which will require refuelling in the field:

- Tugboat for Namport;
- Heavy-duty mining dump truck;

- Port equipment;
- Locomotive for TransNamib/Traxtion;
- Trucks for long-distance road transport; and
- Gensets.

Table 4-6: Fuelling Base Case

Number of vehicles	10 per day
Maximum per vehicle	30 kg (heavy-duty truck)
Average fill per vehicle	20 kg
Throughput per day	200 kg
Maximum fuelling time	Max. 15 minutes
Maximal fuelling in sequence	Two parallel fuelling possible



srk consulting | **CLEANERGY EIAR** Illustration of the Hydrogen Refuelling Station | Project No. 585529

Figure 4-11: Illustration of the Hydrogen Refuelling Station

Effluents/Emissions from the GHDP Electrolyser

Effluent from the GHDP electrolyser should be suited to run into the sewer without requiring additional treatment. These effluents will be generated from the following sources:

- Water purification;
- Condensate from condensate trapes, chiller and the dryer;
- Air compressor (oil-free type) and dryer; and
- Other sources not specified.

Emissions to air include:

- Gaseous hydrogen releases routed out to atmosphere at a safe location by means of a central vent stack;

- Gaseous oxygen released to atmosphere; and
- Gaseous nitrogen released to atmosphere.

Training Centre

To kickstart the project, Cleanergy will need to train a number of people around Walvis Bay from basic hydrogen knowledge to providing hands-on experience. The training centre which will include classrooms and workshops facilities and will be one of its kind where various groups of people can learn and develop hydrogen skills (Figure 4-12).

Training will typically be provided to hydrogen off-takers, service and engineering companies and people from neighbouring communities. One of the key objectives of the pilot project is thus to develop the local skillset required to support green hydrogen projects.

Education will be necessary to guarantee Cleanergy's license to operate and to showcase the potential of hydrogen to the whole community. Beside these intense and practical training opportunities in Walvis Bay, Cleanergy also want to support the education of the Namibian youth in the rest of Namibia.

Cleanergy believes that the highest impact on education can be reached by joining forces with all relevant stakeholders. Therefore, Cleanergy reached out to different educational institutions in Namibia including:

- UNAM – A Memorandum of Understanding has been signed between UNAM and Cleanergy Solutions Namibia. UNAM is the premier institution of tertiary education in Namibia consisting of four faculties and twelve campuses countrywide. This outreach makes UNAM a truly community-based institution, renowned for its academic excellence, outstanding research, and community development projects.

  Cleanergy Solutions Namibia and UNAM are willing to collaborate on the following possible R&D projects:

  - Comparison of different technologies for electrolysers and solar parks within the Namibian environment. For research purposes different technologies can be evaluated in the Cleanergy pilot plant; and
  - Optimisation of full plant scenarios based on analyses of operational and production data.
- Namibia University of Science and Technology (NUST); and
- Namibian Institute of Mining and Technology (NIMT) Arandis - NIMT provides cost effective and quality vocational and educational training to Namibian students. The goal of the Institute is to equip Namibians with skills and knowledge that will enable them to take up positions as artisans within different sectors such as mining, civil, engineering, mechanics, electronics etc.

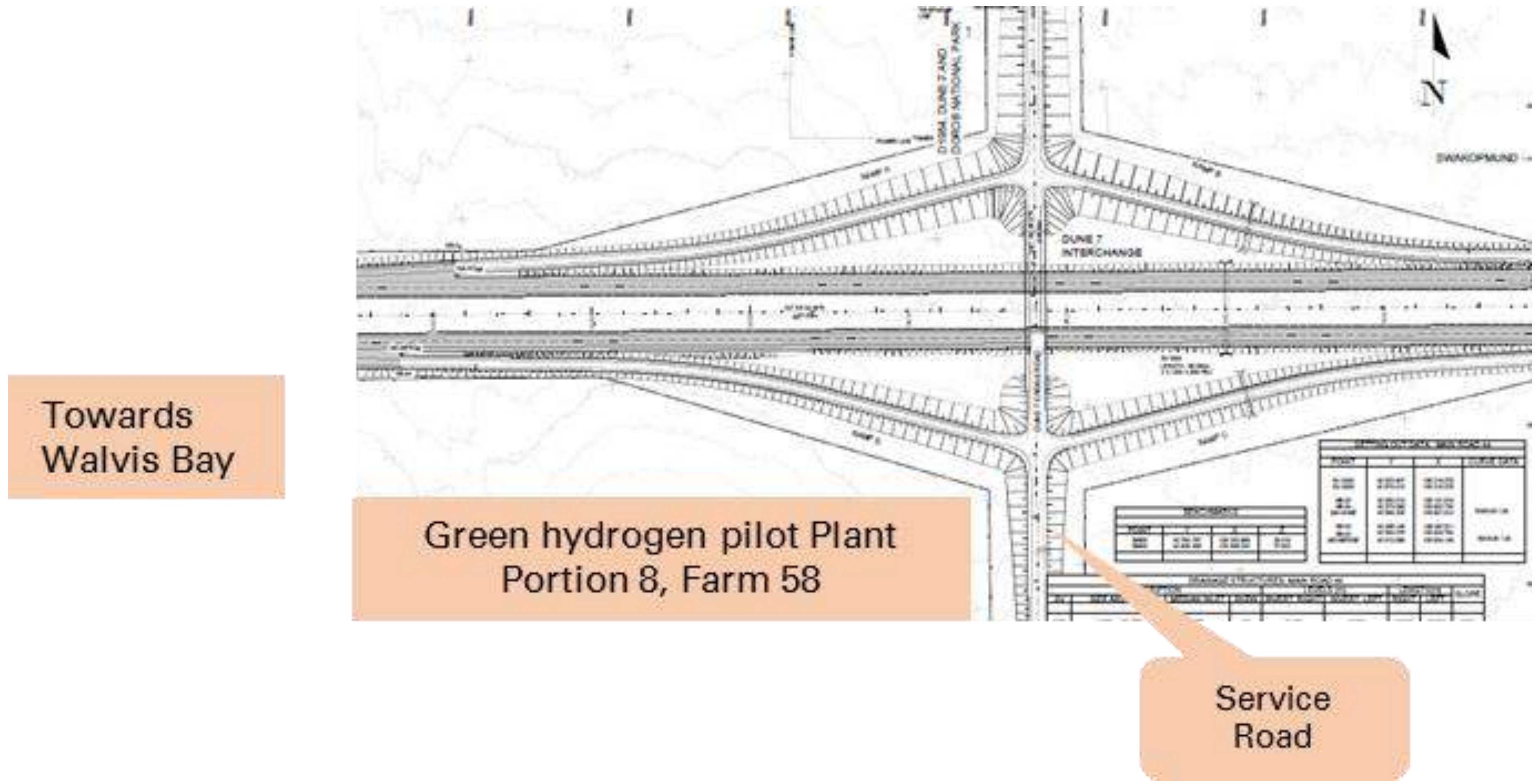
  NIMT and Cleanergy Solutions Namibia are willing to collaborate on the education of artisans (vocational training) to enable them to become the future employees of the Cleanergy GHDP. The collaboration can include course content and provision of training equipment related to hydrogen production and hydrogen applications.

srk consulting	**CLEANERGY EIAR** Training Centre	Project No. 585529

Figure 4-12: Training Centre

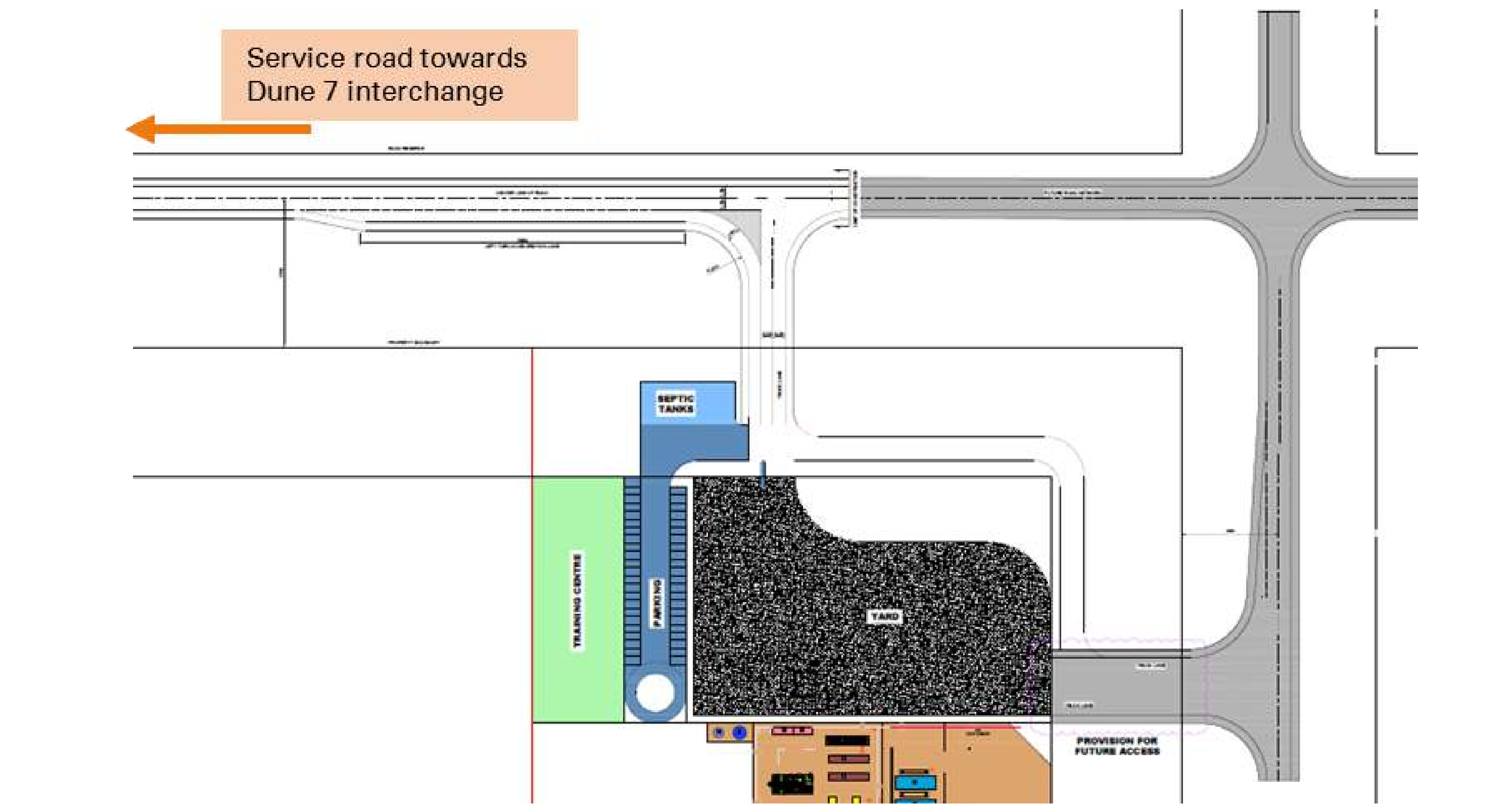
4.5.3 Access Road

It is noted that the Dune 7 interchange and service road to the heavy industrial zone needs to be completed in order to gain access site (Figure 4-13). Figure 4-14 illustrates the site entrance road proposed for the Cleanergy GHDP Project.



srk consulting	**CLEANERGY EIAR** Dune 7 Interchange and Service Road	Project No. 585529

Figure 4-13: Dune 7 Interchange and Service Road



srk consulting	**CLEANERGY EIAR** Proposed Site Entrance Road	Project No. 585529

Figure 4-14: Proposed Site Entrance Road

4.5.4 Electrical Transmission

The Cleanergy GHDP Project requires grid connection to support night-time operation and/or production. To kick-start the pilot project a minimum of 600 kiloVolt Ampere (kVA) grid power during night hours will be needed to support auxiliary system demands and the training/office building.

To future proof the plant, it is necessary to have a 5 MVA grid connection, where surplus electricity from the PV system could potentially be injected into the grid whilst off takers for the hydrogen are being developed. Once the hydrogen off-take base has been established, the 5 MVA grid connection can be used for producing hydrogen during night hours (by using surplus electricity).

As the connection to the grid will ultimately be the responsibility of Erongo RED, a separate EIA process will be undertaken to obtain an ECC for the connection to the Erongo RED grid.

4.5.5 Water and Waste Management Systems

Stormwater Management

Separation of clean and dirty water principles will be applied at the Cleanergy GHDP project. Stormwater will be separated using stormwater berms as well as through the use of diversion systems of clean and dirty water.

Waste Generation

Cleanergy GHDP will be designed and operated according to best international practice for effective management of waste at the site. During construction, the following wastes are likely to be produced: building rubble i.e., bricks, tiles, pavers, carton boxes, steel off-cuts, timber, excess unusable soil, etc. An area will be designated/secured off specifically for construction waste that will be required to be serviced/cleaned up by waste removal companies at least twice a week, or as required.

Non-hazardous wastes will be separated at source into labelled, covered, and fit for purpose waste bins. Waste bins will be made available across the campsite and waste skips will be made available at the worksite. Colour coding will be utilized for the waste bins/skips of the different non-hazardous waste streams. Waste collection points will be distributed at strategic points throughout the camp and worksites. All waste collection points will be sized and provided with enough waste bins/skips based on the projected amount of waste that is anticipated to be received.

Due to the remoteness of the site, workers will be expected to bring their own food and beverages from home. Contractors usually erect staff canteen areas being in containers or tented areas which the personnel can use for tea times/lunch/relaxation.

Hazardous waste will be separated at source at designated hazardous waste collection points, which enable appropriate segregation and storage of this waste stream pursuant to compatibility requirements. The hazardous waste collection points shall be within hard standing, bunded and roofed areas to prevent release to the environment. The hazardous waste bins will be removed periodically to a registered landfill site by an accredited waste contractor. Hazardous waste will be segregated into three main categories, but a compatibility review will be undertaken, and all hazardous waste bins will be clearly labelled to ensure incompatible hazardous waste stream that could react against each other are avoided:

- Hydrocarbons and lubricants (oil filters, oily rags, etc);
- Unspent or leftover chemicals (subject to compatibility as per the labels in the waste bins);
- Medical waste.

Other waste streams include a continuous waste gas stream from electrolyser at a flow rate of 791 kg/h (max.) and condensate from the air compressors.

The composition of the electrolyser waste gas stream is as follows:

- O_2: 90.14 wt.%
- H_2: 0.03 wt.%
- H_2O: 9.83 wt.%

Potable Water Pipeline Connection

At full load, the electrolyser requires 1200 litres (1.2 m^3) per hour to produce 90 kg of hydrogen. Of this, 200 litres per hour will be rejected by the electrolyser's water treatment system. From this volume, 1 000 litres are effectively split into hydrogen and oxygen, while the rest is used as cooling water.

Depending on the season, Cleanergy will require between 10 and 14 m^3 of potable water per day for hydrogen production. The extra water can be used for different purposes including:

- Domestic/Sanitation;
- Growing plants on site; and
- Cleaning the solar panels.

The water which will be used in the process is potable water to be supplied directly to site from municipality with a direct connection to the main water pipelines. The closest municipal water access point is approximately 1.5 km from the site. A new pipeline connection has to be established to have water access. To ensure safe operations and sustainable water usage, the option of a 400 m^3 to 500 m^3 water buffer tank will be envisaged.

Wastewater

During construction, chemical toilets will be used, and the sewage removed by an accredited contractor. It is anticipated that chemical toilets will need to be serviced 3-4 times per week subject to usage frequency.

The sanitary system to be used and implemented during the operational phase can be described as a flushing toilet with conservancy tank. This system consists of a standard flushing toilet that drains into a storage or conservancy tank on the property; alternatively, several properties' toilets can drain into one large tank. A vacuum tanker regularly conveys the excrement to a central sewage treatment works for purification before the treated effluent is discharged into a watercourse.

Wastewater from the electrolyser will be collected in a wastewater sump (ca. 60 m^3). The overflow of the wastewater sump goes to the sanitary wastewater tank.

Potentially the wastewater will be used for cleaning the solar panels and process equipment. It can also be used for irrigation.

4.6 Project Activities

Activities associated with the development and operation of the proposed Cleanergy GHDP Project are described in the following sections.

4.6.1 Site Preparation Phase

Site preparation activities will commence following the granting of the ECC. This Phase would include limited clearance of vegetation present on site, the installation of perimeter fencing, site levelling and preliminary earthworks. Thereafter, the project site will be marked out, construction site offices set up and a temporary access road to site constructed.

4.6.2 Construction Phase

Once site preparation activities have been completed, the Construction Phase of the proposed Cleanergy GHDP Project will commence. Construction phase activities will include:

- Bulk earthworks;
- Layer works and surfacing of roads and hardstand areas;
- Installation of subsurface civil services such as water, sewer, fire and electrical networks;
- Construction of general storage facilities for water and sewage (complete);
- Excavation of cable and pipeline trenches;
- Ramming or drilling of the mounting structure frames;
- Installation of the PV modules onto the frames;
- Installation of measuring equipment;
- Laying of cables between the module rows to the inverter stations;
- Optionally laying of gravel or aggregate from nearby quarries placed in the rows between the PV panel array for enhanced reflection onto the panels, assisting in vegetation control and drainage;
- Construction of foundations for the inverter stations and installation of the inverters;
- Construction of the foundations for the hydrogen production electrolysers, compressors, storage vessels, power container and hydrogen dispensing station;
- Construction of the substation and BESS foundations and installation of the substation components and placement of BESS;
- Construction of operations and maintenance buildings;
- Construction of refuelling station;
- Piping structure installation and piping interconnections between components;
- Cable structure installation and cabling interconnections between components;
- Undertaking of rehabilitation on cleared areas where required;
- Testing and commissioning;
- General fencing; and
- Removal of equipment and disassembly of construction camp.

It is noted that where possible, Cleanergy will source materials, plant and equipment from suppliers within the vicinity of the project area. The bulk of the specialist equipment, i.e., PV modules, inverters, BESS, substation components and BESS, etc, will be imported from China, Europe and/or South Africa and be shipped to Walvis Bay.

The construction phase of the proposed Cleanergy GHDP Project is estimated to take approximately 6-12 months.

4.6.3 Operational Phase

The proposed project will be operated on a 24-hour, 7 days a week basis. The operation phase of the proposed project will comprise the following activities:

- Operating of Training Centre which will include classrooms and workshops facilities from where basic hydrogen knowledge to hands on experience can be delivered to various parties;
- Installation and testing of different green hydrogen technologies;
- Regular cleaning of the PV modules by trained personnel;
- Vegetation management under and around the PV modules to allow maintenance and operation at full capacity;
- Maintenance of all components including PV modules, mounting structures, trackers, inverters, substation transformers, BESS, and equipment;
- Office management and maintenance of operations and maintenance of buildings;
- Supervision of the solar PV facility operations;
- Supervision of the hydrogen production, storage and dispensing facilities;
- Site security monitoring;
- Executing storm water management plan;
- Managing sewage disposal; and
- General road/site maintenance.

4.6.4 Decommissioning Phase

Whilst the solar PV plant itself will have an anticipated life cycle of 25 years, the GHDP will only be in operation for as long as it is feasible. If decommissioned, the necessary approvals will be obtained before all components are to be removed and the site rehabilitated. Materials will be recycled where possible and where it is not possible to recycle the materials, these will be disposed of in accordance with local regulations and international best practice.

5 Alternatives

During the Scoping Phase, based on professional judgement of the EAP, the engineering design consultants and I&AP comments, different alternatives have been considered for the proposed GHDP Project. The aim of Section 5 is to detail and compare the environmental and social impacts and risks of the project alternatives for the purpose of selecting preferred alternative(s). Section 5 has compiled in compliance with Section 8(g) of the EIA Regulations.

The project components for which alternatives were considered included and are described in the following sections:

- Site;
- Type of renewable energy to be utilised;
- Source of water used for hydrogen production; and
- Technology to be utilised for hydrogen production process.

5.1 Site Alternatives

Both the demonstration and PV plant will be located on one site. Two potential sites were considered. One in Walvis Bay and the other in Arandis. It was agreed that the plant should be located in an area that:

- Was already zoned as an industrial area;
- Is approximately 15 km from the Walvis Bay port;
- Is sufficiently sized for all the infrastructure;
- Will not disturb other economic activities;
- Is close to towns with sufficient accommodation for additional personnel;
- Has adequate access to service providers for services and maintenance;
- Has easy access from the D1984 highway; and
- Has access to all major transport corridors.

The site at Arandis was discarded. The decision approach considered superior transportation accessibility and connectivity as well as plans to establish a new economic zone which outweighed Arandis' favourable solar irradiation conditions.

5.2 Technical Alternatives

5.2.1 Hydrogen Production

Options weighed for the type of hydrogen production method included:

- **Grey hydrogen** which is based on natural gases mainly methane (CH_4) emitting a carbon content (CO_2) to the atmosphere. The plant configuration was, however, too extensive, and complex.
- **Blue hydrogen** which is similar to grey hydrogen, but CO_2 is rather captured or separated and sent to long-term storage or used as a raw material in the chemical industry instead of being released to the atmosphere. Storage possibilities or the chemical usage thereof were, however, limited.

- **Orange hydrogen** which is based on biogas through the fermentation of biomass to incineration and gasification, however its carbon content is very high.
- **Green hydrogen** which is based on renewable energy and water transforming water into oxygen and hydrogen done through water electrolysis. This was the preferred option because of the abundance of renewable energy in the form of solar energy and because the process of converting water into oxygen and hydrogen is relatively well established.

5.2.2 Water Provisioning

Because clean water of good quality is required for the green hydrogen production process, desalination and obtaining water directly from the municipality were the two options considered.

Desalinisation uses thermal or membrane processes, usually reverse osmosis to treat seawater to be of suitable quality that can be used in the hydrolysis process. The largest desalinisation plant in Namibia is the Orano Plant, 35 km north of Swakopmund and selling water to NamWater and the mining industry.

Because the demand of water for the proposed project is less than 14 m^3/d, it can easily and effectively be supplied by the municipality which already provides water of potable quality. The preferred option was thus to obtain **water from the municipality**.

5.2.3 Water Electrolysis

Technologies that were considered for water electrolysis were:

- Alkaline electrolysis (TRL 8-9);
- Proton exchange membrane or polymer electrolyte membrane (TRL 8);
- Solid oxide electrolysis cell/high temperature electrolysis (TRL 6); and
- Anion exchange membrane (TRL 6).
- Even though TRL 6 processes can bring distinctive improvements more easily, only TRL 8 and 9 were considered for the proposed project.

Between the alkaline electrolysis and proton exchange membrane, the proton exchange membrane process was chosen because of its reduced capacity, the lower importance of the pilot plant purpose, intrinsic hydrogen purity, and elimination of a compression stage.

5.2.4 Utilisation of Hydrogen

Options considered for the usage of elementary hydrogen included:

- Compressed hydrogen which was only feasible for clients in Namibia or neighbouring countries as it cannot be shipped over long distances. A medium-term possibility is to use dual-fuel engines for short-sea shipping and trucks at a pressure level of 350 bar;
- Liquified hydrogen which can be transported over long distanced, but the material requirements and heat duty are more demanding; and
- Liquid Organic Hydrogen Carriers (LOHC) which absorbs and releases hydrogen chemically allowing safe storage and transport, but proven LOHC capacities have not reached their sizes yet, making it less likely for usage.

Options considered for the usage of a carbon-containing product included methane, methanol, and synthetic fuels. Sufficient CO_2 and CO quantities required in these usages can, however, not be obtained in Namibia and was ruled out.

Options considered for the usage of ammonia which is the only economical way to bind nitrogen in the atmosphere chemically, producing wither grey ammonia from natural gas or green ammonia from solar irradiation. Both of these options were feasible, but for the purposes of the proposed demonstration plant the compressed hydrogen option is the most technically feasible. For this option, the demonstration plant will use only compressed hydrogen tanks.

5.3 No-Go Option

The “no-go” option is the alternative of foregoing the implementation of the project entirely. If the project does not proceed, it will imply that no negative environmental impacts will materialise at the proposed footprint area. However, the overall environmental benefit of using green hydrogen as an energy source will be lost. When compared to current energy sources used, zero polluting emissions is a major advantage associated with the use of green hydrogen.

Further, the socio-economic benefits associated with green hydrogen will also be lost. None of the environmental and social risks identified in Section 7, are considered to be fatally flawed.

6 Description of the Baseline Environment

The following section presents an overview of the biophysical and socio-economic environment in which the proposed project is located, so as to:

- Understand the general sensitivity of and pressures on the affected environment;
- Inform the identification of potential issues and impacts associated with the proposed project, which was assessed during the impact assessment phase;
- Identify gaps in available information to inform specialist study requirements; and
- Start conceptualising practical mitigation measures.

Baseline information for this EIAR was sourced through desktop analysis and information contained in studies undertaken by the various Namibian governmental departments and environmental non-governmental organisations. Baseline information was obtained from the following sources:

- Atlas of Namibia (Mendelsohn et al., 2002) and Namibia's Coast (Robertson et al., 2012);
- EIA study for the Establishment of Walvis Bay Golf Course and Residential Areas to be known as the Presidents Links Estate (KPM Environmental Consulting, 2021);
- EIA study for the HDF Energy Renewstable Swakopmund Project (SLR, 2022);
- Integrated Urban Spatial Development Framework for Walvis Bay (2011);
- Information found through internet searches on the project area;
- Topocadastral and geological maps covering the application area at scales ranging from 1:50 000 to 1:250 000; and
- Inputs from environmental and social specialists.

It is noted that the proposed Cleanergy GHDP Project area does not have any major unique habitats, is not in a pristine condition and is heavily impacted by various anthropomorphic activities.

6.1 Socio – Economic Environment

This section of the report describes the national, regional, constituency and local social and economic characteristics of the area where the GHDP is proposed to be constructed. It discusses socio-economic features such as population, demography, household economics, education, health, economic activities and social infrastructure, amongst others. This Section has been extracted from the Social Baseline Study compiled by Sustainable Development Africa cc (Mouton, 2022).

6.1.1 National Context

Namibia is a sovereign country located in the south-western part of Africa, bordered by four countries and an ocean: South Africa, Angola, Botswana, Zambia and Zimbabwe, as well as the Atlantic Ocean to the west. Namibia is vast with large open spaces extending over 824 000km^2. The population has grown from 1.8 million in 2001 to 2.1 million in 2011 and 2.45 million in 2019 (NSA, 2014). Namibia is sparsely populated with a population density of 2.6 people per km^2.

Namibia is divided into 14 administrative and political regions and 121 constituencies. The number of constituencies differ for each region depending on geographical and population size. The Khomas Region houses the largest population, and serves as the country's capital, with Windhoek being the capital city. The region with the smallest population is Omaheke, situated on the eastern side bordering Botswana, followed by Hardap and Karas regions in the south.

Namibia is generally an arid, dry country with highly variable rainfall, resulting in many people depending on dryland cropping for subsistence. It largely depends on her natural resources, which include gold, zinc, diamonds, uranium, copper, fisheries, wildlife and the 'wide open spaces' (tourism).

Notwithstanding rapid urbanisation since the early 1990s, two-thirds of Namibia's households live in rural settings, with slightly more than half headed by males. Namibia has made great strides in alleviating poverty but continues to battle with one of the highest inequality rates in the world. Namibia continues to be challenged with poverty in certain social pockets across the 14 regions, which is further constrained by the economic downturn over the past few years, high levels of unemployment, inadequate implementation of policies across sectors, and impacts of the COVID-19 pandemic, amongst other factors. Notwithstanding these challenges, Namibia continues to strive towards achieving Vision 2030, Harambee Prosperity Plan (HPP), Global Sustainable Development Goals and the African Union Agenda 2063. Namibia's overall development is guided by Vision 2030, supported by short-term five-year development plans and sectoral policies, plans and strategies. Namibia's fifth National Development Plan (NDP 5) aims to:

- Achieve inclusive, sustainable and equitable economic growth;
- Build capacity and healthy human resources;
- Ensure sustainable environment and enhances resilience; and
- Promote good governance through effective institutions (Mouton, 2022).

Namibia is divided into fourteen administrative and political regions, of which the Erongo Region is one. The Walvis Bay City falls within the boundaries of the Erongo Region, which is situated in the west central part of Namibia. The proposed GHDP will be situated on the eastern boundaries Walvis Bay in the newly developed industrial zone, near the Walvis Bay International Airport and the well-known Dune 7. The Erongo Region is bordered by the Khomas Region to the southwest, Hardap Region to the south, Otjozondjupa Region to the east, Kunene Region to the north and the Atlantic Ocean to the west. Seven constituencies make up the Erongo Region. The renowned, majestic Erongo mountain range, which sprawls across the plains between the cities of Omaruru and Karibib, inspired the region's name. The Southern African Development Community (SADC) region's largest seaport port is located in Walvis Bay, while Swakopmund, the region's capital, is a popular tourist and holiday destination for domestic, regional and international tourists.

6.1.2 Regional Context

According to the 2011 Namibia Population and Housing Census[10], there were 150,809 people living in Erongo Region, of which 70,986 were women and 79,823 were males (Mouton, 2022). The population of the area increased at an annual growth rate of 3.4 percent annually. Only 13 percent of the population resided in rural areas, while 87 percent resided in urban areas. This is a result of a significant share of people moving from rural to urban areas such as Walvis Bay in search of employment, especially among young individuals. Averaging 3.3 people per home, there were 44,116 households in the region in 2011.

The population of the Erongo Region, together with the Khomas Region, was projected to increase the most amongst all 14 regions over 20 years. It was expected that over a third of Namibia's population would live in the two above-mentioned regions in the future (Mouton, 2022). At an average annual population growth rate of 3.4 percent for the ten-year period from 2001 to 2011, the Erongo

[10] This is the latest population and housing census. The 2021 Population and Housing Census was postponed due to COVID-19 regulations in the year 2021, but also due to financial shortages.

Region is projected to have a total population of 220,000 by 2022 (NSA, 2014b). The Erongo Region is divided into the following seven constituencies:

- Arandis;
- Daures;
- Karibib;
- Omaruru;
- Swakopmund;
- Walvis Bay Rural; and
- Walvis Bay Urban.

6.1.3 Settlement Patterns

The City of Walvis Bay is located between the Namib Dune Belt and the Atlantic Ocean, west of the B2 road from Swakopmund to Walvis Bay. A bypass on the east of the Dune Belt connects Walvis Bay and Swakopmund as well, which runs parallel to the coastal road on the west of the Dune Belt. This bypass is primarily for use by heavy trucks. The proposed GHDP is situated adjacent to this highway (D1984).

The City cuts across the boundaries of the Walvis Bay Urban and Walvis Bay Rural constituencies. The entire population of Walvis Bay Urban Constituency falls within the city’s boundaries, while about 90 percent of the population of Walvis Bay Rural falls within the city’s boundaries.

The City of Walvis Bay was initially developed to serve the harbour and continues to focus primarily on harbour and ancillary services. The Central Business District (CBD) is located in the centre of all neighbourhoods, adjacent to the harbour. Walvis Bay Municipality foresees that the future growth of the city will be eastwards due to the unavailability of land to the north, the ocean to the west and the Tsau //Khaeb National Park (restricted diamond area - *Sperrgebiet*) to the south. The industrial area was originally located north of the harbour with the main purpose of serving the fishing industry, cargo processing, import and export of bulk materials (Mouton, 2022). The designated Export Processing Zone (EPZ) was developed after Independence. The current industrial growth area is eastward, following the railway for some 10 km, and the bypass behind the dune belt.

As a Local Authority, the City is managed by the Municipal Council and Management.

The City of Walvis Bay is divided into formal and informal residential areas. Formal residential areas included Walvis Bay Central, Meersig/Lagoon, Naraville, Kuisebmund, Tutaleni, Langstrand and Dolfynstrand. Informal residential homes are found in back yards of many households in the Kuisebmund neighbourhood, as well as in areas adjacent to the Kuisebmund neighbourhood. Those living in formal residence make up most of the population at 50,673 and 28,842 in informal residential units (Walvis Bay, 2014).

6.1.4 Demographics

The City of Walvis Bay cuts across the Walvis Bay Urban and Walvis Bay Rural constituencies. Data from these two constituencies combined are therefore used to present the City of Walvis Bay. The Walvis Bay Urban Constituency is home to the second largest population after the Swakopmund Constituency. However, the City of Walvis was home to the largest population in the region in the year

2011 at 62,096 residents[11], compared to 44,725 in Swakopmund (Mouton, 2022). Other urban localities in the region have very small populations; an average of about 5,000 in 2011.

The City of Walvis Bay grew from a population of 43,566 combining Walvis Bay Urban and Rural constituencies in 2001 to 62,096 in 2011 (Mouton, 2022). The City of Walvis Bay's annual population growth rate was estimated at 4.7 percent (Mouton, 2022). This is due to the influx of people after Namibia's Independence to find employment in the fishing industry, but also due to the large industrial activities and the most recent expansion of the Walvis Bay Port. Walvis Bay Municipality noted that, "with prospects for an increase in uranium mining activity, coal export from Botswana, increased imports of fuel and other products for Namibia and the SADC region, it is unlikely that growth will slow in the short and medium terms. The prospects of finding a commercially viable offshore oil reserve in the near future could drive growth even higher" (Mouton, 2022).

There seems to be different population sizes for Walvis Bay based on official documents. The NSA reported 62,096 total population in the year 2011. The Urban Dynamics Town Planners counted 79,515 total population in 2012. The Walvis Bay Municipality in the Integrated Urban Spatial Development Framework (IUSDF) noted that 'the latter population size was more likely to be correct as the 2011 census undercounted the population due to confusion about backyard shacks. This opinion is shared by municipal offices' (Walvis Bay Municipality, 2014). Taking the 79,515 and the 4.7 annual population growth rate into consideration, the 2022 projected population size of the City of Walvis Bay is 125,868. This constitutes 57.2 percent of the Erongo Region's population in the year 2022, compared to 41 percent in 2011.

The population of Walvis Bay normally increases by about 10,000 between March and August due to increased opportunities in the fishing industries. With the expansion of cargo handling, this number most probably increased (Mouton, 2022).

The population density in Walvis Bay Urban Constituency was 1,896 persons per km^2, followed by Swakopmund Constituency at 228 persons per km^2. The lowest population density was found in the Daures Constituency with 0.6 persons per km^2 (Mouton, 2022).

Sex Ratio

More than half of the population (52.9 percent) in the Erongo Region were male. Although the proportion was greater than 50 percent in both urban and rural areas, the former had more males. Walvis Bay Urban Constituency had a gender distribution of 54 percent males and 46 percent females, (Mouton, 2022). Walvis Bay Urban Constituency had 117 males per 100 females in the year 2011, while the Walvis Bay Rural Constituency had 111 males per 100 females. The 117 males per 100 females for Walvis Bay Urban Constituency was highest than the overall regional urban proportion of 111 males per 100 females.

Age Structure

The table below shows the population's age distribution by major age cohorts by region, geographic area and constituencey. The Erongo Region has a high proportion of young people with 27.5 percent under the age of 15. Urban settings had higher proportions of young people than rural settings, which is understandable as schools and other social services are more accessible in urban settings. The percentage of elderly individuals (those 60 years and older) was also higher in rural areas than in urban areas (10.2 percent vs. 4.9 percent). At contituency level, Walvis Bay Urban Constituency had

[11] It should be noted that the City of Walvis Bay cuts across constituency boundaries, including Walvis Bay Urban and Walvis Bay Rural constituencies. The total population of the two constituencies in the year 2011 was 62,744, while the City of Walvis Bay was 62,096. This means that only a small proportion of Walvis Bay Rural Constituency falls within the rural area, while the remaining areas fall within the city's boundaries.

a lower percentage of the population in the age group of 0-4 and slightly less in the age group of 5-14 (Mouton, 2022). This can be related to improved family planing, although household sizes were found to be slightly higher in Walvis Bay Urban Constituency than Walvis Bay Rural Constituency (3.7 and 3.9 respectively). The productive, working age cohort was at a high of 71.56 percent and 76.12 percent for Walvis Bay Urban and Rural constituencies respectively (Mouton, 2022).

Table 6-1: Age Cohort Percentages by Area (Mouton, 2022)

Area	Percent Age-group			
	0 to 4 Years	5 to 14 Years	15 to 59 Years	60+ Years
Erongo	10.8	16.7	66.9	5.6
Urban	10.4	16.1	68.6	4.9
Rural	14.1	20.9	54.8	10.2
Arandis	9.6	18.5	63.9	8.0
Daures	14.8	22.7	51.4	11.1
Karibib	13.1	19.9	59.7	7.3
Omaruru	12.3	19.9	60.8	7.0
Swakopmund	10.0	15.7	68.5	5.7
Walvis Bay Rural	11.0	15.7	71.2	2.1
Walvis Bay Urban	9.6	14.4	71.5	4.5

Household Characteristics

Household size: Average household size in the Erongo Region was smaller than most other regions in the country at 3.3 people per household. Similar household sizes were found in Walvis Bay Urban and Rural constituencies (3.2 and 3.3 people per household).

Head of household: The majority of households in the region were headed by males (65.6 percent), with similar trends in Walvis Bay Urban and Rural (Mouton, 2022). However, there were households headed by children and orphans due to the high HIV mortality in the region, and more specifically Walvis Bay. One percent of households in the region were headed by children, while 0.4 percent were headed by orphans. The trend was similar in Walvis Bay Urban and Rural (Mouton, 2022).

Household income: The Namibia Household Income and Expenditure Survey (2015/16) found that 80.0 percent of households in the Erongo Region depended on salaries/wages as their main source of income, followed by businesses (5.5 percent), pensions (5.2 percent), remittances/grants (5.0 percent), and drought relieve (0.9 percent). Subsistence farming was regarded as main source by only 0.4 percent, while 0.1 percent depended on commercial farming (NSA, 2016). The 2011 Census recorded similar findings for Walvis Bay Urban and Rural constituencies.

The Walvis Bay Municipality reported that the average household income ranged from N$6,000 to N$7,000 per month in the year 2012[12] (Walvis Bay Municipality, 2014). Those in formal residential areas have an average income of N$12,500 per month. The Langstrand/Dolfynstrand neighbourhoods are

[12] Please note that this is the latest report that the consultant had access to from the Walvis Bay Municipality.

home to the wealthiest in terms of monthly income with an average of N$25,000 per month. The poorest cohort of the population lives in informal residences with a household income of about N$1,004 per month.

Housing unit type: The type of housing units in Walvis Bay Urban and Rural constituencies were mostly detached houses (43.3 percent and 39.2 percent respectively). In addition to the above, similar proportions were impoverished housing units (31.5 percent and 38.8 percent respectively). Other types of housing units included detached houses, semi-detached houses, apartments/flats, mobile homes, single quarters and traditional dwellings. Close to half of the houses were owned, while the rest were rented. The average number of persons per bedroom was 1.5 (Mouton, 2022).

Most of the households in Walvis Bay Urban (67.3 percent) used cement blocks/bricks as the main material for the outer walls of houses, while 46.0 percent in Walvis Bay Rural Constituency used the same (Mouton, 2022). Close to one-third (34.8 percent) of households in Walvis Bay Rural Constituency used prefabricated materials. The latter is mostly used by impoverished households. Asbestos sheets were mostly used as the main material for the roof in Walvis Bay Urban and Rural constituencies (63.3 percent and 61.3 percent respectively). Most of the households used tiles and cements as the main material for floors.

Sources of Energy: Almost all households in Walvis Bay Urban and Rural constituencies used electricity from mains (97.3 percent and 96.6 percent respectively) (Mouton, 2022). The remaining households used gas, firewood and charcoal. Solar energy was not widely used across the different constituencies.

Water Supply: All households in Walvis Bay Urban and Rural constituencies had access to safe drinking water (99.7 percent and 99.2 percent respectively). However, only 49.8 percent of households in Walvis Bay Rural used piped water inside the household, while 48.1 percent use piped water from outside (35.1 percent for Walvis Bay Urban Constituency) (Mouton, 2022).

Sanitation: Almost all households in Walvis Bay Urban and Rural constituencies has access to flush toilets (99.4 percent and 97.4 respectively). However, roughly half are private flush toilets while the other half are shared.

Waste Disposal: Over 90 percent of households reported regular collection of waste in the municipal area. Small proportions reported irregular collection, while others dump garbage by the roadside and burnt it.

6.1.5 Labour Force

The labour force participation rates[13] for Walvis Bay Urban and Rural constituencies were 81.4 percent and 85.4 percent respectively. This was higher than the national labour force participation rate of 71.2 percent in 2018 (Mouton, 2022).

In the year 2011, 70.1 percent of the Erongo Region's economically active population was employed while 29.9 percent was unemployed. Urban settings had similar proportions of employed and

[13] The NSA defined labour force participate rate as "the proportion of the economically active population in a given working age population, i.e., the number of persons in the labour force given as a percentage of the working age population in that population group" (NSA, 2018, p.35).

unemployed, while more people in rural areas were unemployed (34.5 percent). In urban settings, females were more likely to be unemployed (39.1 percent) than males (21.4 percent). Close to half of the female population in the Erongo Region's rural settings were unemployed (47.6 percent), compared of males (26.3 percent) in the same geographical settings (Mouton, 2022).

Main occupations in the region were craft and related trade workers (21.6 percent) followed by elementary occupations (20.9 percent), service workers (13.5 percent) and skilled agricultural and fisheries workers (10.0 percent) (Mouton, 2022). The main industries in the Erongo Region that employed people included manufacturing (13.8 percent), mining and quarrying (11.7 percent), agricultural, forestry and fishing (11.5 percent), construction (9,5 percent), and motor vehicle repairs (9.2 percent). Other industries included electrical, plumbing, transportation and storage, accommodation and food service activities, ICT, financial insurances, real estate, professional scientific and technical services, administrative and support services, public administration, education, health and social work, arts, entertainment and recreation (Mouton, 2022).

More than two-thirds were employed by the private sector (73.2 percent), followed by the public sector (17.2 percent) (Mouton, 2022). Other sectors included subsistence farming, family workers, and other.

6.1.6 Education

Education in the Erongo Region is managed by the decentralised Directorate of Education, under the Erongo Region Council. The schooling system is divided into the following phases:

- Junior Primary (Pre-primary to Grade 3);
- Senior Primary (Grades 4-7);
- Junior Secondary (Grades 8-9); and
- Senior Secondary (Grades 10-12).

Ministry of Education, Arts and Culture's education statistics for the year 2019 recorded 75 schools, 45,082 learners, 1,811 teachers and 459 support staff in the Erongo Region. The number of schools increased from 64 in 2013 to 75 in 2019 (Mouton, 2022).

Formal schools in the Erongo Region are divided into three educational circuits for managerial purposes: Walvis Bay, Swakopmund and Omaruru circuits. The Walvis Bay Circuit includes schools in both Walvis Bay Urban and Rural constituencies. For the City of Walvis Bay, the following schools were found:

- International School of Walvis Bay;
- Walvis Bay Primary School;
- The Dolphin Schools;
- Flamingo Primary School;
- Alexanders Private School;
- Walvis Bay Private High School;
- JTC Private School;
- Duinesig High School;
- De Duine Secondary School;
- Prominence Private School;
- Duneside High School;

- JJ Private School;
- Walvis Bay Play School;
- Kuisebmund Primary School;
- Flamingo Secondary School;
- Tutaleni High Schools; and
- Immanuel Ruiters Middle School.

Average class size in the Erongo Region was 32.1, slightly higher than the national average of 30.6 learners (Mouton, 2022). The learner : teacher ratio was found to be 25:1 in 2019 (Mouton, 2022). This ratio includes private schools and additional teachers hired by school boards in state schools. This ratio is lower than the national average.

Very high levels of literacy rates were found amongst the adult population (those 15 years of age and above). For the Erongo Region, 96.7 percent of the adult population was literate. The proportion for Walvis Bay Urban was even higher at 98.9 percent. Adult females were slightly more literate than adult males (99.1 percent and 98.7 percent respectively). Almost all young adults (15-24 years of age) were found to be literate in the City of Walvis Bay (99.3 percent) (Mouton, 2022).

The proportion of children enrolled in early childhood development (ECD) programmes was very low for the region (24.2 percent). The proportions were not very different for Walvis Bay Urban and Rural (27.8 percent and 25.6 percent respectively) (Mouton, 2022). No significant differences were recorded for male and female children in Walvis Bay Urban and Rural constituencies. A much higher proportion of children attended Edu-care, than pre-primary (Mouton, 2022).

A high of 5.2 percent of the Erongo Regional population of those six years of age and above never attended formal school, against the 2.7 percent in Walvis Bay Urban and 4.1 percent in Walvis Bay Rural constituencies (Mouton, 2022). Close to half of the adult population in the region completed primary education before leaving formal education. The overall school enrollment rate for the region was 56.8 percent, and about 58 percent for the Walvis Bay Urban Constituency and 52 in Walvis Bay Rural Constituency. Overall enrollment into primary education was high at 92 percent for both Walvis Bay Urban and Rural constituencies (Mouton, 2022).

The survival rate from primary to secondary school in 2018 was 88.2 percent. The survey rate from grade 9 to 10 in 2018 was 78.3 percent, while the survival rate from grade 11 to 12 in 2018 was 44.2 percent. The survival rate indicates the percentage of learners expected to stay in school until reaching the next grade. This means that only 44.2 percent of learners were expected to remain in schools until Grade 12 (Mouton, 2022).

6.1.7 Health

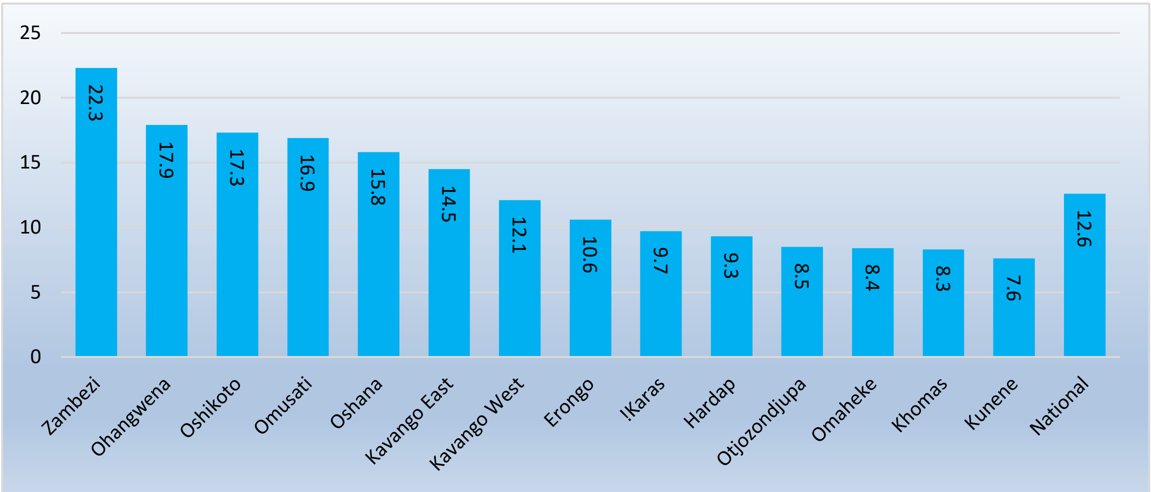
Leading causes of death in Namibia included AIDS-related deaths, other cardiovascular diseases, ill-defined diseases, lower respiratory infections, TB, diarrhoeal diseases, cerebrovascular disease, nephritis and nephrosis, road traffic accidents and other digestive diseases (Mouton, 2022).

HIV and AIDS

The National Strategic Framework for HIV and AIDS Response in Namibia, 2017/18-2021/22 (Mouton, 2022) indicated that “Namibia has a high HIV prevalence and incidence rates, generalised and matures HIV epidemic, with the majority of new HIV infections transmitted through unprotected heterosexual sex. Co-morbidities and opportunistic infections add to the HIV burden”.

HIV and AIDS continue to pose a challenge to Namibia's socio-economic development. HIV and AIDS was regarded as a key developmental and health challenge in the region, because it continues to be the leading cause of death in the country, according to the Namibia Mortality and Causes of Death Report, 2020. The predominant mode of transmission of HIV in Namibia and the Erongo Region is through heterosexual sexual intercourse, followed by perinatal transmission. It can also be transmitted via other modes, such as infected blood and unsafe injections.

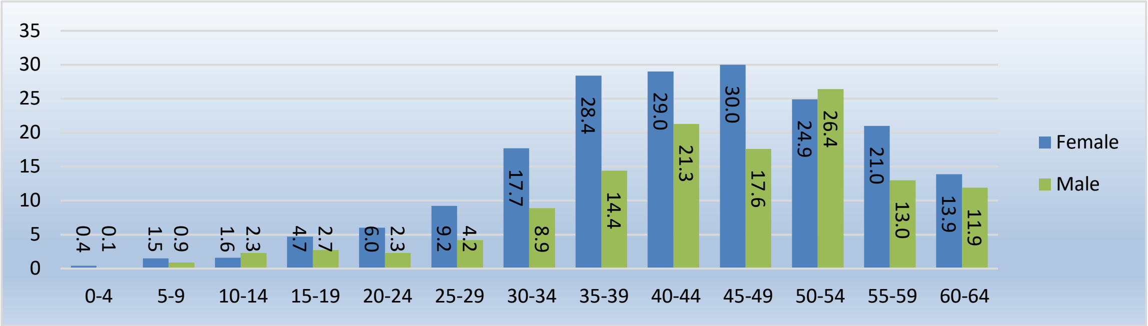
The national HIV prevalence based on the Namibia Population-Based HIV Impact Assessment (Mouton, 2022) was 12.6 percent among adults 15 – 64 years of age. The Country Operational Plan of PEPFAR noted that the projected HIV prevalence for the adult population was 8.4 percent (PEPFAR, 2022). The region in Namibia with the highest prevalence based on NAMPHIA was found to be the Zambezi Region (22.3 percent) followed by Ohangwena (17.9 percent) and Oshikoto (17.3 percent) regions. The Erongo Region's rate was 10.6 percent in 2018.



srk consulting	**CLEANERGY EIAR** HIV PREVALENCE BY REGION, 2018 (%)	Project No. 585529

Figure 6-1: HIV Prevalence by Region, 2018 (%; NAMPHIA, 2018)

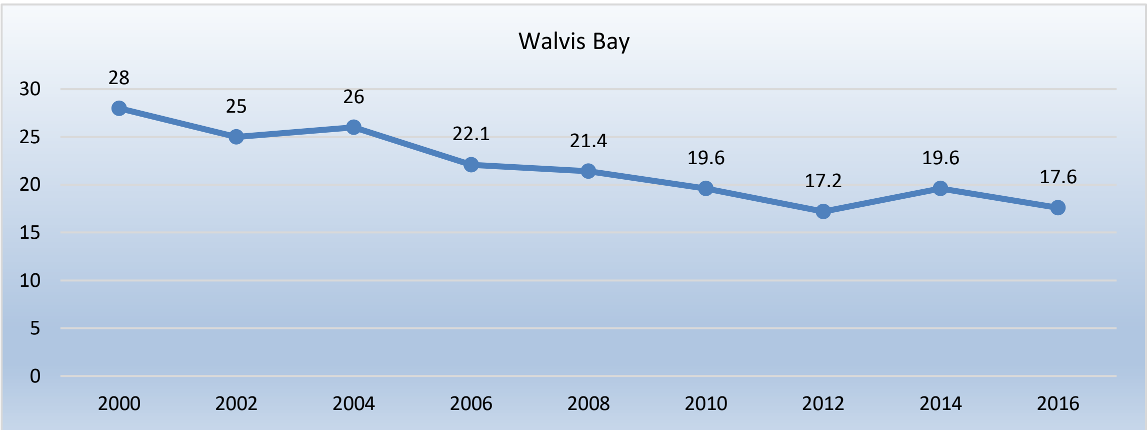
The HIV prevalence at national level is higher among the productive and reproductive age cohorts and among females, as per Figure 6-2. Female HIV prevalence was higher than male prevalence for all age cohorts, except for the 50-54 age cohorts. The difference between male and female prevalence was especially evident amongst the 20-39 age cohorts, where twice as many females were infected than males. This age cohort is generally the reproductive age range for females.



srk consulting	**CLEANERGY EIAR** NATIONAL HIV PREVALENCE BY AGE (%)	Project No. 585529

Figure 6-2: National HIV Prevalence by Age (%; NAMPHIA, 2018)

The above-mentioned NAMPHIA was the first population-based survey of its kind conducted in 2017. Prior to this, HIV prevalence was determined by the National HIV Sentinel Survey (NHSS)[14], carried out by the MoHSS. Hospitals in the following three towns were used as sentinel sites in the Erongo Region, Walvis Bay, Swakopmund and Usakos. Walvis Bay is considered one of hotspots for HIV infections in the country due to high migration levels, being a hub for economic activities. The adult HIV prevalence for Walvis Bay was 17.6 percent in 2016. The HIV prevalence in Walvis Bay has been on a consistent decrease since the early 2000s from a high of 28.0 percent amongst the adult population to 17.6 in 2016. The assumption is that this prevalence rate is lower in the year 2022, due to the extensive HIV prevention measures amongst key populations, such as seafarers, commercial sex workers, truck drivers, adolescent girls and young women, and men having sex with men amongst others.



srk consulting	**CLEANERGY EIAR** HIV PREVALENCE BY REGION, 2018 (%)	Project No. 585529

Figure 6-3: HIV Prevalence Walvis Bay, 2000-2016 (%; MoHSS, 2016)

Namibia has made significant strides in responding to HIV and AIDS with 97 percent of those knowing the HIV status being on antiretroviral treatment (ART). Namibia's plan was to achieve the 90-90-90 UNAIDS target towards ending the AIDS pandemic by 2020, which was achieved prior to the due date. The NAMPHIA found that 86.0 percent of PLHIV aged 15-64 years of age reported to know their HIV

[14] The National HIV Sentinel Survey (NHSS) is conducted every two years amongst pregnant women attending antenatal care facilities to determine HIV prevalence. The NHSS has been carried out since 1992. The last Sentinel Survey was carried out in 2016

status; 96.4 percent of PLHIV who knew their HIV status were on ART; and 91.3 percent of PLHIV and who were on ART were virally suppressed.

Great strides have been made in Walvis Bay as well with a combination of HIV testing, prevention, treatment and management services being provided by the following public, private and Civil Society Organisations (CSOs):

- MoHSS;
- Walvis Bay Municipality;
- Ministerial HIV and AIDS Workplace programmes;
- WBCG;
- Project Hope;
- IntraHealth; and
- NAPPA.

Tuberculosis

As indicated above, TB is the fifth highest cause of death in Namibia. Those infected with HIV are about 25 times more likely to develop active TB. Walvis Bay is therefore prone to high TB rates. About 5 percent of deaths in the Erongo Region was caused by TB (NSA, 2020).

Malaria

About 7 percent of deaths in the Erongo Region was caused by malaria (NSA, 2020).

Health Facilities

Table 6-2 summarises available health facilities.

Table 6-2: Health Facilities in Public Sector, Private Sector; and Civil Society (Mouton, 2022)

Public Sector	
1	Coastal Clinic
2	Kuisebmund Health Centre
3	Narraville Clinic
4	Utuseb Clinic
5	Walvis Bay Clinic
6	Walvis Bay District Hospital
7	HAART Clinic
8	Walvis Bay District Health Office
9	Walvis Bay Correctional Facility
Private Sector	
1	Cadilu Fishing Clinic
2	Erongo Imaging Clinic
3	Etale Clinic
4	Gendor Clinic
5	Hangana Seafood Clinic

6	Hyperbalic Oxygen Treatment Centre
7	Medixx Occupational Health Clinic
8	Merlus Clinic
9	Mondi-Packaging Clinic
10	Namport Health Centre
11	Ocnam-Occupational Care Namibia
12	Welwitchia Hospital Immunization Clinic
13	Welwitschia Private Hospital
Civil Society	
1	Namibia Planned Parenthood Association
2	Walvis Bay (WBCG) Clinic
3	Men's Health
4	Abt Associates Namibia

6.1.8 Social Cohesion

Domestic Violence

The Namibia Demographic and Health Survey 2013 (Mouton, 2022) noted that domestic violence is a serious endemic challenge in Namibia. Two-thirds of women between the ages of 15 and 49 have experienced physical violence, while 27.0 percent in the Erongo Region experienced the same. Women who were divorced/separated/widowed, no education and in the lowest wealth quintile were more likely to have experienced physical violence. Close to one in ten women (7.4 percent) aged 15-49 have experienced sexual violence in the Erongo Region (Mouton, 2022). Husbands/partners were most likely to be the perpetrator of sexual violence against married women, while strangers were more like to do the same against women who are unmarried. One in ten men (9.5 percent) reported that their spouses committed physical violence against them. Only 30.9 percent of women who have experienced physical or sexual violence in the Erongo Region sought help to stop the violence (Mouton, 2022). Main source for seeking help was one’s own family, followed by the police and social work organisations.

Orphanhood

In Namibia, about 14 percent of children were orphaned according to the DHS, mainly due to AIDS related death. Rural children were found to be more likely orphaned than urban children. The Erongo Region had one of the lowest proportions (9.0 percent) of orphaned children (one or both parents passed on) compared with other regions in the country (Mouton, 2022). The proportions of orphaned children in the Walvis Bay Urban and Rural did not differ much from the region proportion (9.0 percent and 10.2 percent, respectively (Mouton, 2022).

6.1.9 Information and Communication Technology

The majority of people in the Erongo Region had access to main information and technologies. In 2011, more than three quarters in urban settings in the Erongo Region had access to radio, television, and mobile phones. The latter will be much higher in 2022 as access has increased. Access to computers and the internet was significantly lower at less than one quarter for those in urban settings. However, this is bound to be higher in 2022.

6.1.10 Economic Activities

The Erongo Region continues to be one of the most affluent regions in Namibia, following the Khomas Region. The economy of Walvis Bay has been flourishing for many years, but especially since the development of the expanded harbour and construction of the Dunes Mall. Most of the economic activities in Walvis Bay are directly or indirectly dependent on the fishing industry. Economic activities in Walvis Bay include the following:

- Informal business sector;
- Accommodation and food services, such as restaurants, beverage stores;
- Administrative and support services;
- Air transportation;
- Arts, Entertainment and Recreational services, including gambling and clubbing;
- Building material, garden equipment and supplies;
- Chemical manufacturing;
- Clothing and clothing accessories stores;
- Construction;
- Information, communication, and technology;
- Couriers and messengers;
- Education and health services;
- Electrical equipment, appliances;
- Finance, financial services, trusts, and insurance;
- Fishing;
- Furniture and home furnishing stores;
- Fuel stations;
- Engineering services, especially for the transport and fishing sectors;
- Health services, including ambulatory health care services;
- Manufacturing, such as machinery manufacturing;
- Merchant wholesalers;
- Mining, quarrying;
- Motor vehicle and part dealers;
- Postal services;
- Printing and related support activities;
- Real estate, including rental and leasing services;
- Rail transportation;
- Tourism, including scenic and sightseeing transportation;
- Sporting goods, hobby, book, and music stores;

- Transportation and warehousing, including truck, rail, and air transportation;
- Utilities;
- Waste management and remediation services; and
- Wholesale trading.

This section will focus on the following key economic activities: fishing, aquaculture, retail, tourism, mining, and construction.

Fishing

The economy of Walvis Bay depends largely on the thriving fishing industry, which employs around 10,000 people (Walvis Bay Pamphlet, n.d.). The coastline extends for 1,570 km and 200 nautical miles into the sea (Mouton, 2022). The fishing industry is the third-largest economic sector and contributes around 6.6 percent to the GDP (GDP). In 2008, the combined value of fishing, onshore processing, and offshore processing was N$3,410 million (ERC, 2015). The Ministry of Fisheries and Marine Resources allocate fishing quotas to private and semi-state entities to harvest various species such as hake, horse mackerel, pilchard, rock lobster, anchovy, tuna and crab, amongst others. Other fishing economic activities include: ship repair, stevedores and freight forwarders, amongst others.

Aquaculture

Aquaculture has expanded over the years producing oyster, mussel and abalone. Most of these species are exported to European countries (Mouton, 2022).

Retail

Walvis Bay has a flourishing retail sector, strengthened by the construction of the Dunes Mall in year 2017, which includes

- Grocery stores, including household appliances;
- Clothing stores, including shoes, handbags;
- Music stores;
- Electronics, such as computers, cell phones, etc.;
- Furniture stores;
- Book and stationary stores;
- Alcohol beverages;
- Camping equipment;
- Household building materials;
- Restaurants; and
- Retails services, such as plumbing, electrical, house repairs and maintenance, mechanical, etc.

Tourism

Namibia is well known as an iconic tourist-friendly country in Africa. Walvis Bay is home to some of the most attractive tourist attractions in the Erongo Region. However, neighbouring Swakopmund is better known as a tourist destination than Walvis Bay. The following are tourist activities provided in Walvis Bay:

- Water recreational park, called Dolphin Park;
- Desert tours, including the highest Dune 7;
- Dune 4x4 tours;
- Catamaran sunset cruises;
- Exclusive dolphin and seal tours;
- Balloon rides, kayaking;
- Angling trips;
- Dune sand boarding;
- Desert/Skeleton Coast charter flights;
- Historic Kuiseb Delta tours;
- Dune quad biking;
- Topnaar/Nara tours;
- Abundant birdlife on the lagoon and beyond. Bird island; and
- Aguano platform.

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Figure 6-4: Photos of Tourist Activities In and Around Walvis Bay

Mining

In sub-Saharan Africa, Walvis Bay Salt Holdings (Pty) Ltd. and its many subsidiaries manufacture the majority of the solar sea salt. The company uses 90 million m^3 (cubic meters) of seawater per year to process, resulting in the production of more than 900,000 tons of high-quality salt. A total of 5000ha is used for the operation. South Africa, Cameroon, Nigeria, and European nations are among the countries receiving exports from Walvis Bay Salt Holdings (Mouton, 2022). The Group also produces premium table salt for the Southern African market in addition to producing salt for the chemical industry and other general uses. Beyond South Africa, triple-refined sea salt is also exported, primarily for human consumption, to Angola, the Democratic Republic of the Congo, Botswana, and Zambia.

Granite is mined about 200 km west of Walvis Bay but quarried about 15 km east of the city.

Construction

Construction has significantly expanded in Walvis Bay over the recent years with the expansion of the harbour and associated dry docks and spin-off economic activities. New townships and industrial areas contribute to this increase.

6.1.11 Infrastructural Development

Harbour

The Walvis Bay Port in the Erongo Region serves as a transportation centre for regional and global trade between members of the Southern African Development Community (SADC), Europe, America, and the rest of the world. The Walvis Bay Port is managed by the Namibia Port Authority (Namport). Namport also manages the Lüderitz Port on the southern Namibian coastline.

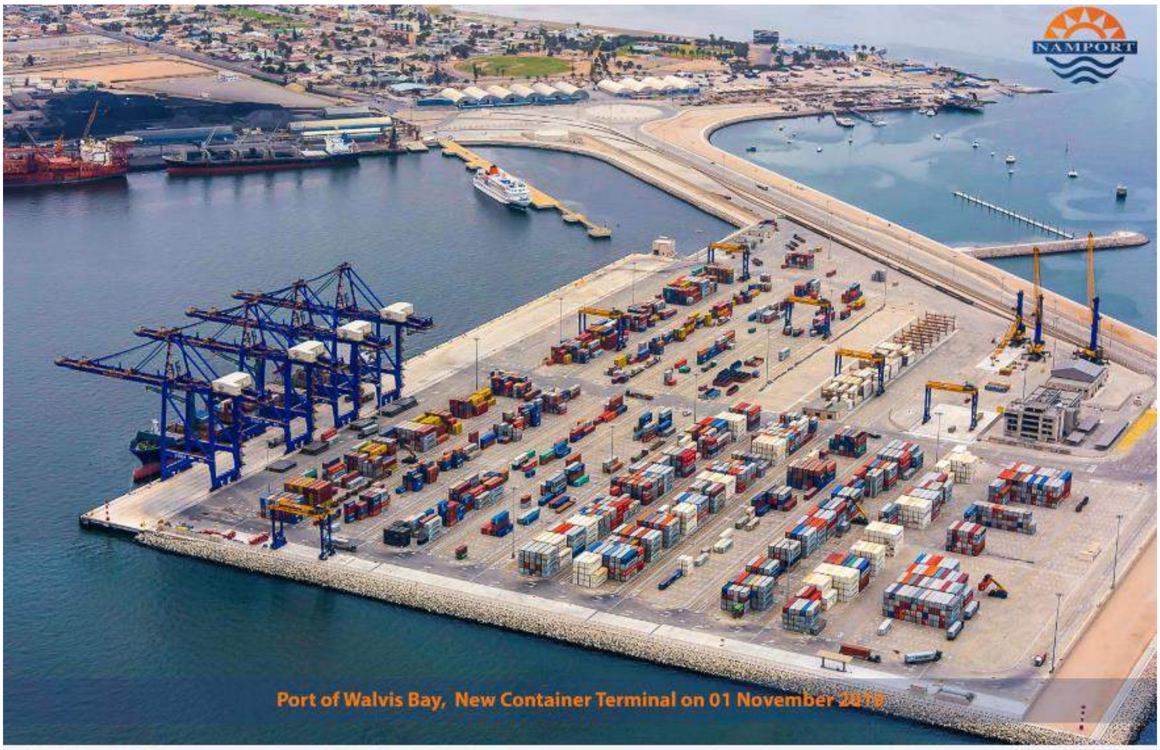

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Figure 6-5: Port of Walvis Bay (Mouton, 2022)

One of Africa's most effective and well-equipped ports, Walvis Bay Port can handle more than eight million tons of cargo annually (Mouton, 2022). It is divided into two parts: the fishing harbour, which is owned by the fishing industry, and the commercial harbour, which is run by Namport. A variety of terminal facilities are available at the commercial harbour to handle bulk, containerized, frozen, and dry goods (Mouton, 2022).

The country now has high-end port infrastructure thanks to the new container terminal at the Namibian Port of Walvis Bay, which was constructed between 2014 and 2019. According to a study from the African Development Bank (AFDB) released on September 3, 2020, the terminal, which was completed in August 2019, is now fully functional (Mouton, 2022). Walvis Bay has been driven towards becoming a southern African logistics hub by the expansion. The expansion also encouraged new maritime access to serve the landlocked countries of SADC (AFDB, 2020). According to the study, the project “overall has fully accomplished its goals,” increasing the terminal’s annual capacity from 355,000 TEUs (20-feet equivalent unit) to 750,000 TEUs. Additionally, it has decreased container transit time from 14.5 days to 9.5 days and reduced the vessel waiting times to less than 8 hours. In addition, the study noted that the new terminal resulted in an eight percent increase in demand for services from the port of Walvis Bay. In 2020 and 2021, it is anticipated that cargo volumes, revenues, and income from other services (maritime, port, berth and light dues, and other storage and handling fees) will all rise by at least eight percent and stay steady for the future, (AFDB, 2020).

The following services are provided:

- Marine services;
- Cargo handling;
- Cold storage;
- Ship and rig repair; and
- Vessel and cargo agents.

Road Transportation

The road network to and from Walvis Bay is considered mostly well developed to bitumen standard for the vast lengths of the networks, although some road stretches have reached the end of their operational lifespans, while other stretches have gravel surfaces (such as large stretches of the Trans-Cunene Corridor). The Roads Authority (RA) Master Plans include the rehabilitation of existing networks and upgrading of some gravel surface roads to bitumen standards to improve quality of key corridors. The City of Walvis Bay is connected to four main transportation corridors:

- The 1,900km Trans-Kalahari Corridor connects Walvis Bay, via Gobabis with Botswana and Gauteng Province, South Africa;
- The 2,500km Tran-Caprivi Corridor connect Walvis Bay, via Katima Mulilo with Zimbabwe, Zambia and the Republic of Congo;
- The 1,600km Trans-Cunene Corridor connects the Port of Walvis Bay, via Oshikango with Lubango in southern Angola; and
- The Trans-Orange Corridor connects the Port of Walvis Bay, via Keetmanshoop and the Port of Luderitz with the Northern and Western Cape Provinces, South Africa.

The road from Walvis Bay to the GHDP site is of high-quality bitumen standard for most parts of the road. The GHDP is located next to a newly developed highway between Walvis Bay and Swakopmund with two lanes in both directions.

Rail Transportation

The City of Walvis Bay is connected to four key railway lines connecting key locations within Namibia with countries in SADC:

- The Trans-Caprivi Corridor is supported by a railway line that runs from Walvis Bay to Grootfontein, (ERC, 2015). The railroad line continues in Livingstone, Zambia;
- The Trans-Kalahari Corridor is supported by a railway line that runs from Walvis Bay to Gobabis via Windhoek, from where merchandise is transported by road to Lobatse, Botswana;
- The Trans-Cunene Corridor is supported by the northern railway line, which currently runs from Walvis Bay to Ondangwa with a projected extension to the border of Oshikango, Namibia; and
- The Trans-Orange Corridor is supported by the southern railway line, which connect Walvis Bay with Windhoek, Keetmanshoop, Luderitz and the Northern and Western Cape Provinces, South Africa.

Air Transportation

The Walvis Bay International Airport (WBIA) is located 16km outside of Walvis Bay in an eastern direction, connecting Walvis Bay with key locations in Namibia, South Africa and beyond. The WBIA is located about 5 km from the proposed GHDP site. The WBIA was recently expanded to accommodate larger airliners and transport flights, providing additional support to the port and other socio-economic infrastructure and services in Walvis Bay and the region. The airport is managed by the NAC.

Energy

Namibia produces electricity from five power stations across the country but also relies on imported power from South Africa (Eskom). “The domestic energy supply has failed to keep pace with the rising demand, and Namibia generates less than half of the energy it consumes.” (Mouton, 2022). Therefore, imported energy from Eskom is crucial to keep up with the energy needs of the Namibian economy. A government-owned power utility named NamPower, manages the supply of electricity from five power stations located in Namibia: Ruacana Hydroelectric Power Station, Van Eck Power Station, Paratus Power Station, ANIXAS Power Station and Ombuvu Power Station. These power stations should produce at a combined capacity of 516.5 MW, however as the International Trade Administration documented, these stations do not always operate at full capacity. There is a need for alternative energy sources and increased capacity of current power stations.

NamPower has a long-term goal to make Namibia energy self-sufficient, but in the short term they have signed new purchase agreements with other neighbouring countries. These new agreements will be crucial for the near future as the purchase agreement with Eskom expires in 2025, (International Trade Administration, 2022). In addition to developments regarding energy supply, NamPower has completed the N$ 3.2 billion TransCaprivi interconnector, (International Trade Administration, 2022). This connects Namibia to the power grids of Zimbabwe and Zambia.

The City of Walvis Bay sources its electricity from NamPower, via Erongo Regional Electricity Distributor Company (Pty) Ltd. (Erongo Red). There is one wind turbine outside Walvis Bay but serves as a measurement station only. No other renewable energy sources were used, except for small privately-run solar systems for household and small business use.

Telecommunication

International standard telecommunications infrastructure provides access to all inhabitants in Walvis Bay. The various antennas and fiber infrastructure by MTC, Paratus and Telecom provide for universal access for personal and commercial use.

Water Supply

As indicated earlier in the report, all households have access to potable water in Walvis Bay. Water is provided from the Namibia Water Corporation (Ltd) (NamWater), via the Walvis Bay Municipality to households, businesses and other services. The main water source is the Kuiseb River, however some supply derives from the desalination plant near Swakopmund.

6.2 Biodiversity

This Section has been extracted from the Biodiversity Baseline Study compiled by Peter Cunningham (Cunningham, 2022).

6.2.1 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 6-6).

6.2.2 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 fygies (*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 manly associated with the Kaokoveld (north-western) and the succulent Karoo (southwestern) Namibia. The major threats to the floral diversity in Namibia are:

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

According to Giess (1971) the Southern Namib stretches from the Swakop River southwards until Lüderitz. *Stipagrostissabulicola* (tough dune grass) occurs with *Trianthemahereroeensis* on the dunes while the inter-dune flats (streets) are covered with *Stipagrostisgonatostachys* after rains. The eastern inland sections – pro-Namib – are dominated by *Stipagrostisobtusa* 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 & 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 *Arthraerualeubnitziae*. 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 non-existent in the general area (although browse is good along the ephemeral Kuiseb River) with the risk of farming viewed as high and the tourism potential of this area viewed as average.

6.2.3 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 Kuiseb 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 three 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%).

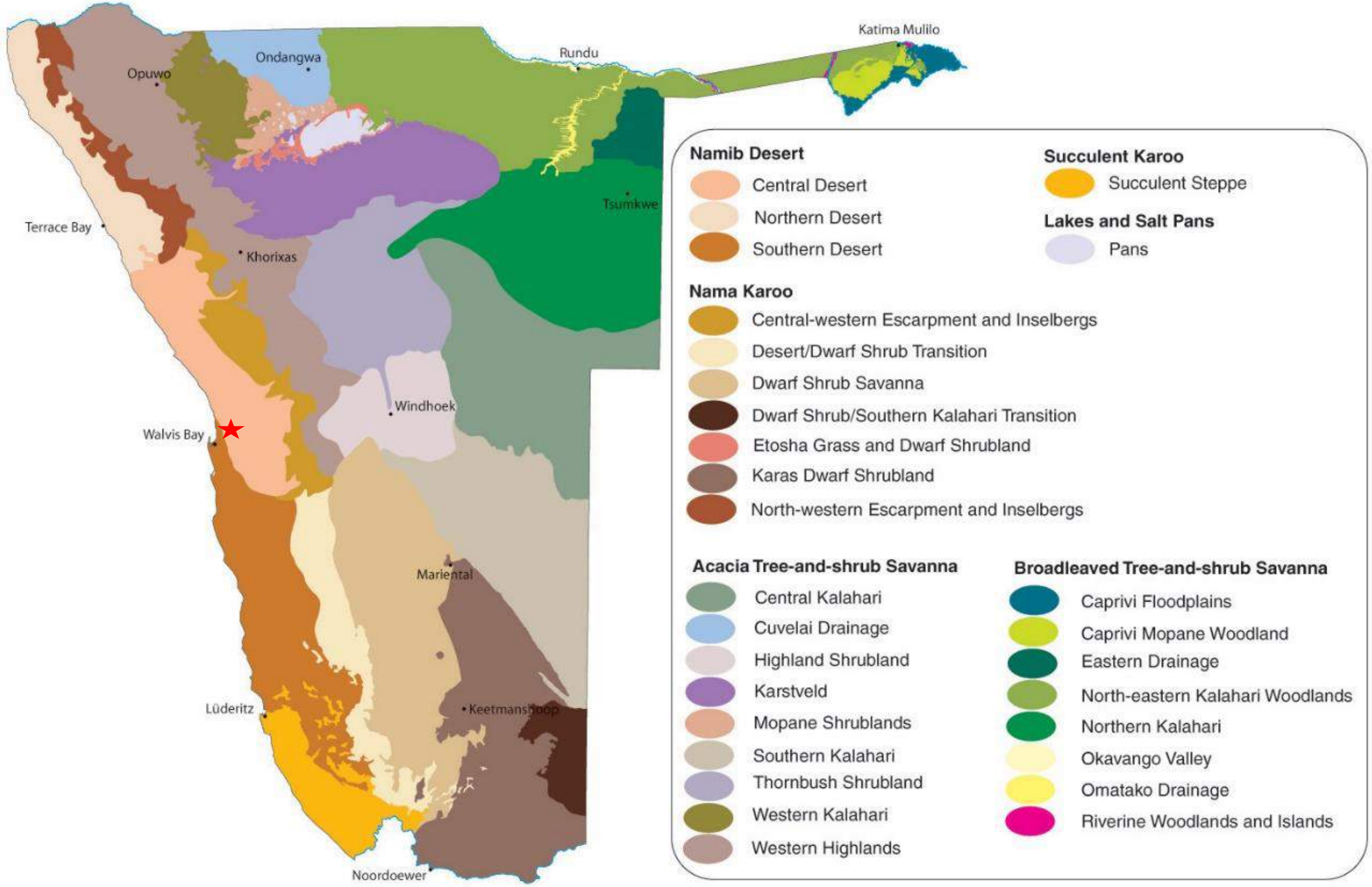

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Figure 6-6: Biomes and Vegetation Types in Namibia with the GHDP Area Shown as Red Star (Mendelsohn et al. 2002)

6.2.4 Description of Affected Environment

Vertebrate Fauna

Reptile Diversity

Reptile diversity known and/or expected to occur in the general project area (GHDP) – literature study only – is presented in Figure 6-6.

Approximately 261 species of reptiles are known or expected to occur in Namibia thus supporting approximately 30% of the continent's 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. *Pelomedusasubrufa* 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. *Lycophidioncapense* and *Lycophidionnamibianum* 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 6-3 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 *Pachydactylusrangei* (Web-feeted gecko).

Afroeduraafricanaafricana 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 *Pedioplanishusabensis* 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, 2022).

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 tortoise, 1 terrapin, 14 lizards of which 6 species classified as endemic (42.9% endemic), 1 plated lizard, 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 *Afroeduraafricanaafricana* (African flat gecko) and *Pedioplanishusabensis* (Husab sand lizard) are viewed as the most important reptiles potentially occurring in the general area.

Pedioplanishusabensis 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 *Lycophidionnamibianum* (Namibian wolf snake) are the snakes viewed as the most important in the area.

The most important species is the endemic *Pedioplanishusabensis* (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, 2022). 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.

Table 6-3: 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					
Stigmochelys pardalis	Leopard Tortoise	Vulnerable; Peripheral; Protected Game		LC	C2
Pelomedusa galeata (subrufa)	Marsh/Helmeted Terrapin	Secure		LC	C3
SNAKES					
Thread Snakes					
Namibiana (Leptotyphlops) occidentalis	Western Thread Snake	Endemic; Secure	P	LC	
Namibiana (Leptotyphlops) labialis	Damara Thread Snake	Endemic; Secure		LC	
Quill Snouted Snakes					
Xenocalamus bicolour bicolor	Bicoloured Quill-snouted Snake	Secure			
Typical Snakes					
Boaedon (Lamprophis) fuliginosus	Brown House Snake	Secure		LC	
Lycophidion capense	Cape Wolf Snake	Secure		LC	
Lycophidion namibianum	Namibian Wolf Snake	Endemic; Secure		LC	
Pseudaspis cana	Mole Snake	Secure		LC	
Pythonodipsas carinata	Western Keeled Snake	Endemic; Secure		LC	
Dipsina multimaculata	Dwarf Beaked Snake	Endemic; Secure		LC	
Psammophis trigrammus	Western Sand Snake	Endemic; Secure		LC	
Psammophis notostictus	Karoo Sand Snake	Secure		LC	
Psammophis leightoni namibensis	Namib Sand Snake	Secure		LC	
Dasypeltis scabra	Common/Rhombic Egg Eater	Secure		LC	
Aspidelaps lubricus infuscatus	Coral Snake	Secure		LC	
Aspidelaps scutatus	Shield-nose Snake	Endemic; Secure		LC	
Naya nigricincta	Black-necked Spitting Cobra	Endemic; Secure	R		
Bitis arietans	Puff Adder	Secure		LC	
Bitis caudalis	Horned Adder	Secure		LC	

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
LIZARDS					
Skinks					
Typhlacontias brevipes	FitzSimon's Burrowing Skink	Endemic; Secure		LC	
Trachylepis acutilabris	Wedge-snouted Skink	Secure		LC	
Trachylepis occidentalis	Western Three-striped Skink	Secure		LC	
Trachylepis striata wahlbergi	Striped Skink	Secure		LC	
Trachylepis sulcata	Western Rock Skink	Secure		LC	
Trachylepis variegata variegata	Variegated Skink	Secure		LC	
Old World Lizards					
Heliobolus lugubris	Bushveld Lizard	Secure		LC	
Meroles anchietae	Shovel-snouted Lizard	Secure		LC	
Meroles reticulatus	Reticulated Desert Lizard	Endemic; Secure		LC	
Meroles suborbitalis	Spotted Desert Lizard	Endemic; Secure		LC	
Pedioplanis breviceps	Short-headed Sand Lizard	Endemic; Secure		LC	
Pedioplanis namaquensis	Namaqua Sand Lizard	Secure		LC	
Pedioplanis inornata	Plain Sand Lizard	Endemic; Secure		LC	
Pedioplanis husabensis	Husab Sand Lizard	Endemic; Secure		LC	
Plated Lizards					
Cordylosaurus subtessellatus	Dwarf Plated Lizard	Endemic; Secure		LC	
Monitors					
Varanus albigularis	Rock or White-throated Monitor	Vulnerable; Peripheral; Protected Game	S to V	LC	C2
Agama					
Agama planiceps	Namibian Rock Agama	Endemic; Secure		LC	
Chameleons					
Chamaeleo namaquensis	Namaqua Chameleon	Secure		LC	C2
Geckos					

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
Afroedura africana africana	African Flat Gecko	Endemic; Insufficiently known; Rare?		LC	
Chondrodactylus angulifer namibensis	Giant Ground Gecko	Endemic; Secure		LC	
Narudasia festiva	Festive Gecko	Endemic; Secure		LC	
Pachydactylus bicolor	Velvety Thick-toed Gecko	Endemic; Secure		LC	
Pachydactylus kochii	Kock's Thick-toed Gecko	Endemic; Secure		LC	
Pachydactylus turneri	Turner's Thick-toed Gecko	Secure		LC	
Pachydactylus punctatus	Speckled Thick-toed Gecko	Secure		LC	
Pachydactylus rugosus rugosus	Rough Thick-toed Gecko	Endemic; Secure		LC	
Pachydactylus weberi werneri	Weber's Thick-toed Gecko	Endemic; Secure		LC	
Ptenopus carpi	Carp's Barking Gecko	Endemic; Secure		LC	
Ptenopus garrulus maculatus	Common Barking Gecko	Endemic; Secure		LC	
Ptenopus kochi	Koch's Barking Gecko	Endemic; Secure		LC	
Phelsuma (Rhoptropus) afer	Common Namib Day Gecko	Endemic; Secure			
Phelsuma (Rhoptropus) boultoni	Boulton's Namib Day Gecko	Endemic; Secure			
Phelsuma (Rhoptropus) bradfieldi	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 (2022): LC – Least Concern [All other species not yet assessed]
CITES: CITES Appendix 2/3 species
Source for literature review: Alexander & Marais (2007), Branch (1998), Branch (2008), Bonin *et al.* (2006), Boycott & Bourquin (2000), Broadley (1983), Buys & Buys (1983), Cunningham (2006a), Griffin (2003), Hebbard (n.d.), IUCN (2022), Marais (1992), SARDB (2004), Schleicher (2020), Tolley & Burger (2007)

Species such as *Chamaeleonamaquensis*, 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 6-3. 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.* (2006) from Gobabeb, Griffin (2005) from Valencia, Cunningham (2006b) 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.* (2006) 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 70 km southeast of the general GHDP area) (Table 6-4).

Table 6-4: Reptiles Recorded on the Gravel Plains at Gobabeb (Henschel et al., 2006)

Family and Scientific name	Common name
Gekkonidae	
Chondrodactylus angulifer	Giant Ground Gecko
Pachydactylus kockii	Koch's Thick-toed Gecko
Pachydactylus turneri	Turner's Thick-toed Gecko
Pachydactylus scherzi	Schertz's Thick-toed Gecko
Pachydactylus rugosus	Rough Thick-toed Gecko
Pachydactylus rangei	Palmato gecko
Ptenopus carpi	Banded Barking Gecko
Ptenopus garrulus	Common Barking Gecko
Rhoptropus afer	Common Namib Day Gecko
Rhoptropus barnardi	Lesser Namib Day Gecko
Rhoptropus bradfieldi	Bradfield's Namib Day Gecko
Narudasia festiva	Festive Gecko
Lacertidae	
Meroles suborbitalis	Spotted Desert Lizard
Pedioplanis breviceps	Short-headed Sand Lizard
Pedioplanis lineoocellata	Ocellated Sand Lizard
Pedioplanis namaquensis	Namaqua Sand Lizard
Pedioplanis undata	Western Sand Lizard
Scincidae	
Trachylepis acutilabris	Wedge-snouted Skink
Trachylepis occidentalis	Western Three-striped Skink
Trachylepis spilogaster	Namibian Tree Skink

Table 6-5 indicates the reptile diversity known, reported and/or expected to occur (77 species) in the general Valencia Uranium area (approximately 50 km northeast of the general GHDP area) as presented by Griffin (2005).

Table 6-5: Reptiles Reported and/or Expected to Occur in the General Valencia Area (Griffin & Coetzee, 2005)

Species: Scientific name	Common name
Turtles and Tortoises and Terrapins	
Geochelone pardalis	Leopard tortoise
Pelomedusa subrufa	Marsh/Helmeted Terrapin
Snakes	
Worm Snakes	
Leptotyphlops occidentalis	Western Thread/Worm Snake
Leptotyphlops labialis	Damara Thread/Worm Snake
Leptotyphlops scutifrons	Peter’s Thread/Worm Snake
Blind Snakes	
Rhinotyphlops lalandei	Delalande’s Blind Snake
Rhinotyphlops schinzi	Beaked Blind Snake
Boas and Pythons	
Python anchietae	Namibian Dwarf Python
Typical Snakes	
Lamprophis fuliginosus	Brown House Snake
Pseudaspis cana	Mole Snake
Psammophylax rhombeatus	Spotted Skaapsteker
Dipsina multimaculata	Dwarf Beaked Snake
Psammophis trigrammus	Western Sand Snake
Psammophis notostictus	Karoo Sand Snake
Psammophis leightoni namibensis	Namib Sand Snake
Psammophis subtaeniatus	Western Striped-bellied Sand Snake
Psammophis leopardinus	Leopard Whip Snake
Dasypeltis scabra	Common/Rhombic Egg Eater
Philothamnus semivariegatus	Spotted Bush Snake
Telescopus beetzii	Namaqua Tiger Snake
Telescopus semiannulatus	Southern Tiger Snake
Telescopus sp. nov.	Damara Tiger Snake
Pythonodipsas carinata	Western keeled Snake
Prosymna frontalis	Shouthwestern Shovel-snout
Aspidelaps lubricus infuscatus	Coral Snake
Aspidelaps scutatus scutatus	Shield-nose Snake
Naja anchietae	Angolan Cobra
Naja nigricollis nigricincta	Black-necked Spitting Cobra
Naja woodi	Black Spitting Cobra
Naja nivea	Cape Cobra

Species: Scientific name	**Common name**
Dendroaspis polylepis	Black Mamba
Bitis arietans	Puff Adder
Bitis caudalis	Horned Adder
Lizards	
Worm Lizards	
Zygaspis quadrifrons	Kalahari Round-headed Worm Lizard
Skinks	
Trachylepis acutilabris	Wedge-snouted Skink
Trachylepis occidentalis	Western Three-striped Skink
Trachylepis hoeschi	Western Rock Skink
Trachylepis spilogaster	Namibian Tree Skink
Trachylepis sulcata	Western Rock Skink
Trachylepis variegata variegata	Variegated Skink
Trachylepis wahlbergii	Wahlberg's Striped Skink
Old World Lizards	
Nucras intertexta	Spotted Sandveld Lizard
Heliobolus lugubris	Bushveld Lizard
Meroles knoxii	Round-snouted Sand Lizard
Meroles cuneirostris	Wedge-snouted Desert Lizard
Meroles suborbitalis	Spotted Desert Lizard
Pedioplanis breviceps	Short-headed Sand Lizard
Pedioplanis lineoocellata	Ocellated Sand Lizard
Pedioplanis namaquensis	Namaqua Sand Lizard
Pedioplanis gaerdesi	Damara Sand Lizard
Pedioplanis undata	Western Sand Lizard
Pedioplanis inornata	Plain Sand Lizard
Pedioplanis hasabensis	Husab Sand Lizard
Plated Lizards	
Cordylosaurus subtessellatus	Dwarf Plated Lizard
Gerrhosaurus nigrolineatus	Black-lined Plated Lizard
Gerrhosaurus validus	Giant Plated Lizard
Monitors	
Varanus albigularis	Rock Monitor
Agamas	
Agama anchietae	Western Rock Agama
Agama planiceps	Namibian Rock Agama
Chameleons	
Chamaeleo namaquensis	Namaqua Chameleon
Geckos	
Afroedura africana africana	African Flat Gecko
Chondrodactylus angulifer namibensis	Giant Ground Gecko

Species: Scientific name	Common name
Narudasia festiva	Festive Gecko
Pachydactylus bicolour	Velvety Thick-toed Gecko
Pachydactylus capensis	Cape Thick-toed Gecko
Pachydactylus fasciatus	Damaraland Banded Thick-toed Gecko
Pachydactylus kockii	Koch’s Thick-toed Gecko
Pachydactylus punctatus	Speckled Thick-toed Gecko
Pachydactylus turneri	Turner’s Thick-toed Gecko
Pachydactylus scherzi	Schertz’s Thick-toed Gecko
Pachydactylus rugosus rugosus	Rough Thick-toed Gecko
Pachydactylus weberi	Weber’s Thick-toed Gecko
Lygodactylus bradfieldi	Namibian Dwarf Gecko
Ptenopus garrulus maculatus	Common Barking Gecko
Rhoptropus afer	Common Namib Day Gecko
Rhoptropus barnardi	Lesser Namib Day Gecko
Rhoptropus bradfieldi	Bradfield’s Namib Day Gecko

A survey of the reptiles associated with the Trekkopje Uranium Mining area (approximately 110 km northeast of the general GHDP area) conducted by Cunningham (2006b) indicated the presence of 22 reptile species (8 snakes, 1 skink, 2 lizards, 2 agamas, 1 chameleon and 8 geckos) (Table 6-6).

Table 6-6: Reptiles Recorded in the General Trekkopje Uranium Mining Area (Cunningham, 2006b)

Species: Scientific name	Species: Common name
Typical Snakes	
Lamprophis fuliginosus	Brown House Snake
Lycophidion namibianum	Namibian Wolf Snake
Dipsina multimaculata	Dwarf Beaked Snake
Psammophis leightoni namibensis	Namib Sand Snake
Dasypeltis scabra	Common Egg Eater
Aspidelaps lubricus infuscatus	Coral Snake
Naya nigricincta	Black-necked Spitting Cobra
Bitis caudalis	Horned Adder
Lizards	
Skinks	
Trachylepis acutilabris	Wedge-snouted Skink
Old World Lizards	
Pedioplanis namaquensis	Namaqua Sand Lizard
Pedioplanis husabensis	Husab Sand Lizard
Agamas	
Agama aculeata	Ground Agama
Agama anchietae	Anchieta’s Agama
Chameleons	
Chamaeleo namaquensis	Namaqua Chameleon

Species: Scientific name	Species: Common name
Geckos	
Chondrodactylus angulifer namibensis	Giant Ground Gecko
Lygodactylus bradfieldi	Bradfield's Dwarf Gecko
Pachydactylus bicolor	Velvety Thick-toed Gecko
Pachydactylus serval serval	Western Spotted Thick-toed Gecko
Ptenopus carpi	Carp's Barking Gecko
Rhoptropus afer	Common Namib Day Gecko
Rhoptropus boultoni	Boulton's Namib Day Gecko
Rhoptropus bradfieldi	Bradfield's Namib Day Gecko

A survey of the reptiles associated with the Valencia Mine (approximately 50 km northeast of the general GHDP area) conducted by Cunningham (2007) indicated the presence of 14 reptile species (5 snakes, 2 skinks, 1 lizard, 1 agama, 1 chameleon and 4 geckos) (Table 6-7).

Table 6-7: Reptiles recorded in the general Valencia area (Cunningham, 2007)

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

A survey of the reptiles associated with the INCA Uranium and Iron (INCA) and Tubas Red Sands Uranium (TRS) sites (approximately 40 km northeast of the general GHDP area) conducted by Cunningham (2010) indicated the presence of 14 reptile species (3 snakes, 1 skink, 2 lizards, 1 chameleon and 7 geckos) (Table 6-8).

Table 6-8: Reptiles Recorded in the General INCA and TRS Areas (Cunningham, 2010)

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

A survey of the reptiles associated with the Khan River area (approximately 40 km 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 6-9).

Table 6-9: Reptiles Recorded in the General Khan River Area (Cunningham, 2011)

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

A survey of the reptiles associated with the Marenica Mining site in the Spitzkoppe area (approximately 170 km northeast of the general GHDP area) conducted by Henschel *et al.* (2011) indicated the presence of 19 reptile species (1 snake, 5 skinks, 6 lizards, 2 agamas, 1 chameleon and 4 geckos) (Table 6-10).

Table 6-10: Reptiles recorded in the general Marenica (Spitzkoppe) area (Henschel et al., 2011)

Family and Scientific name	Common name
Typical Snakes	
Psammophis leightoni namibensis	Namib Sand Snake
Lizards	
Skinks	
Trachylepis acutilabris	Wedge-snouted Skink
Trachylepis occidentalis	Western Three-striped Skink
Trachylepis hoeschi	Western Rock Skink
Trachylepis spilogaster	Namibian Tree Skink
Trachylepis variegata variegata	Variegated Skink
Old World Lizards	
Pedioplanis breviceps	Short-headed Sand Lizard
Pedioplanis inornata	Plain Sand Lizard
Pedioplanis namaquensis	Namaqua Sand Lizard
Agamas	
Agama anchietae	Anchieta's Agama
Agama planiceps	Namibian Rock Agama
Chameleons	
Chamaeleo namaquensis	Namaqua Chameleon
Geckos	
Chondrodactylus angulifer namibensis	Giant Ground Gecko
Pachydactylus bicolor	Velvety Thick-toed Gecko
Pachydactylus turneri	Turner's Thick-toed Gecko
Pachydactylus scherzi	Schertz's Thick-toed Gecko
Ptenopus garrulus maculatus	Common Barking Gecko
Rhoptropus boultoni	Boulton's Namib Day Gecko
Rhoptropus bradfieldi	Bradfield's Namib Day Gecko

A survey of the reptiles associated with the Ongolo and Tumas sites (approximately 60 km northeast of the general GHDP area) conducted by Cunningham (2013) indicated the presence of 26 reptile species (6 snakes, 3 skinks, 6 lizards, 1 monitor, 1 chameleon and 9 geckos) (Table 6-11).

Table 6-11: Reptiles Recorded in the General Ongolo and Tumas Areas (Cunningham, 2013)

Family and Scientific name	Common name
Typical Snakes	
Dipsina multimaculata	Dwarf Beaked Snake
Psammophis leightoni namibensis	Namib Sand Snake
Aspidelaps lubricus infuscatus	Coral Snake
Naya nigricincta	Black-necked Spitting Cobra
Bitis arietans	Puff Adder
Bitis caudalis	Horned Adder
LIZARDS	
Skinks	
Trachylepis acutilabris	Wedge-snouted Skink
Trachylepis sulcata	Western Rock Skink
Trachylepis variegata variegata	Variegated Skink
Old World Lizards	
Meroles reticulatus	Reticulated Desert Lizard
Meroles suborbitalis	Spotted Desert Lizard
Pedioplanis breviceps	Short-headed Sand Lizard
Pedioplanis namaquensis	Namaqua Sand Lizard
Pedioplanis inornata	Plain Sand Lizard
Pedioplanis husabensis	Husab Sand Lizard
Monitors	
Varanus albigularis	Rock or White-throated Monitor
Chameleons	
Chamaeleo namaquensis	Namaqua Chameleon
Geckos	
Chondrodactylus angulifer namibensis	Giant Ground Gecko
Pachydactylus bicolor	Velvety Thick-toed Gecko
Pachydactylus kochii	Kock’s Thick-toed Gecko
Pachydactylus turneri	Turner’s Thick-toed Gecko
Pachydactylus punctatus	Speckled Thick-toed Gecko
Ptenopus carpi	Carp’s Barking Gecko
Ptenopus garrulus maculatus	Common Barking Gecko
Rhoptropus afer	Common Namib Day Gecko
Rhoptropus boultoni	Boulton’s Namib Day Gecko

A pilot study conducted by Kavari (2007) on the reptile diversity associated with the future expansion of the Rössing Uranium Mine (approximately 50 km northeast of the general GHDP area) indicated the presence of 6 reptile species (3 geckos, 1 lizard, 1 chameleon and 1 snake) (Table 6-12).

Table 6-12: Reptiles Recorded in the General Rössing Uranium Mine Area (Kavari, 2007)

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

A survey of the reptiles associated with the Kuiseb River Delta area (approximately 25 km southwest of the general GHDP area) conducted by Cunningham (2019) indicated the presence of 5 reptile species (2 snakes, 1 burrowing skink, 1 typical skink and 1 lizard) (Table 6-13).

Table 6-13: Reptiles Recorded in the General Kuiseb River Delta Area, (Cunningham, 2019)

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

A survey of the reptiles associated with the Tumas area (approximately 50 km 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 6-14).

Table 6-14: Reptiles Recorded in the General Tumas Area (Cunningham, 2020)

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

Amphibian Diversity

Amphibian diversity known and/or expected to occur in the general GHDP area (literature study only), is presented in Table 6-15.

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 habitats for amphibians (Cunningham & 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 & Carruthers, 2009). The area is underrepresented, 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 (*Poyntonophrynushoeschi* and *Phrynomantisannectens*) (Griffin, 1998b) – i.e., high level (40%) of amphibians of conservation value from the general area. The IUCN (2022) 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.

Table 6-15: 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			
Amietophrynus poweri	Western Olive Toad		LC
Poyntonophrynus hoeschi	Hoesch's Pygmy Toad	Endemic	LC
Rubber Frog			
Phrynomantis annectens	Marbled Rubber Frog	Endemic	LC
Sand Frogs			
Tomopterna tandyi	Tandy's Sand Frog		LC
Platannas			
Xenopus laevis	Common Platanna		LC

Endemic – Griffin (1998b)
IUCN (2022): LC – Least Concern
Source for literature review: Carruthers (2001), Channing (2001), Channing & Griffin (1993), Du Preez & Carruthers (2009), Griffin & Coetzee (2005), IUCN (2022), Passmore & 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 Marenicaarea (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.

Mammal Diversity

Mammal diversity known and/or expected to occur in the GHDP area (literature study only), is presented in Table 6-16.

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 (2022) 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 & 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 (*Cistugoseabrae*) listed as endemic and rare; Littledale’s whistling rat (*Protomyslittledaleinamibensis*) – 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 (*Parahyaenabrunnea*) and leopard (*Parthera pardus*) listed as near threatened and vulnerable (population trends decreasing), respectively by the IUCN (2022). 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 is 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 6-16: 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					
Macroscelides (proboscideus) flavicaudatus	Round-eared Elephant-shrew	Endemic; Secure		LC	
Aardvark					
Orycteropus afer	Aardvark	Secure; Protected Game		LC	
Bats					
Eidolon helvum	African Straw-coloured Fruit Bat	Secure; Migrant		NT	
Rhinolophus darlingi	Darling’s Horseshoe Bat	Secure; Peripheral	NT	LC	
Rhinolophus fumigatus	Rűppell’s Horseshoe Bat	Secure	NT	LC	
Taphozous mauritianus	Mauritian Tomb Bat	Secure		LC	
Nycteris thebaica	Egyptian Slit-faced Bat	Secure		LC	
Sauromys petrophilus	Robert’s Flat-headed Bat	Secure		LC	
Tadarida aegyptiaca	Egyptian Free-tailed Bat	Secure		LC	
Miniopterus natalensis	*Natal Long-fingered Bat	Secure	NT	LC	
Cistugo seabrae	*Namibian Wing-gland Bat	Endemic; Rare	V	LC	
Eptesicus hottentotus	Long-tailed Serotine Bat	Secure		LC	
Mimetillus thomasi	Thomas’s Flat-headed Bat	Not listed			
Neoromicia zuluensis	Zulu Serotine Bat	Secure		LC	
Pipistrellus rueppellii	Rűppell’s Pipistelle Bat	Insufficiently known; Peripheral		LC	
Hares and Rabbits					
Lepus capensis	Cape Hare	Secure		LC	
Porcupine					
Hystrix africeaustralis	Porcupine	Secure		LC	
Rats and Mice					
Petromys typicus	Dassie Rat	Endemic; Secure	NT		
Pedetes capensis	Springhare	Secure		LC	

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
Rhabdomys pumilio	Four-striped Grass Mouse	Secure		LC	
Mastomys coucha	Southern Multimammate Mouse	Secure		LC	
Aethomys chrysophilus	Red Veld Rat	Secure		LC	
Aethomys namaquensis	Namaqua Rock Mouse	Secure		LC	
Protomys littledalei namibensis	Littledale's Whistling Rat	Endemic	NT		
Desmodillus auricularis	Cape Short-tailed Gerbil	Secure		LC	
Gerbillurus paeba	Hairy-feeted Gerbil	Secure		LC	
Gerbillurus setzeri	Setzer's Hairy-feeted Gerbil	Endemic		LC	
Petromyscus collinus	Pygmy Rock Mouse	Endemic; Secure		LC	
Mus musculus	House Mouse	Invasive alien		LC	
Primates					
Papio ursinus	Chacma Baboon	Secure; Problem animal		LC	C2
Carnivores					
Parahyaena (Hyaena) brunnea	Brown Hyena	Insufficiently known; (Vulnerable?); Peripheral	NT	NT	
Crocuta crocuta	Spotted Hyena	Secure?; Peripheral	NT	LC	
Felis silvestris	African Wild Cat	Vulnerable		LC	C2
Suricata suricatta marjoriae	Suricate	Endemic; Secure		LC	
Otocyon megalotis	Bat-eared Fox	Vulnerable(?); Peripheral; Protected Game		LC	
Vulpes chama	Cape Fox	Vulnerable?		LC	
Canis mesomelas	Black-backed Jackal	Secure; Problem animal		LC	
Ictonyx striatus	Striped Polecat	Secure		LC	
Mellivora capensis	Ratel	Secure; Protected Game		LC	
Acinonyx jubatus	Cheetah	Vulnerable; Protected Game	V	V	C1
Caracal caracal	Caracal	Secure; Problem animal		LC	C2
Panthera pardus	Leopard	Secure(?); Peripheral; Protected Game		V	C1
Pigs					

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status		
			SARDB	IUCN	CITES
Phacochoerus africanus	Warthog	Secure; Huntable game		LC	
Zebra					
Equus zebra hartmannae	Hartmann's Mountain Zebra	Endemic; Secure; Specially Protected Game	E	V	C2
Antelopes					
Oryx gazella	Gemsbok	Secure; Huntable game		LC	
Tragelaphus strepsiceros	Kudu	Secure; Huntable game		LC	
Sylvicapra grimmia	Common Duiker	Secure		LC	
Antidorcas marsupialis	Springbok	Secure; Huntable game		LC	
Raphicerus campestris	Steenbok	Secure; Protected Game		LC	

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

IUCN (2022): 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

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

Source for literature review: De Graaff (1981), Estes (1995), Frost (2014), Griffin & Coetzee (2005), IUCN (2022), Joubert & Mostert (1975), Monadhem *et al*. (2010), Picker & Griffiths (2011), Skinner & Smithers (1990), Skinner & Chimimba (2005), Stander & Hannsen (2003) and Taylor (2000)

Bird Diversity

Bird diversity known and/or expected to occur in the general GHDP area (literature study only), is presented in Table 6-17.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.,* 2002). 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 20-50 km 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, secretary bird) 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 6-17 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 (2022) lists 1 species as critically endangered (white-backed vulture), 5 species as endangered (Ludwig’s bustard, lappet-faced vulture, martial eagle, black harrier, secretary bird), 1 species as vulnerable (tawny eagle,) and 1 species as near threatened (kori bustard) (All other species are listed as Least Concern and/or not yet been assessed by the Red List).

Table 6-17: 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
Struthio camelus	Common Ostrich			
Pternistis adspersus	Red-billed Spurfowl		N-end	
Numida meleagris	Helmeted Guineafowl			
Dendropicos namaquus	Bearded Woodpecker			
Tockus monteiri	Monteiro's Hornbill	End		
Tockus damarensis	Damara Hornbill	End	N-end	
Tockus leucomelas	Southern yellow-billed Hornbill		N-end	
Tockus nasutus	African Grey Hornbill			
Upupa africana	African Hoopoe			
Phoeniculus purpureus	Green Wood-Hoopoe			
Rhinopomastus cyanomelas	Common Scimitarbill			
Colius colius	White-backed Mousebird		End	
Urocolius indicus	Red-faced Mousebird			
Poicephalus rueppellii	Rüppell's Parrot	End; NT	N-end	
Agapornis roseicollis	Rosy-faced Lovebird	End	N-end	
Cypsiurus parvus	African Palm Swift			
Tachymarptis melba	Alpine Swift			
Apus bradfieldi	Bradfield's Swift		N-end	
Apus affinis	Little Swift			
Apus caffer	White-rumped Swift			
Corythaixoides concolor	Grey Go-away Bird			
Tyto alba	Barn Owl			
Ptilopsis granti	Southern White-faced Scops Owl			
Bubo capensis	Cape Eagle-Owl	NT		

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
Bubo africanus	Spotted Eagle Owl			
Bubo lacteus	Verreaux's Eagle-Owl			
Glaucidium perlatum	Pearl-spotted Owlet			
Asio capensis	Marsh Owl			
Columba livia	Rock Dove			
Columba guinea	Speckled Pigeon			
Streptopelia capicola	Cape Turtle Dove			
Streptopelia senegalensis	Laughing Dove			
Oena capensis	Namaqua Dove			
Neotis ludwigii	Ludwig's Bustard	E	N-end	E
Ardeotis kori	Kori Bustard	NT		NT
Eupodotis rueppellii	Rüppell's Korhaan	End	N-end	
Pterocles namaqua	Namaqua Sandgrouse		N-end	
Pterocles bicinctus	Double-banded Sandgrouse		N-end	
Vanellus armatus	Blacksmith Lapwing			
Rhinoptilus africanus	Double-banded Courser			
Elanus caeruleus	Black-shouldered Kite			
Aegypius tracheliotos	Lappet-faced Vulture	V		E
Gyps africanus	White-backed Vulture	E		CE
Circaetus pectoralis	Black-chested Snake-Eagle			
Melierax canorus	Southern Pale Chanting Goshawk		N-end	
Melierax gabar	Gabar Goshawk			
Accipiter badius	Shikra			
Circus maurus	Black Harrier	E	End	E
Buteo augur	Augur Buzzard			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
Aquila verreauxii	Verreaux's Eagle	NT		
Polemaetus bellicosus	Martial Eagle	E		E
Aquila rapax	Tawny Eagle	E		V
Aquila pennatus	Booted Eagle	E		
Sagittarius serpentarius	Secretarybird	V		E
Falco rupicolus	Rock Kestrel			
Falco rupicoloides	Greater Kestrel			
Falco chicquera	Red-necked Falcon			
Falco biarmicus	Lanner Falcon			
Falco peregrinus	Peregrine Falcon	NT		
Ciconia nigra	Black Stork	E		
Egretta garzetta	Little Egret			
Ardea cinerea	Grey Heron			
Ardea melanocephala	Black-headed Heron			
Bubulcus ibis	Cattle Egret			
Scopus umbretta	Hamerkop			
Dicrurus adsimilis	Fork-tailed Drongo			
Nilaus afer	Brubru			
Tchagra australis	Brown-crowned Tchagra			
Telophorus zeylonus	Bokmakierie		N-end	
Batis pririt	Pririt Batis		N-end	
Corvus capensis	Cape Crow			
Corvus albus	Pied Crow			
Lanius collaris	Common Fiscal			
Parus cinerascens	Ashy Tit		End	

Species: Scientific name	**Species: Common name**	**Namibian conservation and legal status**	**International Status**	
			Southern Africa	**IUCN**
Riparia paludicola	Brown-throated Martin			
Hirundu albigularis	White-throated Swallow			
Hirundo dimidiata	Pearl-breasted Swallow			
Hirundo fuligula	Rock Martin			
Pycnonotus nigricans	African Red-eyed Bulbul		N-end	
Sylvietta rufescens	Long-billed Crombec			
Eremomela icteropygialis	Yellow-bellied Eremomela			
Eremomela gregalis	Karoo Eremommela		End	
Parisoma layardi	Layard’s Tit-Babbler		End	
Parisoma subcaeruleum	Chestnut-vented Tit-Babbler		N-end	
Zosterops pallidus	Orange River White-eye		End	
Cisticola subruficapilla	Grey-backed Cisticola		N-end	
Cisticola juncidis	Zitting Cisticola			
Cisticola jaridulus	Desert Cisticola			
Prinia flavicans	Black-chested Prinia			
Mirafra sabota	Sabota Lark			
Ammomanopsis grayi	Gray’s Lark	End		
Certhilauda subcoronata	Karoo Long-billed Lark		End	
Eremopterix verticalis	Grey-backed Sparrowlark		N-end	
Calandrella cinerea	Red-capped Lark			
Alauda starki	Stark’s Lark		N-end	
Bradornis infuscatus	Chat Flycatcher		N-end	
Melaenornis mariquensis	Marico Flycatcher		N-end	
Muscicapa striata	Spotted Flycatcher			
Cercotrichas paena	Kalahari Scrub-Robin			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
Namibornis herero	Herero Chat	End	N-end	
Oenanthe monticola	Mountain Wheatear		N-end	
Oenanthe pileata	Capped Wheatear			
Cercomela schlegelii	Karoo Chat		N-end	
Cercomela tractrac	Tractrac Chat		N-end	
Cercomela familiaris	Familiar Chat			
Myrmecocichla formicivora	Ant-eating Chat		End	
Onychognathus nabouroup	Pale-winged Starling		N-end	
Lamprotornis nitens	Cape Glossy Starling			
Creatophora cinerea	Wattled Starling			
Chalcomitra senegalensis	Scarlet-chested Sunbird			
Nectarinia fusca	Dusky Sunbird		N-end	
Sporopipes squamifrons	Scaly-feathered Finch		N-end	
Plocepasser mahali	White-browed Sparrow-Weaver			
Philetairus socius	Sociable Weaver		End	
Ploceus velatus	Southern Masked-Weaver			
Quelea quelea	Red-billed Quelea			
Amadina erythrocephala	Red-headed Finch		N-end	
Estrilda erythronotos	Black-faced Waxbill			
Estrilda astrild	Common Waxbill			
Passer domesticus	House Sparrow			
Passer motitensis	Great Sparrow		N-end	
Passer melanurus	Cape Sparrow		N-end	
Passer griseus	Southern Grey-headed Sparrow			
Motacilla capensis	Cape Wagtail			

Species: Scientific name	Species: Common name	Namibian conservation and legal status	International Status	
			Southern Africa	IUCN
Crithagra atrogulariis	Black-throated Canary			
Serinus flaviventris	Yellow Canary		N-end	
Serinus albogularis	White-throated Canary		N-end	
Emberiza impetuani	Lark-like Bunting		N-end	
Emberiza tahapisi	Cinnamon-breasted Bunting			
Emberiza capensis	Cape Bunting		N-end	

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

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

IUCN (2022): 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), Hokey *et al*., (2006), IUCN (2022), 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 6-17), especially Rüppels 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, secretary bird) 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) by the IUCN (2022).

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 (*Sterna 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 (2022). With 98% of the Damara tern breeding population being in Namibia (Braby, 2010a; Braby, 2010b; Braby, 2011; Crawford & 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 & 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.

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 & Marais (1986) [23 spp.], Curtis & Mannheimer (2005) [39 spp.], Mannheimer & Curtis (2009) [26 spp.], Mannheimer & Curtis (2018) [14 spp.], Van Wyk & 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 6-18).

A total of 39 larger trees and shrubs are known and/or expected to occur in the general area (See Table 6-18). According to Curtis & Mannheimer (2005), Mannheimer & Curtis (2009) and Mannheimer & 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. *Arthraerualeubnitziae* is endemic to the fog zone in the central Namib region (Burke, 2003).

The most important species expected to occur in the general area are *Acanthosicyoshorridus* (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 & 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 & 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 &Van Wyk (1997) are excluded here.

Table 6-18: 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**
Acacia erioloba		√	√	√	Protected (F)
Acacia reficiens				√	
Acanthosicyos horridus		√	√	√	Protected (F); N-end
Adenolobus garipensis			√		
Adenolobus pechuelii		√	√	√	
Aloe asperifolia				√	NC
Aptosimum spinescens			√		
Arthraerua leubnitziae	√		√	√	End
Asclepias buchenaviana				√	
Barleria lancifolia			√		
Boscia foetida			√		
Calicorema capitata			√		
Capparis hereroensis		√			End
Commiphora glaucescens			√		
Commiphora saxicola			√	√	End; Protected (F)
Cyphostemma currorii			√		Protected (F)
Dyerophytum africanum			√		
Euclea pseudebenus			√	√	Protected (F)
Euphorbia virosa			√		C2
Faidherbia albida		√		√	Protected (F)
Gossypium anomalum		√			
Hoodia currorii			√	√	NC
Ipomoea adenioides				√	
Lycium cinereum		√		√	

Lycium hirsutum		√			
Lycium tetrandrum		√			
Maerua schinzii			√		Protected (F)
Monechma cleomoides			√		
Moringa ovalifolia			√		Protected (F)
Parkinsonia africana				√	
Pechuel-Loeschea leubnitziae		√		√	
Petalidium setosum			√	√	
Salsola spp.	√Δ	√	√	√	
Salvadora persica		√	√	√	
Sarcocaulon marlothii				√	
Tamarix usneoides		√	√	√	Protected (F)
Tetragonia reduplicata				√	
Welwitschia mirabilis			√	√	Protected (F); NC; C2
Zygophyllum stapffii	√	√		√	End

End; N-end = Endemic and Near-endemic (Craven, 1999; Mannheimer & 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 (*Adeniapechuelii*), 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 6-19).

Table 6-19: 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
Adenia pechuelii	End, NT
Aloe namibensis	End, NC, C2, LC
Lithops gracilidelineata subsp. *gracilidelineata*	NC, LC
Lithops ruschiorum	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 6-7). The two endemic species (*Arthraerualeubnitziae* [pencil bush], *Zygophyllumstapffii*[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 (Figure 6-8 and Figure 6-9).

srk consulting	**CLEANERGY EIAR** *Salsola Nollothensis* (Saltbush) Shrubs are the most Numerous Plants in the GHDP Area	Project No. 585529

Figure 6-7: *Salsola Nollothensis* (Saltbush) Shrubs are the Most Numerous Plants in the GHDP Area

srk consulting	**CLEANERGY EIAR** The Endemic *Arthraerua Leubnitziae* (Pencil Bush) Occurs in the GHDP Area although at Low Densities	Project No. 585529

Figure 6-8: The Endemic *Arthraerua Leubnitziae* (Pencil Bush) Occurs in the GHDP Area although at Low Densities

srk consulting	**CLEANERGY EIAR** The Endemic *Zygophyllum Stapffii* (Dollar Bush) Occurs in the GHDP Albeit as Individual Plants Only	Project No. 585529

Figure 6-9: 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 6-10).

srk consulting	**CLEANERGY EIAR** *Salsola Nollothensis* (Saltbush) Hummocks forming along the Ephemeral Drainage Line	Project No. 585529

Figure 6-10: *Salsola Nollothensis* (Saltbush) Hummocks forming along the Ephemeral Drainage Line

Grass Diversity

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

Southern Namib

Desert grasses are dominated by the genus *Stipagrostis* (Lovegrove, 1999). *Stipagrostissabulicola* (tough dune grass) occurs on the dunes while the inter-dune flats (streets) are covered with *Stipagrostisgonatostachys* after rains. The eastern inland sections – pro-Namib – are dominated by *Stipagrostisobtusa* 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 *Odysseapaucinervis* (Müller, 1984; Van Oudtshoorn, 1999).

Table 6-20 indicates the grasses known and/or expected to occur in the general area and are derived from [1]Müller (1984), [2]Van Oudtshoorn (1999), [3]Burke (2003), [4]Curtis & Marais (1986) and [5]Müller (2007).

Table 6-20: 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]*Anthephora pubescens*			Decreaser	High
[2]*Aristida adscensionis*			Increaser 2	Low
[2]*Aristida congesta*			Increaser 2	Low
[2,5]*Bachiaria deflexa*			Increaser 2	Average
[2,3]*Cenchrus ciliaris*			Decreaser	High
[1,2,3]*Centropodia glauca*			Decreaser	High
[1,2]*Chloris virgata*			Increaser 2	Average
[2,4]*Cladoraphis spinosa*			Increaser 1	Average
[1,2,5]*Cynodon dactylon*			Increaser 2	High
[1,2]*Dactyloctenium aegyptium*			Increaser 2	Average
[1,2]*Enneapogon cenchroides*			Increaser 2	Low
[1,2,3]*Enneapogon desvauxii*			Intermediate	Average
[1,2]*Enneapogon scaber*			?	Low
[2]*Enneapogon scoparius*			Increaser 2	Low
[1,5]*Entoplocamia aristulata*			Intermediate	Low
[1,5]*Eragrostis annulata*			Increaser 2	Low
[2]*Eragrostis cilianensis*			Increaser 2	Low
[1,2,5]*Eragrostis echinochloidea*			Increaser 2	Average
[2]*Eragrostis lehmanniana*			Increaser 2	Average
[2,3,5]*Eragrostis nindensis*			Increaser 2	Average
[1]*Eragrostis omahekensis*		End	?	Low
[1,5]*Eragrostis porosa*			Intermediate	Low
[2]*Eragrostis rotifer*			Intermediate	Low
[2,5]*Eragrostis superba*			Increaser 2	Average
[2,5]*Fingerhuthia africana*			Decreaser	Average
[2]*Melinis repens*			Increaser 2	Low
[1,4,5]*Odyssea paucinervis*			?	Low
[2,5]*Panicum repens*			Decreaser	High
[2,4]*Phragmites australis*			Decreaser	Low

Species: Scientific name	**Species confirmed: Gravel plain area**	**Namibian conservation and legal status**	**Ecological Status**	**Grazing Value**
[1,5]*Pogonarthria fleckii*			Increaser 2	Low
[2]*Polypogon monspeliensis*			?	Average
[2]*Schmidtia kalahariensis*			Increaser 2	Low
[1,2]*Schmidtia pappophoroides*			Decreaser	High
[1]*Setaria appendiculata*			Decreaser	High
[2]*Setaria megaphylla*			Decreaser	High
[1,2]*Setaria verticillata*			Increaser 2	Average
[4]*Sporobolus consimilis*			?	Low
[2]*Sporobolus festivus*			Increaser 2	Low
[4]*Sporobolus nebulosus*			Increaser 2	Low
[1,2,3,5]*Stipagrostis ciliata*			Decreaser	High
[1,2,5]*Stipagrostis hirtigluma*			Increaser 2	Low
[1,5]*Stipagrostis hochstetteriana*			Decreaser	Average
[1,2,5]*Stipagrostis namaquensis*			?	Average
[3]*Stipagrostis sabulicolia*		End*	?	?
[1,2,5]*Stipagrostis obtusa*			Decreaser	High
[1,2,5]*Stipagrostis uniplumis*			Increaser 2	Average
[1,2,5]*Tricholaena monachne*			Increaser 2	Average
[2,5]*Tragus berteronianus*			Increaser 2	Low

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

? = Undetermined in literature

Δ = 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 *Eragrostisomahekensis* 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 *Stipagrostissabulicolia* as a "true Namib endemic" which only occurs in the dune fields of the Namib Desert. The annual *Stipagrostishermanii* occurs on the gravel and sandy/gravel plains, while *S. sabulicolia* 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 *Stipagrostissabulicolia* and *Cladoraphis spinosa* form dense stands in some parts of the Kuiseb River Delta area (Cunningham, 2020). According to Burke (2003), the endemic *Stipagrostissabulicolia* 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 *Eragrostisomahekensis* and *Stipagrostissabulicolia*. 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 6-11).

srk consulting	**CLEANERGY EIAR** The Barren Sandy Gravel Gypsum Plain Area is Devoid of Vegetation including Grasses	Project No. 585529

Figure 6-11: The Barren Sandy Gravel Gypsum Plain Area is Devoid of Vegetation including Grasses

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 & 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 (Moller & 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 endemicity is even sparser (Craven, 1998). To indicate how poorly known lichens are from Namibia, the recent publication by (Schultz & Rambold, 2007) 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 form the Namibian coast (Schultz & 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 & 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 6-12).

srk consulting	**CLEANERGY EIAR** An Unidentified Lichen Species (probably *Caloplaca spp*.) Observed in the GHDP Area	Project No. 585529

Figure 6-12: 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 are 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 & Cole, 2005; Earle & 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.

Important Species

Reptiles

The endemic *Pedioplanishusabensis* (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 *Afroeduraafricanaafricana* (African flat gecko), *Leptotyphlops occidentalis* (western thread snake) and *Lycophidionnamibianum* (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, 2022). 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 (2022). 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 Rüppels 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, secretary bird) 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, secretary bird), vulnerable (tawny eagle) and near threatened (kori bustard) by the (IUCN, 2022).

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 (!Nara) can be considered one of the most characteristic plants in the Namib Desert (Seely, 2010). It 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 & 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* area 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.

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 (*Cucurbitacea*e) 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 sabulicolia*.

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.

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 endemicity 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 & 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 (Figure 6-18 and Figure 6-19).

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. (Figure 6-13 to Figure 6-15).

srk consulting	**CLEANERGY EIAR** Off Road Driving and Old Tracks Remain Visible for Years in the Sandy Gravel Gypsum Plain Areas	Project No. 585529

Figure 6-13: Off Road Driving and Old Tracks Remain Visible for Years in the Sandy Gravel Gypsum Plain Areas

srk consulting	**CLEANERGY EIAR** Various Past and Present Construction Activities have Degraded the General Area	Project No. 585529

Figure 6-14: Various Past and Present Construction Activities Have Degraded the General Area

srk consulting	**CLEANERGY EIAR** Litter is Scattered throughout the Area	Project No. 585529

Figure 6-15: 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 6-16) 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 6-17).

srk consulting	**CLEANERGY EIAR** A Well Frequented Brown Hyena (*Parahyaena (Hyaena) brunnea*) Resting Site Beneath the Granite Riverban	Project No. 585529

Figure 6-16: A Well Frequented Brown Hyena (*Parahyaena (Hyaena) brunnea*) Resting Site Beneath the Granite Riverbank

srk consulting	**CLEANERGY EIAR** The Eroded Granite Riverbank System viewed as the Most Important Habitat in the General GHDP Area	Project No. 585529

Figure 6-17: The Eroded Granite Riverbank System Viewed as the Most Important Habitat in the General GHDP Area

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 6-18).

srk consulting	**CLEANERGY EIAR** A Well Vegetated Hummock System a	Project No. 585529

Figure 6-18: 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

srk consulting	**CLEANERGY EIAR** An Example of a Dolerite Ridge a	Project No. 585529

Figure 6-19: An Example of a Dolerite Ridge, Further to the North of the GHDP Area, Viewed as a 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 & 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 fly paths associated with this ephemeral drainage line (SAIEA, 2010).

Kuiseb River Delta [biodiversity red flag area]

The Kuiseb River has a catchment area of 15,500km^2 and a total length of 420km with the common riparian vegetation including species such as *Acacia erioloba*, *Acanthosicyoshorridus*, *Eucleapseudebenus*, *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 & 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]

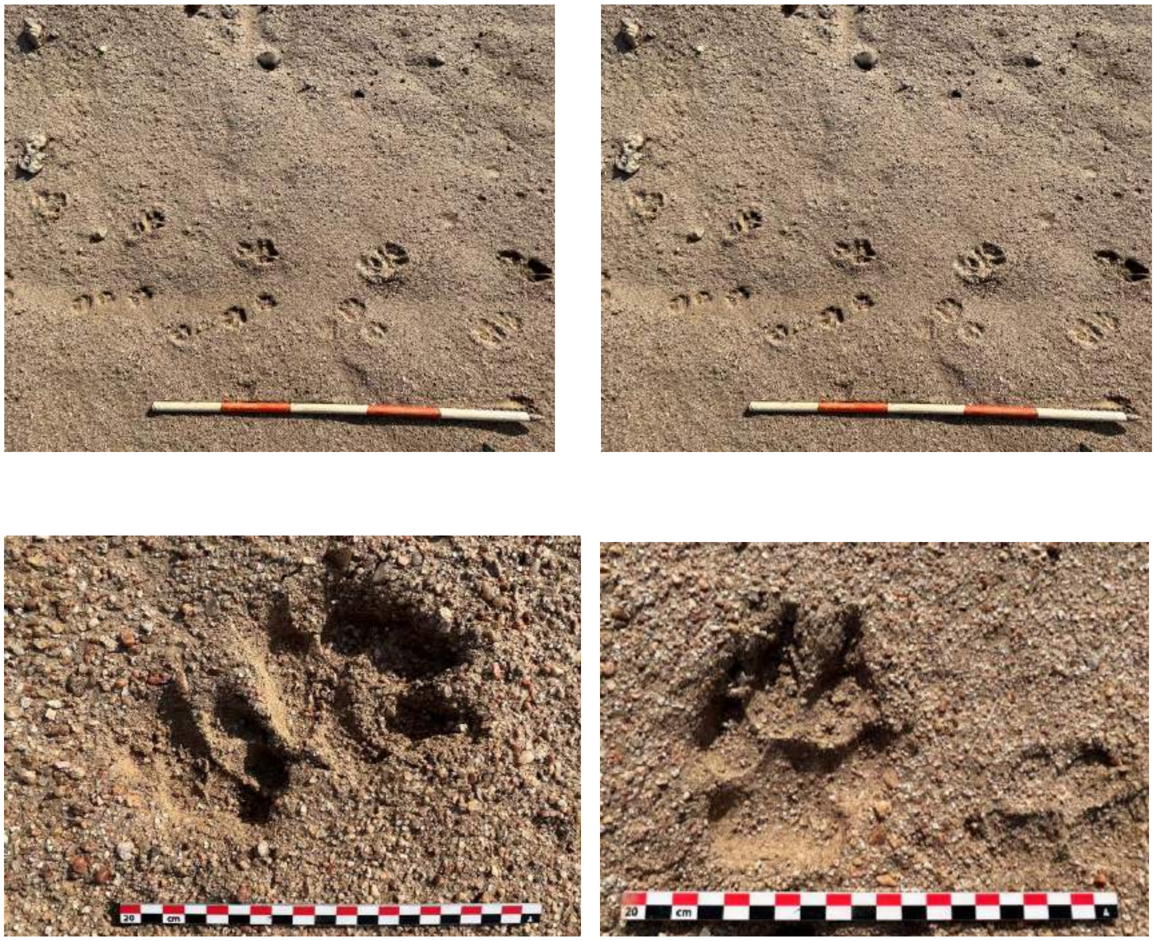
The *Acanthosicyoshorridus* (!nara) fields in the Kuiseb River Delta area fall within the 'biodiversity red flag' area (and the *raison d'être* for the listing) (SAIEA 2010). The endemic and protected *Acanthosicyoshorridus* (!nara) is important as a commodity for the Topnaars living along the Kuiseb 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 *Acanthosicyoshorridus* (!nara) in the lower Kuiseb 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).

6.3 Heritage and Cultural Aspects

This Section has been extracted from the Heritage and Archaeological Baseline Study compiled by Research Culture Heritage Services cc (Nankela, 2022).

Namibia has a very diverse culture. Cultures commonly found in Namibia include the Afrikaners, German communities, African communities, and Creole communities. The Rehobothers closely resembles the mid-20th century rural Afrikaner culture, while the Nama has more in common with African communities. The northern African cultures formed from a mixed farming context unlike the Damara and Herero. The San's culture was ruined by wartime exploitation and ranch labourers (Britannica, 2022).

The proposed GHDP site is an area between Walvis Bay and Swakopmund in proximity to D1984 road network. It is a designated light/heavy industrial area that has been also subject to intensive recreational pressure associated with the Dune 7. Other activities in the area, such as quad-biking, off-road driving and sightseeing appear to be operating. However, these are not regulated. The topography of the proposed GHDP site is relatively flat and on level ground with an altitude of 50m above sea level. Its weather is largely influenced by arid coastal conditions that are maintained by the cold Benguela Current that flows northwards from the South Atlantic Ocean, driven by strong south-westerly winds. Its geology is characterised by two distinct geomorphological units. The largest by far being the gravel coastal plain and a dry disappeared riverbeds with lateral erosion of previous floods barely visible (Figure 6-20). During the site visit, no animals were observed in the area, but multiple fresh footprints belonging to carnivores - hyena or jackal (not confirmed) were visible on the ground (Figure 6-21) and these differ in size and morphological appearance. One plant species was registered in the project - isolated patches of *Arthraerua leubnitziae* hummocks (Figure 6-22).



srk consulting	**CLEANERGY EIAR** Animal Tracks Registered within the GHDP	Project No. 585529

Figure 6-20: Animal Tracks Registered within the GHDP (Nankela, 2022)

srk consulting	**CLEANERGY EIAR** The Endemic *Arthraerua Leubnitziae* Recorded in the Footprint of the Project	Project No. 585529

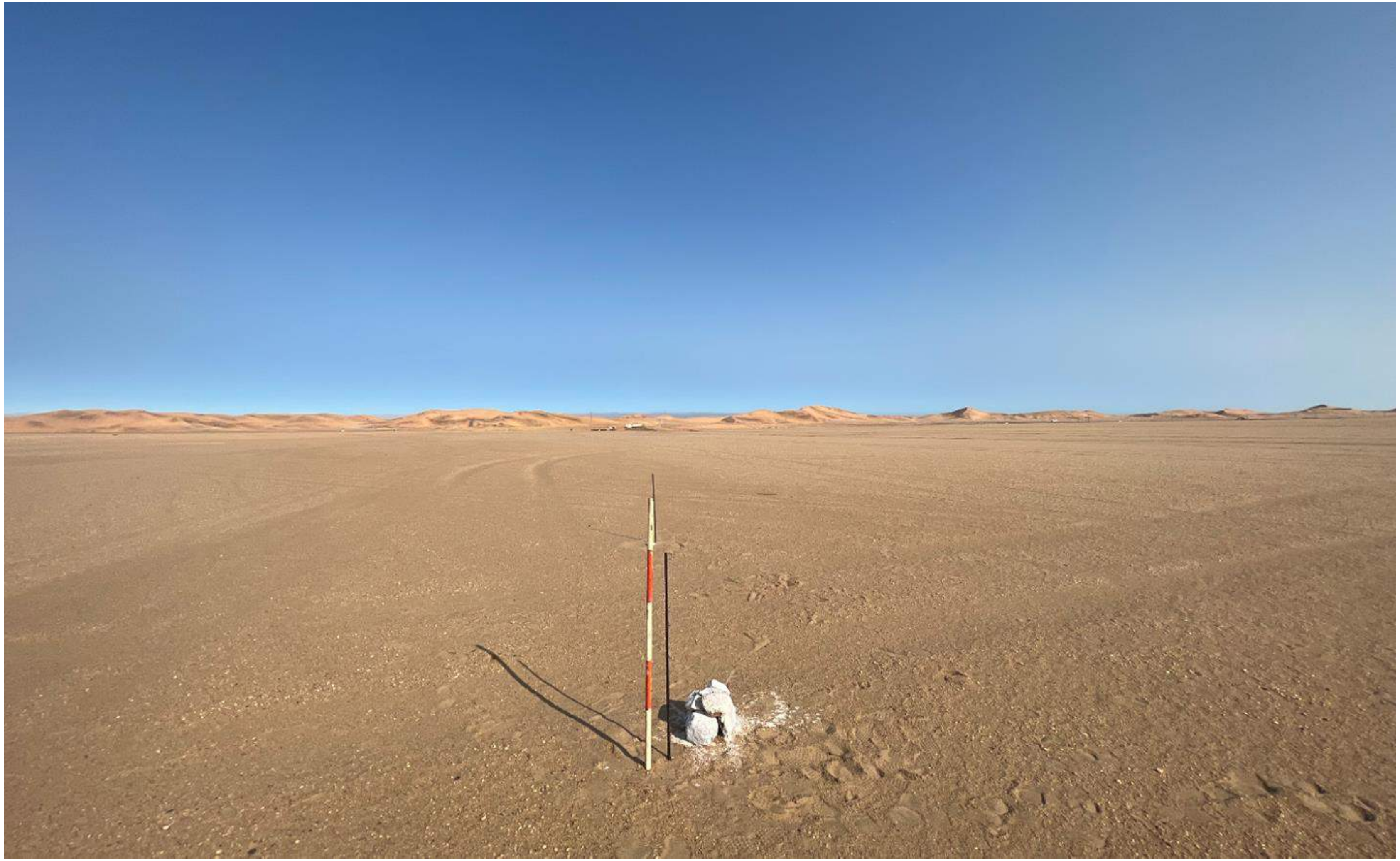
Figure 6-21: The Endemic *Arthraerua Leubnitziae* Recorded in the Footprint of the Project (Nankela, 2022)

6.3.1 Fieldwork

Sites visit and a detailed field investigation was carried out from the 16 to 18 August 2022 by the cultural heritage team. The walkover survey (Figure 6-24) covered an entire combined area of 26 hectares of the proposed sites. In total, this area stretches from the new road D1984 extension which lies just before the western margin of the High Dune Belt overlooking Dune 7 fields (Figure 6-22A) to the eastern small escarpment formed by the lateral erosion of the flood deposits (Figure 6-22B). A systematic visual inspection was undertaken, and photographs taken to record ground conditions and any surface archaeological/cultural heritage sites encountered. The locations of surface features were included in the survey and objects were recorded using a handheld Garmin GPS with an accuracy of +/-2 m horizontally and elevation. The site beacon (Figure 6-23) has been marked for the project.

srk consulting	**CLEANERGY EIAR** Top Image Shows the Distance of the Site from Dune 7 Dune Fields in the Foreground while the Bottom Image is the Periphery Bordering the Site	Project No. 585529

Figure 6-22: Top Image Shows the Distance of the Site from Dune 7 Dune Fields in the Foreground while the Bottom Image is the Periphery Bordering the site (Nankela, 2022)



srk consulting	**CLEANERGY EIAR** Site Beacon (White Stones) Scaled at Local Level	Project No. 585529

Figure 6-23: Site Beacon (While Stones) Scaled at Local Level (Nankela, 2022)

srk consulting	**CLEANERGY EIAR** Walkover Survey within the Proposed GHDP Site	Project No. 585529

Figure 6-24: Walkover Survey within the Proposed GHDP Site (Nankela, 2022)

6.3.2 Literature Review

Available heritage literature indicates that the area covering the GHDP Project falls under then Namib Naukluft Park in the Erongo Region (Figure 6-25). It was proclaimed in August 1979 under the Nature Conservation Ordinance No 4 of 1975.

According to several researchers, the Erongo Region, including the central Namib Desert is recognized as a major archaeological landscape in Namibia (see Wendt, 1972; Kinahan, 1990, 1984, 2020, 2012, 2021; Richter, 1991, Lenssen-Erz, 1997, 2004; Breunig 2003; Pleurdeau *et al*., 2012; Nankela, 2013, 2017, 2020 etc.) also (Figure 6-26). However, a considerable and large part of the region remains archaeologically unregistered because research has concentrated mostly on key major granite landforms which helped to establish the sequence of human occupations and determined the relationship between archaeological sites and the particular types of terrain across the landscape. It is for this reason that the region's archaeological wealth is evidenced in a substantial number of prehistoric human settlements dating from the Early through Middle to Late Stone Age periods (Kinahan, 2012). The earliest evidence of human activity is traced back from 800 000 years Before Present (BP) according to Kinahan (2011). Multiple sources further attests that abundance of significant archaeological sites have been recorded within the last 12 000 to 10 000 years, during Holocene period which coincides with the onset of warmer and moist conditions after the retreat of the Last Ice Age period which led to sudden expansion of human occupation as aridity intensified in the entire Namib Desert and hinterland (Stuut *et al*., 2000; Kinahan, 1991, 2012, 2021; Pleurdeau *et al*., 2012; Nankela, 2007; Lenssen-Erz, 2007). Such changes eventually prompted the Hunter-Gatherers to find refuge in mountainous localities such as the Brandberg, Erongo and Spitzkoppe Mountains where food and shelter was available. Chronologically, records yielded from a series of excavations carried out in these areas roughly over the last 6000 BP to 50 years BP when the rock art tradition was likely abandoned. These archaeological data are attributed to the Hunter-Gatherers and later pastoralists communities.

The coastal region is another crucial archaeological landscape in Erongo. The rich oceanic and coastal biodiversity and its resources has afforded a favorable living environment for the indigenous pastoralists' community as evidenced by Pre-Holocene records including detailed historical records from the last 250 years (Avery, 1984; Kinahan, 1991, 2000, 2001, 2005; Kinahan & Kinahan 2009; Morse *et al*., 2013; Bennett *et al*., 2014; Detroit & Nankela, 2014; Nankela, 2017). These are harvested through a series of detailed archaeological research and surveys assessments. Walvis Bay, a natural harbour, and the largest anchorage on the coast that stretches about 500 km to the north is the first site of contacts between the indigenous communities and Europeans during the late seventeenth century (Kinahan & Kinahan, 2009). To date, Walvis Bay, and its surrounding environment i.e., Kuiseb Delta and Dune Belt Areas also Kuiseb Delta Conservation Areas (KDCA) has registered approximately 235 archaeological sites of which 75% dates from prehistoric period linked to the indigenous communities such as the Topnaar (Aonin). They were purportedly wealthy pastoralists that controlled extensive grazing lands around in the interior of the country and exploited the coastal resources (Kinahan, 2001; Kinahan & Kinahan, 2009). Such sites are generally characterized by shell middens of various extensions, accumulations of skeletal remains of marine and terrestrial (wild and domestic) vertebrates, pottery, beads, human footprints, and various artifacts including human remains buried under silt deposits with some largely exposed by natural erosion corresponding to the flood deposits of Kuiseb River (Detroit & Nankela, 2014).

As Walvis Bay became the gateway to the interior for traders, explorers, missionaries, and settlers; evidence of contact with the Western world has been registered in the episodic river delta at Walvis Bay, with over 58 sites (Ibid 2009). Here, the pastoralists reportedly traded (bartered) cattle, sheep, hides, and feathers were traded (Kinahan, 2000; 2001) for the European exotic goods such as glass beads, porcelain, gin bottles and tins food, among other things (Kinahan & Kinahan, 2009). However, during the first half of the nineteenth century importation of traded goods intensified around Walvis Bay coastline which encouraged movements further inland where merchants settled and established themselves further (Kinahan, 2000; Kinahan & Kinahan, 2009; Nankela, 2017; 2021). Although material evidence of these historical settlements is less documented and poorly preserved, debris of what is left is visible in the landscape today and can easily be mistaken for trash. The genetic character of artefacts found in these sites comprised of material trace of the European community of the time. They include remnant of building materials, broken bottles inclusive of square case gin bottles, tins, rusted copper wires and drums, old post (indicative of settlement), old clothing, fishing nets, charcoal, animal bones fragments, decorated porcelains, cups, trade beads, used bullets and consumed products i.e., shell maddens all dating from the 17th to 19th Century during intense trading economy between the European merchants and indigenous traders. Possible historic graves and skeletal remains of animals (mainly horses) might also be expected at such sites (Kinahan 2000; Nankela, 2017; 2020).

For instance, the new Wastewater Treatment Works located about 10 km near Farm No. 60 just behind Dune 7 recreational area has produced similar materials finds (Nankela, 2017). Another site near Swakop River 25 km from Walvis Bay also yielded similar finds (Nankela, 2021). A further 40 km south of Walvis Bay, a commercial fishing establishment at Sandwich Harbour reportedly existing alongside the indigenous settlements from 1860 to the late 1880s who largely dependent upon wage labour and European charity" (Kinahan, 1991).

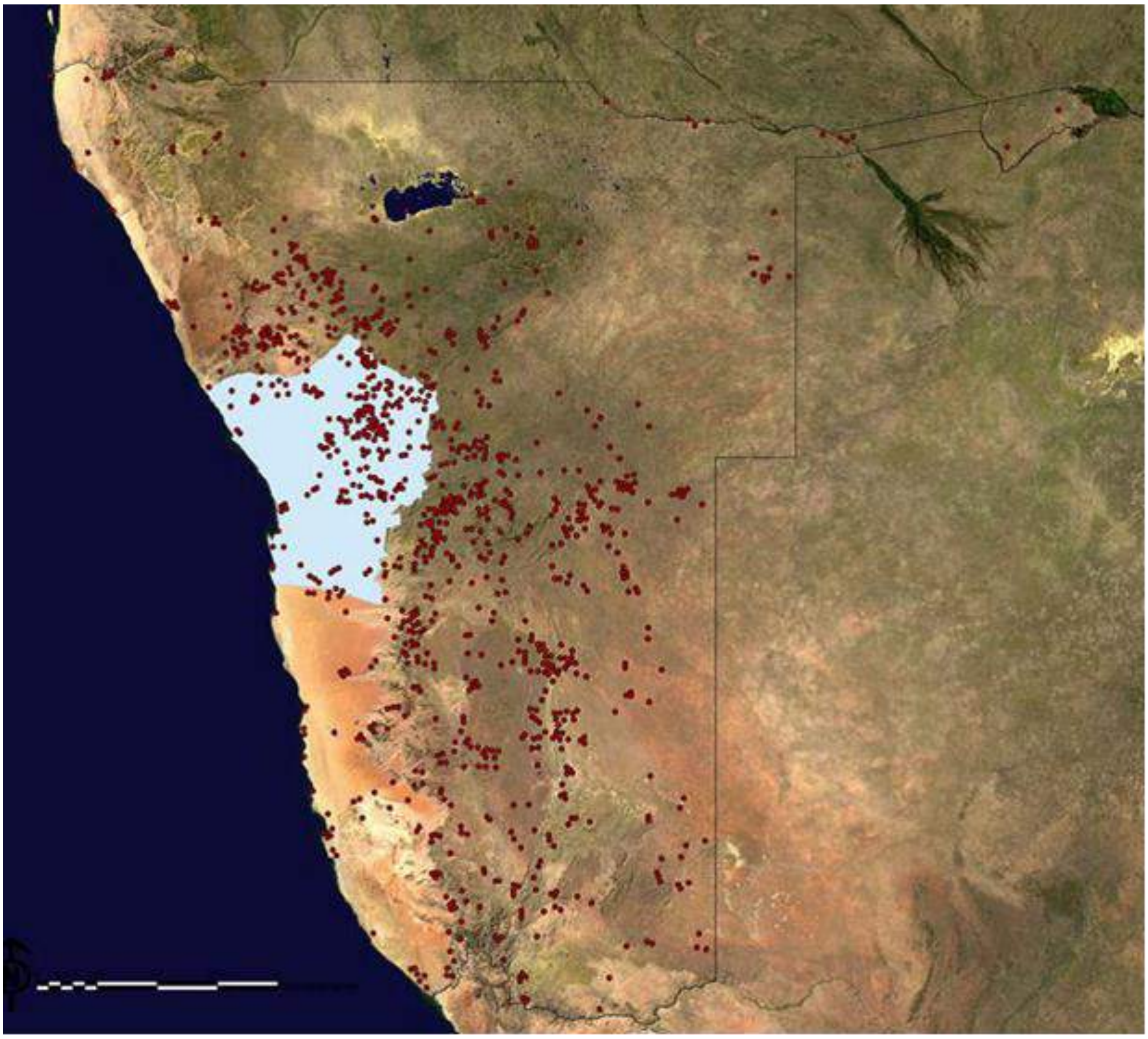
The overall distribution of heritage sites beyond KDCA decreases towards the hinterland where the proposed GHDP site lies. This is largely attributed to increased footprints of anthropogenic impacts on the environment with clear visible damages and disturbances from earlier and current constructions of infrastructure development i.e., railway line and service road, roads networks, telecommunication lines, town expansions, sewerage, and water utilities as well as increased tourism activities associated with recreational area of Dune 7. Natural impacts such as erosion (mainly by the wind and sand movements) related to coastal dynamic environment also threaten the integrity of many archaeological and historic sites in this area.

This erosion process aggravates archaeological remains including possible buried remains which might be preserved and protected under shallow sedimentary deposits. Further, coastal fogs and other forms of moisture degrade artefacts and reduces the visibility of the sites. The unregulated tourism activities such as off-road driving and quad biking within the area can easily damage heritage resources unintentionally through trampling and crashing. As a result, their historical value is compromised, and its significance rating is therefore relatively very low to 0.

srk consulting	**CLEANERGY EIAR** An Edited Satellite Map of the Dorob National Park, indicating its Geographical Boundaries and GHDP Site Location	Project No. 585529

Figure 6-25: An Edited Satellite Map of the Dorob National Park, indicating its Geographical Boundaries and GHDP Site Location[15]

[15] Source- NASA, 2006 Accessed from: https://upload.wikimedia.org/wikipedia/commons/4/42/Namib-Naukluft-Park-Borders-Sat.jpg on the 8th September 2022.

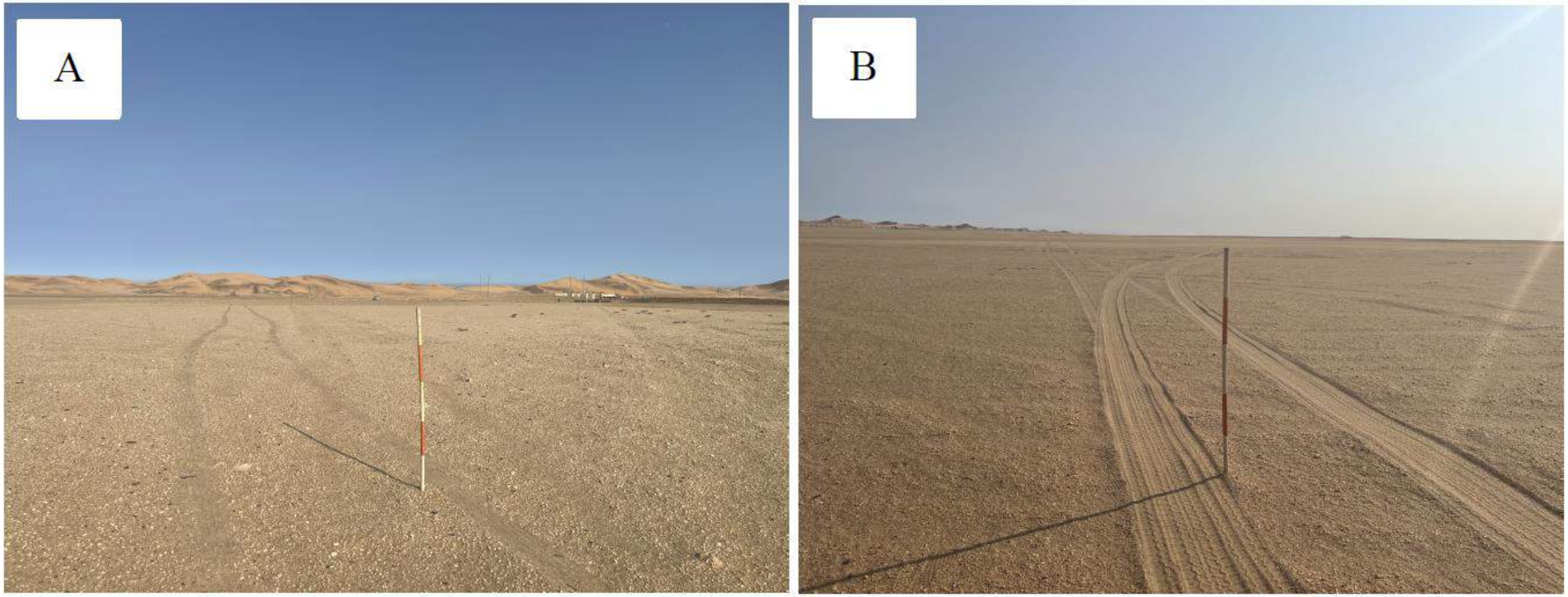


srk consulting	**CLEANERGY EIAR** Erongo Region (Blue Highlight) in Relation to the Distribution of Archaeological Sites in Namibia	Project No. 585529

Figure 6-26: Erongo Region (Blue Highlight) in Relation to the Distribution of Archaeological Sites in Namibia (John Kinahan, 2012)

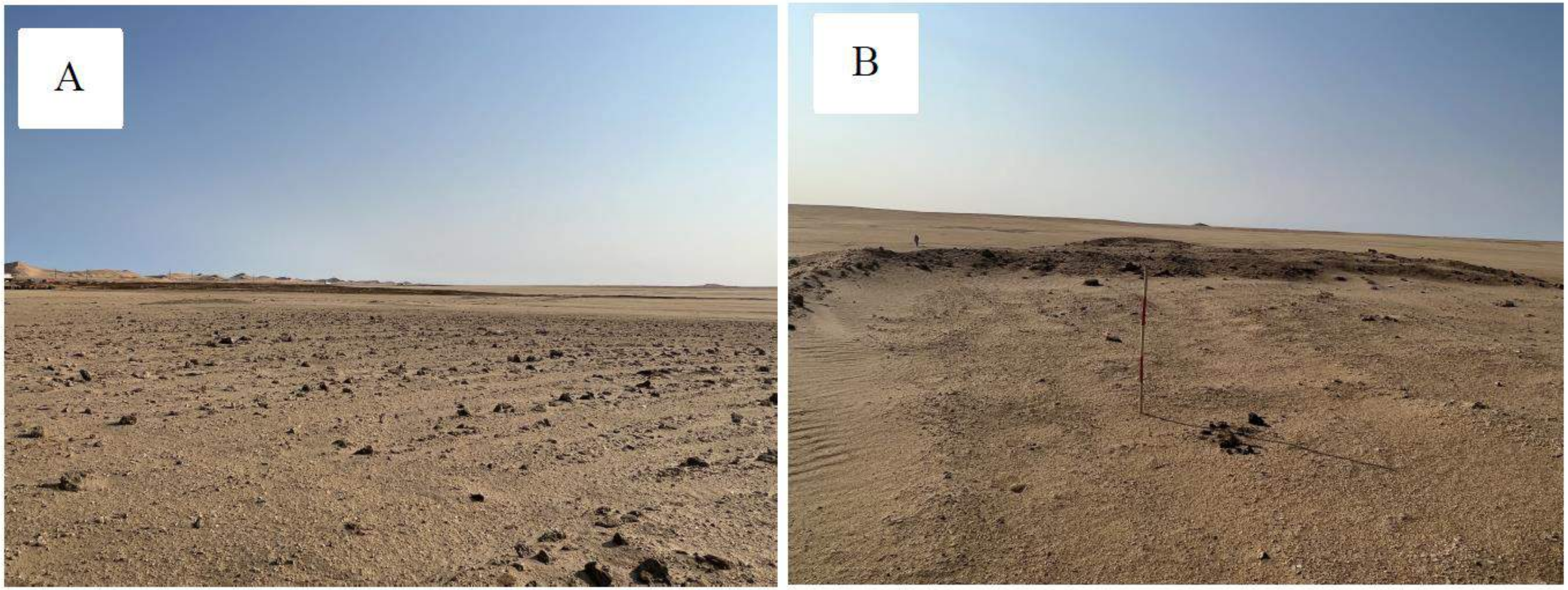
6.3.3 Data Analysis & Results

Due to relative homogeneity of the site's topography and its geomorphology, no traces of significant archaeological and historical evidence relevant under the provisions of the National Heritage Act (No. 27 of 2004) were found. This is attributed to the surface disturbances related to the rehabilitations (Figure 6-27 A&B), constructions, and erections infrastructure-related development i.e., roads, telecommunication lines and service roads in vicinity to the proposed site. The present off-road vehicle prints (Figure 6-28 A&B) and possible recreational activities carried out in the area has also disturbed the site context. However, typical few surface finds in the form of rusted tins, broken glass, and animal bones fragments (mandible) were recoded (Figure 6-30). The context of the majority of the finds suggests that such surface deposits might be as a result of gradual aeolian erosion and natural erosion of the surface of the flood deposit rather than a secondary context by prehistoric nomads. However, if they are associated with the materials linked to the 17th to 19th Century during trading economy between the European merchants and indigenous traders, their significance is reduced considerably due to surface disturbances and the fact that these surface materials are seemingly in secondary deposition. However, one feature that stood out (Figure 6-29 D) is an industrial plastic pole cut off a concrete foundation with legible numbers that reads “RWK 227”. A quick internet search revealed that it is most probably a “screw compressor” which may attest to the previous industrial use of this area. However, this find was recorded in the immediate surrounding of the site limit and not within the project area.



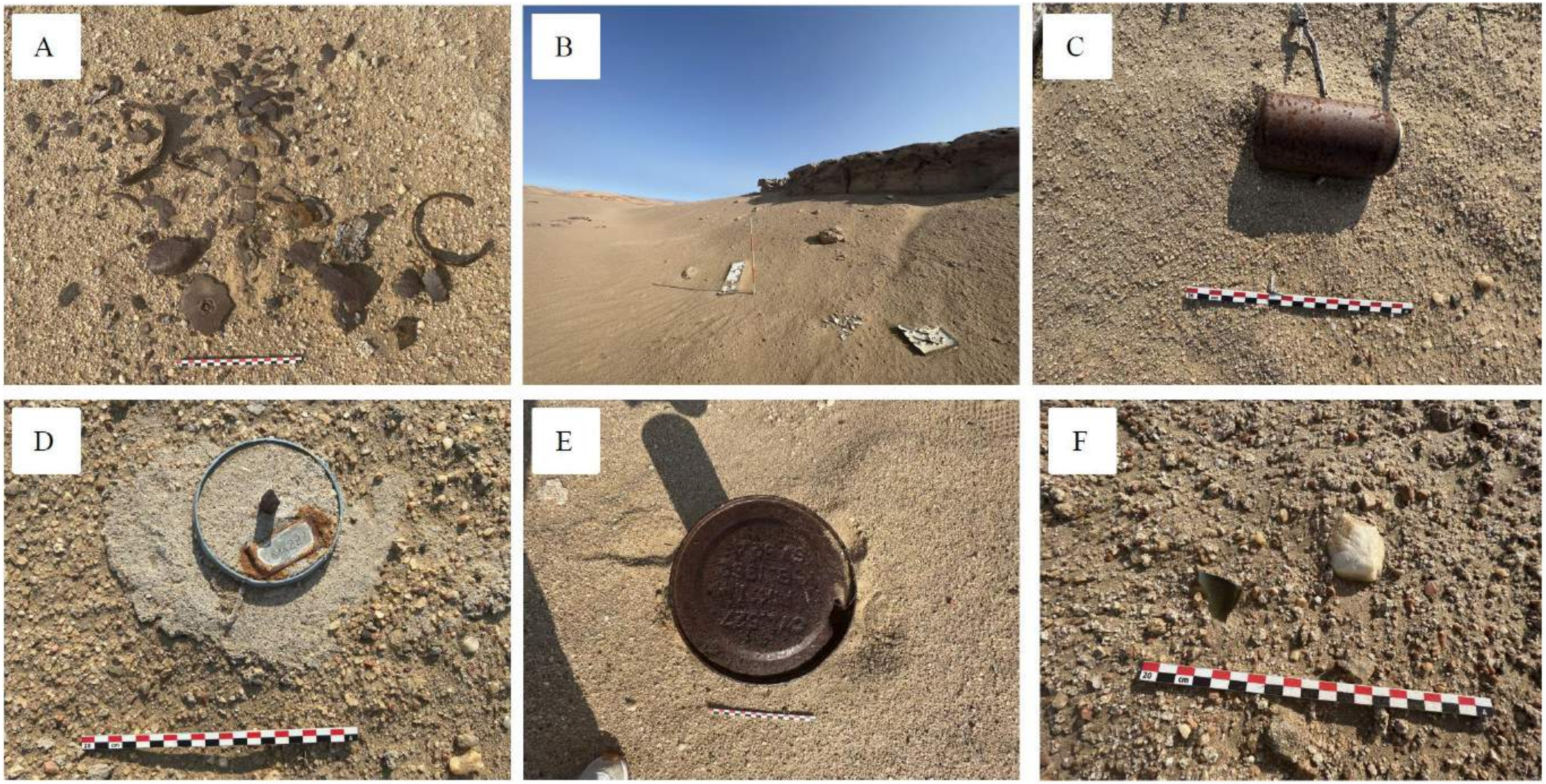
srk consulting	**CLEANERGY EIAR** Off-roads Vehicle Tracks found in the Project Site	Project No. 585529

Figure 6-27: Off-roads Vehicle Tracks found in the Project Site (Nankela, 2022)



srk consulting	**CLEANERGY EIAR** Rehabilitated Surface Land of the Project Site	Project No. 585529

Figure 6-28: Rehabilitated Surface Land of the Project Site (Nankela, 2022)



srk consulting	**CLEANERGY EIAR** The Site Repertoire: Surface Finds within the Project Site	Project No. 585529

Figure 6-29: The Site Repertoire: Surface Finds with Project Site. From A, C & E is the Debris of Rusted Cans and Broken Glass while B and D are Indeterminate Objects (Nankela, 2022)

srk consulting	**CLEANERGY EIAR** A Fragment Mandible of Upper Maxillary Cheek Dental of an Unidentified Animal	Project No. 585529

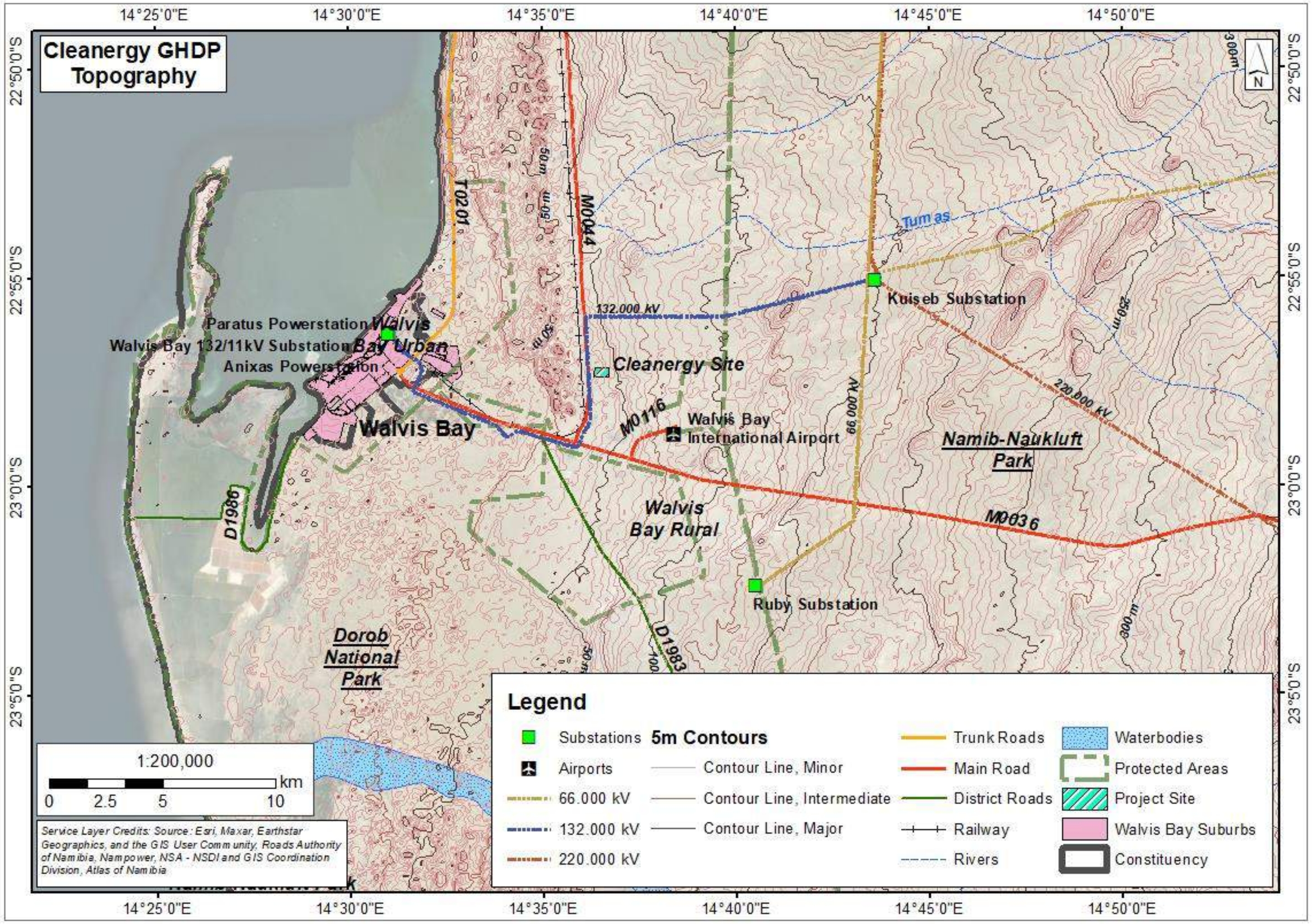
Figure 6-30: A Fragment Mandible of Upper Maxillary Cheek Dental of an Unidentified Animal / Probably a Horse (Nankela, 2022)

6.4 Topography

The gradient of the Central Namib is gradual at 1% in elevation from the coast to the escarpment feet. There are no major landscape features aside from a few river valleys, inselbergs, and dunes influencing the climate between the escarpment and the ocean (Watson & Lemon, 1985). This allows the steady development of gradients impacting temperature, humidity, fog, and wind patterns. The isohyets mostly run parallel to the coast; however, some gradients are in opposite directions, changing the climatic characteristics from the coast inland. The Central Namib was thus divided in several zones namely the Pro-Namib, eastern zone, middle zone, foggy interior zone, and cool foggy coastal zone which are analysed by vegetation, land use, and soil processes (Hachfield & Jurgens, 2000).

The terrain is overall very flat aside from Dune 7 located on the proposed site's western side and some smaller sand dunes. The site is between 30 and 50 m above sea level.

The study area for the proposed Cleanergy GHDP terrain is overall very flat aside from Dune 7 located on the proposed site's western side and some smaller sand dunes. The site is between 30 and 50 m above sea level (Topographic-map, 2022). A depiction of the area's topography is provided in Figure 6-31.



srk consulting

CLEANERGY EIAR

Topography

Project No.
585529

Figure 6-31: Topography

6.5 Water Resources

6.5.1 Existing data

The project area is located some 10 km east of Walvis Bay, immediately east of Dune 7 and 20 km north of the Kuiseb River. Existing surface and hydrogeological data on the project area is scarce. The data sources used in the study are listed in Table 6-21. No boreholes in the vicinity of the project area are present in the GROWAS database.

Table 6-21: Data Sources Consulted in the Study (Sarma, 2022)

Ref	Dataset	Source
1	Borehole information	GROWAS borehole database. Geohydrology Division, Directorate of Water Resources Management, MAWLR
2	Geological information	Geology Mapsheet 2214. Geological Survey Namibia.
3	Analysis of groundwater samples	Project field work. One sample taken and submitted for analysis.
4	General hydrogeological data	GIS datasets of the Hydrogeological map of Namibia.
5	Digital elevation data	Shuttle Radar Topography Mission (SRTM) www2.jpl.nasa.gov/srtm
6	Climate and topography of the project area	GIS datasets of the Atlas of Namibia www.atlasofnamibia.online

6.5.2 Surface Water

Existing data on the hydrology of the coastal areas of Namibia is scarce with the exception of the larger ephemeral rivers. The following description and interpretation is based on topographic, climatic and hydrology data as indicated (Table 6-21) (Sarma, 2022).

On a regional scale, topographic level from inland central plateau areas in Namibia to the ocean with a steep increase in slope at the 'Great Escarpment'. The westward slope beyond the escarpment of the coastal plains is relatively gentle. West flowing ephemeral rivers that originate inland, east of the Escarpment, have their headwaters in areas of higher rainfall. These include large rivers such as the Swakop and Kuiseb. The large rivers are important water sources for the dry coastal areas either as surface water or as recharge source to alluvial aquifers. Significant seasonal flows occurs in intervals of 3 to 5 years. The Kuiseb River alluvial aquifers supply Walvis Bay (Rooibank and Dorop aquifers). Occasional flooding in Walvis Bay (e.g., in 2021) occurred due to flow in the Kuiseb River in response to higher rainfall in inland areas (Khomas Hochland). The Swakop River flow is dammed upstream (Swakoppoort Dam) and in exceptional rainfall seasons, overflow occurs that reach the coastline. The Kuiseb and Swakop Rivers are 32 km to the north and 20 km south of the site, respectively, and do not have any direct impact on the study site (Sarma, 2022).

The area is bordered by the Kuiseb 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 (Cunningham, 2022). These larger rivers, the Swakop and the Kuiseb, do not affect the local hydrology (Sarma, 2022).

In contrast to the larger ephemeral rivers, locally dry rivers channels noted at the site and surroundings have much smaller catchments (Figure 6-34) with their extent limited to the arid or hyper arid parts of the Namib Desert (Figure 6-33) and are not connected to the larger river catchments. The channels as captured from 1:50,000 scale topographic map and mapped from aerial photos (Google Earth) and DEM (ALOS Work 3D), are shown in Figure 6-33. These channels also flow due west over the coastal gravel plains and are seen to terminate in the coastal dune belt between Walvis Bay and Swakopmund. The channels are ill-defined with eroded banks and are partly covered by aeolian sand (Sarma, 2022).

Flow in these ephemeral rivers will occur in response to rainfall in the catchments. Rainfall records from the Gobabeb Station consisting of monthly totals from 2015 to 2022 (eight years) give a mean annual rainfall of 12.5 mm per year (Coastal Met, Gobabeb Station, SASSCAL Weathernet, 2022) while an older but much longer record from 1931 to 1990 (Station 18852, Namibia Meteorological Service) gives a slightly higher mean annual rainfall figure of 13.8 mm/year. Two markedly high rainfall events in the record are 96.5mm in 1933/34 season and 64.2 mm in 1975/76. Significantly high rainfall can be expected as suggested by frequency analyses using the longer rainfall record - 65 mm event for a 50-year return period and 85 mm event for a 100-year return period (Sarma, 2022).

High runoff due to rainfall can result due to low vegetation cover and exposed rocky surfaces and result in short but rapid flows in the ephemeral streams or as sheet flow where channels are not well defined. The position of channels within the site should thus be taken into consideration during planning of the infrastructure and storm water drainage systems designed accordingly. Based on the above it can be concluded that the surface water features in the site are obscured due to very infrequent flows typical of arid conditions but occasional high intensity flow can be expected and will need management (Sarma, 2022).

Two important coastal wetlands – i.e., Walvis Bay Wetlands and Sandwich Harbour – both Ramsar sites, occur in the area (Cunningham, 2022). 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 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 (Cunningham, 2022). 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) (Cunningham, 2022).

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 (Cunningham, 2022).

A well vegetated hummock system is present 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 (Cunningham, 2022).

Surface drainages are limited to seasonal streams that have catchments within the arid coastal areas (Sarma, 2022).

Overall surface water and groundwater potential of the area is low and hypersaline underground brines with salinity exceeding that of seawater by more than five times is noted at shallow levels some 2 kilometres south of the site.

srk consulting	**CLEANERGY EIAR** Surface Water Resources	Project No. 585529

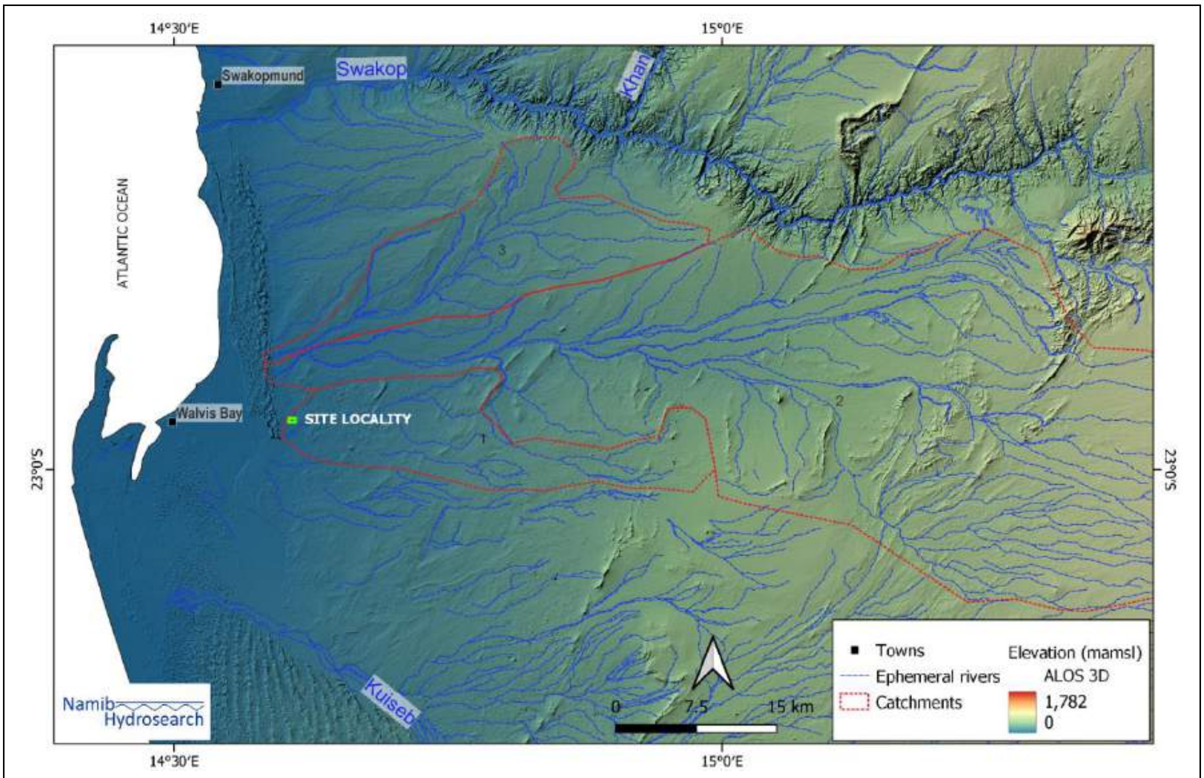
Figure 6-32: Surface Water Resources

6.6 Hydrogeology

This Section has been extracted from the Surface and Geohydrological Baseline Study compiled by Diganta Sarma (Sarma, 2022).

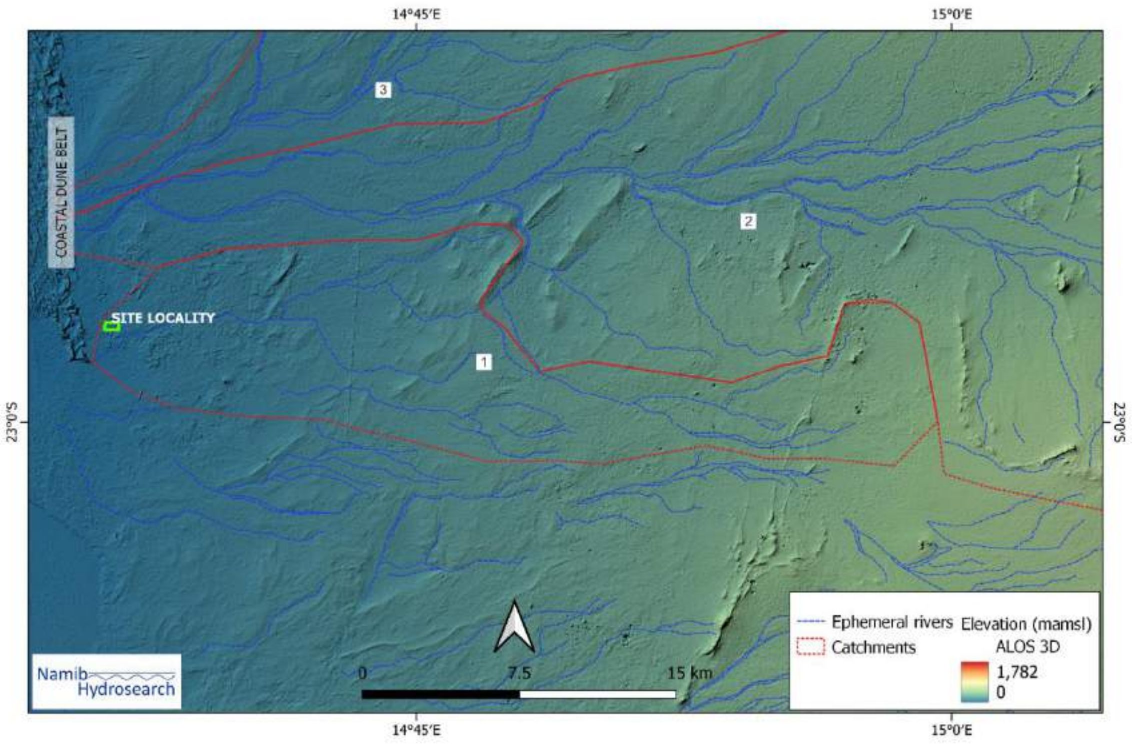
The geology of the area consists of Damara Supergroup rocks that include the Nosib Group and the intrusive granites of a similar age, the Salem Granite (Figure 6-51 and Table 6-22). Mapped lithologies in the exposed hard rock outcrop in the vicinity of the site comprises of granite, quartzite, and marble. The land surface is covered by superficial deposits of sand and gravel, gypcrete, calcrete and alluvial deposits (sand and clay) along ephemeral rivers. Hardrock outcrops are few. Immediately west of the site towards Walvis Bay is a band of aeolian dune sand.

Westward-flowing groundwater that originates in the inland hard rock areas discharges to the coastal sediments. The aquifers in the project site are generally of very low potential, and mostly saline to hyper-saline. This is a result of low groundwater flow rates and high residence time due to low hydraulic conductivity and gentle hydraulic gradient. Local groundwater recharge is also negligible under the hyper-arid conditions of the Namib Desert. Where the westward topographic gradient is steeper or impervious bedrock is present, springs emanate from the sediments. Cross-section A-B below frames the conceptual hydrogeological setting.



srk consulting	**CLEANERGY EIAR** Regional Topography and Drainage	Project No. 585529

Figure 6-33: Regional Topography and Drainage of the Project Area (Sarma, 2022)



srk consulting	**CLEANERGY EIAR** Local Hydrology and Relief in Relation to the Site Locality	Project No. 585529

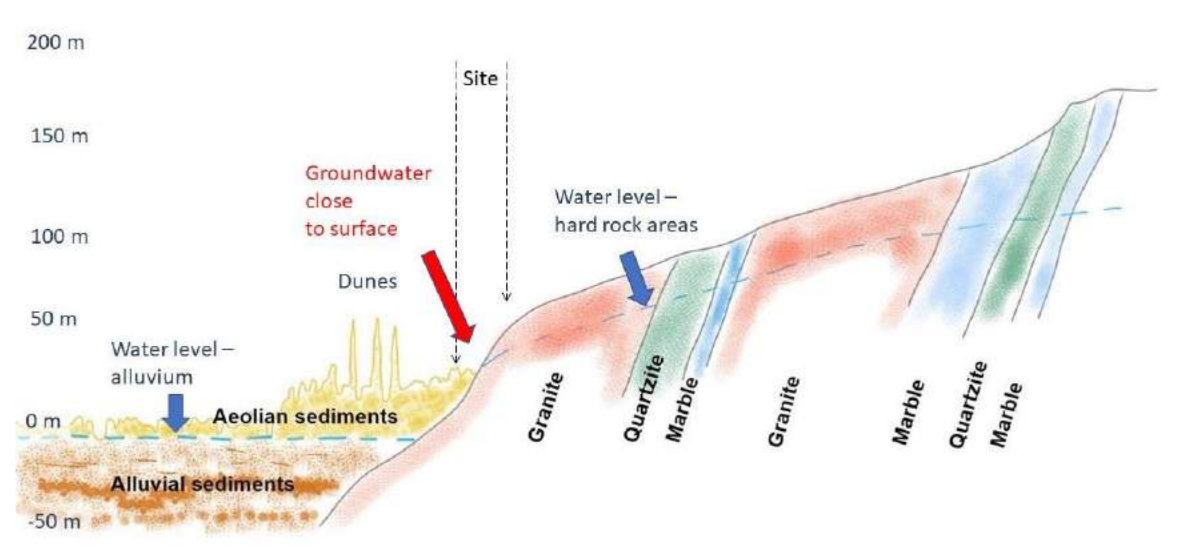
Figure 6-34: Local Hydrology and Relief in relation to the Site Locality (Sarma, 2022)

Table 6-22: Lithological units in the project area

Lithology	Geology	Lithocode	Supergroup	Group	Formation
Granite	Biotite Granite	NgSAs			Salem Granite
Quartzite	Quartzite	Net	Damara	Nosib	Etusis
Marble	Calc-silicate	NKn	Damara	Nosib	Khan
Granite	Biotite Granite	NgSAs			Salem Granite
Marble	Calc-silicate	NKn	Damara	Nosib	Khan
Quartzite	Quartzite	Net	Damara	Nosib	Etusis

The long residence time results in evaporation / evapotranspiration of the groundwater which concentrates soluble salts causing the groundwater to become brackish to saline. Mineral dissolution is another process of increasing salinity. Gypcrete (consisting of gypsum, $CaSO_4.H_2O$) and halite (NaCl) that have accumulated in the coastal sediments over time are dissolved by groundwater (and occasional surface flow) adding to the salinity of the groundwater. The groundwater is therefore not potable and unusable by humans or local fauna. Limited and temporary use for road building activities was noted.

Towards the south, the alluvial Kuiseb River aquifers are found, from which the Rooibank and Dorob Water Supply Schemes supply potable water to the Walvis Bay Municipality. The Kuiseb River Aquifers are known as productive primary alluvial aquifers that are recharged by seasonal river flow in response to rainfall in the inland elevated areas (Khomas Hochland). These alluvial aquifers are limited to the Kuiseb River course and delta and not present in the project area.



srk consulting	**CLEANERGY EIAR** Vertical Scale and Interpreted Geological and Hydrogeological Setting	Project No. 585529

Figure 6-35: Cross-section A-B with Exaggerated Vertical Scale and Interpreted Geological and Hydrogeological Setting.

Field Investigations

A site visit was undertaken to confirm the hydrogeology conditions of the area, particularly the presence of shallow groundwater reported close to the project site. The site activities and findings are described here. A picture of the site is shown in Figure 6-36.

1. The project site was inspected for signs of shallow groundwater. A pit (Pit 1) of approximately 1.5 m depth was hand excavated at a topographical low point in an ephemeral river course inside the site. Figure 6-37 shows the excavated pit. The sequence of sedimentary layers encountered are gravel and sand, gypcrete layer, minor clay, followed by aeolian (dune) sand below 0.6 m. No moisture was detected in the excavated pit. Excavation had to be stopped at

1.5 m due to continuous collapsing of the dune sand. The overall impression is that the sediments at this location are dry.

2. Areas with ponded water is visible on satellite imagery (Google Earth) and is located approximately 2 km south of the site (Figure 6-38). Two areas of ponding were noted with a roughly south-west extension of the ponded areas (Figure 6-38 and Figure 6-39). Recent excavations are visible, and the ponded water is being used in the nearby Walvis Bay – Swakopmund highway construction. These recent excavations are in sediments similar to that excavated in Pit 1. There is clear indication of halite (salt) precipitation in these ponds (Figure 6-39).
3. Water quality measurements were taken in two locations. Brine Pool 1 has specific gravity of 1.134 indicating salinity level well over sea water. The second location (Brine Pool 2) to the south, has an even higher specific gravity of 1.22. The range of salinity is 161,000 mg/l to 272,000 mg/l based on (Baseggio, 1974) and the two readings indicating that the groundwater is hypersaline brine.
4. Other parameters recorded are Brine Pool 1 – pH: 7.5, Temperature: 26.5C; Brine Pool 2 – pH: 7.1, Temperature: 25.3C. Electrical conductivity was above the range of measurement of the field instrument.
5. A sample from Brine Pool 1 was collected for standard water quality analysis.

In summary, the area is underlain by unconsolidated surficial sediments above Damara Supergroup meta-sedimentary rocks and granitic intrusive. No shallow groundwater is detected at the site. Springs discharging hypersaline groundwater are present approximately two kilometres south of the site. No groundwater of potable quality for use by humans or fauna is present in the area.

srk consulting	**CLEANERGY EIAR** View from the Site Facing Towards West	Project No. 585529

Figure 6-36: View from the Site Facing Towards West

srk consulting	**CLEANERGY EIAR** Pit 1	Project No. 585529

Figure 6-37: Pit 1, Excavated at the Site

srk consulting	**CLEANERGY EIAR** Brine Pool 1	Project No. 585529

Figure 6-38: View of Brine Pool 1

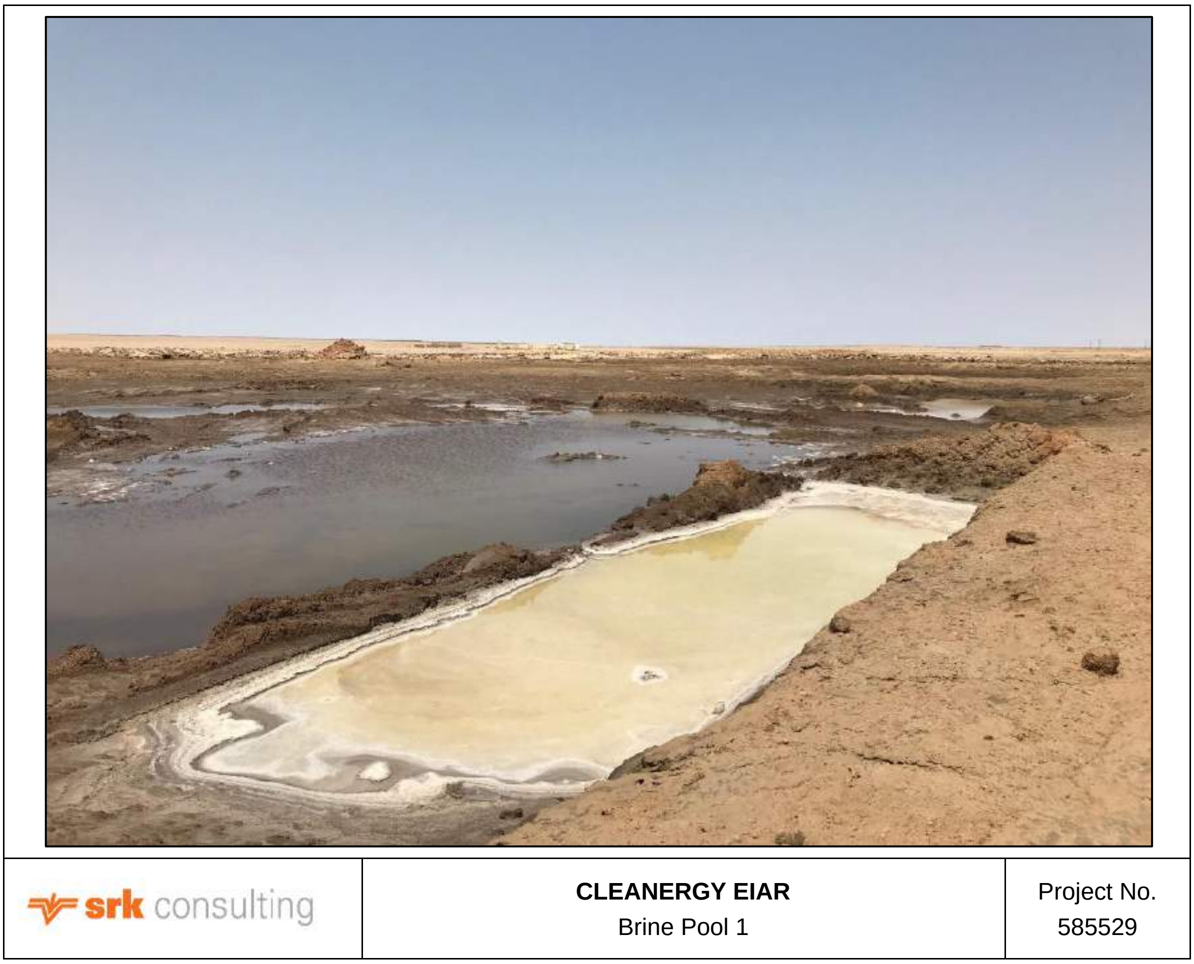


Figure 6-39 Excavated part of Brine Pool 2 with halite precipitate

6.7 Visual

This Section has been extracted from InSite Landscape Architects Report (Bredell, 2022). Within the wider region and context of the receiving environment, the area has been modified due to numerous infrastructure-related and manmade interventions such as roads, bridges etc. In stark contrast with this is the Natural uniqueness of the Dorob National Park and within that, Dune 7 desert landscape that dominates the skyline to the east of the study area.

In terms of the natural uniqueness, "irreplaceability" of the site and within local, regional and international context, the scenic, landmark and therefore tourism significance of Dune 7 is noted. Dune 7 is the highest dune in Namibia. The dune has been measured at over 383 meters and is named Dune 7 because it is the seventh dune one encounters after crossing the river Tsauchab. In the context of the surrounding region, at a local, regional and national scale, the site has international relevance as a world-famous tourist attraction.

Dune 7 is located within the Dorob National Park ("dry land") which is a protected area in the Erongo, Region along the central Namibian coast, and stretches along the coastline for 1,600 km. The proposed development site is located (east) in a direct line approximately 500 m outside the conservation area.

In terms of the general visual sensitivity of the affected environment, the site is vulnerable and exposed. The general sensitivity originates from the largely flat and very subtle undulating macro landscape to the east and south. To the east are open vistas in contrast to the "buffered" natural desert dunes to the west of the site. This expansive landscape is more sensitive to visual impacts due to the very low vegetation cover.

Visual Sensitivity, in this instance, refers to the capacity of an environment to tolerate disturbance (taking the environment's natural capacity to recover from disturbance as well as existing cumulative impacts into account).

The proposed development footprint itself is located on an already modified and disturbed landscape, thus resulting in a very little, or no permanent loss of vegetation cover or of a natural landscape.

The affected environment could be categorised as having a low tolerance to disturbance and is mainly due to the macro landscape, context, and exposed short-, medium-, and long-range views to the east. These sensitivities influence the sensitivity of the overall system, mainly due to the location of the existing aerodrome in relation to the proposed development site.

The below baseline Visual Impact Assessment data collection was completed with thorough literature review as well as a site investigation and field survey conducted on 23 and 24 August 2022.

6.7.1 Visual Character

The physical and landscape related baseline and characteristics of the study area contribute to its overall visual character and uniqueness of the landscape and "landscape sense of place" also known as genius loci.

Landscape character is defined here as a "distinct, recognisable, and consistent pattern of elements in the landscape that makes one landscape different from another..." (Swanwick, 2002).

Visual character largely depends on the level of change or transformation from a natural baseline in which there is little evidence of human transformation of the landscape, to a modified and ultimately transformed landscape.

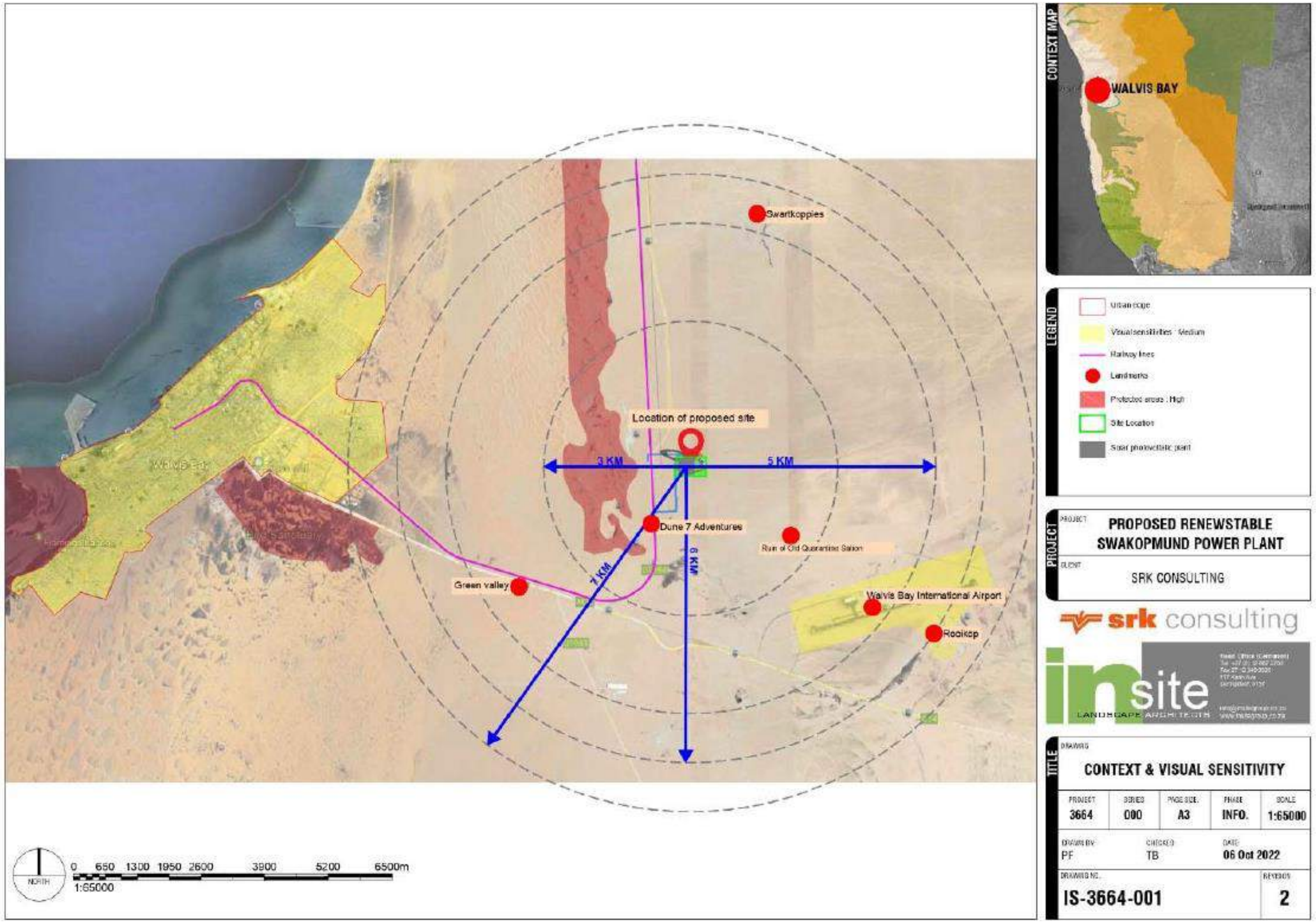
Varying degrees of human transformation of a landscape would result in differing visual characteristics to that landscape, with a highly modified urban or industrial landscape being at the opposite end of the scale to a largely natural, pristine, totally undisturbed, or natural landscape.

- Visual character is also influenced by the presence of built infrastructure including buildings, roads, and other objects such as telephone and electric infrastructure. In the case of the proposed study area, all of the following linear elements influence the visual baseline:
    - Ongoing road works and road widening (highway under construction);
    - Existing railway line;
    - Existing power lines all run in a general north-south direction and mostly linear development footprints; and
    - Arterial roads and temporary and/or permanent access roads.

The visual character of an area largely determines the 'sense of place' relevant to the area. The 'sense of place' is generally defined by its unique quality or character of a place, whether natural, rural, or urban which results in a uniqueness, distinctiveness, or strong identity. The level of modification, and therefore the identity of the study area is varying:

- Across much of the western portion of the study area there are relatively low levels of human transformation and visual degradation is low, and as such the natural character has been largely retained;
- The flowing desert landscape and unique identity is strongly supported by the uniqueness and landmark status associated with Dune 7; and
- Much of the eastern portion of the study area has, however, been transformed resulting in vast and open wasteland visual character in these areas.

- The area east of the railway is largely modified and a transformed landscape (Figure 6-40).



srk consulting	**CLEANERGY EIAR** Site Location, Visual Sensitivities	Project No. 585529

Figure 6-40: Visual Context - Study Area

The level of transformation in the landscape is an important factor in this context, as the introduction of the proposed Cleanergy Green Hydrogen Demonstration Plant (GHP) Walvis Bay, would result in less visual contrast, where other manmade elements are already present.

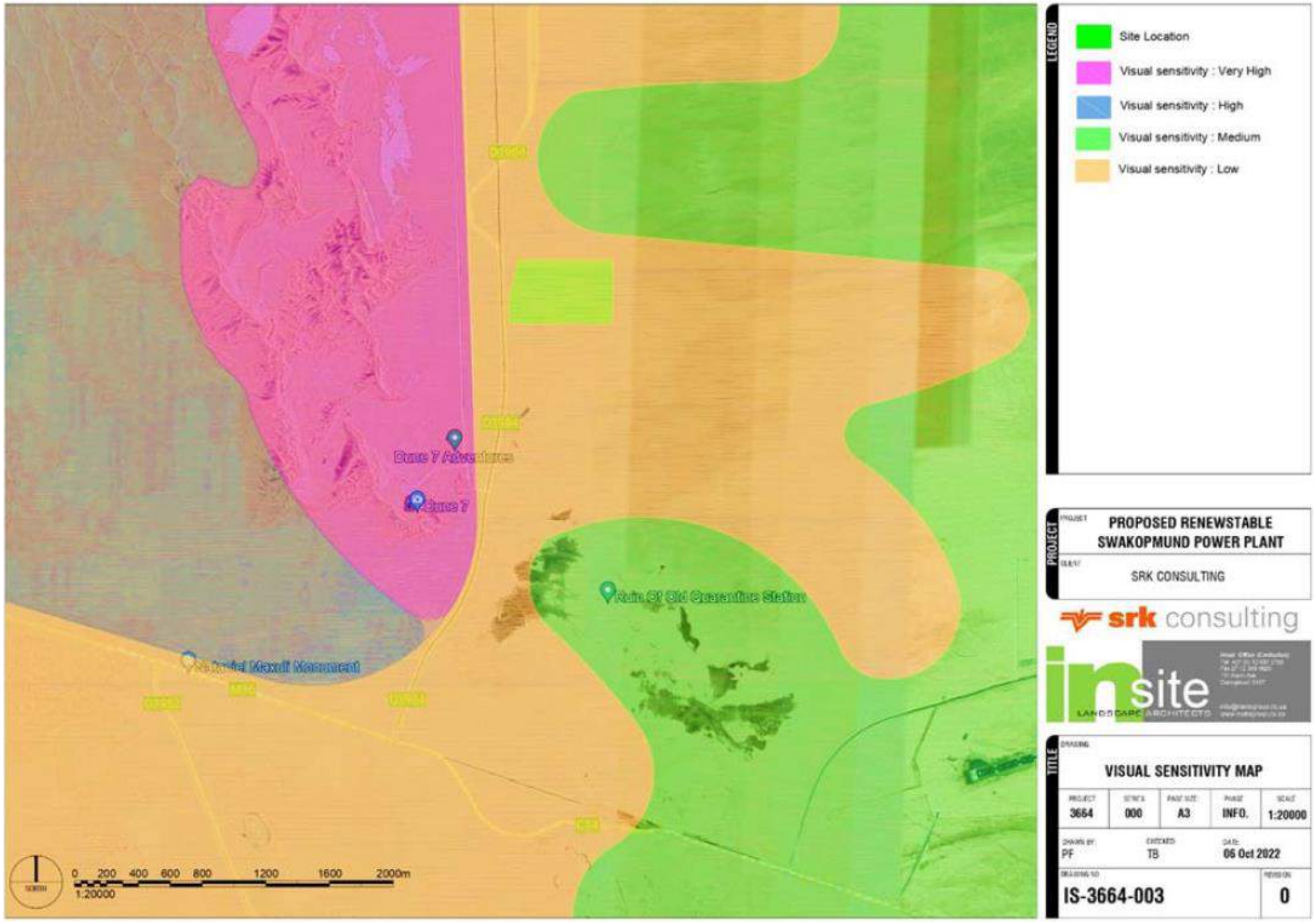
In this instance the level of contrast will be highly evident, most especially the Solar PV Array, but also the other resulting infrastructure associated with the Cleanergy Demonstration Plant (GHP).

The scenic quality of the landscape is also an important factor contributing to the visual character of an area or the inherent 'sense of place'.

Visual appeal is often associated with unique natural features or distinct variation in landform, shapes, and texture, which in this case is very evident within the greater landscape, but also local context and uniqueness of the study area.

Note that the nature of the receiving environment is such that any development footprint plus vertical scale gets emphasized in the vastness of the landscape. As a result, the largely natural and unspoilt desert landscape (macro environment) features as the dominant landform in an otherwise modified (micro) environment.

Noted furthermore that the existing Nature Conservation area that is located west of the development footprint increases the scenic appeal (e.g., as a tourism destination) as well as landscape and visual interest of the area.



srk consulting	**CLEANERGY EIAR** Site Location, Visual Sensitivities	Project No. 585529

Figure 6-41: Visual Sensitivity Map

6.7.2 Visual Absorption Capacity

Visual absorption capacity is the ability of the landscape to absorb a proposed new development without any significant change in the visual character and quality of the existing landscape.

The level of absorption is largely based on the physical characteristics of the landscape (existing topography, landform, and vegetation cover), and the level of transformation that is present in the landscape. Any visual and landscape intervention is emphasized within the relative exposed and relatively flat topography of the study area. The lack of vegetation found in a desert environment will further reduce the visual absorption capacity of the study area. This would be offset to a smaller extent because much of the adjacent landscape, east and south of the study area have already undergone large scale transformation.

The absence of a direct visual link to the urban development beyond the dunes (west of the development footprint) will make the site more protected and buffered from long range views to and from the site in a western direction. In contrast the ongoing extensive roads upgrade and existing airport developments and associated infrastructure and close proximity to the proposed project will marginally increase the overall visual absorption capacity of the landscape.

6.7.3 Visual Implications

Areas of flat relief towards the eastern portion of the study area are characterized by wide open ranging vistas, whilst views westwards will be constrained by the higher line of sand dunes evident in the landscape in the western sector of the study area.

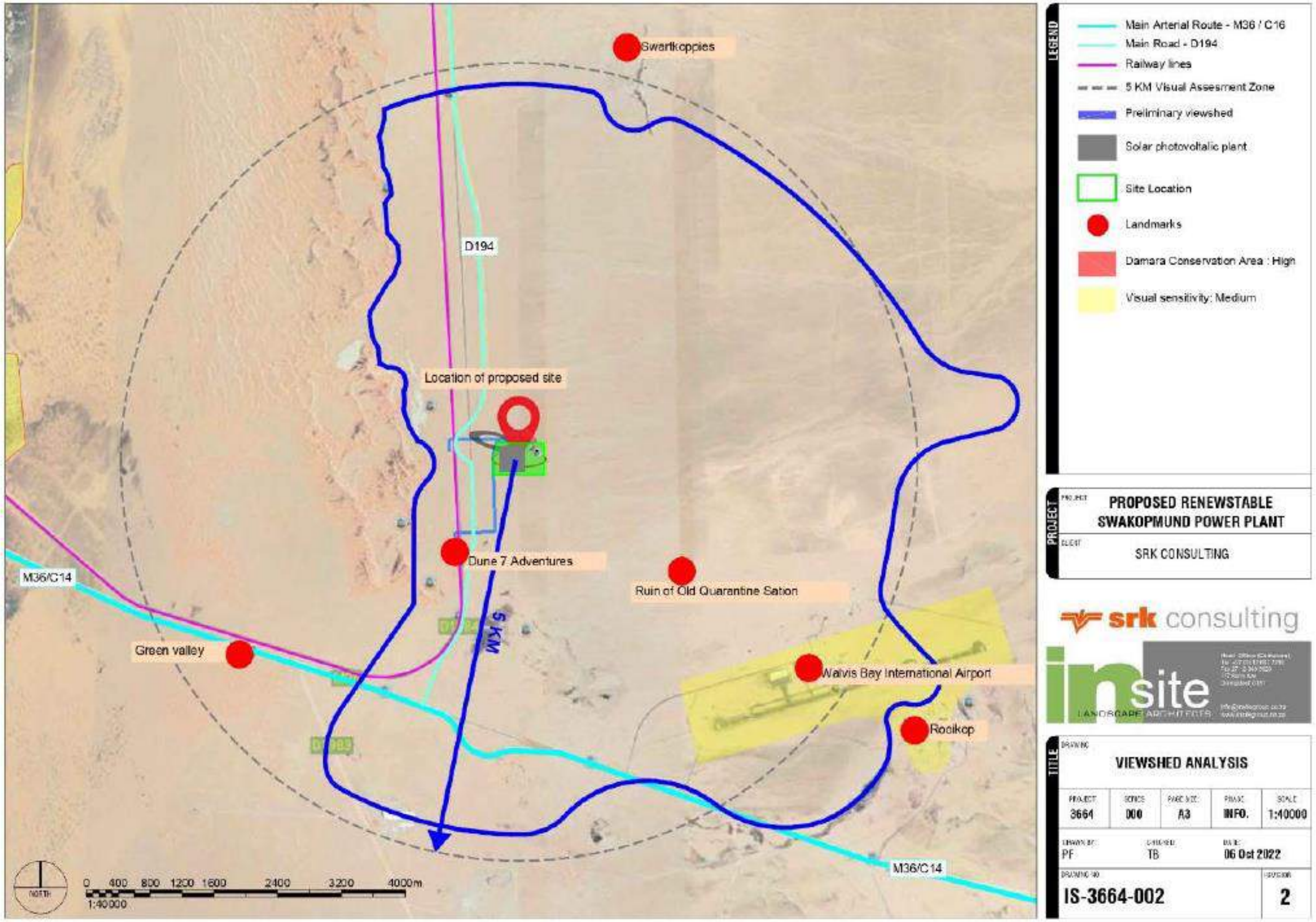
The position of the viewer within the landscape will influence the types of vistas to be experienced. Viewers located within a more raised position e.g., roadways and elevated dunes etc. will have direct views of the proposed development site.

Viewers located within a more defined valley for example would have limited or constrained vistas.

Notably the same is also true of objects placed at different elevations and within different landscapes, and different settings or visual contexts. Typically objects or developments placed on higher-elevations, slopes or ridgelines would be more visible, while those placed in valleys or in case plateaus would be notably less visible. In the context of this GHDP, development and the associated elements will not be located in high elevation or slopes or on ridgelines and as such will be a low impact on the skyline.

Localised Topographic variations may limit views of the development from some part of the study area, but across the remainder of the study area there will be little topographic shielding to reduce the visibility, especially those of larger elements of the proposed project (both vertically and horizontally larger elements area noted).

From the locally occurring receptor locations, then considering that the PV panels will be the most visible element of the proposed development, a viewshed analysis for the proposed PV development footprint was done (Figure 6-42).



srk consulting	**CLEANERGY EIAR** Visual Sensitivities and Preliminary Viewshed Analysis	Project No. 585529

Figure 6-42: Viewshed Analysis in terms of Local Landmarks

A worst-case scenario will be assumed when undertaking the analysis in which the proposed PV panels will be signed a maximum height of 14 meters. It is, however, anticipated that the proposed PV panels will not be higher than 2 meters. The resulting viewshed as shown in Figure 6-42 indicates that the solar PV arrays would be visible, or partially visible from much of the southern and eastern sector of the study area.

This analysis is restricted to the visibility of the GHDP and does not consider the other elements of the proposed roadway and resulting highway, interchange and resulting infrastructure upgrades.

See attached artist impression of the proposed development; refer to Figure 6-43 and Figure 6-44.

srk consulting	**CLEANERGY EIAR** Artist Impression of the Proposed Cleanergy GHDP	Project No. 585529

Figure 6-43: Artist Impression of the Proposed Cleanergy GHDP

Figure 6-44 Artist impression of the proposed development Cleanergy GHDP and various operational components.

srk consulting	**CLEANERGY EIAR** Artist Impression of the Proposed Cleanergy GHDP	Project No. 585529

Figure 6-44: Artist Impression of the Proposed Cleanergy GHDP (2)

6.7.4 Glint and Glare of the Proposed Photovoltaic Panels

Broadly translated (visual) receptors are sensitive elements, which absorb light, and transmit the visual signal to the brain.

Ground based receptors as identified on the attached maps for this project include:

- Existing railway;
- Freeway adjacent to the development; and
- Local identified tourist attractions including Dune 7 and various associated buildings.

Aviation receptors are those specific towards the aviation industry and associated infrastructure. Receptors include:

- Walvis Bay International Airport, Namibia;
- Air traffic control (ATC) tower; and
- Aircraft in aerodromes on final approach or departure from runways.

Glint can be described as a direct reflection of the sun from the surface of the solar PV panel and can be described as a momentary flash of light.

Glare is significantly less intense in comparison to glint and can be described as a continuous source of bright light, relative or in comparison to a diffused light.

The Visual Impact Assessment will consider best practise and international as well as local aviation authority guidelines with regards to glint and glare. The study will also review and assess the potential visual hazard regarding light-sensitive receptors for solar (photovoltaic) developments and infrastructure with reflective surfaces. This will be documented in relation to background and research studies documented and reported – by others.

The ICOA (part II) Land use and environmental management guideline Chapter 4 Page 4-15 states, in terms of airport support elements and renewable sources of power generation, that:

> *"Consideration of a large solar array should be accompanied by an ocular analysis of glint and glare. This will help identify solar panel orientation that maximise system performance while eliminating risk of glint and glare which could be hazardous to air traffic control and pilots"*

A Visual Impact Assessment will be undertaken to assess the practical impacts of the proposed Cleanergy GHDP Project and to develop appropriate environmental management measures to reduce the impact thereof.

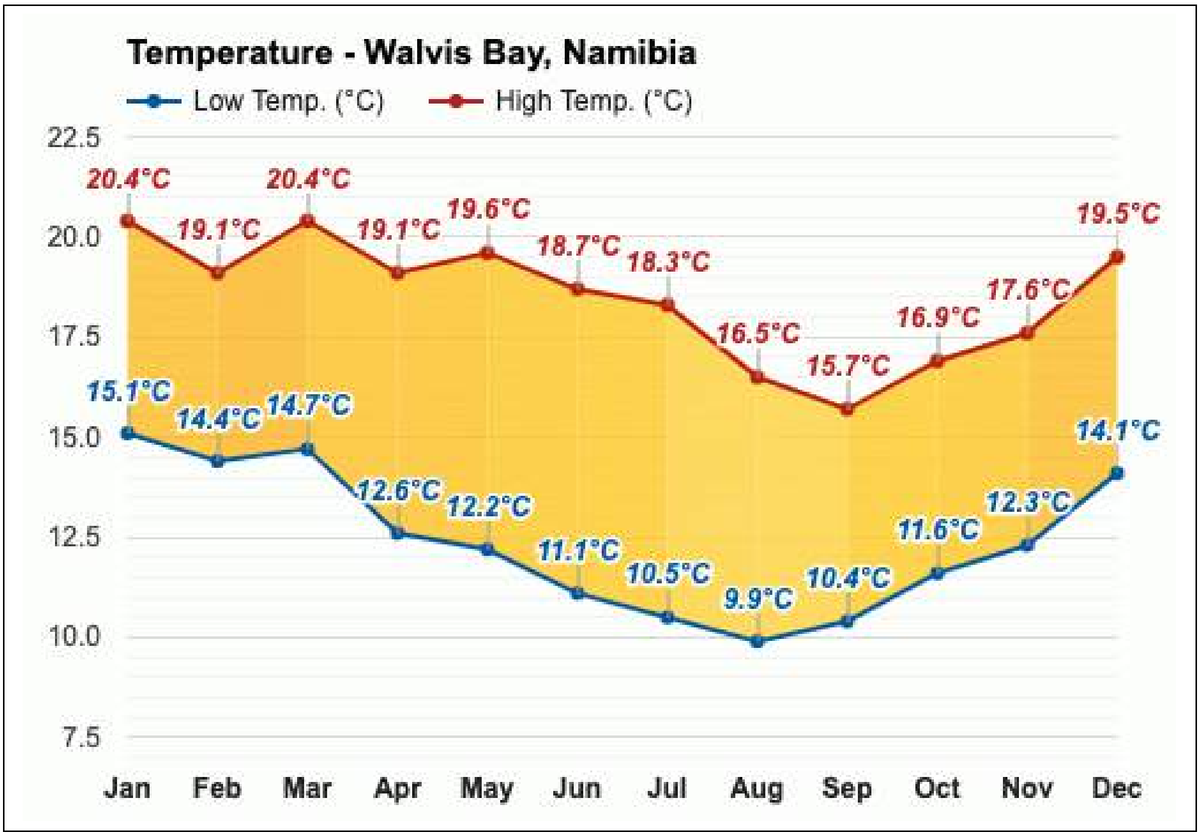
6.8 Climate

The Erongo Region, located in the western part of Namibia, falls within the west coast arid zone of southern Africa, and is characterised by low rainfall, extreme temperatures and unique climatic factors influencing the natural environment and biodiversity. Episodic dust storms, associated with easterly wind conditions, are common during austral autumn and winter months. During these events, dust is transported westwards over long distances across the Namibian continent towards the Atlantic Ocean (Liebenberg-Enslin et al., 2017). This descend of air leads to a drop in air pressure as a result of vertical air column expansion, and the development of warm berg-wind conditions as a result of adiabatic heating. Although strong, hot and often uncomfortable for people, easterly wind conditions are usually relatively short lived (Liebenberg-Enslin et al., 2017).

6.8.1 Temperature

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%.

Figure 6-45 shows that maximum temperatures for Walvis Bay stay fairly constant from December to May with an average range between 19.1 °C and 20.4 °C and vary between 18.7 °C and 17.6 °C from June to November. The minimum temperatures are also fairly constant between December and March, ranging between 14.1 °C and 15.1 °C, while the minimum temperatures vary more between April and November, ranging from 9.9 °C and 12.6 °C (Weather Atlas, 2022).

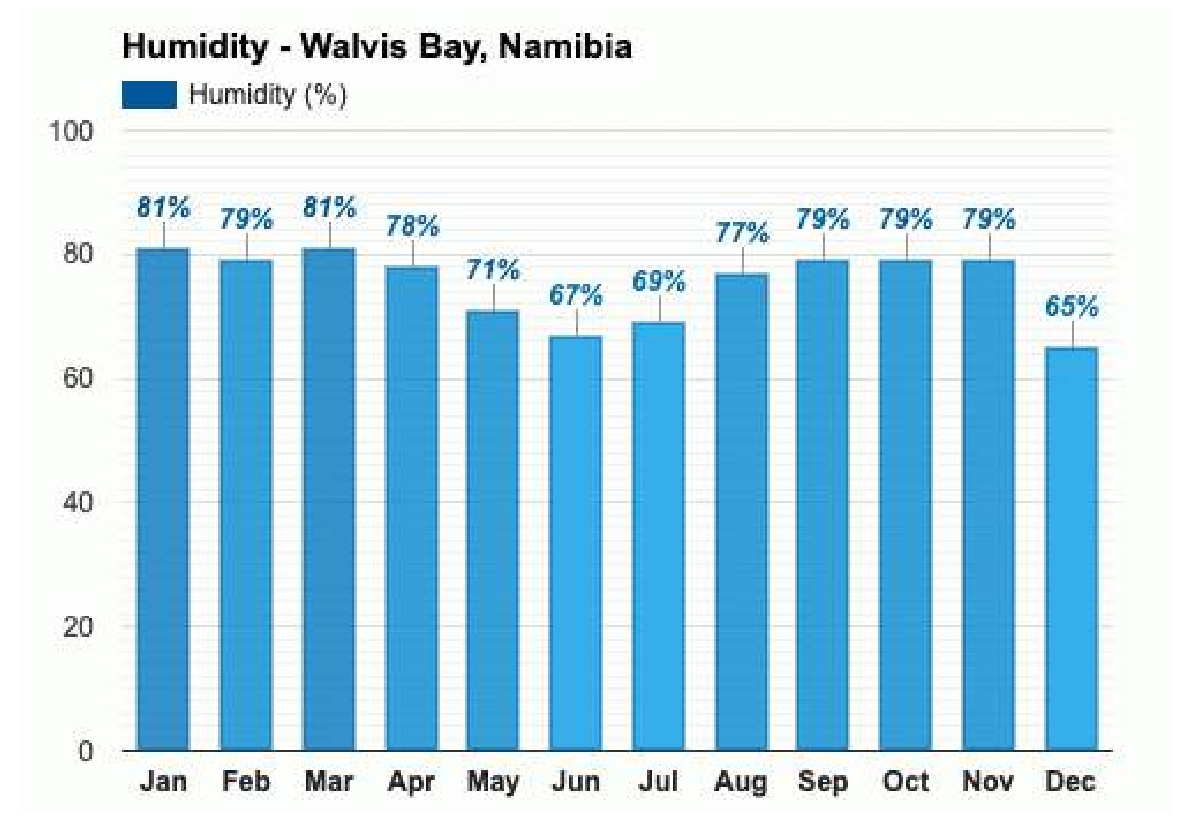


srk consulting	**CLEANERGY EIAR** Walvis Bay Climate Description	Project No. 585529

Figure 6-45: Walvis Bay Temperatures (°C) (Weather Atlas, 2022).

6.8.2 Humidity

The relative humidity for the Walvis Bay area is high, ranging from a high of 81% in January and March to a low of 65% to 71% in May, June, July, and December (Figure 6-46) (Weather Atlas, 2022).

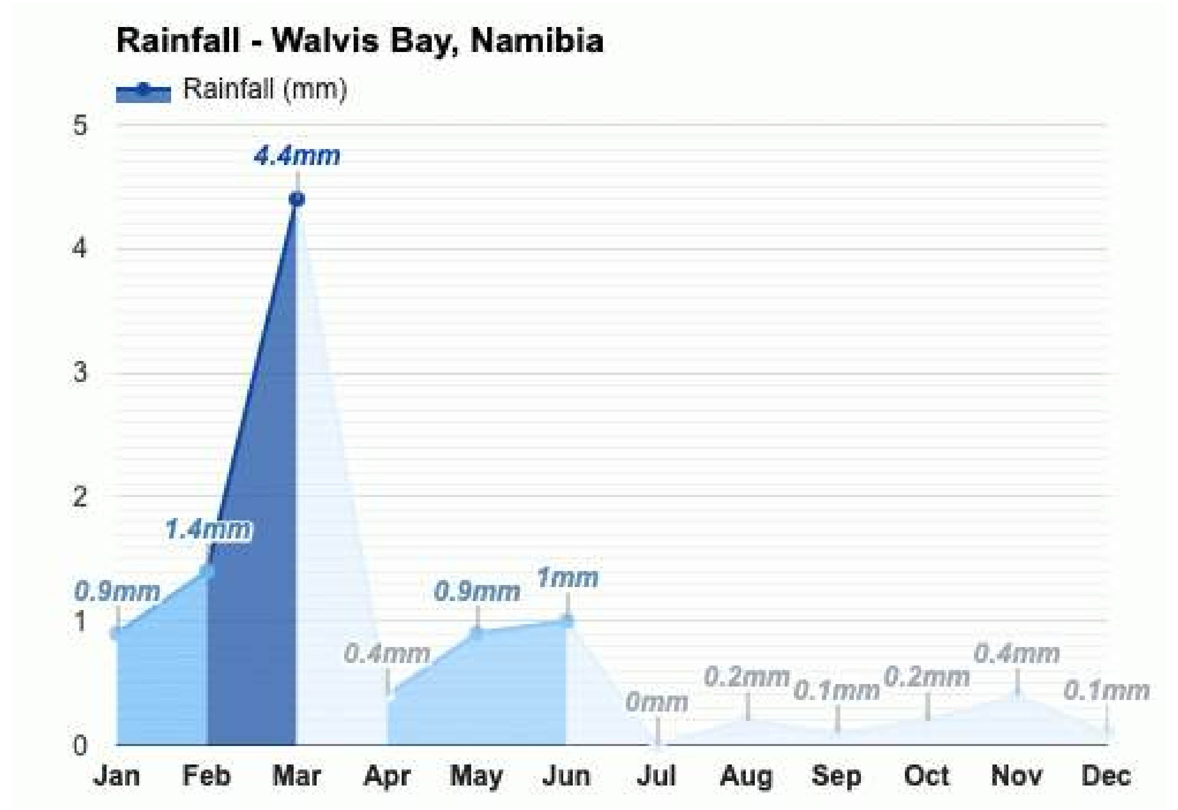


srk consulting	**CLEANERGY EIAR** Walvis Bay Climate Description	Project No. 585529

Figure 6-46: Walvis Bay Relative Humidity (%) (Weather Atlas, 2022).

6.8.3 Rainfall

Figure 6-47 illustrates that rainfall is more-or-less evenly spread from July to December for the Walvis Bay Area. The average amount of rainfall is slightly higher in January and from April to June and peaks in March at 4.4 mm (Weather Atlas, 2022).



srk consulting	**CLEANERGY EIAR** Walvis Bay Climate Description	Project No. 585529

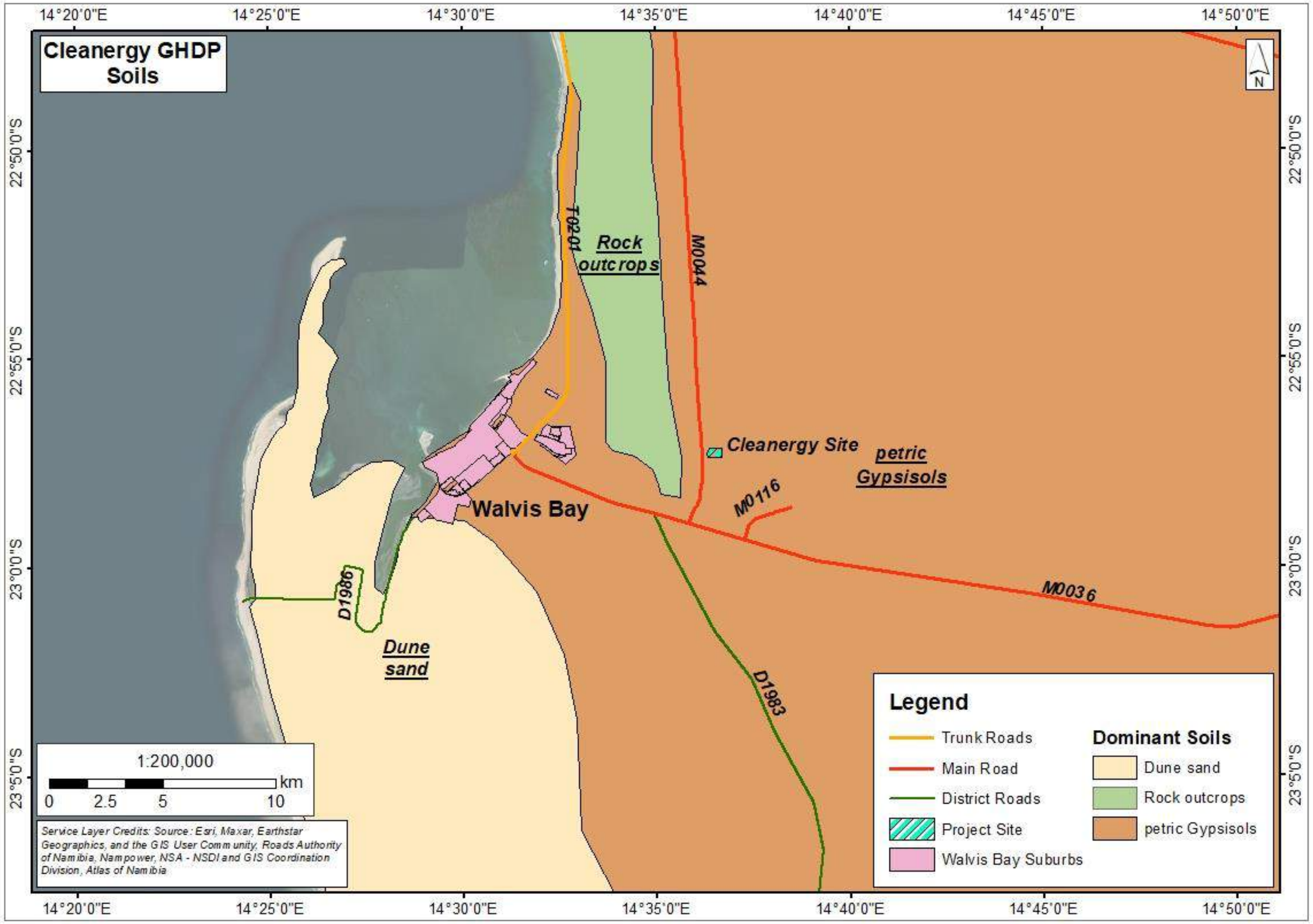
Figure 6-47: Walvis Bay Rainfall (mm) (Weather Atlas, 2022).

6.9 Soils

The most common soils in Namibia are arenosols (sandy soils) and leptosols (young soils on fertile rock). Fertile fluvisols are only found along ephemeral river courses and in the Caprivi region. Walvis Bay specifically is situated on petric gypsisols (Kamuhelo, 2015) which are soils with a substantial secondary accumulation of Gypsum (Schreiber & Schneider, 2001).

The dominant soils present at the Cleanergy GHDP Project area 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).

Soils of the regions are provided in Figure 6-48. Land use of the proposed project site is zoned as Heavy Industrial Area.



srk consulting	**CLEANERGY EIAR** Soils	Project No. 585529

Figure 6-48: Soil Map

6.10 Land Uses

6.10.1 Current Land Uses

Walvis Bay is situated in the Erongo Region along the western coast of Namibia, about 30 km from Swakopmund and 400 km west of Windhoek. Its northern boarders of the town area stretch right from the middle of the Swakop River while its southern boundaries stretch up to the Kuiseb River. The eastern boundary extends into the Namib Desert all the way up the Namib Naukluft Park. To the west, the town area covers the famous Pelican Bay area. In total, the Walvis Bay town area covers an area of approximately 1124 km² in extent (SLR, 2022).

Urbanisation is a phenomenon which is observed all over the world, but it is particularly virulent in Africa. Namibia is no exception, and nor is Walvis Bay, where urban growth has been overwhelming in recent years. Walvis Bay is the third largest urban settlement in Namibia after Windhoek, the Capital City and Rundu (Worldatlas, 2022).

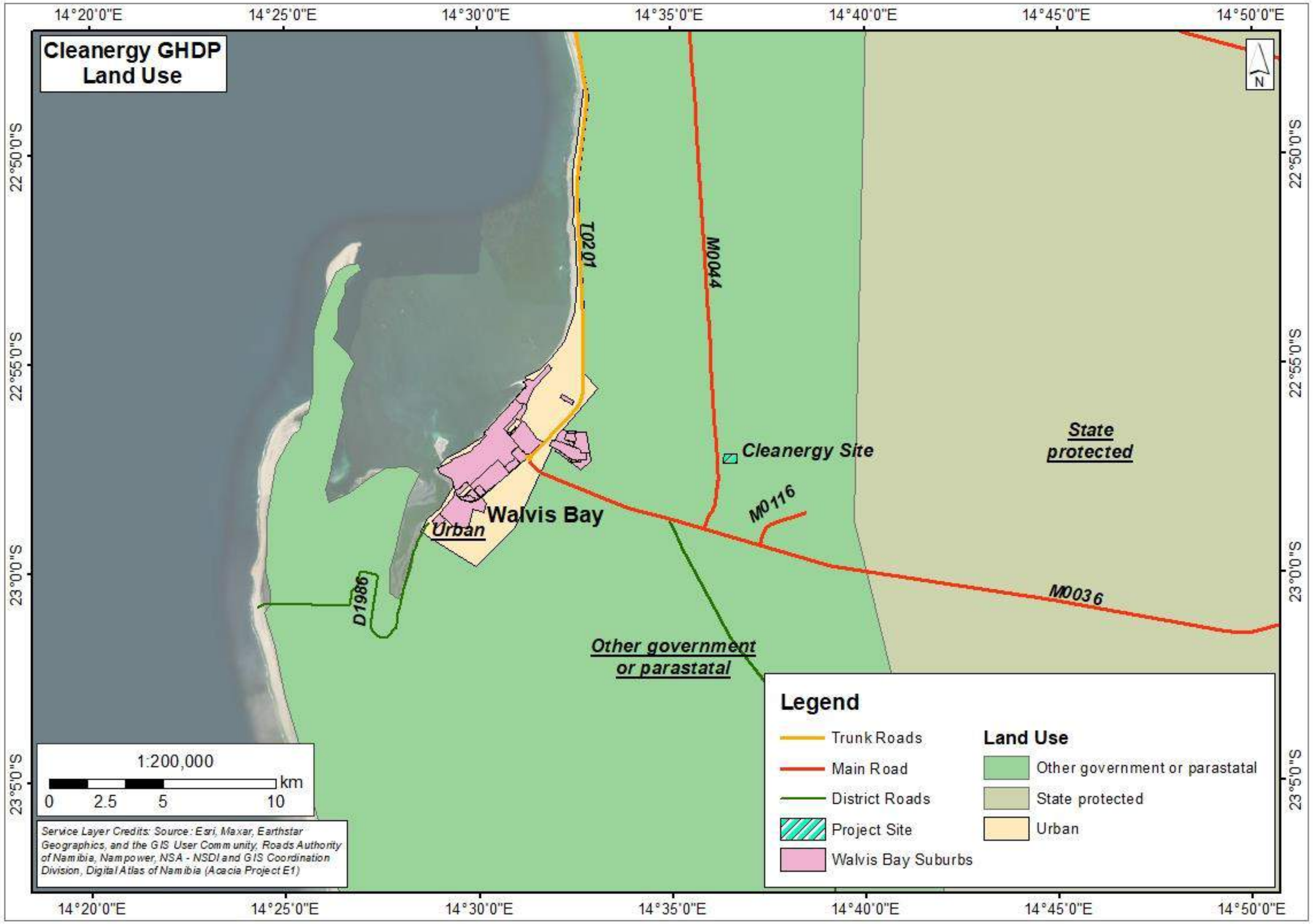
The town's strategic location and position has led it to become Namibia's only harbour town able to accommodate larger ships. These deep-sea harbour qualities led to various industrial growths, particularly the fishing industry, which is the primary industrial sector due to the boats at the harbour as well as large cargo handling owing to the deep and stable port. The port and fishing industry attracted many supporting industrial services such as the transportation services of bulk goods in all rail, air, and road networks. This strategic advantage not only serves the rest of the country but goes as far as serving all neighbouring landlocked countries such as Zimbabwe, Zambia, and Botswana.

The well-developed road network links Walvis Bay to the rest of the country and SADC region, making it accessible to the central and southern regions of the country. The existing railway line is also well connected to the rest of the country. The Walvis Bay Airport is the second major gateway that is developed and managed by Namibian Airports Company.

Subsequent to the above background, Walvis Bay has become a national node resulting in increased in-migration as well as internal population growth (New Era Live, 2021). The town is growing rapidly due to increased employment opportunities created as many more industrial activities are earmarked for the town of Walvis Bay. Although seen by many as an unhealthy trend, especially where the physical manifestation is unplanned and unhygienic squatter camps, it is now generally recognized that rural-urban migration usually provides better life options for the marginalized poor leaving rural areas. At first, migrants will find themselves in a highly uncomfortable environment without access to adequate shelter, water or sanitation. They will, however, find better access to health and education and they will have the opportunity to find a job or to engage in informal economic activities. Life expectancy is notably better in towns than it is in the rural areas (Hitula, 2011). The property market is also growing rapidly due to the developments along the coast offering some of the best sea front properties. These developments also attract a high influx of holiday makers as well as holiday homes. In addition, more immigrants in search of employment opportunities need housing and accommodation, creating a serious housing shortage. This can be seen by the number of increased back yard shacks within the Kuisebmond Township and the number of requested general residential housing projects which yield high numbers of low- to middle-income housing. This has resulted in direct competition between housing development and industrial growth in general (Hitula, 2011).

Figure 6-49 illustrates existing districts and suburbs.

The proposed project area is located within an area zoned as Heavy Industrial Area. The Proposed Cleanergy GHDP Project 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” i.e., habitats or migration routes which are critical for species’ survival. This area falls outside of the immediate project area.



srk consulting	**CLEANERGY EIAR** Land Use	Project No. 585529

Figure 6-49: Land Use

6.10.2 Other Notable Land Uses

Other land uses undertaken in the region which contribute to the environmental baseline include:

- **Salt production** - Namibia is the largest salt producer in sub-Saharan Africa. Walvis Bay Salt Holdings (Pty) Ltd, through its various subsidiaries, is the largest producer of solar evaporated sea salt in sub-Saharan Africa. The Walvis Bay Salt Refiners site is located in the Kuiseb river delta at the southern end of the Walvis Bay lagoon which is a Ramsar site;
- **Mariculture** - A Strategic Environmental Assessment developed for the Erongo Region, indicated that suitable locations for sea-based and land-based aquaculture were limited and would primarily be associated with Walvis Bay and Swakopmund (SLR, 2022). Two plots between Walvis Bay and Swakopmund have been specifically zoned for land-based aquaculture developments; and
- **Ecotourism -** The old West Coast Recreation Area, now part of the newly proclaimed Dorob National Park, is renowned for its excellent angling. For tourists, one of the most unique and interesting aspects of Walvis Bay is the huge natural lagoon. This always has numerous seabirds on and around it. Over 100,000 birds were counted on the lagoon, the most noticeable being the flamingos and pelicans (SLR, 2022). These are joined annually by another 200,000 migratory birds, making this an excellent place for keen birdwatchers. It is an ideal place from which to enjoy a guided trip to Sandwich Harbour, a freshwater lake surrounded by dunes 40 km south of the town. It is also very convenient for kayak trips to Pelican Point and the adventurous can go and climb Dune 7, just outside town. In town, attractions include the local museum, birdlife information centre and several restaurants and cafés.

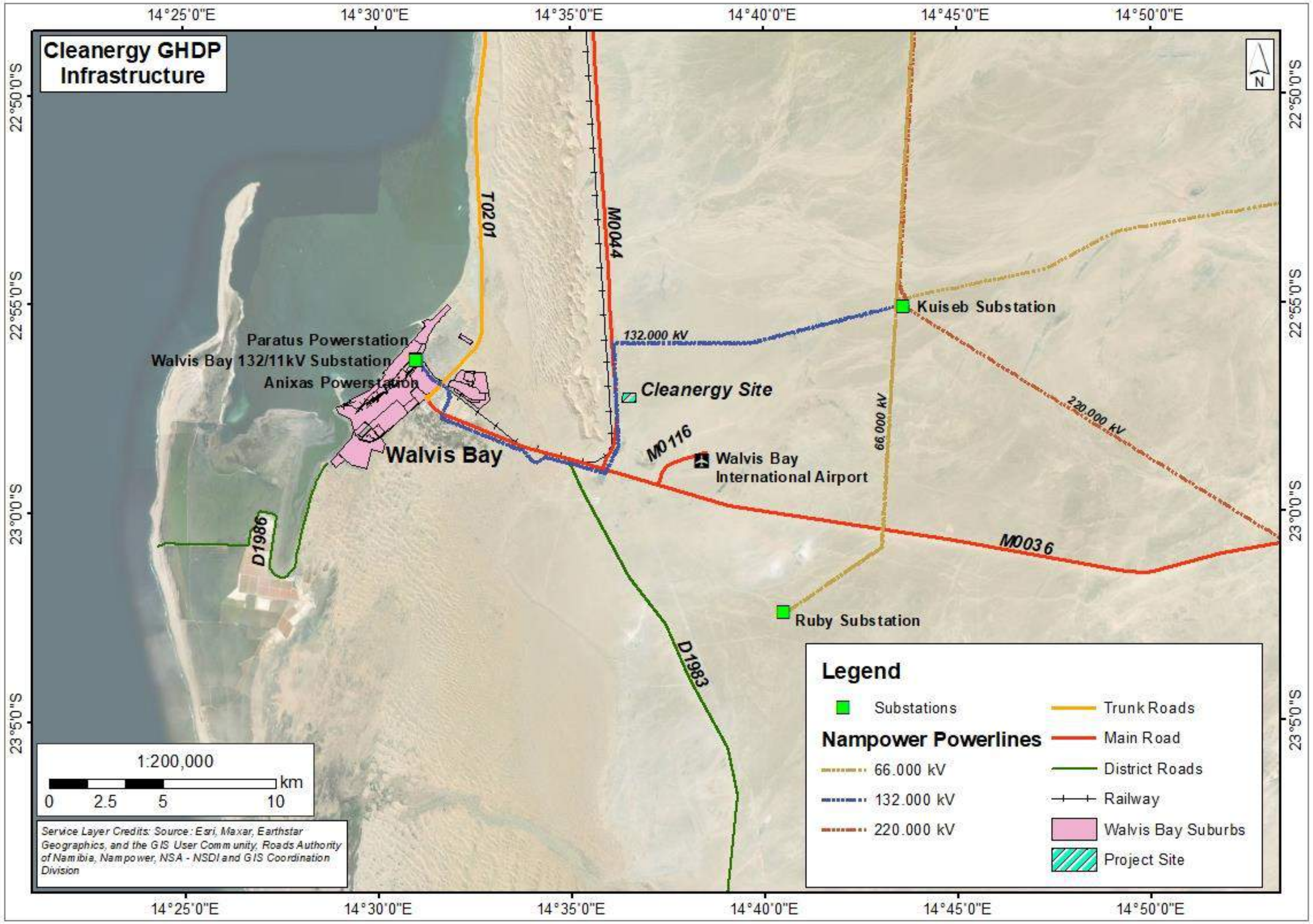
6.10.3 Planned Future Land Uses

The proposed project area is located within an area zoned as Heavy Industrial Area. Currently, it is unknown which other developments will occur in close proximity to the project area as many developers have come forward with proposed projects, but none have materialised to date.

6.10.4 Infrastructure

Walvis Bay is linked to Swakopmund and the national road network via the B2 main road. The new dual carriageway behind the dunes, MR44, has been upgraded to enable heavy trucks to access the Port of Walvis Bay, without driving through Swakopmund. Within the town, suburbs are split up by large road infrastructure (SLR, 2022).

A railway links the hinterland, Swakopmund and Walvis Bay, although it is not largely used by industry, which prefers road transport.



srk consulting	**CLEANERGY EIAR** Infrastructure Map	Project No. 585529

Figure 6-50: Infrastructure Map

6.11 Geography

The Erongo Region in which Walvis Bay is situated makes up 7.7% of Namibia's total area. This region is surrounded by the Kunene in the north, Otjozondjupa in the northeast, the Khomas in the southeast, and the Hardap in the south. The Erongo Region reaches westwards from the Central Plateau across the Escarpment and Central-Western Plains to the Central Namibian coast. The distance covered is between 200 km and 350 km. It also stretches from the Ugab River in the north to the Kuiseb River in the south, covering approximately 300 km. The Atlantic Ocean is situated on its western side (ERC, 2015).

The Kuiseb River, ending close to the proposed project site divides the dunes in the south and the gravel plains in the north. This river disappears into the sand in the Kuiseb Delta and does not reach the sea. Walvis Bay then extracts underground water where the river ends. The Erongo Region was named after the Erongo Mountains which consists of an eroded relic of a volcano. This mountain dominates the flat plains in the west, flanked by the Namib Desert in the west and woodland savannah in the east (ERC, 2015).

6.12 Geology

The geology in Walvis Bay is made up of Swakop lithologies consisting of schist with Matchless Amphibolite. The Namibian supergroup is present dating between 1 000 to 542 million years ago and forms part of the Proterozoic Damara Orogen Belt (Intercontinental Belt) and the Coastal Branch (Ministry of Mines and Energy, 2011).

The dominant geology in the general Cleanergy GHDP Project 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). Figure 6-51 provides the underlying geology of the study site and the geology of the surrounding area.

srk consulting	**CLEANERGY EIAR** Geology	Project No. 585529

Figure 6-51: Geology

6.13 Air Quality

In general, the air quality in Walvis Bay is of good quality according to the Air Quality Index (AQI) and its main pollutant, $PM_{2.5}$ concentration meets the World Health Organisation (WHO) annual air quality guideline value of 2.1 µg/m^3. Surrounding areas in the proposed project area include roads and an airport which add to the reduction of air quality, however, there are few other developments in the nearby area.

The proposed Cleanergy GHDP Project may potentially result in nuisance dust during the construction phase of the project. The impacts of these emissions are expected to be low on the surrounding areas due to the status quo in the area. Provision has been made for the practical impacts of the proposed Cleanergy GHDP Project to be assessed during the EIA phase of the project but since the impact is expected to be limited, no specific air specialist study is envisaged.

6.14 Noise

Current sources of noise on the surrounding area include highways and the Walvis Bay International Airport. The construction and operation of the proposed Cleanergy GHDP is not expected to generate material noise nuisance. Provision is made for the practical impacts of the proposed project to be further considered during the impact assessment phase of the EIA, although, since the impact is expected to be limited, no specific noise specialist study is envisaged.

6.15 Areas of Conservation Concern

As mentioned previously, the proposed development area falls adjacent the recently proclaimed Dorob National Park Figure 6-52. 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 (Cunningham, 2022).

As mentioned previously, 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 6-16) 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.

A well vegetated hummock system is 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 6-18).

An example of a dolerite ridge, further to the north of the GHDP area, is viewed as unique habitat to a variety of flora and vertebrate fauna (Figure 6-19).

srk consulting	**CLEANERGY EIAR** Protected Areas	Project No. 585529

Figure 6-52: Protected Areas

7 Environmental Impact Assessment, Mitigation and Monitoring

A Risk Assessment (RA) addressing the aspects, impacts, and the severity and probability of the risks related to the identified water uses was conducted

7.1 Impact Assessment Methodology

The anticipated impacts associated with the proposed project will be assessed according to SRK's standardised impact assessment methodology, which is presented below. This methodology has been utilised for the assessment of environmental impacts where the consequence (extent, intensity, and duration of the impact) and probability of the impact have been considered in parallel to provide an impact rating and hence an interpretation in terms of the level of environmental management required for each impact as follows:

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 7-1: Criteria used to determine the Consequence of the Impact

Rating	Definition of Rating	Score
A. ***Extent***– *the area over which the impact will be experienced*		
Local	Confined to project or study area or part thereof (e.g., site)	1
Regional	The region, which may be defined in various ways, e.g., cadastral, catchment, topographic	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[16] are lost	3
C. ***Duration***– *the timeframe over which the impact will be reversed*		
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2
Long-term	More than 15 years or irreversible	3

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

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

Table 7-2: 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 is derived, the probability of the impact occurring is considered using the probability classifications presented in the table below.

Table 7-3: 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

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

Table 7-4: 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 are 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 7-5: Impact status and confidence classification

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

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

1. **INSIGNIFICANT**: the potential impact is negligible and **will not** have an influence on the decision regarding the proposed activity/development.
2. **VERY LOW**: the potential impact is very small and **should not** have any meaningful influence on the decision regarding the proposed activity/development.
3. **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

4. **MEDIUM**: the potential impact **should** influence the decision regarding the proposed activity/development.
5. **HIGH**: the potential impact **will** affect the decision regarding the proposed activity/development.
6. **VERY HIGH**: The proposed activity should only be approved under special circumstances.

In the report, practicable mitigation and optimisation measures are recommended and impacts rated in the prescribed way both without and with the assumed effective implementation of essential mitigation and optimisation measures. Mitigation and optimisation measures are either:

1. **Essential**: best practice measures which must be implemented and are non-negotiable; and
2. **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.

7.2 Anticipated Environmental, Social, and Cultural Impacts

Anticipated impacts that have been identified by the project team are summarised in Table 7-6. The detailed specialist reports with the impact assessments are attached in Appendix D.

All impacts in terms of Pre-Construction, Construction and Operation, together with the recommended mitigation measures were addressed in the Impact Assessment Phase of the project.

Table 7-6: Summary of Potential Environmental Impacts Associated with the Proposed Development

Element of Environment	Key Issue	Driver	Infrastructure Component	Conclusion
Socio-Economic	Positive (+): • Potential positive impact on livelihoods/increase in temporary employment opportunities during the Construction Phase; • Positive Socio-Economic Impact as a result of skills development in the Green Energy Field (Operational Phase); • The positive impact resulting from the Construction and Operation of the proposed Cleanergy GHDP relates to the hydrogen production experience gained within Namibia, the demonstration of the potential successful commercialisation of hydrogen within Namibia and the training of local employees with the conversion of renewable electricity energy into green molecules like hydrogen and the successful demonstration; and • Construction and the Operation of the Cleanergy GHDP will not only provide employment opportunities but the sale of hydrogen will also contribute to the Namibian economy (albeit small as this is only a demonstration plant). Considerable economic investment will also be made during the design and construction phases of the project.	Job creation; Skills development.	Not applicable	Undertake a Socio-Economic Impact Assessment during the Construction Phase of the Project which incorporates the views of inhabitants on the ground in close proximity to the development.
	Negative (-): • Potential negative impact on Sense of Place due to the permanent alteration of the current landscape (Operational Phase).	Operational Phase activities and above surface infrastructure development including linear infrastructure i.e., water pipeline, PV panels and other infrastructure causing visual disturbance to road users, including tourists travelling between the coast and Windhoek.	Operational Phase activities and above surface infrastructure including pipeline, PV panels and other infrastructure.	Visual Impact Assessment was commissioned to assess the potential impacts. Impacts can be managed through mitigation measures which will be included in the EMP.
	Negative (-): • Influx of job seekers during the Construction Phase, may have a negative social impact as a result of	Available job opportunities; Unsafe practices; and Inappropriate waste management practices.	Not applicable	Undertake a Socio-Economic Impact Assessment during the Construction Phase of the Project which incorporates the views of inhabitants on the ground in close proximity to the development.

Element of Environment	Key Issue	Driver	Infrastructure Component	Conclusion
	increased social pathologies and increase petty crimes due to potential squatting; and • Health and safety risks may arise during especially the Construction Phase, as a result of workers lighting fires on site, littering and lack of housekeeping.			
Air Quality	Negative (-): • Potential deterioration of air quality due to the generation and dispersion of dust caused by activities undertaken during the Construction Phase of the project.	Construction phase activities associated with the GHDP and associated infrastructure.	Construction phase activities associated with the GHDP and associated infrastructure.	Air quality is not seen as an impact which cannot be managed with appropriate dust mitigation measures which will be included in the EMP. Air quality therefore does not require further consideration. Impacts can be managed through mitigation measures which will be included in the EMP.
Noise	Negative (-): • Potential increase in ambient noise levels (in the immediate vicinity of the project) during the Construction Phase, as a result of vehicles and machinery.	Construction phase activities associated with the GHDP and associated infrastructure.	Construction phase activities associated with the GHDP and associated infrastructure.	As the proposed GHDP will be located within an area zoned as heavy industrial, the area is already disturbed by other activities and there are no sensitive receptors on site, it is not foreseen that a Noise Impact Assessment will be required. Impacts can be managed through mitigation measures which will be included in the EMP.
Heritage Resources	Negative (-): • Potential destruction or loss of cultural artefacts and/or sites of archaeological importance as a result of the Construction Phase of the project.	Construction phase activities associated with the GHDP and associated infrastructure.	Construction of all infrastructure associated with the GHDP.	A Heritage Impact Assessment was commissioned to assess the potential impact of the project on heritage resources. Impacts can be managed through mitigation measures which will be included in the EMP.
Visual/Landscape	Negative (-): • Indirect visual impact due to dust generation as a result of the movement of vehicles and materials, to and from the site area during the Construction Phase of the project; • Potential deterioration of the visual quality and sense of place of the site during the Construction and Operational Phases of the proposed GHDP, specifically as a result of the solar arrays; • Glint and glare from the solar array during the Operational Phase of the project may further impact	Construction phase activities and above surface infrastructure development including linear infrastructure i.e., water pipeline, PV panels and other infrastructure causing visual disturbance to road users, including tourists travelling between the coast and Windhoek.	Construction phase activities and above surface infrastructure including pipeline, PV panels and other infrastructure.	Visual Impact Assessment was commissioned to assess the potential impacts. Impacts can be managed through mitigation measures which will be included in the EMP.

Element of Environment	Key Issue	Driver	Infrastructure Component	Conclusion
	on aeronautical, particularly flights on approach and departure from the Walvis Bay Airport; • Clearing of vegetation and shaping of soil (i.e., in creating the platforms for the various proposed development footprints and/or activities during the Construction Phase; • PV panels will likely impact both long- and short-range views during the Operational Phase; • The balance of the development footprint will also dominate the medium- and short-range views to and from the site during the Operational Phase; and • Impact on the regional landscape due to a new development altering the natural environment during the Operational Phase.			
Biodiversity – Fauna and Flora	Negative (-): • Physical terrestrial habitat disturbance, alteration and loss of vertebrate fauna habitat during the Construction Phase of the project; • Physical terrestrial habitat disturbance, alteration and loss of vertebrate flora habitat during the Construction Phase of the project; • Restriction of animal movement and entrapment including: • Disruption of brown hyena movement patterns during the Construction Phase; • Pipeline trench acts as pitfall trap during the Construction Phase; and • Aboveground pipeline acting as a barrier to ungulates and ostrich during the Operational Phase; • Establishment and spread of alien invasive plants during the Operational Phases of the project; and • Solar plant potentially disrupting avifauna during the Operational Phase of the project.	Activities and footprints associated with all infrastructure during Construction and Operational Phases.	Construction and Operation of all infrastructure associated with the GHDP.	A Biodiversity Impact Assessment was undertaken to determine the potential impact on biodiversity as well as to develop site-specific management measures. Impacts can be managed through mitigation measures which will be included in the EMP.
Surface water	Negative (-): • The physical disturbance and destruction of dry and ephemeral water courses and drainage lines during the Construction Phase of the project;	Activities and footprints associated with all permanent and temporary infrastructure during Construction;	Solar PV plant and Hydrogen Plant, conservancy tanks,	A Surface water Impact Assessment was undertaken to determine the potential impact on surface water and to develop site-specific management measures to protect the surface water resources. Impacts can be managed

Element of Environment	Key Issue	Driver	Infrastructure Component	Conclusion
	• Possible deterioration of water resources as result of accidental spillages of hazardous substances from construction vehicles/machinery, as well as from hazardous materials storage areas during the Construction Phase of the project; • Increased surface runoff during the Construction and Operational Phases; and • Increased erosion, sedimentation, and deposition during the Construction and Operational Phases.	Waste and wastewater management; Hazardous materials handling.	hazardous material storage areas, hydrogen refuelling station etc.	through mitigation measures which will be included in the EMP.
Groundwater	Negative (-): • Possible deterioration of groundwater as a result of accidental spillages of hazardous substances from construction vehicles/machinery, as well as from hazardous materials storage areas during the Construction Phase of the project; • Changes to geohydrological regime as a result of the Construction and Operational Phases of the project; • Deterioration of reinforced concrete by ingress of brine during the Construction and Operational Phases; and • Corrosion of metal structures through corrosion by brine during the Construction and Operational Phases.	Activities and footprints associated with all permanent and temporary infrastructure during Construction; Waste and wastewater management; Hazardous materials handling.	Solar PV plant and Hydrogen Plant, conservancy tanks, hazardous material storage areas, hydrogen refuelling station etc.	A Groundwater Impact Assessment was undertaken to determine the potential impact on groundwater and to develop site-specific management measures to protect the groundwater resources. Impacts can be managed through mitigation measures which will be included in the EMP.
Soils	Negative (-): • Physical damage and destruction of soil crusts and soil horizons during the Construction Phase of the project; and • Possible deterioration of soils as a result of accidental spillages of hazardous substances from construction vehicles/machinery, as well as from hazardous materials storage areas during the Construction Phase of the project.	Hazardous materials and waste handling and storage.	Solar PV plant, GHDP infrastructure, hydrogen refuelling station, waste and hazardous storage facilities.	Issues and impacts relating to soil will be considered as part of the Terrestrial Impact Assessment, the Groundwater Impact Assessment and Waste Management. Impacts can be managed through mitigation measures which will be included in the EMP.
Climate Change	Negative (-): • During the Construction Phase, the movement of vehicles and earth moving machinery may result in the production of carbon dioxide (Green House Gas), which may have an impact on the climate in the area.	Tail pipe emissions from construction vehicles and equipment. For the Operational Phase, power generation is mostly limited to renewable sources	Construction vehicles and equipment. Erongo RED emergency power use.	Green House Gas emissions during Construction and Operational Phases are unlikely to have a noticeable negative impact on climate change. The Construction Phase will also be relatively short. For the Operational Phase, power generation is

Element of Environment	Key Issue	Driver	Infrastructure Component	Conclusion
	• Positive (+): • Positive climate change adaption as a result of the development of green hydrogen projects during the Operational Phase of the project.	and the Green House Gas emissions will be negligible. Electricity sourced from Erongo RED to drive night-time operations.		mostly limited to renewable sources and the Green House Gas emissions will be negligible. As green energy will mostly be used and produced on site, the project will ultimately have a positive impact on Climate Change. For the purpose of the demonstration plant, it is not anticipated that a Climate Change Study will be required.
Waste storage, handling and disposal	Negative (-): • Inappropriate storage, handling and disposal of waste during the Construction and Operational Phases of the project may lead to impacts on surface water, groundwater and soils; and • Inappropriate storage, handling and disposal of waste during the Construction and Operational Phases of the project may attract scavenging animals to the area which poses a safety risk to the Walvis Bay Airport.	Waste generation and the storage, handling and disposal thereof.	Waste management facilities.	During Construction and Operational Phases of the proposed project, large volumes of both general and hazardous waste will be produced. It is, however, important to consider proper waste management taking into account the project components, area to be developed, and activities to occur. A specialist study is, however, not required, but waste management practices were considered, developed, and included in the EMP.
Gas storage	Negative (-): • Potential for explosions and fires as a result of Hydrogen gas leaking into the atmosphere and coming into contact with a fire source during the Operational Phase.	Storing of hydrogen gas in gas cylinders.	Compressors and storage facilities	During the Operational Phase of the proposed GHDP, large volumes of Hydrogen will be produced, compressed, and stored on site. It is thus important to consider the risk of fires and explosions. The requirement for a risk assessment to be undertaken has been included in the EMP.

7.3 Cumulative Impacts

Activities undertaken by different industries can result in several complex effects on the natural biophysical and social environment. These impacts are mainly identified as direct and immediate effects on the environment by a single entity affecting a variable of the environment. The direct impacts have the potential to combine and interact with other activities, depending on the surrounding environmental state and land use. These impacts may aggregate or interact with other impacts to cause additional effects, not easily quantified when assessing an individual entity.

The EMA EIA Regulation of 2012 specifically requires that cumulative impacts be assessed. The impact assessment phase includes a description and analysis of the potential cumulative effects of the proposed Cleanergy GHDP, considering the effects of any changes on the:

- Biophysical; and
- Socio-economic conditions.

The following potential preliminary cumulative impacts have been identified based on the project description and past studies:

- Positive Socio-Economic impacts as a result of temporary employment, skills development in the Green Energy Field etc.;
- Clearance of soil crust and soil horizons and potential loss of habitat due to the development of the proposed Cleanergy GHDP Project;
- Soil erosion due to cleared areas within an area already previously disturbed;
- Emissions due to construction and operational equipment and machinery, adding to overall ambient air quality impact;
- Increased influx of job seekers to the general area as a result of the construction activities of the Cleanergy GHDP Project; and
- The construction period may cause traffic-related impacts on the local road network.

The Biodiversity Impact Assessment (Cunningham, 2022) listed expected cumulative impacts associated with the proposed GHDP as:

- An increase in transmission line developments potentially exacerbating the current negative impact of these structures on ‘pylon sensitive bird’ species;
- An increase in aboveground pipeline developments potentially exacerbating the current negative impact of these structures on ungulate and ostrich movement and foraging patterns;
- An increase in all general urban developments potentially exacerbating the foraging patterns and inter- and intra- social behaviour of unique species such as brown hyena;
- 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., *Chamaeleonamaquensis*, various *Phelsuma (Rhoptropus*) and *Meroles spp.*); and
- An increase in all general urban developments potentially exacerbating the overall impact on the Tumas River drainage line ‘delta area’ and associated Salsola hummock habitats.

The Visual Impact Assessment (Bredell, 20222) also assessed cumulative impacts and identified potential sensitive receptors including:

- Conservation Areas already identified, plus these protected or pristine areas that rely on a wilderness experience for their visitors;
- Individuals and organisations who depend on scenic and recreation resources for their livelihood; and
- Tourists, and tourist operators who may rely on uninterrupted views and absence of visual intrusions.

The EAP team and specialists identified significant past and present projects and activities that may interact with the project to produce cumulative impacts during the impact assessment phase of the process. The EAP team and specialists included detailed mitigation and management measures in the EMP that Cleanergy will be required to implement to, where possible, avoid the negative impact and/or minimise the significance of the impacts.

7.4 Risk Assessment Results

The impact assessment results are presented in Table 7-7 and Table 7-8 for each impact for the planning, construction, operational and rehabilitation phases of the project relating to the triggered EMA Listed Activities 1(a), 2.1, 2.3, 9.1, 9.4, 9.5, 10.1(a), and 10.1(b).

Table 7-7: Quantitative Impact Assessment on Construction Activities

	Without Mitigation								With Mitigation							
	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***	***Extent***	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Construction Phase																
Socio-Economic																
Potential positive impact on livelihoods/increase in temporary employment opportunities.	(Inter)national	Low	Medium-term	**Medium**	Probable	**MEDIUM**	+ve	High	(Inter)national	Low	Medium-term	**Medium**	Probable	**MEDIUM**	+ve	High
	3	1	2	**6**					3	1	2	**6**				
	Degree to which impact can be reversed								The impact is positive, and this section is therefore not applicable.							
	Degree to which impact may cause irreplaceable loss								The impact is positive, and this section is therefore not applicable.							
	Degree to which impact can be mitigated								The impact is positive, and this section is therefore not applicable.							
	Mitigated outcome								The impact is positive, and this section is therefore not applicable.							
Negative social impact as a result of an influx of job seekers and potential squatting leading to an increase in social pathologies and petty crimes.	Local	Medium	Medium-term	**Low**	Probable	**LOW**	– ve	High	Local	Medium	Medium-term	**Low**	Possible	**VERY LOW**	– ve	High
	1	2	2	**5**					1	2	2	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed.							
	Degree to which impact may cause irreplaceable loss								Temporary increase in petty crimes and social pathologies.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less petty crimes and social pathologies.							
Health and safety risk as a result of workers on site leading to the lighting of fires on site, littering, and lack of housekeeping.	Local	Medium	Medium-term	**Low**	Probable	**LOW**	– ve	High	Local	Medium	Medium-term	**Low**	Possible	**VERY LOW**	– ve	High
	1	2	2	**5**					1	2	2	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed.							
	Degree to which impact may cause irreplaceable loss								Increase in risk of fires and explosions which might damage much of the equipment.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less risk to employees and surrounding companies due to wildfires.							
Air Quality																
Potential deterioration of air quality due to the generation and dispersion of dust (Increase in ambient air concentrations).	Local	Medium	Medium-term	**Low**	Probable	**LOW**	– ve	High	Local	Low	Medium-term	**Very low**	Probable	**VERY LOW**	– ve	High
	1	2	2	**5**					1	1	2	**4**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed.							
	Degree to which impact may cause irreplaceable loss								Construction will temporarily lead to the deterioration of air quality.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less deterioration of air quality.							

	Without Mitigation								With Mitigation							
	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***	***Extent***	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Noise																
Potential increase in ambient noise levels (in the immediate vicinity of the project) as a result of vehicles and machines operating on site.	Local	Low	Medium-term	**Very low**	Probable	**VERY LOW**	– ve	High	Local	Low	Short-term	**Very low**	Possible	**INSIGNIFI-CANT**	– ve	High
	1	1	2	**4**					1	1	1	**3**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed.							
	Degree to which impact may cause irreplaceable loss								The impact is anticipated to be temporary and not cause irreplaceable loss.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Lowered noise levels due to construction activities.							
Heritage and Archaeological Resources																
Potential destruction or loss of cultural artefacts and/or sites of archaeological importance as a result of vehicles and machines operating on site.	Local	Medium	Medium-term	**Low**	Possible	**VERY LOW**	– ve	High	Local	Low	Short-term	**Very low**	Possible	**INSIGNIFI-CANT**	– ve	High
	1	2	2	**5**					1	1	1	**3**				
	Degree to which impact can be reversed								It is anticipated that impacts cannot be reversed.							
	Degree to which impact may cause irreplaceable loss								Irreplaceable loss might occur if any archaeological artifacts or sites are damaged during construction.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less risk to damage any historical or archaeological artifacts and sites.							
Visual																
Landscape impact and the loss of vegetation cover as a result of the movement of vehicles and materials, to and from the site area.	Local	Medium	Medium-term	**Low**	Probable	**Medium**	– ve	High	Local	Medium	Medium-term	**Low**	Possible	**Low**	– ve	High
	1	2	2	**5**					1	2	2	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed.							
	Degree to which impact may cause irreplaceable loss								Loss is not likely to be irreplaceable as dust generation is expected to be significantly less post construction.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less deterioration of visual quality.							
Potential deterioration of visual quality and sense of place as a result of construction activities and dust generation.	Local	Medium	Medium-term	**Low**	Probable	**MEDIUM**	– ve	High	Local	Medium	Medium-term	**Low**	Possible	**LOW**	– ve	High
	1	2	2	**5**					1	2	2	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed.							
	Degree to which impact may cause irreplaceable loss								Glint and glare impacts on visual quality is anticipated to increase as construction continues and will not be replaced.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less deterioration of air quality.							

	Without Mitigation								With Mitigation							
	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***	***Extent***	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Biodiversity – Fauna and Flora																
Physical terrestrial habitat disturbance, alteration and loss of vertebrate fauna and flora habitat.	Local	Medium	Long-term	**Medium**	Definite	**MEDIUM**	– ve	High	Local	Low	Long-term	**Low**	Definite	**LOW**	– ve	High
	1	2	3	**6**					1	1	3	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed to some extent.							
	Degree to which impact may cause irreplaceable loss								The impact is expected to be permanent.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Decrease in habitat disturbance, alteration, and loss of fauna habitats.							
Loss of fauna as a result of the movement of vehicles and machinery and materials to and from the site.	Local	Medium	Long-term	**Medium**	Definite	**MEDIUM**	– ve	High	Local	Low	Long-term	**Low**	Definite	**LOW**	– ve	High
	1	2	3	**6**					1	1	3	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed to some extent. The site is already disturbed and might not be likely.							
	Degree to which impact may cause irreplaceable loss								The impact is expected to be temporary and can be replaced where areas are not permanently transformed.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Decrease in habitat disturbance, alteration, and loss of fauna.							
Loss of flora as a result of the movement of vehicles and machinery and materials to and from the site.	Local	Low	Long-term	**Low**	Definite	**LOW**	– ve	High	Local	Low	Long-term	**Low**	Definite	**LOW**	– ve	High
	1	1	3	**5**					1	1	3	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed to some extent. The site is already disturbed and might not be likely.							
	Degree to which impact may cause irreplaceable loss								The impact is expected to be temporary and can be replaced where areas are not permanently transformed.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Decrease in habitat disturbance, alteration, and loss of flora.							
Establishment and spread of alien invasive plants.	Regional	Medium	Medium-term	**Medium**	Probable	**MEDIUM**	– ve	High	Regional	Medium	Medium-term	**Medium**	Possible	**LOW**	– ve	High
	2	2	2	**6**					2	2	2	**6**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed to some extent.							
	Degree to which impact may cause irreplaceable loss								The impact is expected to be temporary but can also become permanent.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Decrease in establishment of alien invasive species.							

	Without Mitigation								With Mitigation							
	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***	***Extent***	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Surface Water																
The physical disturbance and destruction of dry and ephemeral water courses and drainage lines.	Local	Medium	Long-term	**Medium**	Probable	**MEDIUM**	– ve	High	Local	Low	Long-term	**Low**	Probable	**LOW**	– ve	High
	1	2	3	**6**					1	1	3	**5**				
								Degree to which impact can be reversed	It is anticipated that impacts cannot be reversed.							
								Degree to which impact may cause irreplaceable loss	The impact is anticipated to cause irreplaceable loss if not mitigated.							
								Degree to which impact can be mitigated	Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
								Mitigated outcome	Less disturbance and deterioration of water bodies.							
Deterioration of water bodies as a result of accidental spillages of hazardous substances from construction vehicles/machinery, as well as from hazardous materials storage areas.	Regional	Medium	Medium-term	**Medium**	Possible	**LOW**	– ve	High	Local	Low	Medium-term	**Very low**	Possible	**INSIGNIFI-CANT**	– ve	High
	2	2	2	**6**					1	1	2	**4**				
								Degree to which impact can be reversed	It is anticipated that impacts cannot be reversed.							
								Degree to which impact may cause irreplaceable loss	The impact is anticipated to cause irreplaceable loss if not mitigated.							
								Degree to which impact can be mitigated	Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
								Mitigated outcome	Less disturbance and deterioration of water bodies.							
Increased surface runoff due to compacted land areas that decreases infiltration.	Regional	Medium	Medium-term	**Medium**	Probable	**MEDIUM**	– ve	High	Regional	Low	Medium-term	**Low**	Probable	**LOW**	– ve	High
	2	2	2	**6**					2	1	2	**5**				
								Degree to which impact can be reversed	It is anticipated that impacts can be reversed.							
								Degree to which impact may cause irreplaceable loss	The impact is not anticipated to cause irreplaceable loss if not mitigated.							
								Degree to which impact can be mitigated	Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
								Mitigated outcome	Less increased surface runoff.							
Increased erosion, sedimentation, and deposition due to increased runoff caused by compact land that moves sand and soil with the runoff flow.	Regional	Medium	Medium-term	**Medium**	Possible	**LOW**	– ve	High	Local	Low	Medium-term	**Very low**	Possible	**INSIGNIFI-CANT**	– ve	High
	2	2	2	**6**					1	1	2	**4**				
								Degree to which impact can be reversed	It is anticipated that impacts can be reversed to some extent.							
								Degree to which impact may cause irreplaceable loss	The impact is not anticipated to cause irreplaceable loss if not mitigated.							
								Degree to which impact can be mitigated	Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
								Mitigated outcome	Less erosion and sedimentation.							

	Without Mitigation								With Mitigation							
	Extent	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*	*Extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Groundwater																
Possible deterioration of groundwater as a result of accidental spillages of hazardous substances from construction vehicles/machinery as well as from hazardous materials storage areas resulting in seeping into water bodies.	Regional	High	Medium-term	**High**	Possible	**MEDIUM**	– ve	High	Regional	Medium	Medium-term	**Medium**	Possible	**LOW**	– ve	High
	2	3	2	**7**					2	2	2	**6**				
	Degree to which impact can be reversed								It is anticipated that impacts cannot be reversed.							
	Degree to which impact may cause irreplaceable loss								The impact is anticipated to cause irreplaceable loss if not mitigated.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less disturbance and deterioration of groundwater.							
Deterioration of reinforced concrete and metal structures due to the ingress of brine that causes weathering of infrastructure.	Local	Medium	Long-term	**Medium**	Probable	**MEDIUM**	– ve	High	Local	Low	Long-term	**Low**	Probable	**LOW**	– ve	High
	1	2	3	**6**					1	1	3	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts cannot be reversed.							
	Degree to which impact may cause irreplaceable loss								The impact is not anticipated to cause irreplaceable loss if not mitigated.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less disturbance and deterioration of concrete structures.							
Soils																
Physical damage and destruction of soil crusts and soil horizons as a result of the movement of vehicles and machinery and materials to and from the site.	Local	Medium	Medium-term	**Low**	Probable	**LOW**	– ve	High	Local	Low	Medium-term	**Very low**	Possible	**INSIGNIFI-CANT**	– ve	High
	1	2	2	**5**					1	1	2	**4**				
	Degree to which impact can be reversed								It is anticipated that impacts cannot be reversed.							
	Degree to which impact may cause irreplaceable loss								The impact is anticipated to cause irreplaceable loss if not mitigated.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less disturbance and destruction of soils.							
Possible deterioration of soils as a result of accidental spillages of hazardous substances from construction vehicles/machinery as well as from hazardous storage areas.	Local	Medium	Medium-term	**Low**	Probable	**LOW**	– ve	High	Local	Low	Medium-term	**Very low**	Possible	**INSIGNIFI-CANT**	– ve	High
	1	2	2	**5**					1	1	2	**4**				
	Degree to which impact can be reversed								It is anticipated that impacts cannot be reversed.							
	Degree to which impact may cause irreplaceable loss								The impact is anticipated to cause irreplaceable loss if not mitigated.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less disturbance and destruction of soils.							

	Without Mitigation								**With Mitigation**							
	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***	***Extent***	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Climate Change																
The movement of vehicles and earth moving machinery may result in the production of carbon dioxide (Green House Gas), which may have an impact on the climate in the area.	Regional	Medium	Medium-term	**Medium**	Probable	**MEDIUM**	– ve	High	Local	Medium	Medium-term	**Low**	Probable	**LOW**	– ve	High
	2	2	2	**6**					1	2	2	**5**				
								Degree to which impact can be reversed	It is anticipated that impacts cannot be reversed.							
								Degree to which impact may cause irreplaceable loss	The impact is anticipated to cause irreplaceable loss if not mitigated from the start of the Construction Phase.							
								Degree to which impact can be mitigated	Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
								Mitigated outcome	The impact will contribute less to climate change.							
Waste Storage, Handling and Disposal																
Inappropriate storage, handling and disposal of waste may lead to impacts on surface water, groundwater and soils.	Regional	Medium	Medium-term	**Medium**	Possible	**LOW**	– ve	High	Local	Medium	Medium-term	**Low**	Possible	**VERY LOW**	– ve	High
	2	2	2	**6**					1	2	2	**5**				
								Degree to which impact can be reversed	It is anticipated that impacts cannot be reversed.							
								Degree to which impact may cause irreplaceable loss	The impact is anticipated to cause irreplaceable loss if not mitigated.							
								Degree to which impact can be mitigated	Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
								Mitigated outcome	Minimised deterioration of surface water, groundwater, and soils.							
Inappropriate storage, handling and disposal of waste may attract scavenging animals to the area which poses a safety risk to the Walvis Bay Airport.	Regional	High	Long-term	**Very high**	Possible	**HIGH**	– ve	High	Regional	Medium	Medium-term	**Medium**	Possible	**LOW**	– ve	High
	2	3	3	**8**					2	2	2	**6**				
								Degree to which impact can be reversed	It is anticipated that impacts cannot be reversed.							
								Degree to which impact may cause irreplaceable loss	The impact is not anticipated to cause irreplaceable loss.							
								Degree to which impact can be mitigated	Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
								Mitigated outcome	Risk posed to the Walvis Bay International Airport will be reduced.							

Table 7-8: Quantitative Impact Assessment on Operational Activities

<table>
<tr><th></th><th colspan="8">Without Mitigation</th><th colspan="8">With Mitigation</th></tr>
<tr><th></th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td colspan="17">Operational Phase</td></tr>
<tr><td colspan="17">Socio-Economic</td></tr>
<tr><td rowspan="6">Potential positive Socio-Economic impacts including:
Skills development in the Green Energy Field;
The hydrogen production experience gained within Namibia, the demonstration of the potential successful commercialisation of hydrogen within Namibia and the training of local employees with the conversion of renewable electricity energy into green molecules like hydrogen and the successful demonstration;
The sale of hydrogen will contribute to the Namibian economy (albeit small as this is only a demonstration plant). Considerable economic investment will also be made during the design and construction phases of the project.</td><td>Regional</td><td>Medium</td><td>Long-term</td><td>High</td><td rowspan="2">Probable</td><td rowspan="2">HIGH</td><td rowspan="2">+ve</td><td rowspan="2">High</td><td>Regional</td><td>Medium</td><td>Long-term</td><td>High</td><td rowspan="2">Probable</td><td rowspan="2">HIGH</td><td rowspan="2">+ve</td><td rowspan="2">High</td></tr>
<tr><td>2</td><td>2</td><td>3</td><td>7</td><td>2</td><td>2</td><td>3</td><td>7</td></tr>
<tr><td colspan="8">Degree to which impact can be reversed</td><td colspan="8">The impact is positive, and this section is therefore not applicable.</td></tr>
<tr><td colspan="8">Degree to which impact may cause irreplaceable loss</td><td colspan="8">The impact is positive, and this section is therefore not applicable.</td></tr>
<tr><td colspan="8">Degree to which impact can be mitigated</td><td colspan="8">The impact is positive, and this section is therefore not applicable.</td></tr>
<tr><td colspan="8">Mitigated outcome</td><td colspan="8">The impact is positive, and this section is therefore not applicable.</td></tr>
<tr><td rowspan="6">Potential negative impact on Sense of Place due to the permanent alteration of the current landscape.</td><td>Regional</td><td>Medium</td><td>Long-term</td><td>High</td><td rowspan="2">Probable</td><td rowspan="2">HIGH</td><td rowspan="2">– ve</td><td rowspan="2">High</td><td>Regional</td><td>Low</td><td>Long-term</td><td>Medium</td><td rowspan="2">Probable</td><td rowspan="2">MEDIUM</td><td rowspan="2">– ve</td><td rowspan="2">High</td></tr>
<tr><td>2</td><td>2</td><td>3</td><td>7</td><td>2</td><td>1</td><td>3</td><td>6</td></tr>
<tr><td colspan="8">Degree to which impact can be reversed</td><td colspan="8">It is anticipated that impacts will likely not be reversed.</td></tr>
<tr><td colspan="8">Degree to which impact may cause irreplaceable loss</td><td colspan="8">The impact is anticipated to cause irreplaceable loss as the landscape will be permanently altered.</td></tr>
<tr><td colspan="8">Degree to which impact can be mitigated</td><td colspan="8">Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.</td></tr>
<tr><td colspan="8">Mitigated outcome</td><td colspan="8">The infrastructure will be more visually appealing.</td></tr>
<tr><td rowspan="6">Loss of containment of hydrogen: At the electrolyser with the potential of explosion impacting of site workers/employees; and Stored on-site and at the hydrogen storage/refuelling facility with potential of explosion impacting on workers and general public.</td><td>Local</td><td>Medium</td><td>Long-term</td><td>Medium</td><td rowspan="2">Possible</td><td rowspan="2">LOW</td><td rowspan="2">– ve</td><td rowspan="2">High</td><td>Local</td><td>Low</td><td>Long-term</td><td>Low</td><td rowspan="2">Possible</td><td rowspan="2">VERY LOW</td><td rowspan="2">– ve</td><td rowspan="2">High</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>6</td><td>1</td><td>1</td><td>3</td><td>5</td></tr>
<tr><td colspan="8">Degree to which impact can be reversed</td><td colspan="8">It is anticipated that impacts cannot be reversed.</td></tr>
<tr><td colspan="8">Degree to which impact may cause irreplaceable loss</td><td colspan="8">The impact is expected to cause irreplaceable loss of human lives and replaceable loss of infrastructure.</td></tr>
<tr><td colspan="8">Degree to which impact can be mitigated</td><td colspan="8">Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.</td></tr>
<tr><td colspan="8">Mitigated outcome</td><td colspan="8">Lower risk of fires and explosions.</td></tr>
</table>

	Without Mitigation								With Mitigation							
	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***	***Extent***	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Visual																
Light pollution	Regional	Low	Long-term	**Medium**	Probable	**MEDIUM**	– ve	High	Local	Low	Long-term	**Low**	Possible	**VERY LOW**	– ve	High
	2	1	3	**6**					1	1	3	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts can likely be reversed.							
	Degree to which impact may cause irreplaceable loss								The impact is anticipated to cause irreplaceable loss if not mitigated.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Reduced light pollution.							
Landscape impact due to a man-made structure that will be operated instead of the previous natural environment	Local	Medium	Medium-term	**Low**	Possible	**MEDIUM**	– ve	High	Local	Low	Medium-term	**Very Low**	Possible	**LOW**	– ve	High
	1	2	2	**5**					1	1	2	**4**				
	Degree to which impact can be reversed								It is anticipated that impacts will likely not be reversed as the structures will be permanent for the foreseeable future.							
	Degree to which impact may cause irreplaceable loss								The impact is anticipated to cause irreplaceable loss if not mitigated.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Reduced landscape impact.							
Potential deterioration of visual quality and sense of place as a result of operating the PV solar plant resulting in the glint and glare from the solar array.	Regional	Medium	Long-term	**High**	Probable	**HIGH**	– ve	High	Regional	Medium	Long-term	**High**	Possible	**MEDIUM**	– ve	High
	2	2	3	**7**					2	2	3	**7**				
	Degree to which impact can be reversed								It is anticipated that impacts will likely not be reversed as the solar array will be operational on a daily basis.							
	Degree to which impact may cause irreplaceable loss								The impact is anticipated to cause irreplaceable loss as the solar array will be operational on a daily basis.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less impact from glint and glare from the solar panels, but impact still remains.							
Impact on aeronautical, particularly flights on approach and departure from the Walvis Bay Airport as a result of operating the PV solar plant resulting in the glint and glare from the solar array.	Regional	Medium	Long-term	**High**	Probable	**HIGH**	– ve	High	Regional	Medium	Long-term	**High**	Possible	**MEDIUM**	– ve	High
	2	2	3	**7**					2	2	3	**7**				
	Degree to which impact can be reversed								It is anticipated that impacts will likely not be reversed as the solar array will be operated daily and positioned upwards.							
	Degree to which impact may cause irreplaceable loss								The impact is anticipated to cause irreplaceable loss as the solar array will be operated daily and positioned upwards.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less impact from glint and glare from the solar panels on pilots.							

	Without Mitigation								With Mitigation							
	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***	***Extent***	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
PV panels will likely impact both long- and short-range views of passers-by due to glint and glare.	Regional	Medium	Long-term	**High**	Probable	**HIGH**	– ve	High	Regional	Medium	Long-term	**High**	Possible	**MEDIUM**	– ve	High
	2	2	3	**7**					2	2	3	**7**				
	Degree to which impact can be reversed								It is anticipated that impacts cannot be reversed.							
	Degree to which impact may cause irreplaceable loss								Loss can be replaced to some extent.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Glint and glare impacts on passers-by will be reduced.							
The balance of the development footprint will also dominate the medium- and short-range views to and from the site due to the site containing a new development in a natural environment.	Regional	Medium	Long-term	**High**	Probable	**HIGH**	– ve	High	Regional	Medium	Long-term	**High**	Possible	**MEDIUM**	– ve	High
	2	2	3	**7**					2	2	3	**7**				
	Degree to which impact can be reversed								It is anticipated that impacts cannot be reversed.							
	Degree to which impact may cause irreplaceable loss								Loss cannot be replaced.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Impact of views to the site will be less impacted.							
Impact on the regional landscape due to the GHDP being a new man-made development in the surrounding natural environment.	Local	Low	Long-term	**Low**	Possible	**VERY LOW**	– ve	High	Local	Low	Medium-term	**Very low**	Possible	**INSIGNIFI-CANT**	– ve	High
	1	1	3	**5**					1	1	2	**4**				
	Degree to which impact can be reversed								It is anticipated that impacts cannot be reversed.							
	Degree to which impact may cause irreplaceable loss								Loss cannot be replaced.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Impact on regional landscape (visual disturbance) will be less significant.							
Biodiversity – Fauna and Flora																
Restriction of animal movement and entrapment including: Disruption of brown hyena movement patterns; Pipeline trench acts as pitfall trap; and Aboveground pipeline acting as a barrier to ungulates and ostrich.	Regional	Medium	Long-term	**High**	Probable	**HIGH**	– ve	High	Local	Low	Long-term	**Low**	Possible	**VERY LOW**	– ve	High
	2	2	3	**7**					1	1	3	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts cannot be reversed.							
	Degree to which impact may cause irreplaceable loss								If the impact is not mitigated, irreplaceable loss will be incurred.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Reduced animal mortality.							

	Without Mitigation								With Mitigation							
	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***	***Extent***	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Establishment and spread of alien invasive plants.	Local	Low	Long-term	**Low**	Definite	**LOW**	– ve	High	Local	Low	Short-term	**Very low**	Definite	**VERY LOW**	– ve	High
	1	1	3	**5**					1	1	1	**3**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed to some extent.							
	Degree to which impact may cause irreplaceable loss								If the impact is not mitigated, irreplaceable loss will be incurred.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Reduced spread of alien invasives species or avoiding alien species from becoming in invasive.							
Solar plant potentially disrupting avifauna i.e. bird collisions on infrastructure such as solar panel arrays and fencing.	Local	Low	Long-term	**Low**	Probable	**LOW**	– ve	High	Local	Low	Long-term	**Low**	Probable	**LOW**	– ve	High
	1	1	3	**5**					1	1	3	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts cannot be reversed.							
	Degree to which impact may cause irreplaceable loss								If the impact is not mitigated, irreplaceable loss and disruption of avifauna will occur.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Reduced disruption of avifauna.							
Attraction of birds to novel habitats through the provision of artificial habitats and resources.	Regional	Medium	Long-term	**High**	Possible	**MEDIUM**	– ve	High	Local	Medium	Long-term	**Medium**	Possible	**LOW**	– ve	High
	2	2	3	**7**					1	2	3	**6**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed.							
	Degree to which impact may cause irreplaceable loss								It is anticipated that impacts might not cause irreplaceable loss.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Reduced disruption of avifauna.							
Surface Water																
Increased surface runoff due to compacted land areas that decrease infiltration.	Local	Medium	Long-term	**Medium**	Probable	**MEDIUM**	– ve	High	Local	Low	Long-term	**Low**	Possible	**VERY LOW**	– ve	High
	1	2	3	**6**					1	1	3	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed to some extent.							
	Degree to which impact may cause irreplaceable loss								Loss cannot be replaced if no mitigation measures are implemented.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less surface runoff.							
Increased erosion, sedimentation, and deposition due to increased runoff caused by compact land that moves sand and soil with the runoff flow.	Local	Medium	Long-term	**Medium**	Possible	**LOW**	– ve	High	Local	Low	Long-term	**Low**	Possible	**VERY LOW**	– ve	High
	1	2	3	**6**					1	1	3	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts cannot be reversed.							
	Degree to which impact may cause irreplaceable loss								Loss cannot be replaced if no mitigation measures are implemented.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Decreased erosion, sedimentation, and deposition.							

<table>
<tr><th rowspan="2"></th><th colspan="8">Without Mitigation</th><th colspan="8">With Mitigation</th></tr>
<tr><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td colspan="17">Groundwater</td></tr>
<tr><td rowspan="6">Changes to geohydrological regime as a result of movement of vehicles and machinery and materials to and from the site resulting in the interaction of vehicles and machinery with the environment and hydrology lines.</td><td>Regional</td><td>Low</td><td>Long-term</td><td>Medium</td><td rowspan="2">Possible</td><td rowspan="2">LOW</td><td rowspan="2">– ve</td><td rowspan="2">High</td><td>Local</td><td>Low</td><td>Long-term</td><td>Low</td><td rowspan="2">Possible</td><td rowspan="2">VERY LOW</td><td rowspan="2">– ve</td><td rowspan="2">High</td></tr>
<tr><td>2</td><td>1</td><td>3</td><td>6</td><td>1</td><td>1</td><td>3</td><td>5</td></tr>
<tr><td colspan="8">Degree to which impact can be reversed</td><td colspan="8">It is anticipated that impacts can be reversed to some extent.</td></tr>
<tr><td colspan="8">Degree to which impact may cause irreplaceable loss</td><td colspan="8">If the impact is not mitigated, irreplaceable loss will occur.</td></tr>
<tr><td colspan="8">Degree to which impact can be mitigated</td><td colspan="8">Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.</td></tr>
<tr><td colspan="8">Mitigated outcome</td><td colspan="8">Little change to the geohydrological regime.</td></tr>
<tr><td rowspan="6">Deterioration of reinforced concrete and metal structures due to the ingress of brine that causes weathering of infrastructure.</td><td>Local</td><td>Medium</td><td>Long-term</td><td>Medium</td><td rowspan="2">Probable</td><td rowspan="2">MEDIUM</td><td rowspan="2">– ve</td><td rowspan="2">High</td><td>Local</td><td>Low</td><td>Long-term</td><td>Low</td><td rowspan="2">Probable</td><td rowspan="2">LOW</td><td rowspan="2">– ve</td><td rowspan="2">High</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>6</td><td>1</td><td>1</td><td>3</td><td>5</td></tr>
<tr><td colspan="8">Degree to which impact can be reversed</td><td colspan="8">It is anticipated that impacts cannot be reversed.</td></tr>
<tr><td colspan="8">Degree to which impact may cause irreplaceable loss</td><td colspan="8">Loss can be replaced if no mitigation measures are implemented.</td></tr>
<tr><td colspan="8">Degree to which impact can be mitigated</td><td colspan="8">Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.</td></tr>
<tr><td colspan="8">Mitigated outcome</td><td colspan="8">Deterioration of reinforced concrete at a slower pace.</td></tr>
<tr><td rowspan="6">Surface water, groundwater and soil deterioration as a result of inappropriate storage, handling and disposal of waste resulting in the seeping of waste.</td><td>Regional</td><td>Low</td><td>Long-term</td><td>Medium</td><td rowspan="2">Possible</td><td rowspan="2">LOW</td><td rowspan="2">– ve</td><td rowspan="2">High</td><td>Local</td><td>Low</td><td>Long-term</td><td>Low</td><td rowspan="2">Possible</td><td rowspan="2">VERY LOW</td><td rowspan="2">– ve</td><td rowspan="2">High</td></tr>
<tr><td>2</td><td>1</td><td>3</td><td>6</td><td>1</td><td>1</td><td>3</td><td>5</td></tr>
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<tr><td colspan="8">Mitigated outcome</td><td colspan="8">Reduced risk of contamination.</td></tr>
<tr><td colspan="17">Soils</td></tr>
<tr><td rowspan="6">Possible deterioration of soils as a result of accidental spillages of hazardous substances from construction vehicles/machinery as well as from hazardous storage areas.</td><td>Regional</td><td>Medium</td><td>Medium-term</td><td>Medium</td><td rowspan="2">Possible</td><td rowspan="2">LOW</td><td rowspan="2">– ve</td><td rowspan="2">High</td><td>Local</td><td>Low</td><td>Medium-term</td><td>Very low</td><td rowspan="2">Possible</td><td rowspan="2">INSIGNIFI-CANT</td><td rowspan="2">– ve</td><td rowspan="2">High</td></tr>
<tr><td>2</td><td>2</td><td>2</td><td>6</td><td>1</td><td>1</td><td>2</td><td>4</td></tr>
<tr><td colspan="8">Degree to which impact can be reversed</td><td colspan="8">It is anticipated that impacts cannot be reversed.</td></tr>
<tr><td colspan="8">Degree to which impact may cause irreplaceable loss</td><td colspan="8">Loss cannot be replaced if no mitigation measures are implemented.</td></tr>
<tr><td colspan="8">Degree to which impact can be mitigated</td><td colspan="8">Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.</td></tr>
<tr><td colspan="8">Mitigated outcome</td><td colspan="8">Reduced risk of contamination.</td></tr>
</table>

	Without Mitigation								With Mitigation							
	Extent	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***	***Extent***	***Intensity***	***Duration***	***Consequence***	***Probability***	***Significance***	***Status***	***Confidence***
Climate Change																
Positive climate change adaption as a result of the development of green hydrogen projects.	Regional	Medium	Long-term	**High**	Probable	HIGH	+ve	High	Regional	Medium	Long-term	**High**	Probable	HIGH	+ve	High
	2	2	3	**7**					2	2	3	**7**				
	Degree to which impact can be reversed								The impact is positive, and this section is therefore not applicable.							
	Degree to which impact may cause irreplaceable loss								The impact is positive, and this section is therefore not applicable.							
	Degree to which impact can be mitigated								The impact is positive, and this section is therefore not applicable.							
	Mitigated outcome								The impact is positive, and this section is therefore not applicable.							
Waste Storage, Handling and Disposal																
Inappropriate storage, handling and disposal of waste may lead to impacts on surface water, groundwater and soils.	Local	Medium	Long-term	**Medium**	Possible	LOW	– ve	High	Local	Low	Long-term	**Low**	Improbable	VERY LOW	– ve	High
	1	2	3	**6**					1	1	3	**5**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed to some extent.							
	Degree to which impact may cause irreplaceable loss								If the impact is not mitigated, irreplaceable loss will occur.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less deterioration of surface water, groundwater, and soil.							
Inappropriate storage, handling and disposal of waste may attract scavenging animals to the area which poses a safety risk to the Walvis Bay Airport.	Regional	Medium	Long-term	**High**	Probable	HIGH	– ve	High	Local	Medium	Long-term	**Medium**	Possible	LOW	– ve	High
	2	2	3	**7**					1	2	3	**6**				
	Degree to which impact can be reversed								It is anticipated that impacts can be reversed to some extent.							
	Degree to which impact may cause irreplaceable loss								If the impact is not mitigated, irreplaceable loss will occur.							
	Degree to which impact can be mitigated								Based on the mitigation measures provided in Section 8.3, there is some degree to which impacts can be mitigated.							
	Mitigated outcome								Less attraction of animals to the airport.							

7.5 Mitigation Measures

Mitigation measures to be implemented during the construction and operational phase of the proposed GHDP are provided in Table 7-9 and a comprehensive EMP is attached in Appendix E. No mitigation measures were discussed for positive impacts that the GHDP may result in as mitigation measures are not expected to result in an enhanced positive impact.

Table 7-9: Mitigation Measures to be Implemented During the Different Phases of the Proposed GHDP

Element of Environment	Impact	Mitigation Measures	Project Phase
Site Documentation and Reporting	None	• Update the Health and Safety Plan to include the Cleanergy GHDP Project.	Pre-Construction
		• Update the Emergency Response Plan to include the Cleanergy GHDP Project.	
		• Update the Waste Management Plan to include the Cleanergy GHDP Project.	
		• Update the Preventative Maintenance Programme to include the Cleanergy GHDP Project.	
		• A physical access plan to the construction area (and camp if to be established) must be compiled and the contractor must adhere to this plan at all times; • Provide the ECO with a layout of the site indicating the position of all of the following, as applicable: o Ablution facilities; o Storage areas; o Ready-mix areas; o Stockpile areas; o Waste disposal facilities; o Hazardous substances storage areas, etc. • The Main Contractor must draw up method statements for relevant construction/decommissioning activities.	Pre-Construction and Decommissioning
		• A complaints register to be kept on site; • An environmental incident register to be kept on site; • Safe disposal certificates shall be stored and provided on request; • Non-conformance reports to be kept on site; • Written corrective actions to be kept on site; • A copy of the Environmental Authorisation to be kept on site; and • A copy of the EMP to be kept on site.	Construction, Operational and Decommissioning
		• Copies of applicable Cleanergy operating procedures to be kept on site.	All Phases
Project Contract and Programme	None	• This EMP must be included as part of the tender documentation thereby making it part of the required scope of work. The mitigation measures as set out in this EMP are enforceable under the general conditions of contract; • Each contractor will employ their own Safety Officer to monitoring the safety conditions during the construction phase. Cleanergy Safety Officer will oversee the contractor; and • The Main Contractor must draw up method statements for relevant construction/decommissioning/maintenance activities.	Pre-Construction and Decommissioning

Element of Environment	Impact	Mitigation Measures	Project Phase
Environmental Awareness	Enhance a positive impact by taking care of and protecting the environment as far as possible	• The Contractor must ensure that all the personnel on site are familiar with and understand the specifications contained in the EMP; • Contractors and personnel should be required to participate in training and awareness programs. Proof of training to be kept on file; and • All workers that have completed the induction should sign that they have understood and will implement the measures required.	Construction, Operational and Decommissioning
		• The contractor is expected to have safety "toolbox" talks in accordance with the risks and trends associated with the project. Proof of these talks shall be kept on site.	Construction and Decommissioning
		• The contractor will develop a specific emergency procedure and plan.	Pre-Construction
Socio-Economic / Health and Safety	Increase positive impacts on employment and decrease negative impacts on social aspects through thorough planning	• Socio-Economic Impact assessment to be undertaken focused on managing of Construction Phase Socio-Economic impacts. All management measures proposed must be implemented; • Local employment and procurement targets for the contractor for inclusion into tender documents must be developed by Cleanergy; • Contractors to: ○ Compile a Social and Environmental Policy in line with Cleanergy's Health, Safety and Environmental policy to which compliance will be reviewed against; and ○ Develop and submit task/site-specific health and safety plans covering environmental, health & safety aspects as well as work method statements; • Stakeholder communication plans for emergency response and coordination to be developed in the event of an aircraft crash; • Project footprint to be minimised by optimising the use of the available footprint; and • Boundaries of the GHDP should be positioned at least 45 m from the edge of road D1984.	Pre-Construction
	Increase employment opportunities	• Encourage the local employment; and • Ensure employment opportunities for local small- and medium-sized enterprise (SME) contractors during site clearance, preparation, and construction.	Pre-Construction and Decommissioning
	Positive contribution to air quality	• Transfer experience regarding green hydrogen production.	Operational
	Increase skills development	• Demonstrate the potential successful commercialisation of green hydrogen in Namibia; and • Train local employees with the conversion of renewable electricity into green hydrogen molecules.	Operational
	Increase contribution to Namibian economy	• Encourage economic investment as a result of producing and selling green hydrogen.	Operational

Element of Environment	Impact	Mitigation Measures	Project Phase
	Potential dust impact on visibility and efficiency of solar panels	• Reduce speed limits to 40 km/h or recommended limit based on risk evaluation.	Construction, Operational and Decommissioning
	Impact on social and security due to an influx of construction workers, contractors and employees	• Reduce speed limits to 40 km/h or recommended speed limit based on risk evaluation; • An inventory of all chemicals on site must be kept together with the respective Safety Data Sheets (SDS); • No alcohol /drugs are permitted on site; • No firearms allowed on site, unless used by security personnel; • Correct Personal Protective Equipment (PPE) must be worn at all times by the personnel on site; • Personnel must be trained on the use of PPE; • In the event of an emergency, the Contractor shall contact the Cleanergy emergency services. Telephone numbers of Cleanergy emergency services must be posted conspicuously at the site; • No fires are allowed on the site, unless in areas demarked and managed for this purpose; and • All workers will be made aware of fire risks.	Construction, Operational and Decommissioning
		• A register will be kept on what PPE has been issued and when. Contractors are to take disciplinary action against employees who fail to adhere to the PPE requirements.	Construction and Decommissioning
		• Although not compulsory, it is recommended that the foundations excavations must be inspected by a qualified geologist prior to placing any concrete and/or commencing backfilling.	Construction
	Potential impact on the sense of place as a result of land clearing	• Limit the aerial extent of the disturbance to the exact footprint of the proposed development, including the laydown areas surrounding the primary footprint.	Construction and Operation
	Potential impact on the environment due to a shortage of ablution facilities and operation thereof in an environmentally responsible manner	• Sufficient ablution facilities shall be provided to service the site; • Ablution facilities shall be serviced on a regular basis by an approved service provider to keep them in good functional working order and in an acceptable state of hygiene; • Contents from the chemical toilets shall not be discharged into the environment but shall be removed by an approved service provider; and • The necessary agreement between the Service Provider and the Contractor for the removal of the sewage must be in place and shall be made available on request.	Construction and Decommissioning
		• The maximum walking distance from a work site to a toilet shall not exceed 200 meters; and • Ablution facilities shall not be placed within 100-year floodline of any water course, identified wetlands or boreholes used for drinking water.	Construction, Operational and Decommissioning

Element of Environment	Impact	Mitigation Measures	Project Phase
	Risk of explosion, high pressure storage, and rust intrusion from hydrogen buffer and storage tanks	• Pressure equipment (i.e. low pressure hydrogen buffer tank, medium pressure hydrogen storage tank and high pressure hydrogen buffer storage tank) servicing and inspections to be undertaken as follows: ○ Yearly visual inspections; ○ Adhere to construction and coating requirements for rust prevention and resistance; ○ Annual pressure tests to be undertaken by an approved inspection authority with the Namibian Ministry of Labour. Deferment is not acceptable. Consider South African or European based specialists, if not available in Namibia: ▪ Include Service Level Agreement with local registration condition; and ▪ Hydrogen and large high pressure bulk installations experience/knowledge; • Contract Major Hazardous Installation specialist (if none is available in Namibia from South Africa, Europe or the United States of America) to conduct a Major Hazardous Installation Assessment (explosion impact) and provide requirements and guidance on the effective management of the installation; • Contract a Specialists Master Installation Electrician to inspect and certify electrical installations, identify explosive zoning requirements and develop an Explosive-Zone Management System; • Conduct yearly compliance inspections and report on findings and corrective actions.	Construction, Operational and Decommissioning
	Possible risk of thermal runaway occurring at the end or close to the end of the battery pack life	• Install trip breakers in the event of thermal runaway; and • Repairs and maintenance should include current testing to identify possible weak points in the installation. This will depend on parallel or sequential or series installation methodology.	Construction and Operational

Element of Environment	Impact	Mitigation Measures	Project Phase
Groundwater	Potential impact on Groundwater as a result of the construction and operation of the Cleanergy GHDP Project	• Geotechnical investigation to be undertaken.	Pre-construction
		• The tanks are to be fitted with High Level Alarms. These alarms are activated when product filling approaches the maximum capacity of the tank allowing sufficient time for transfer of product into the tank to be stopped; and • Commissioning of the tanks will only occur once a leak test certificate has been issued.	Operation
		• The tanks will be placed within a bunded area. The bunded area will be frequently inspected and repaired when necessary; • Storm water generated around the site will be diverted away to the clean water environment; • No washing of vehicles shall be allowed outside demarcated areas. Washing bays for vehicles and other equipment shall be provided with appropriate soak ways, will be clearly demarcated, and will not be allowed to contaminate any surface runoff; • Sufficient areas shall be provided for the maintenance and washing of vehicles; • Refuelling of vehicles will only be allowed in designated areas; • All construction equipment shall be parked in a demarcated area and provided with a drip tray; • Surface bulk storage of hydrocarbons must be situated in a dedicated area, which will include a bund or a drain where necessary to contain any spillages during the use, loading and off-loading of the substance; • Bund sizing will be done at 110% of the largest tank volume minus the volume occupied by any adjacent tanks in the same bund; • Bund areas must be impermeable; • Bund area must have a facility such as a valve/sump to drain or remove clean stormwater; • Contaminated water shall be pumped into a container for appropriate removal and disposal; • Regular inspections shall be carried out to ensure the integrity of the bund walls; and • All vehicles shall be on a preventative maintenance schedule to ensure that the equipment is in a good working order to prevent the leakages of oil and diesel.	Construction, Operation and Decommissioning
		• All preventative servicing of earth moving equipment and construction vehicles shall be serviced off site.	Construction and Decommissioning
		• Tarpaulins will be placed on the ground to prevent oil, grease, hydraulic fluid and diesel spills during emergency repairs. All oil spills will be remedied using approved methodologies. The contaminated soils will be removed and disposed of responsibly; and • The borehole water quality and yield programme for the Cleanergy Synfuels Operations will be updated to include additional parameters as recommended in the Geotechnical Study and monitored.	Construction and Operation

Element of Environment	Impact	Mitigation Measures	Project Phase
Surface Water	Potential impact on surface water / wetlands / aquatic ecosystems as a result of the construction and operation of the Cleanergy GHDP Project	• Designate the eroded granite ephemeral riverbank to the east of the GHDP area as a No-Go area; • Adequate stormwater management must be incorporated into the design of the project. Stormwater releases to the environment must be at pre-development discharge rates; • Placement of material stockpiles must be planned as such to be within the areas designated as having a low sensitivity and outside of drainage lines;	Pre-construction
		• Ensure clean and dirty water segregation; • Spill kits to be made available at areas of possible spillages of hazardous substances; • Drivers and operators shall be trained to use spill kits and contain spillages to the smallest possible areas and the training records shall be made available on request; • Remediation of spillages must be conducted on a continual basis; • Contaminated runoff will be contained and connected to the site oily water sewer where practical; • No direct discharge of polluted water to the environment is permitted, unless authorised by Synfuels Environmental Department; • An inspection programme shall be implemented to ensure that all the mechanical equipment is inspected regularly to ensure the optimal functioning of the equipment; • Refuelling of equipment shall occur in designated areas by trained people; • Bund sizing will be done at 110% of the largest tank volume minus the volume occupied by any adjacent tanks in the same bund, with an allowance of an additional 300 mm used for ballast stones placed in the tank bunds; and • Contaminated soil shall be removed and disposed of to an appropriate licensed landfill site or can be removed by a service provider that is qualified to clean the soil.	Construction and Operation
		• Adequate stormwater management must be incorporated into the design of the project in order to prevent contamination of watercourses and wetlands from dirty water.	Pre-Construction, Construction and Operation

Element of Environment	Impact	Mitigation Measures	Project Phase
Air Quality	Potential impact originating from nuisance dust, the emission of carbons and other ambient air pollutants	• Mitigation measures may be implemented to reduce dust levels from the entrainment of dust. These measures will range from watering of roads, application of a chemical dust suppressant and/or paving of roads; • A speed limit of 40 km/h (or limit as determined by a risk assessment) shall apply to limit vehicle entrained dust from the unpaved roads; • Ensure that all exposed areas and material stockpiles are adequately protected against the wind. This may include the wetting of exposed soil/gravel areas during windy conditions, covering of material stockpiles, etc.; • All construction equipment must be scheduled for preventative maintenance to ensure the functioning of the exhaust systems to reduce excessive emissions and limit air pollution; and • Chemical toilets must be emptied / serviced on a regular basis. Proof of this must be kept on file.	Construction and Operation
Climate Change	Emissions of Green House Gasses as a result of the use of construction vehicles and machinery	• All the construction vehicles shall undergo maintenance on a regular basis to ensure the combustion engine vehicle efficiency.	Construction and Operation
		• Ensure regular servicing and maintenance of all combustion engine operated machinery.	Construction and Decommissioning
	Emissions of Green House Gasses as a result of green hydrogen production from solar energy	• The purpose of the GHDP should remain throughout to produce green hydrogen by mainly using electricity generated from a renewable energy source.	Operation

Element of Environment	Impact	Mitigation Measures	Project Phase
Heritage / Paleontological Resources	Potential impact on areas of archaeological/paleontological resources when clearing and operating land	• Contractors and personnel involved in clearing and earthworks should be required to participate in training and awareness programs to ensure that they are aware of work stoppage and reporting procedures should archaeological sites or graves be exposed during development activities; and • Findings should be reported to the foreman who should then: o Report findings, site location and actions taken to superintendent;. o Cease any works in immediate vicinity Action by superintendent; o Visit site and determine whether work can proceed without damage to findings; o Determine and mark exclusion boundary; o Site location and details to be added to GIS for field confirmation by archaeologist who should: ▪ Inspect site and confirm `addition to GIS. ▪ Advise NHC and request written permission to remove findings from work area. ▪ Recover, package and label findings for transfer to National Museum. • In the event of discovering human remains: o Actions as above; o Field inspection by archaeologist to confirm that remains are human; o Advise and liaise with NHC and Police; and o Recover remains and remove to National Museum or National Forensic Laboratory, as directed.	Construction and Operation

Element of Environment	Impact	Mitigation Measures	Project Phase

Flora	Potential impact on flora as a result of construction activities, clearing of land and removing important vegetation	**Development footprint:**
		• Vegetation clearance shall be kept to a minimum and all activities must be contained within the project footprint to minimise disturbance outside these areas; and
		• Vehicles must be restricted to travelling on designated access roads to limit the ecological footprint of the proposed activity;
		Weed Control and Management:
		• Implement an alien invasive species management plan;
		• Removal of the alien and weed species encountered on the property must take place in order to comply with existing legislation;
		• Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
		• Removal of species should take place throughout the construction and operational phases;
		• Sourcing of fill material should be sourced from weed free areas to minimize the risk of spreading alien invasive species and to reduce ongoing alien vegetation removal; and
		• Construction vehicles and equipment (including construction material) should be free of plant material when leaving the site to avoid road reserve contamination.
		Rehabilitation:
		• All disturbed habitat areas must be rehabilitated as soon as possible to ensure that floral ecology is re-instated.
		Floral:
		• Sensitive floral species, if encountered, must be rescued and relocated;
		• The following should be ensured:
		    ○ If any threatened species, or nationally or provincially protected floral will be disturbed, ensure effective relocation of individuals to suitable similar habitat;
		    ○ All rescue and relocation plans should be overseen by a suitably qualified specialist;
		    ○ All sensitive open space areas will be demarcated and access into these areas shall be prohibited.
			Construction
			Operation

Element of Environment	Impact	Mitigation Measures	Project Phase
Fauna	Potential impact on fauna as a result of construction activities and trenches, etc. present on site during construction and operation	• Adequate bird and bat protection management must be incorporated into the design of the project including but not limited to: o Buildings and other infrastructure to be designed as such to minimise the potential for bat and bird nesting; o Servitudes for roads, cables and pipelines should share servitudes as far as practically possible; o The upper wire strand of all fencing should be demarcated to ensure that it is visible to low flying birds in low light conditions; • Road width to be kept to a minimum. Run-off control measures must be constructed on either side of roads to allow for small terrestrial animals to cross. Ditches/trenches should have slopes of less than 45˚ and vertical sides should be avoided.	Pre-construction
		• The proposed development footprint areas should remain as small as possible and be confined to already disturbed areas within the project area; • No trapping or hunting of fauna is to take place; • Edge effects of all construction and operational activities, such as erosion and alien plant species proliferation, which may affect faunal habitat, need to be strictly managed in disturbed areas; • Should any species of conservational concern be noted within the study area, these species should be relocated to similar habitat within or in the vicinity of the study area with the assistance of a suitably qualified specialist; • All informal fires in the vicinity of construction areas should be prohibited; and • It is recommended that a speed limit of 40 km/h (or limit as determined by a risk assessment) is implemented on all roads running through the study area during the construction phase in order to minimise risk to fauna from vehicles.	Construction and Operation
		• Designate the eroded granite ephemeral riverbank to the east of the GHDP area as a No-Go area; • 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; and • Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase.	Construction

Element of Environment	Impact	Mitigation Measures	Project Phase
Visual	Potential visual impact as a result of movement of machinery, the establishment of infrastructure and dust generation	• Lightning must be planned and designed to avoid the spillage of artificial light into the surrounding areas and to reduce the potential impact on the Walvis Bay Airport's operations. The type of lighting, the position, direction and height thereof must be carefully considered to reduce the magnitude of light spilt into the surrounding environment. Outside lighting of the facility, including security lighting must be kept to the absolute minimum; • Overhead lighting to be shielded and pointing downwards onto the area where illumination is required and not be directed upwards or outwards. The International Dark-Sky Association's guidelines for the quality of outdoor lighting can be used as reference for preserving and protecting the night-time environment, including its wildlife (www.darksky.org); and • Solar PV panels must be designed as such to limit the potential glint and glare impacts originating it.	Pre-construction
		• The number of construction vehicles and machinery to be used shall be kept to a minimum; • Site clearance shall be kept to a minimum and limited to the footprint of project area; • Where required, all lighting shall be kept to a minimum within the requirements of safety, security, and efficiency; • Areas east of the project site should be demarcated as no-go areas; • An aesthetical committee will be established to ensure adherence to architectural design guidelines and landscape architectural design guidelines; • The training centre, 350 bar dispensers, and related shade canopy structure will have well-articulated architectural designs that will blend into the desert landscape; • Fences and wall designs should avoid reflective material with a target specification for textured matt-coloured dark natural materials, tone paint colours and limited mild steel fixings; • Vertically mounted structures such as water tanks and the low-pressure buffer tank should avoid light or reflective material and should rather target textures and matt coloured dark natural tone paint colours; and • For horizontally mounted structures, the following mitigation measures are proposed: ○ Process and power containers (avoid reflective material. target a specification for textures matt coloured dark natural tone paint colours); ○ Compressor (avoid reflective material. target a specification for textures matt coloured dark natural tone paint colours); ○ 300 bar buffer (avoid reflective material. target a specification for textures matt coloured dark natural tone paint colours); ○ 500 bar storage tanks (avoid reflective material. target a specification for textures matt coloured dark natural tone paint colours); and ○ Tube trailers bays (avoid reflective material. target a specification for textures matt coloured dark natural tone paint colours).	Construction and Operation

Element of Environment	Impact	Mitigation Measures	Project Phase
		• Stockpiles will be kept at a height consistent to the surrounding environment; • Construction camps will be demarcated. All material stockpiles created during the construction phase will be screened from the public when not in use; and • Construction camps should not be erected in the area east of the project site.	Construction and Decommissioning
		• The footprint area of the decommissioning activities must be landscaped to represent the surrounding natural environment. Landscaping must be done so that pooling of water does not occur; and • Disturbed areas will be top soiled in order to promote vegetation growth. Seeding of indigenous species will be conducted should natural succession not establish.	Decommissioning
		• Wind erosion control measures including silt fences (especially on exposed slopes) should be implemented; and • Landscape and building maintenance should be ensured.	Construction, Operation and Decommissioning
	Glint and glare impacts originating from the solar PV panels	• The total height of the solar PV panels and associate platforms should not exceed 2 m height above natural ground level.	Construction
		• A low stone wall should at as a visual buffer around the solar PV farm footprint; • Ocular analyses of glint and glare should be conducted; • Solar PV panels will be used with a special Anti-Reflective (AR) coating; and • Glass surfaces on the solar PV panels should be textured.	Construction and Operation
Noise	Potential generation of nuisance noise due to the operation of construction and operational machinery and vehicles	• Correct PPE must be worn at all times by the personnel on the construction site; • Adhere to local regulations regarding the generation of noise and hours of operation; • Muffling units on vehicles and equipment must be kept in good working order; • All equipment must be kept in good working order, with immediate attention being paid to defective silencers, slipping fanbelts, worn bearings and other sources of noise; • Equipment must be operated within specifications and capacity (e.g., no overloading of machines); • Regular maintenance of equipment must be undertaken; and • Equipment shall be switched off when not in operation.	Construction and Operation
Soils, Land Use and Land Capability	Potential impact on soils, land use and land capability as a result of compaction, clearing of vegetation and improper storage and handling of oils, fuels and other hazardous substances	• When mortar is used on site, the following guidelines apply: ○ Carefully control all on-site operations that involve the use of mortar and concrete. ○ Limit mortar mixing to single sites where possible. ○ Use plastic trays or liners when mixing mortar and concrete: Do not mix mortar and concrete directly on the ground. ○ Dispose of in the approved manner.	Construction and Decommissioning

Element of Environment	Impact	Mitigation Measures	Project Phase
		• No waste or spillage of effluent should be allowed to occur within or near sensitive habitat boundaries; • A pollution control system/spill handling procedure must be implemented to limit impact of such occurrences and prevent discharge to the receiving environment; • Contaminated soil shall be removed and disposed of to an appropriate licensed landfill site; • No field maintenance of equipment shall be permitted, except for emergency repairs; • Drip trays shall be used when dispensing fuel or oils from the earthmoving equipment outside designated areas; • Drip trays shall only be emptied into a dedicated container; • Erosion control measures shall be implemented where deemed necessary; • Prevent erosion from stockpiles to prevent increase in turbidity of watercourses; • Stockpiles shall be maintained until the topsoil is required for rehabilitation purposes; • All erosion damage must be repaired as soon as possible; and • Tarpaulins will be placed on the ground to prevent oil, grease, hydraulic fluid and diesel spills during emergency repairs.	Construction and Operation
		• The footprint area of the decommissioning activities must be landscaped to represent the surrounding environment. Landscaping must be done so that pooling of water does not occur; • Demolish and remove all infrastructure not required post-closure; and • Should there be reason or suspect reason the soils are contaminated following decommissioning activities, the soils will be assessed by a competent person and remediated by Cleanergy within a reasonable timeframe.	Decommissioning
Traffic	Potential impact on traffic as a result of increased vehicle numbers and the impact on road degradation	• Road safety measures are to be employed to manage traffic and to reduce traffic collision risks; • Ensure that road junctions between road D1984 and the access roads have good lines of sight; and • Signage should be erected in cooperation with local authorities to show restricted areas and roads, access points, speed limits, traffic rules, etc.	Pre-Construction
		• Speed limits will be reduced to 40 km/h (or speed limit determined after risk evaluation) to reduce dust and noise generation; • Where possible the transportation of construction materials and rubbish shall be undertaken outside traffic peak hours to minimise inconveniencing other road users; and • All the construction vehicles shall undergo maintenance on a regular basis to ensure the combustion engine vehicle efficiency.	Construction and Operation

Element of Environment	Impact	Mitigation Measures	Project Phase
Hazardous substances	Potential environmental impact as a result of poor hazardous material management practices	• The Cleanergy GHDP Project to allow for all hazardous chemical storage equipment (e.g., tanks) to meet appropriate standards for structural design and integrity; • Bund sizing will be designed at 110% of the largest tank volume minus the volume occupied by any adjacent tanks in the same bund; • Dry chemical and paint storage areas shall have restricted access (i.e., lockable) and have impervious floors and adequate weather protection against rain and wind to prevent accidental spillage, dispersal or spoilage of stored chemicals; • A hazardous Risk Assessment to be undertaken to cover safety systems of the equipment with particular reference to the monitoring of the hydrogen concentration within the building and associated mitigation to prevent the explosion of hydrogen. Process Hazard Analyses and an Emergency Response plan to be developed; • The Cleanergy GHDP Project to allow for leak detection technology; • The Cleanergy GHDP Project to allow for shutdown vales to shut down or isolate tanks and pipes;	Pre-construction
		• Commissioning of the tanks will only occur once a leak test certificate has been issued; and • All workers that have completed the induction should sign that they have understood and will implement the measures required.	Construction
		• Establish delivery procedures to ensure that hazardous materials are handled with care and stored correctly; • Ensure that subcontractors and delivery companies are informed of delivery procedures and are made aware of restrictions, in terms of where materials can be stored/placed; • An appointed representative of the Contractor must supervise all deliveries, particularly those of a hazardous nature; • The valves of cylinders, both Full and Empty, must be kept properly closed; • Where extreme temperatures prevail (>60˚C Cylinder Surface Temperature), cylinders shall be stored so that they are protected from the direct rays of the sun; • Cylinders shall always be handled, stored, used and transported upright. They shall not be dropped, dragged or rolled on their sides or allowed to skid. Cylinders that are too large to be carried shall be tilted and rolled on the rims of their feet rings or bases; • Cylinders should always be stored in a well-ventilated area, chained and away from sparks, flames or any source of heat or ignition; • All combustible materials to be a radius of 3 m away from any gas storage areas. In the case of any flammable or any other gas storage areas, open flames, welding and cutting operations, smoking etc., shall be prohibited in or near the storage area; and • Erect suitable warning and information signage near the storage facility.	Construction, Operation and Decommissioning

Element of Environment	Impact	Mitigation Measures	Project Phase
		• The tanks are to be fitted with High Level Alarms. These alarms are activated when product filling approaches the maximum capacity of the tank allowing sufficient time for transfer of product into the tank to be stopped.	Operation
		• The Contractor shall not be released from site until the SHE and Project Manager has signed off the release documentation and is satisfied with the contractor's adherence to the EMP and EA; and • An inventory of all chemicals on site must be kept together with the respective Safety Data Sheets (SDS).	Construction and Decommissioning
Waste Management	Potential environmental impact as a result of poor waste management practices	• Adequate provision must be made for the collection and storage of solid waste; • Storage areas should be weather resistant;. • Provision for the separation and storage of recyclables and returnable packaging must be made to reduce the volume of waste ultimately entering the landfill site; and • Provision should be made for dedicated hazardous waste storage facilities with signposted receptables.	Pre-construction
		General: • No soil, rubble or any other material may be deposited in or within 32 m of any watercourse/wetland; • Sufficient bins/skips are to be provided for the safe and environmentally responsible disposal of waste; • Littering on site is forbidden and the site must be cleared of litter at the end of each working day; • Where possible, materials used or generated by construction activities must be recycled; and • Waste generated on the proposed site should be collected by authorised waste contractors and frequently disposed of at a licensed landfill site.	Construction and Operation
		Separation of waste: • All waste shall be separated into general waste and hazardous waste;. • Hazardous waste shall not be mixed with general waste increasing the quantities of hazardous waste to be managed; • General waste could further be separated in waste that can be recycled and/or reused; • No littering shall be allowed in and around the site, a sufficient number of bins shall be provided for the disposal of waste; and • Where necessary dedicate a storage area on site for collection of construction waste.	

Element of Environment	Impact	Mitigation Measures	Project Phase
		Storage of waste: • General waste will be collected in an adequate number of litter bins located throughout the construction site; • Bins must have lids in order to keep rainwater out; • Bins shall be emptied regularly to prevent the bins from overflowing; • All work areas shall be kept clean and tidy at all times; • All waste management facilities will be maintained in good working order; • Waste shall be stored in demarcated areas according to type of waste; • Runoff from any area demarcated for waste will be contained and managed; • Flammable substances must be kept away from sources of ignition and from oxidizing agents; • No builder's rubble shall be disposed of to the riparian area; • If buildings rubble is not removed immediately, it shall be stockpiled outside the 1:50 year floodline and outside the sensitive riparian areas; • Demolition waste and surplus concrete shall be disposed of responsibly; and • Waste shall not be buried or burned on site.	
		Disposal of hazardous waste: • No indiscriminate dumping shall be allowed in or near the construction site; • Hazardous containers shall be disposed of at an appropriate licensed site; • Hazardous waste will be removed and managed by an approved service provider; • A safe disposal certificate will be provided by the approved service provider as proof of responsible disposal of hazardous waste; and • The safe disposal certificate shall be stored and provided on request.	
		Disposal of general waste: • No dumping shall take place in or near the construction site; • All general waste shall be disposed of to a licensed landfill site; and • Demolition waste and building rubble shall be disposed of to an appropriate licensed landfill site.	
General	Impacts on Walvis Bay International Airport	• Ensure airport utilities are not damaged during construction; and • The GHDP should communicate emergency response plans with the Walvis Bay International Airport in case of an aircraft crash, etc. Sufficient bins/skips are to be provided for the safe and environmentally responsible disposal of waste.	Construction and Operation

7.6 Monitoring

Monitoring actions to be implemented during the construction and operational phase of the proposed GHDP are provided in Table 7-10 also included in a comprehensive EMP attached in Appendix E. To ensure good housekeeping, regular audits should be conducted throughout the process and all phases of the project.

Table 7-10: Monitoring Actions to be Implemented During the Construction and Operational Phases of the Proposed GHDP

Element of Environment	Risk	Monitoring Actions
Construction		
Socio-Economic	Negative social impact Health and safety risk	• Ensure good housekeeping by implementing regular audits; • Place of residence of construction workers should be recorded; • Any certificates or qualifications held by employees should be recorded; and • Record should be kept on the wellness of employees before employment and then yearly after being employed.
Air Quality	Deterioration of air quality	• Air quality should be monitored and measured on a daily basis by the DHGP's representative on site and a report should be written with the findings.
Noise	Potential increase in ambient noise levels	• Noise levels should be monitored on a weekly basis and the site register should be checked for any complaints.
Heritage Resources	Potential destruction or loss of cultural artefacts and/or sites of archaeological importance	• The construction site needs to be monitored weekly to record any heritage or archaeological sites or artifacts that might me unearthed.
Visual / Landscape	Deterioration of visual quality Potential deterioration of sense of place	• The GHDP representative should consider any grievances and maintain and check a site logbook on a daily basis.
Biodiversity	Loss of fauna and flora Establishment and spread of alien invasive plants	• Rehabilitation actions should be implemented from the construction phase and should be enforced through a comprehensive restoration plan. This plan should be in place before commencing with clearing of the site and construction; • Site fences, ditches, drains, and other areas that may harm or result in the loss of species should be monitored and inspected on a daily basis either physically or by using cameras. This should also be done to identify any access points fauna might have to the site; • An invasive species removal plan should be in place before commencing with construction for the duration of the GHDP life; • A post-construction monitoring programme should be implemented; and • Any fauna mortalities should be recorded and reported.
Surface water	Deterioration of water bodies	• Stormwater infrastructure should be monitored on a regular basis to ensure proper drainage; • Monitor watercourses downstream of the GHDP to ensure water quality is not compromised by the activity; • Bund areas, areas where vehicles are kept, and construction vehicles itself should be inspected regularly to ensure no leakages occur; and • The entire site should be inspected on a daily basis to identify spills.

Element of Environment	Risk	Monitoring Actions
Groundwater	Possible deterioration of groundwater Changes to geohydrological regime	• Bund areas, areas where vehicles are kept, and construction vehicles itself should be inspected regularly to ensure no leakages occur; • The entire site should be inspected on a daily basis to identify spills; and • Any spills that are identified should be recorded and reported.
Soils	Physical damage and destruction of soil crusts and soil horizons Possible deterioration of soils	
Waste storage, handling and disposal	Surface water, groundwater, and soil deterioration Safety risk to the Walvis Bay Airport	• Regular inspections shall be carried out to ensure the integrity of the bunded areas and bund walls.
Operation		
Socio-economic	Possible negative impact on sense of place	• Ensure good housekeeping by implementing regular audits; • Place of residence of employees should be recorded; • Any certificates or qualifications held by employees should be recorded; • Record should be kept on the wellness of employees before employment and then yearly after being employed; and • Reporting should be done annually on any skills training courses and programmes that were implemented or utilised.
Noise	Potential increase in ambient noise levels	• Noise levels should be monitored on a weekly basis and the site register should be checked for any complaints.
Visual/Landscape	Potential deterioration of visual quality and sense of place Impact on aeronautical, particularly flights, on approach and departure from the Walvis Bay Airport	• The GHDP representative should consider any grievances and maintain and check a site logbook on a weekly basis; and • Tracking settings of the solar PV panels should be monitored continuously.
Biodiversity	Restriction of animal movement and entrapment including: • Disruption of brown hyena movement patterns; • Pipeline trench acting as pitfall trap; and • Aboveground pipeline acting as a barrier to ungulates and ostrich. Establishment and spread of alien invasive plants Potential disruption of avifauna	• Rehabilitation actions should be implemented from the construction phase and should be enforced through a comprehensive restoration plan. This plan should be in place before commencing with clearing of the site and construction; • Site fences, ditches, drains, solar panels, and other areas that may harm or result in the loss of species should be monitored on a daily basis. This should also be done to identify any access points fauna might have to the site; • An invasive species removal plan should be implemented for the duration of the GHDP life; • A post-construction monitoring programme should be implemented; • Any fauna mortalities should be recorded and reported; and • Monitor bird mortalities monthly to determine impact.

Element of Environment	Risk	Monitoring Actions
Surface water	Deterioration of water bodies	• Stormwater infrastructure should be monitored on a regular basis to ensure proper drainage; • Monitor watercourses downstream of the GHDP to ensure water quality is not compromised by the activity; • Bund areas, areas where vehicles are kept, and construction vehicles itself should be inspected regularly to ensure no leakages occur; and • The entire site should be inspected on a daily basis to identify spills.
Groundwater	Changes to geohydrological regime	• Regular monitoring and maintenance of infrastructure shall be conducted to ensure that they are in good working order; • Water quality monitoring to ensure that there is no contamination of the groundwater; • Bund areas, areas where vehicles are kept, and construction vehicles itself should be inspected regularly to ensure no leakages occur; • The entire site should be inspected on a daily basis to identify spills; and • Any spills that are identified should be recorded and reported.
Waste storage, handling and disposal	Surface water, groundwater, and soil deterioration Safety risk to the Walvis Bay Airport	• Regular monitoring and maintenance of infrastructure shall be conducted to ensure that they are in good working order; and • Regular inspections shall be carried out to ensure the integrity of the bunded areas and bund walls.
Gas storage	Harm and damage to the environment, employees, and surrounding companies and their operations due to possible fires and explosions.	• Monitor and maintain gas cylinders and other equipment to prevent leaking of Hydrogen gas; and • The Occupational Health and Safety (OHS) Standards should be used to monitor this risk as well as Cleanergy's OHS manual.

8 Assumptions and Limitations

The findings included in this EIAR are based on existing information from specialist studies undertaken in the project area, preliminary assessments undertaken by specialists for the proposed Cleanergy GHDP Project as well as information obtained from environmental GIS databases.

8.1 General

The EIA team made as assumption that that specialist studies conducted for the Cleanergy GHDP project are sufficient and applicable to the proposed project. Technical data and information provided by external specialists to SRK during the EIA were checked and reviewed for quality assurance by SRK. All the data and information are assumed to be accurate and still applicable. It is also assumed that the applicant will comply with all legislation pertaining to the activities of this proposed project and that all permits and licenses that may be required will be identified and applied for prior to commencement of construction activities.

The public involvement process has been sufficiently effective in identifying the critical issues needing to be addressed in the EIA/EMP by the EAP. The public involvement process has sought to involve key stakeholders, including the Competent Authority (MEFT). Wherever possible the information requested and comments raised by I&AP's during the Scoping Phase and EIA Phase have been sufficiently addressed and incorporated into the EIAR/EMP report for perusal and comment. These requests and any further comments were tracked and recorded in the Comments and Response Report.

SRK assumes that Cleanergy will implement the measures contained in the EMP and will adhere to any monitoring procedures. A monitoring and evaluation system, including auditing, will be established and operationalised to track the implementation of the EMP ensuring that management measures are effective to avoid, minimise and mitigate impacts and that corrective action is being undertaken to address shortcomings and/or non-conformances.

Limitations relevant to each specialist study conducted during the Cleanergy GHDP Project EIA will apply to the current assessment. The specialist reports compiled for Cleanergy GHDP Project were employed to assess the significant environmental impacts. Other additional impact on the environment will have a minimal effect and was assessed using the professional judgement of the SRK project team.

8.2 Biodiversity Impact Assessment

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 (Cunningham, 2022). 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 are 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;

- 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; and
- 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.

8.3 Heritage and Archaeology Impact Assessment

The archaeological heritage assessment (Nankela, 2022) largely depended on the indicative of surface finds value recorded during the site visit and intensive field survey. These are supplemented by information yielded from available records harvested from a series of published materials, reports from similar projects undertaken the surrounding areas and a cumulative database of all previous surveys. The records are further augmented by information obtained from local heritage and museum databases to establish a valid baseline against which to assess potential impacts. Therefore, field survey is a critical component that helps to *establish the nature and extent of the visible remains* to enhanced suite of interpretations.

The general lack of vegetation in the proposed GHDP site contributed to the greater visibility of the surface area which allowed intensive survey to identify possible surface remains on the terrain. The survey primarily focused on the site and its surrounding areas tentatively identified as sensitive and of heritage probability (i.e., those noted during the mapping and satellite survey through use of available satellite imagery - Google Earth). In terms of on-site limitations during the survey, the following should be noted: (1) the project area is accessed via a C14 road due to the current upgrades of the D1984 road that connects Walvis Bay and Swakopmund or through a D1984 two bridges (also recently completed). Access control was therefore applied to the area for safety. No access restrictions onto the site were encountered during the site visit and field survey (August 2022). (2) the proposed GHDP site is a highly dynamic environment, with very strong prevailing winds, morning fogs which not only reduce visibility of the surface artefacts but also dislocate them (if they exist) making it difficult to preserve, locate and or to document them. Although all possible care is taken to identify sites of heritage significance during the investigation of the area, it is always possible that hidden or subsurface remains could be overlooked during the survey.

Therefore, the Chance Find Procedure Guidelines from the NHC (2017) must be adopted.

8.4 Visual Impact Assessment

The study is based on several assumptions and is subject to certain limitations, which should be borne in mind when considering information presented in this report (Bredell, 2022). The validity of the findings of the study is not expected to be affected by these assumptions and limitations. The purpose of this Section, however, is to indicate where information gaps occur with the bearing this may have on the visual assessment.

The VIA specialist's study and contribution largely depends on the nature of the development, the larger environmental context and more over the accuracy of the available information.

The following limitations were encountered during the VIA study and certain assumptions were made that included the following:

- It was accepted that the proposed development will be operational for years to come, > 25 years and thus operational impacts are long term;
- Approximate size, height and final alignment of the various development aspects were recorded as being up-to-date and the most recent available and relevant technical information;
- To a large extent, the level of detail and technical information on the project provided was relevant and adequate and does not pose a risk in terms of the visual impacts;
- For the purposes of this study the visual impact of the NamWater line alternatives (specifically) were not assessed in detail. This was mainly due to the insignificant (limited to no change in terms of the view/ view frame of the receptor) visual impact it will have on the report outcome;
- Confirmed that the airport doesn't currently have any night-time operations except in case of emergencies, a few special permits and that night-time operations are not currently commercialised; and
- Thus, as night-time activities generally relate to smaller aviation/planes, issues will need to be more focused on these and not on commercial aviation.

Noted additional (detailed) assumptions made in the report are explicitly stated in the relevant sections.

8.5 Hydrology Impact Assessment

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 (Diganta, 2022). The validity of the findings of the study is not expected to be affected by these assumptions and limitations:

- Lack of hydrogeological studies including drilling information from the area required groundwater conditions to be inferred from published geology and field observations. While the hydrogeological conditions described are generally valid, situations may differ in the local scale.

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

9 Undertaking of Oath by the EAP

SRK and the EAPs managing this project hereby affirm that:

- To the best of our knowledge the information provided in the report is correct, and no attempt has been made to manipulate information to achieve a particular outcome. Some information, especially pertaining to the project description, was provided by the applicant and/or their sub-contractors. In this respect, SRK's standard disclaimer pertaining to information provided by third parties applies;
- To the best of our knowledge all comments and inputs from stakeholders and I&APs have been captured in the report and no attempt has been made to manipulate such comment or input to achieve a particular outcome. Written submissions are appended to the report while other comments are recorded within the report. For the sake of brevity, not all comments are recorded verbatim, and in instances where many stakeholders have made similar comments, they are grouped together, with a clear listing of who submitted which comment(s); and
- Information and responses provided by the EAP to I&APs are clearly presented in the report. Where responses are provided by the applicant (not the EAP), these are clearly indicated.

With respect to EIARs, SRK took account of I&APs' comments and, insofar as comments are relevant and practicable, accommodate these during the EIA/EMP process.

10 Conclusion, Recommendations and Environmental Impact Statement

The aim of this EIAR and EMP is to provide an indication of the identified, positive, and negative environmental and socio-economic impacts associated with the proposed project activities. The proposed project will be located within the New Industrial Zone on farm 58 in Walvis Bay. This site is zoned as Industrial Area is in line with proposed project's description.

Anticipated environmental, social, and cultural impacts have been identified and described in Section 7. Extensive consideration has been given to the proposed location and design of the project and no fatal flaws have been identified during scoping phase. Required specialist studies that were conducted include a groundwater impact assessment, a heritage and archaeology assessment, a visual impact assessment, and a biodiversity impact assessment. A Social Impact Assessment will be undertaken as part of the mitigation measures during the Construction Phase of the project to allow for the full benefit of socio-economic benefits to materialise. A summary of the Environmental Impact Assessment is provided in Table 10-1.

Table 10-1: Summary of the Findings of the Environmental Impact Assessment

Impact	Without Mitigation	With Mitigation
Construction Phase		
Negative social impact as a result of an influx of job seekers and potential squatting leading to an increase in social pathologies and petty crimes.	Low	Very Low
Health and safety risk as a result of workers on site leading to the lighting of fires on site, littering, and lack of housekeeping.	Low	Very Low
Potential deterioration of air quality due to the generation and dispersion of dust (Increase in ambient air concentrations).	Low	Very Low
Potential increase in ambient noise levels (in the immediate vicinity of the project) as a result of vehicles and machines operating on site.	Very Low	Insignificant
Potential destruction or loss of cultural artefacts and/or sites of archaeological importance as a result of vehicles and machines operating on site.	Very Low	Insignificant
Landscape impact and the loss of vegetation cover as a result of the movement of vehicles and materials, to and from the site area.	Medium	Low
Potential deterioration of visual quality and sense of place as a result of construction activities and dust generation.	Medium	Low
Physical terrestrial habitat disturbance, alteration and loss of vertebrate fauna and flora habitat.	Medium	Low
Loss of fauna as a result of the movement of vehicles and machinery and materials to and from the site.	Medium	Low
Loss of flora as a result of the movement of vehicles and machinery and materials to and from the site.	Low	Low
Establishment and spread of alien invasive plants.	Medium	Low
The physical disturbance and destruction of dry and ephemeral water courses and drainage lines.	Medium	Low
Deterioration of water bodies as a result of accidental spillages of hazardous substances from construction vehicles/machinery, as well as from hazardous materials storage areas.	Low	Insignificant
Increased surface runoff due to compacted land areas that decreases infiltration.	Medium	Low
Increased erosion, sedimentation, and deposition due to increased runoff caused by compact land that moves sand and soil with the runoff flow.	Low	Insignificant

Impact	Without Mitigation	With Mitigation
Possible deterioration of groundwater as a result of accidental spillages of hazardous substances from construction vehicles/machinery as well as from hazardous materials storage areas resulting in seeping into water bodies.	Medium	Low
Deterioration of reinforced concrete and metal structures due to the ingress of brine that causes weathering of infrastructure.	Medium	Low
Physical damage and destruction of soil crusts and soil horizons as a result of the movement of vehicles and machinery and materials to and from the site.	Low	Insignificant
Possible deterioration of soils as a result of accidental spillages of hazardous substances from construction vehicles/machinery as well as from hazardous storage areas.	Low	Insignificant
The movement of vehicles and earth moving machinery may result in the production of carbon dioxide (Green House Gas), which may have an impact on the climate in the area.	Medium	Low
Inappropriate storage, handling and disposal of waste may lead to impacts on surface water, groundwater and soils.	Low	Very Low
Inappropriate storage, handling and disposal of waste may attract scavenging animals to the area which poses a safety risk to the Walvis Bay Airport.	High	Low
Operational Phase		
Potential negative impact on Sense of Place due to the permanent alteration of the current landscape.	High	Medium
Loss of containment of hydrogen: At the electrolyser with the potential of explosion impacting of site workers/employees; and Stored on-site and at the hydrogen storage/refuelling facility with potential of explosion impacting on workers and general public.	Low	Very Low
Light pollution	Medium	Very Low
Landscape impact due to a man-made structure that will be operated instead of the previous natural environment	Medium	Low
Potential deterioration of visual quality and sense of place as a result of operating the PV solar plant resulting in the glint and glare from the solar array.	High	Medium
Impact on aeronautical, particularly flights on approach and departure from the Walvis Bay Airport as a result of operating the PV solar plant resulting in the glint and glare from the solar array.	High	Medium
PV panels will likely impact both long- and short-range views of passers-by due to glint and glare.	High	Medium
The balance of the development footprint will also dominate the medium- and short-range views to and from the site due to the site containing a new development in a natural environment.	High	Medium
Impact on the regional landscape due to the GHDP being a new man-made development in the surrounding natural environment.	Very Low	Insignificant
Restriction of animal movement and entrapment including: Disruption of brown hyena movement patterns; and Pipeline trench acts as pitfall trap; and Aboveground pipeline acting as a barrier to ungulates and ostrich.	High	Very Low
Establishment and spread of alien invasive plants.	Low	Very Low
Solar plant potentially disrupting avifauna i.e. bird collisions on infrastructure such as solar panel arrays and fencing.	Low	Low
Attraction of birds to novel habitats through the provision of artificial habitats and resources.	Medium	Low
Increased surface runoff due to compacted land areas that decrease infiltration.	Medium	Very Low

Impact	**Without Mitigation**	**With Mitigation**
Increased erosion, sedimentation, and deposition due to increased runoff caused by compact land that moves sand and soil with the runoff flow.	Low	Very Low
Changes to geohydrological regime as a result of movement of vehicles and machinery and materials to and from the site resulting in the interaction of vehicles and machinery with the environment and hydrology lines.	Low	Very Low
Deterioration of reinforced concrete and metal structures due to the ingress of brine that causes weathering of infrastructure.	Medium	Low
Surface water, groundwater and soil deterioration as a result of inappropriate storage, handling and disposal of waste resulting in the seeping of waste.	Low	Very Low
Possible deterioration of soils as a result of accidental spillages of hazardous substances from construction vehicles/machinery as well as from hazardous storage areas.	Low	Insignificant
Inappropriate storage, handling and disposal of waste may lead to impacts on surface water, groundwater and soils.	Low	Very Low
Inappropriate storage, handling and disposal of waste may attract scavenging animals to the area which poses a safety risk to the Walvis Bay Airport.	High	Low

SRK Consulting has undertaken the ECC application process and subsequent reporting (Scoping as well as the EIAR/EMP) in terms of the proposed Cleanergy GHDP Project in accordance with the requirements of the EMA.

This has included a comprehensive public participation process which sought to identify stakeholders, provide these parties with an adequate opportunity to participate in the project process and guide technical investigations that have taken place as part of the Impact Assessment Phase of this study. Extensive specialist input has been sought for all key environmental aspects.

To date, no serious flaws/aspects that could render this proposed project unfeasible and impractical, have been identified. Potential impacts require careful mitigation and monitoring measures.

Although some of the potential impacts identified during the Impact Assessment Phase were rated as a high significant rating, the overall significance of the activity's impact can be lowered through the implementation of the recommended mitigation measures, as detailed in the EMP.

It is anticipated that it will be possible to successfully mitigate all of the environmental impacts to acceptable levels and the implementation will be monitored and audited to determine the effectiveness of the measures implemented.

Therefore, from an EAP's perspective based on the current project description and the information obtained through existing and recent site-specific studies, there is no reason why the proposed development may not continue subject to the recommended mitigation measures being implemented. The proposed Cleanergy GHDP Project should be allowed to proceed, given the relatively small potential contribution of the project to cumulative impacts (given the implementation of the appropriate recommended environmental management measures) and also considering the positive social and economic benefits associated with the project.

Prepared by	**Reviewed by**
	
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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

11 References

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Appendices

Appendix A: Curriculum Vitae of the Project Team and Projects

Appendix B: MEFT Application Form

Appendix C: Public Participation Process

Appendix C_ 1: Stakeholder Database

Appendix C_ 2: Project Announcement Notifications

Appendix C_ 3: Background Information Document

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Appendix C_ 7: MEFT Meeting

Appendix C_ 8: Focus Group Meetings

Appendix C_ 9: Public Meeting

Appendix C_ 10: Comments and Responses Register

Appendix C_ 11: Stakeholder Communications

Appendix C_ 12: Competent and Commenting Authority Correspondence

Appendix C_ 13: Distribution of Scoping Report

Appendix C_ 14: Transmittal Notes of Scoping Report Distribution

Appendix C_ 15: Distribution of Environmental Impact Assessment Report

Appendix C_ 16: Transmittal Notes of Environmental Impact Assessment Report Distribution

Appendix D: Specialist Studies

Appendix D_ 1: Heritage and Archaeology Impact Assessment

Appendix D_ 2: Biodiversity Impact Assessment

Appendix D_ 3: Visual Impact Assessment

Appendix D_ 4: Hydrology and Geohydrology Impact Assessment

Appendix E: Environmental Management Plan